Canada-Saskatchewan
Irrigation Diversification Centre

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Annual Review
April 1, 2003 to March 31, 2004

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This report and other CSIDC publications are available at our internet address:
http://www.agr.ca/pfra/csidc/csidc.htm

Introduction

Manager's Report

It is my pleasure to present the annual progress report of the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC). This report outlines the range of activities conducted, funded or facilitated by the Centre in 2003-2004.

CSIDC is a federal, provincial, and industry partnership operated under a Memorandum of Understanding (MOU) signed in 1998. The federal government is represented by Agriculture and Agri-Food Canada (AAFC), provincial government by Saskatchewan Agriculture Food and Rural Revitalization (SAFRR), and industry by the Saskatchewan Irrigation Projects Association (SIPA) and the Irrigation Crop Diversification Corporation (ICDC). Each group provides representatives on the Executive Management Committee (EMC). I would like to extend special thanks for their input and support of the Centre.

Executive Management Committee (EMC)

Carl Neggers - AAFC
Scott Wright - SAFRR
Carl Siemens/Ken Plummer - ICDC
Don Fox - SIPA
John Linsley - ICDC/SAFRR
Laurie Tollefson - CSIDC
Steve Morgan Jones - AAFC

In 2003-2004, many changes occurred at the Centre. Federally, a horizontal team approach to support the Agriculture Policy Framework and the theme and national study approach were utilized. Federal staff were placed on the Sustainable Production Systems team (SPS). A national study was developed entitled "Sustainable Systems for Irrigated Crop Production".

Provincially, SAFRR is the representative at the management table. Industry representation through SIPA and ICDC has remained unchanged. Through discussion, the partners' desire to continue the operation of CSIDC in this manner was very apparent.

The year 2003-2004 will be remembered for the severe drought conditions in many parts of Saskatchewan. Irrigated crop production looked particularly promising. Requests for irrigated production information were at an all time high. Requests for irrigated research sites at CSIDC by outside researchers were increased due to the stability irrigation provides. This was reflected in the large turn out at the annual field day and various commodity events held over the course of the summer. Interested individuals were keen to view first hand the benefits and possibilities that irrigation provides.

The Centre relies on federal and provincial A-base funding, industry and agreement support, and research contracts to facilitate its program. Securing sufficient funding to achieve the outcomes outlined in the workplan and national study will be a priority.

Increased crop diversification and value-added opportunities are an outcome of the Centre's strategic framework. CSIDC received funding through the Agri-Food Innovation Fund (AFIF) to study irrigated production of higher valued crops. In addition, AAFC provided support through the National Agri-Environmental Health Analysis and Reporting Program (NAHARP) to develop agri-environmental indicators for water quantity and water use efficiency, particularly as they apply to irrigation.

International activity at the Centre continues to expand. This is through involvement in the Canadian Committee on Irrigation and Drainage (CANCID), the International Commission on Irrigation and Drainage (ICID) and project involvement with the Canadian International Development Agency (CIDA). Worldwide water and irrigation issues are of great importance. CSIDC staff were involved in missions in Israel, Egypt, Iran, Ethiopia and Korea.

Objectives

1. Identify higher value cropping opportunities through market research to help target research and demonstration programs.

2. Conduct, fund and provide support for irrigated research and demonstration to meet the needs of irrigation producers and industry in the province.

3. Develop, refine, and test methods of diversifying and intensifying irrigated crop production in co-operation with outside research agencies.

4. Demonstrate sustainable irrigated crop production practices at CSIDC.

5. Promote and extend sustainable irrigated crop production methods.

6. Evaluate the environmental sustainability of irrigation, and determine the impact of irrigation on natural and physical resources.

7. Promote a Western Canadian approach to irrigation sustainability by interacting with staff from similar institutions and industry across Western Canada, and by transferring this technology to the industry. This will increase levels of co-operation in marketing, research and demonstration in support of diversification and value-added processing.

Staff

Manager:	L. Tollefson	Field Operations:	B. Vestre
Admin. Services Co-ordinator:	M. Martinson	Irrigation:	D. Jacobson
Admin. Assistant:	J. Clark	Maintenance:	A. MacDonald
Clerical:	D. Greig	YMCA Trainees:	J. Lemon
Market Analyst:	H. Clark		R. Wagner
Irrigation Agronomist:	T. Hogg		E. Skaalid
Horticultural Crops Agronomist:	J. Wahab	Summer Staff:	A. Peterman
Technician:	G. Larson		B. Nixon
Technician:	D. David		N. Wawaruk
Technology Transfer:	J. Harrington		P. Spigott
ICDC/SAFRR Agrologists:	J. Linsley,PAg		S. Feltis
	G. Weiterman, PAg		D. Radchenko
	L. Bohrson, PAg		
	K. Olfert, PAg		
	L. Shaw, PAg		
	G. Pederson, PAg		
	C. Ringdal, PAg		
	A. Walker		

Activities

Presentations

CSIDC staff delivered presentations at numerous meetings and conferences. These included:

- OECD Expert Meeting on Agricultural Water Quality and Quantity. Water Use Efficiency Indicators for Irrigation. Gyeongju, Republic of Korea, Oct. 7-10, 2003.
- Fertility Management of Norland and Russet Burbank Potato. Saskatchewan Seed Potato Growers Annual Meeting, Saskatoon, Sask., Nov. 2003.
- Effect of Crop Rotation on Subsequent Potato Yields. Saskatchewan Vegetable Growers Association Annual Conference and Trade Show. Saskatoon, Sask., Nov. 2003.
- Irrigation in Canada and Internationally. Agriculture & Bioresource Engineering students. University of Saskatchewan, Saskatoon, Sask., Nov. 10, 2003.
- Irrigation Indicator Expert Committee - development of water use and water use efficiency indicators, Ottawa, Ont., Dec. 15, 2003.
- CANCID Executive and strategic planning committee. History and role of CANCID. Calgary, Alta., Jan. 9 & 10, 2004.
- NAHARP Indicator Workshop - Water use and water use efficiency for irrigation, Ottawa, Ont., Jan. 15, 2004.
- How Production and Harvesting Affect Medicinal Components. First Annual Herb and Spice Conference and Trade Show. 'From Grass Roots to Global Enterprise: The Canadian Herb and Spice Industry Comes of Age'. Guelph, Ont., Feb. 2004.
- Iranian Technical Mission - Irrigation in Canada, Mar. 8-17, 2004.

CSIDC Display

CSIDC presented a display at the following events:

- Crop Production Show, Saskatoon, Sask.
- Shelterbelt Centre Field Day, Indian Head, Sask.
- CSIDC Annual Field Day, Outlook, Sask.
- Saskatchewan Irrigation Projects Association Meetings, Outlook, Sask.
- Herb & Spice annual meeting, Saskatoon, Sask.
- Irrigation meeting, Delisle, Sask.

Tours

A large number of tours of the Centre and associated programs are conducted each year. Noteworthy tours in 2003/2004 included:

Mexican irrigation researchers	June 24, 2003
Saskatchewan Vegetable Growers Association meeting	June 27, 2003
Egyptian water engineers	July 2, 2003
Dutch farm group	July 3, 2003
Ottawa legal council group	July 7, 2003
CSIDC annual field day	July 9, 2003
Agriculture & Agri-Food Canada higher-value crops team	July 14, 2003
Agriculture & Agri-Food Canada assets team	July 15, 2003
Vegetable tour	July 30, 2003
Potato field day	August 12, 2003
Vegetable field day	August 15, 2003
Ag Extension USA	August 28, 2003
South African land issues study group	September 4, 2003
Corn field day	September 11, 2003
University of Saskatchewan Bioresource Engineers tour	September 15, 2003
Saskatchewan Agriculture, Food & Rural Revitalization group	September 17, 2003
Vocational agriculture students, University of Saskatchewan	September 25, 2003
Food Science graduate students, University of Saskatchewan	September 25, 2003
Egyptian groundwater specialists	October 16, 2003
Egyptian drainage authority technical group	October 20, 2003
Egyptian trade consulate	November 4, 2003
Saskatchewan Vegetable Growers Association	December 10, 2003

Additional tours were held for private industry, producers, associations and other visitors who requested tours.

Factsheets

The following factsheets are available from CSIDC. Please contact the Centre at (306)867-5400 for copies, or visit the website at *www.agri.gc.ca/pfra/csidc/csidc.htm*.

***Cereals*:**

Early Seeding of Irrigated Cereals
Decision Guide for Foliar Disease Control in Irrigated Wheat
Late Nitrogen to Increase Protein in Durum

***Forages**:*

Kentucky Bluegrass Establishment for Seed Production
Effect of Cutting Height on Alfalfa Yield and Quality
Irrigated Timothy Trials at CSIDC
Alfalfa Establishment under Irrigated Conditions
Alfalfa Seed Production under Irrigation
Forage Manager Report

Oilseeds:

Date of Seeding, Seed Rate, and Row Spacing of Irrigated Flax
Seeding Rate and Row Spacing for Irrigated Canola
Crop Management for Sclerotinia Control in Canola
Innovations in Canola Production

Pulse Crops:

Dry Bean - Fertility Management under Irrigation
Dry Bean - Optimum Seeding Rate and Row Spacing
Irrigated Dry Bean Production Package
Field Pea - Optimum Seeding Rates
Field Pea - Selecting a Variety
Intercropping Pea with Oilseeds under Irrigation
Management of Field Pea under Irrigation
Faba Bean Trials at CSIDC
Management of Irrigated Lentil
Irrigated Chickpea Trials at CSIDC

Herbs and Spices:

Herbs, Spices and Essential Oils Research & Demonstration
Annual Caraway Trials at CSIDC
Coriander Trials at CSIDC
Dill Seed Trials at CSIDC
Irrigated Scotch Spearmint Production in Saskatchewan
Agronomic Practices for Commercial Scale Production of *Echinacea angustifolia*
Production Practices for *Echinacea angustifolia*
Agronomic Practices for Commercial Scale Production of Feverfew
Production Practices for Feverfew
Ginseng Production and Marketing on the Prairies
Agronomic Practices for Mechanized Production of Milk Thistle in Saskatchewan
Agronomic Practices for Commercial Scale St. John’s Wort Production
Agronomic Practices for Commercial Scale Stinging Nettle Production

Factsheets (cont.)

Vegetables:

Pumpkin Production
Vegetables: A Growing Industry
Demonstration of Improved Vegetable Production Techniques in Saskatchewan
Cabbage: Post-harvest handling and Storage
Carrots: Post-harvest handling and Storage
Onions: Post-harvest handling and Storage
Melons: Post-harvest handling and Storage
Peppers: Post-harvest handling and Storage

Potatoes:

Cultivar Specific Fertility Management
Irrigation Scheduling for Potatoes
Micronutrients in Potato Production
Processing Potato in Saskatchewan: Potential and Opportunities
Potato Petiole Sap NO_3-N and K Monitoring
Agrochemicals in Soil and Groundwater under Irrigated Potato Production

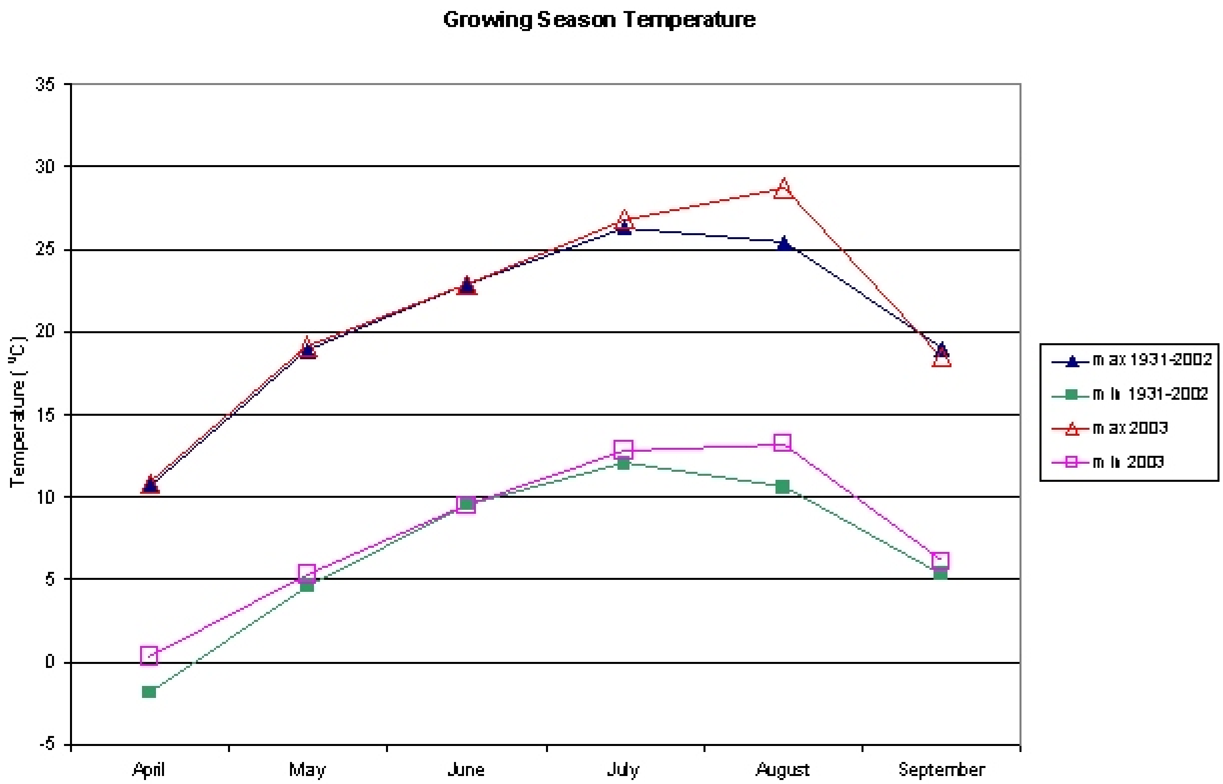
Soils and Fertilizers:

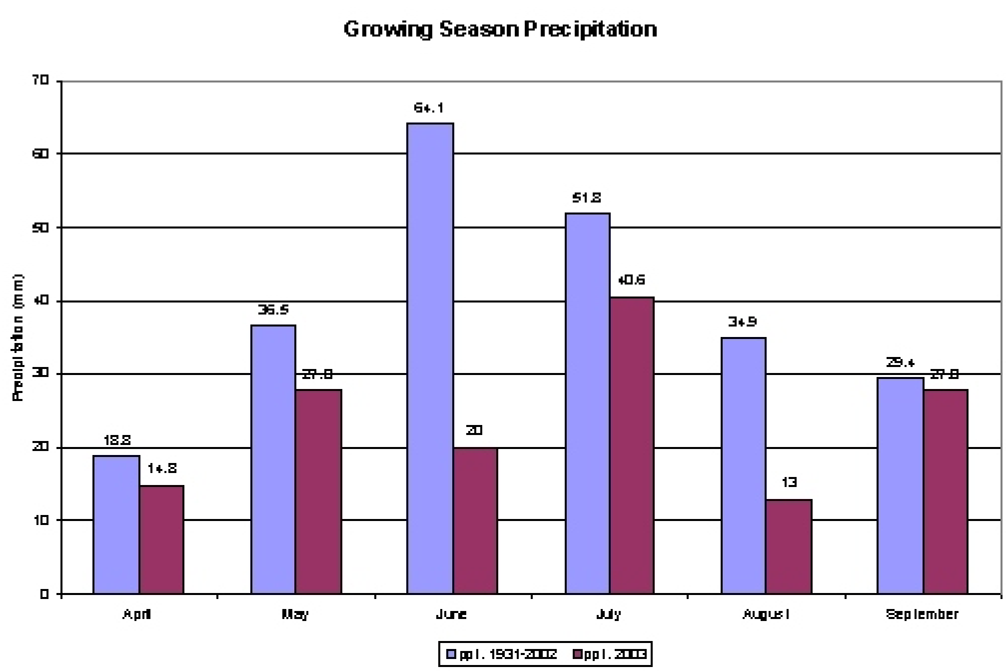
Reclamation of a Saline Field using Subsurface Drains
Rate and Placement Effects of P and K Fertilizer on Peas
Fertility Management of Irrigated Alfalfa
Canola Fertilization Trials at CSIDC
Hog Effluent Research and Demonstration

Other:

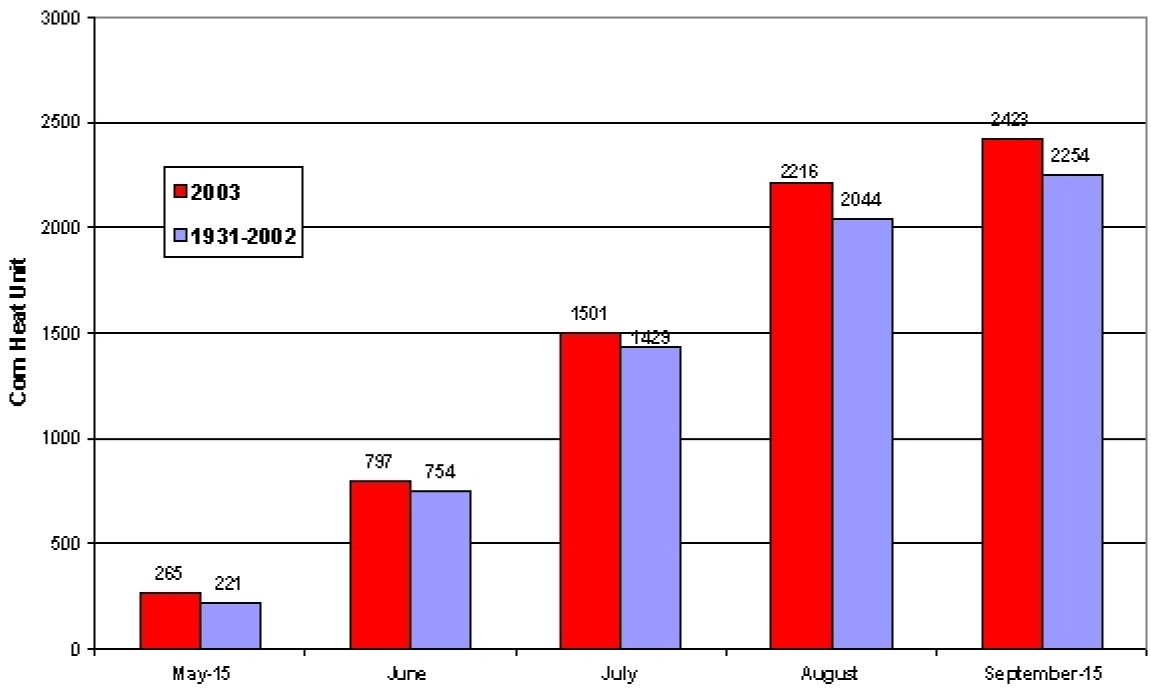
Crop Varieties for Irrigation
Plastic Mulches for Commercial Vegetable Production
Northern Vigor™ in Seed Potato
Overview of CSIDC
Xeriscape Demonstration Project at CSIDC
Fruit Crops in Saskatchewan
Ethanol: Fact or Fiction
ICDC Irrigation Economics and Agronomics
ICDC Crop Manager Report
Irrigation in Saskatchewan
Prairie Province Trickle Irrigation Manual

2003 Weather Summary

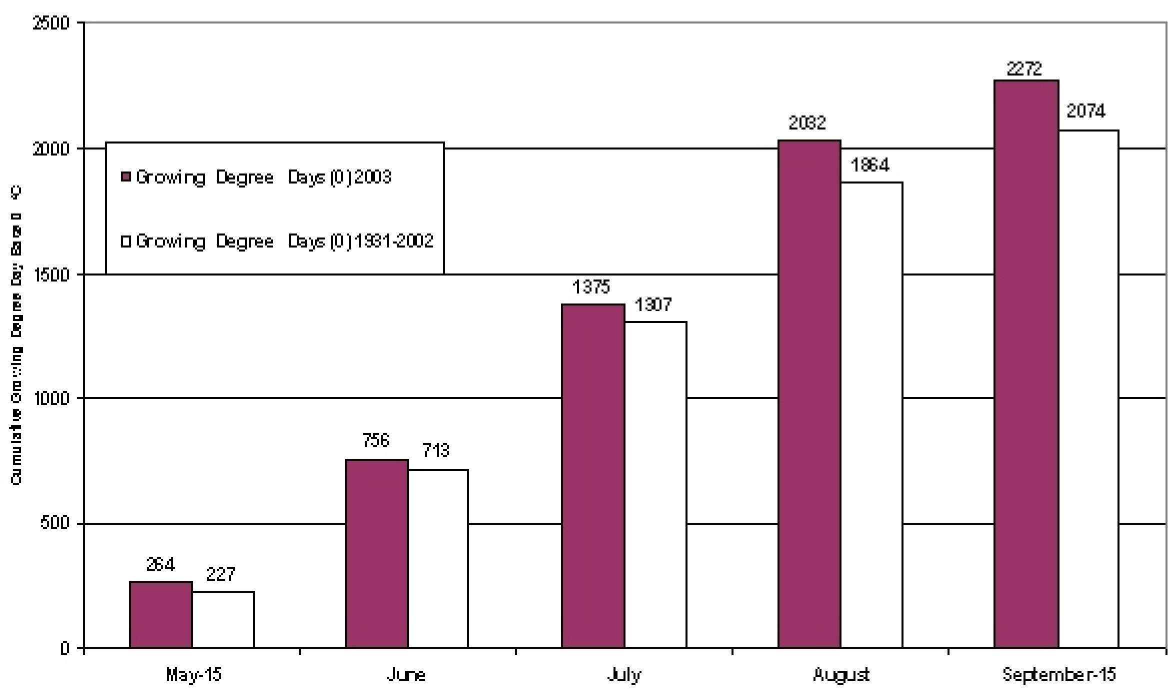




Cumulative Corn Heat Units



Growing Degree Days (Base 0 °C)



2003 Irrigation Data

Field	Crop	Irrigation (mm)					Total Irrigation	Fall Irrigation mm
		May	June	July	Aug	Sept	mm	
1	Durum Wheat	15	115	85	25	0	240	
1	Carrots	15	115	160	100	25	415	
1	Cabbage	40	115	160	125	25	465	
1	Celery	15	115	160	100	25	415	
2	Oats	0	50	100	0	0	150	50
4	Cereal Plots	0	65	195	50	0	310	25
5	Cereal Plots	0	65	195	50	0	310	25
6	Oats	0	50	100	0	0	150	
7	Lentils	0	40	65	25	0	130	25
7	Potatoes	0	65	140	175	25	405	25
8	Pulses	15	90	145	0	0	250	50
8	Russ Hynes plots	15	90	120	0	0	225	50
8	Annual Forages	15	90	180	0	0	285	50
8	Herb & Spices (irrigated only)	0	90	130	75	25	320	
8	Canola Trials	15	90	180	50	0	335	
8	Durum	15	90	180	0	0	285	
9	Canola	15	90	180	25	0	250	50
9	Durum	15	90	120	0	0	225	50
10	Grasses/Alfalfa	50	115	140	125	40	470	
10	Sask. Forage Council plots	50	90	140	125	75	480	
11	Oats	0	65	75	0	0	140	50
11	Corn	0	65	150	150	0	365	
11	Dry Beans	0	65	100	25	0	190	
11	Canola	0	65	150	50	0	265	
11	Chickpea	0	15	0	0	0	15	
11	Peas	0	65	150	50	0	265	
12	Beans NW 1/4	0	130	150	75	0	355	
12	Potatoes	0	130	115	125	25	395	
12	Beans NE 1/4	0	130	115	125	25	395	
12	Alfalfa	0	50	75	100	25	250	
12	Timothy	0	100	150	50	0	300	
Off-station Site								
Northwest		0	105	150	90	0	345	45
Northeast		0	105	105	0	0	210	60
Southeast		0	105	105	0	0	210	60
Southwest		0	105	150	90	0	345	30

Cereals and Oilseeds Program

Cereals Program

Varietal Evaluation:

Agronomic Investigations:

Oilseeds Program

Varietal Evaluation:

Cereals Program

Varietal Evaluation

Western Canada High Yield Wheat Co-operative Test

R. DePauw[1], T. Hogg[2], D. David[2] and C. Ringdal[2]

Funded by Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate potential new Canada Prairie Spring Wheat breeding lines under irrigated conditions in western Canada.*

The High Yield Wheat co-operative test was sown May 21 in 1.5 m x 6.0 m plots. Nitrogen was applied at a rate of 112 kg N/ha as 46-0-0 and phosphorus was applied at a rate of 45 kg P_2O_5/ha as 12-51-0. All fertilizer was side-banded at the time of seeding. The entire plot was harvested for yield estimation.

Results of the test are as presented in Table 1. Several lines combine high yield with good lodging resistance and short stature. Only one CPS-red line, HY669, had yield greater than the check variety AC Crystal. Most CPS-white lines had yield comparable to or higher than the check variety AC Vista. One CPS-white line, HY486, had exceptionally high yield.

The results from this trial are used to assist in the registration decision process for Canada Prairie Spring Wheat (CPS) varieties.

[1]Semiarid Prairie Agricultural Research Centre, Swift Current, Sask.
[2]CSIDC, Outlook, Sask.

Table 1. Yield and agronomic data for the Irrigated High Yield Wheat Co-operative Test, Outlook.						
Entry	Identity	Yield (kg/ha)	Yield % of Market Class Check	Maturity (days)	Height (cm)	Lodge Rating[1]
CPS-Red						
HY417	AC Crystal (check)	7508	100	95	77	0.8
HY962	5701PR (check)	5687	76	91	74	1.0
HY489	9732-BJ3D	7375	98	95	79	2.0
HY667	00W1172	6525	87	93	90	0.3
HY668	00W1182	6653	89	93	86	0.3
HY669	00W1219	7883	105	96	80	1.5
HY670	00W1419	6294	84	95	84	0.3
HY974	97S3134-10	5380	72	94	74	0.5
HY975	99S3111-26-6	6839	91	95	77	0
CPS-White						
HY413	AC Vista (check)	6777	100	92	76	1.0
HY446	AC2000 (check)	6640	98	94	73	0.3
BW264	Snowbird (check)	6035	89	90	86	0
HY475	9525-FM15	7058	104	93	75	1.0
HY476	P9711-PAE03B1	6865	101	94	80	1.3
HY478	9428-BQ04C4	6010	89	92	73	1.0
HY485	S9626-AV09B	6519	96	93	76	0.3
HY486	9624-DR3W	7628	113	95	82	1.3
HY487	9727-HB*2	6478	96	93	79	1.3
HY488	9730-JD3C	7013	103	94	78	0.8
HY490	9732-DX1C	7051	104	96	75	1.0
HY491	C9960-AP61	6616	98	93	77	1.3
HY492	H9803-CU3A	7040	104	94	75	1.0
HY493	H9803-CU3C	6825	101	93	73	0.8
HY671	00W1505	6685	99	94	80	1.5
HY976	BR7030HW	6603	97	91	72	0
LSD (0.05)		709	-	2	4	0.6
CV (%)		7.5	7.5	1.7	4.0	16.3

[1] 0 = erect; 9 = flat

Western Canada Soft White Spring Wheat Co-operative Test

R. Sadasivaiah[1], T. Hogg[2], D. David[2] and C. Ringdal[2]

Funded by Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate potential new Soft White Spring Wheat varieties under irrigated conditions in western Canada.*

The Soft White Spring Wheat co-operative test was seeded May 21 in 1.5 m x 6.0 m plots. Nitrogen was applied at a rate of 112 kg N/ha as 46-0-0 and phosphorus was applied at a rate of 45 kg P_2O_5/ha as 12-51-0. All fertilizer was side-banded at the time of seeding. The entire plot was harvested for yield estimation.

Results of the test are as presented in Table 2. Several lines combine high yield with good lodging resistance and short stature. The lines 02-B30, 02-B40, 02-B10 and 02-B11 had yield comparable to or higher than the check variety AC Andrew. The results from this trial are used to assist in the registration decision process for Canada Western Soft White Spring Wheat (CWSWS) varieties.

Table 2. Yield and agronomic data for the Irrigated Soft White Spring Wheat Co-operative Test, Outlook.

Entry	Yield (kg/ha)	Yield % of AC Andrew	Maturity (days)	Height (cm)	Lodge rating[1]
AC Andrew (SWS241)	7266	100	94	73	0.3
AC Phil (SWS89)	6471	89	94	68	1.0
AC Reed (SWS87)	6662	92	94	72	1.0
AC Nanda (SWS179)	6396	88	94	77	0
02PR-1014	6897	95	95	80	0.3
02PR-1016	6812	94	94	82	0.8
02PR-1118	5987	82	93	78	1.0
02PR-1121	6361	88	95	84	0
02PR-1406	6055	83	95	76	0
02PR-1407	6813	94	94	78	0.5
02PR-1408	5549	76	92	71	0.3
02PR-1412	5853	81	93	71	0
02PR-1416	6236	86	94	74	0.8
02PR-1417	6192	85	96	77	0.5
02-B05	6269	86	93	71	0.8
02-B06	6832	94	95	80	0.8
02-B09	7000	96	94	72	0
02-B10	7657	105	98	82	0.3
02-B11	7427	102	99	83	0
02-B29	6498	89	93	70	0.3
02-B30	7984	110	96	75	0.3
02-B35	6560	90	92	74	1.0
02-B38	6317	87	93	70	0
02-B39	6807	94	95	81	0.8
02-B40	7743	107	95	78	0.3
LSD (0.05)	1134	-	2	7	0.5
CV (%)	12.1	12.1	1.8	6.1	21.2

[1] 0 = erect; 9 = flat

[1]AAFC, Lethbridge Research Centre, Lethbridge, Alberta; [2]CSIDC, Outlook, Saskatchewan

Irrigated Wheat Variety Trials

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by the Irrigation Crop Diversification Corporation

Progress: *Ongoing*

Location: *Four soil associations in the Lake Diefenbaker area.*

Objective: *To evaluate registered wheat varieties under irrigation.*

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

CSIDC (SW15-29-08-W3): Bradwell very fine sandy loam
CSIDC offsite (NW12-29-08-W3): Asquith sandy loam
C. Ringdal (SE07-30-05-W3): Hanley loam - clay loam
R. Pederson (NE20-28-07-W3): Elstow loam

Wheat varieties for the different market classes were tested for their agronomic performance under irrigation. The CSIDC and Pederson sites were seeded May 23, the CSIDC Off-station site May 14 and the Ringdal site May 15. Plot size was 1.5 m x 4.0 m. All plots received 112 kg N/ha as 46-0-0 and 45 kg P_2O_5/ha as 12-51-0. Yields were estimated by harvesting the entire plot. The results are presented in Table 3.

Irrigated wheat yield, height and lodge rating varied among the four sites (Table 3). The highest yielding variety averaged over the four test sites was AC Andrew a Canada Western Soft White Spring market class wheat. AC Meena and Bhishaj, CWSWS varieties, also yielded higher than the check variety AC Barrie. In the Canada Western Red Spring market class Superb, Prodigy, McKenzie and CDC Bounty yielded higher than the check variety AC Barrie. All varieties in the Canada Western Amber Durum market class yielded equal to or greater than AC Barrie. For the Canada Prairie Spring market class 5700PR (CPS-red) and AC2000 (CPS-white) both yielded higher than AC Barrie.

The results from these trials are used to update the irrigation variety database at CSIDC and provide information to irrigators on the best wheat varieties suited to irrigation conditions.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 3. Yield and agronomic data for the irrigated wheat variety trial.

Variety	Pederson site				Ringdal site				CSIDC off-station site				CSIDC site				Mean yield	
	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	kg/ha	% of AC Barrie
Canada Western Red Spring																		
AC Barrie	4715	77	97	0.8	5709	94	99	2	7293	97	98	0.8	5880	79	87	0.5	5899	100
Superb	5303	74	97	0	6188	86	101	1	7285	91	99	0	6631	76	90	0.3	6352	108
CDC Bounty	5071	83	93	1.5	6419	100	99	2	7438	106	97	1	5781	87	86	2	6177	105
CDC Imagine	4434	76	94	0.8	5060	93	99	1	-	-	-	-	5889	77	86	0.3	5128	87
Prodigy	5379	80	94	0	5948	102	100	2.3	7133	99	98	0	6964	87	90	0.3	6356	108
McKenzie	4974	75	96	0.5	6776	93	99	2.5	7760	94	96	1.5	5570	73	88	1.8	6270	106
Alsen	4738	73	99	0	5533	85	102	1	7188	86	100	0	5996	74	92	0	5864	99
Lovitt	4192	79	94	1	5676	98	99	1	6753	97	96	1	5684	79	85	1	5576	95
Harvest	4480	72	94	1	6104	91	99	1	6610	91	96	0.5	5447	75	84	1	5660	96
Journey	5065	79	95	0	5236	90	100	1	6840	93	101	0	5847	79	87	0	5747	97
5500HR	4600	79	95	1	5778	93	99	1.3	6889	96	98	1	5855	80	88	0.8	5781	98
5601HR	3852	82	94	1	4770	99	99	1	6315	103	98	1.3	4896	79	86	1	4958	84
Canada Western Hard White Spring																		
Kanata	4233	73	94	0.8	4181	89	99	1	5708	91	99	0.8	4485	70	87	0.3	4652	79
Snowbird	4523	77	96	1	5129	99	100	1.3	6479	93	98	1	6226	84	89	0.8	5589	95
Canada Western Amber Durum																		
AC Avonlea	5265	77	96	0.3	5588	90	99	1	7388	92	102	0.3	-	-	-	-	6080	103
AC Morse	-	-	-	-	6046	90	100	1	8265	88	99	0	5364	69	89	0.8	6558	111
AC Napolean	5805	75	96	0.3	6090	93	100	1.5	8492	98	99	0.8	5438	74	87	1.3	6456	109
AC Navigator	4564	68	95	1.3	-	-	-	-	6899	82	101	3.3	6063	71	92	1.8	5842	99
DT712	5681	77	96	1	6765	94	100	1	7658	92	100	2	5850	75	86	1.3	6489	110
DT722	4905	65	95	0.8	5607	77	104	2	6588	75	100	1.5	6533	68	90	2.3	5908	100
Canada Prairie Spring - Red																		
5700PR	4468	68	97	0.5	6880	78	102	1	7869	80	99	0	6021	69	91	0.5	6310	107
5701PR	4777	74	97	0.3	6137	86	101	1	6678	84	97	0	5584	73	88	1	5794	98
Canada Prairie Spring - White																		
AC2000	5496	78	94	1	5067	82	102	1	7256	84	98	0	6675	74	90	0.3	6124	104
Canada Western Extra Strong																		
Amazon	4463	87	97	1	4637	106	100	1.5	6994	102	100	1	5712	87	90	1	5452	92
Glenavon	4285	86	97	1	5187	108	100	1.5	6853	105	100	1.3	5846	88	90	1	5543	94
CDC Rama	4310	83	96	1	6066	99	101	1	6883	97	99	0.5	5520	81	90	1.3	5695	97
Canada Western Soft White Spring																		
AC Andrew	5323	70	97	0	6236	82	104	1	8104	85	101	0	7058	72	91	0.8	6680	113
AC Meena	4882	69	96	1	6146	84	104	1	7486	85	102	0.8	6724	72	90	0.5	6310	107
Bhishaj	5265	71	97	1.3	4509	84	103	1	7520	86	100	0.3	7025	75	91	1	6080	103
LSD (0.05)	583	4	2	0.6	1405	4	1	0.7	721	6	3	0.8	1037	6	2	0.7	-	-
CV (%)	8.6	4	1.3	17.4	17.5	3.3	1	12.1	7.2	4.9	1.9	22.6	12.4	5.7	1.8	18.2	-	-

[1] 0 = erect; 9 = flat

Saskatchewan Advisory Council Irrigated Wheat and Barley Regional Variety Tests

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate wheat and barley varieties in various regions of the province.*

The Saskatchewan Advisory Council wheat regional and barley regional tests were seeded on May 23. Plot size was 1.5 m x 4.0 m. All plots received 112 kg N/ha as 46-0-0 and 45 kg P_2O_5/ha as 12-51-0. Each market class was conducted as a separate test. Yields were estimated by harvesting the entire plot.

Results for the CWRS, CWAD, CWSWS, CPS and CWES market classes are shown in Tables 4-8 respectively. All market classes used AC Barrie CWRS wheat as the check. All wheat market classes showed good lodging resistance and short stature. The CWRS (Table 4) and CWES (Table 8) market classes had lines with the highest plant height while the highest lodge ratings were observed for some CWRS lines. AC Barrie yielded higher than all CWRS lines except Superb (Table 4), all CWAD lines except Kyle (Table 5), all CPS lines except AC Crystal, Hy476 and AC Vista (Table 7) and all CWES lines except Glenavon (Table 8). All CWSWS lines had higher yield than AC Barrie (Table 6).

Results for the 2-row and 6-row barley tests are shown in Tables 9 and 10 respectively. Harrington was used as the check for the 2-Row Barley Test while CDC Sisler was used as the check for the 6-Row Barley Test. In the 2-Row Test, all varieties tested had higher yield than the check variety Harrington (Table 9). The 2-row Malt varieties CDC Copeland and Newdale and the Feed varieties Xena and CDC Trey had exceptionally high yield. All 2-Row entries had better lodging resistance than the check variety Harrington. In the 6-Row Test all entries tested had yield higher than the check variety CDC Sisler (Table 10). The Malt variety CDC Yorkton and the Feed variety Vivar were the highest yielding varieties tested. As well, most 6-Row lines had lodging resistance equal to or greater than the check variety CDC Sisler.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 4. Saskatchewan Advisory Council Irrigated Canada Western Red Spring Wheat (CWRS) Regional Test, Outlook.					
Variety	Yield (kg/ha)	Yield % of AC Barrie	Height (cm)	Maturity (days)	Lodging rating[1]
AC Barrie (BW661)	6623	100	86	91	0.8
5500HR (BW245)	6256	94	82	91	0.8
5601HR (BW256)	5555	84	86	90	1
Superb (BW252)	6920	104	80	93	0
Kanata (BW263)	4952	75	78	90	0
Snowbird (BW264)	6015	91	86	91	0.8
Journey (BW243)	5875	89	82	91	0
Harvest (BW259)	5796	88	82	89	1
Lovitt (PT205)	5990	90	83	88	1.5
Alsen (BW316)	6274	95	78	93	0
BW297	6058	91	83	90	0.8
BW307	6528	99	95	90	1.3
BW317	4947	75	77	90	0.3
BW758	5636	85	80	90	1.3
BW776	5455	82	82	89	2
BW781	6462	98	80	91	0.5
BW796	5389	81	81	91	0.5
BW799	6433	97	84	89	1.5
PT555	5382	81	81	88	1.5
PT559	5433	82	83	90	1.8
LSD (0.05)	850	-	7	2	0.6
CV (%)	10.2	10.2	5.7	1.8	17.2

[1] 0 = erect; 9 = flat

Table 5. Saskatchewan Advisory Council Irrigated Canada Western Amber Durum Wheat (CWAD) Regional Test, Outlook.					
Variety	Yield (kg/ha)	Yield % of AC Barrie	Height (cm)	Maturity (days)	Lodging rating[1]
AC Barrie (check)	5793	100	77	86	0.3
Kyle (DT375)	5993	103	93	89	1.8
AC Avonlea (DT661)	5367	93	76	87	1
AC Navigator (DT673)	5313	92	68	88	1.5
AC Napolean (DT494)	5236	90	74	87	1
DT712	4425	76	71	86	1
DT722	5160	89	63	87	0.8
LSD (0.05)	NS[2]	NS	7	NS	0.9
CV (%)	15.8	15.8	5.9	1.8	20.4

[1] 0 = no lodging; 9 = completely lodged
[2] not significant

Table 6. Saskatchewan Advisory Council Irrigated Soft White Spring Wheat (CWSWS) Regional Test, Outlook.

Variety	Yield (kg/ha)	Yield % of AC Barrie	Height (cm)	Maturity (days)	Lodging rating[1]
AC Barrie (check)	5906	100	78	85	0.8
AC Phil (SWS89)	5930	100	68	86	1.0
AC Reed (SWS87)	6411	109	68	86	1.0
AC Nanda (SWS179)	6631	112	77	87	0.3
AC Meena (SWS234)	6912	117	74	86	0.3
AC Andrew (SWS241)	6789	115	72	88	0.8
Bhishaj (SWS285)	6092	103	72	86	1.0
LSD (0.05)	484	-	4	NS[2]	0.6
CV (%)	5.1	5.1	4.1	1.8	19.6

[1] 0 = erect; 9 = flat
[2] not significant

Table 7. Saskatchewan Advisory Council Irrigated Canada Prairie Spring Wheat (CPS) Regional Test, Outlook.

Variety	Yield (kg/ha)	Yield % of AC Barrie	Height (cm)	Maturity (days)	Lodging rating[1]
AC Barrie (check)	5021	100	69	85	0
AC Vista (HY413)	5213	104	67	87	1.0
AC Crystal (HY417)	5591	111	65	87	0.8
5700PR (HY961)	4873	97	63	87	0.5
5701PR (HY962)	4630	92	66	87	1.0
HY475	4821	96	66	87	0.8
HY476	5476	109	71	87	1.0
LSD (0.05)	527	-	NS[2]	NS	0.5
CV (%)	7.0	7.0	5.5	1.0	16.9

[1] 0 = erect; 9 = flat
[2] not significant

Table 8. Saskatchewan Advisory Council Irrigated Canada Western Extra Strong Wheat (CWES) Regional Test, Outlook.

Variety	Yield (kg/ha)	Yield % of AC Barrie	Height (cm)	Maturity (days)	Lodging rating[1]
AC Barrie (check)	4891	100	73	85	0.3
Glenavon (ES13)	4883	100	81	85	1.0
CDC Rama (ES21)	4360	89	76	86	0.8
ES41	4541	93	79	85	0.8
ES54	4290	88	73	85	1.0
ES63	4756	97	70	87	0.3
ES67	4119	84	78	85	1.0
LSD (0.05)	NS[2]	NS	6.0	1	0.6
CV (%)	9.7	9.7	5.6	1	19.6

[1] 0 = erect; 9 = flat
[2] not significant

Table 9. Saskatchewan Advisory Council Irrigated 2-Row Barley Regional Test, Outlook.					
Variety	Yield (kg/ha)	Yield % of Harrington	Height (cm)	Maturity (days)	Lodging rating[1]
Malting					
Harrington (TR441)	6676	100	72	83	6.3
AC Bountiful (TR243)	7057	106	82	84	3.3
CDC Copeland (TR150)	8867	133	90	84	2
Newdale (TR258)	8413	126	76	84	1.3
CDC Select (TR153)	7618	114	79	83	2
Calder (TR262)	7290	109	80	83	4
Feed					
CDC Bold (SD422)	7682	115	75	83	4.7
CDC Dolly (TR318)	7172	107	71	83	3.7
CDC Helgason (TR346)	7255	109	78	84	3
CDC Trey (TR359)	8217	123	81	86	2.3
Xena (TR475)	8603	129	75	85	3
Niobe (TR651)	7538	113	77	83	1.3
Rivers (TR256)	7347	110	80	84	1.7
LSD (0.05)	835	-	5	NS[2]	1.8
CV (%)	6.4	6.4	4	1.5	15.9

[1] 0 = erect; 9 = flat
[2] not significant

Table 10. Saskatchewan Advisory Council Irrigated 6-Row Barley Regional Test, Outlook.					
Variety	Yield (kg/ha)	Yield % of CDC Sisler	Height (cm)	Maturity (days)	Lodging rating[1]
Malting					
CDC Sisler (BT433)	6962	100	89	87	3.7
CDC Battleford (BT456)	7764	112	79	87	3
CDC Springside (BT478)	7885	113	90	87	3.3
CDC Tisdale (BT462)	7716	111	87	86	2.3
CDC Yorkton (BT459)	7977	115	82	87	3.3
Excel (M52)	7430	107	74	85	1.7
Lacey (BT965)	7353	106	76	85	1
Legacy (BT950)	7856	114	80	86	1.7
Feed					
Vivar (SD516)	7981	115	75	87	1.7
LSD (0.05)	NS[2]	NS	6	NS	NS
CV (%)	5.4	5.4	3.9	1.6	20.7

[1] 0 = erect; 9 = flat
[2] not significant

Alberta Corn Committee Hybrid Performance Trials

T. Hogg[1], D. David[1], L. Bohrson[2], B. Beres[3]

Funded by the Alberta Corn Committee and Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To determine the grain and silage production potential of selected corn hybrids in the Lake Diefenbaker Development Area of Saskatchewan.*

The Alberta Corn Committee grain and silage hybrid performance trials were established in the spring of 2003 at the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) located on the SW15-29-08-W3. The soil, developed on medium to moderately coarse-textured lacustrine deposits, was classified as Bradwell L-SiL.

All seeding operations were conducted using a specially designed small plot six row double disc press drill with two sets of discs. One set of discs was used for seed placement while the second set of discs allowed for side band placement of fertilizer. Treatments consisted of selected corn hybrids with varying corn heat unit maturity ratings. The corn was seeded on an 80 cm (32") row spacing using single row cones. Two rows were seeded per pass. The grain corn plots consisted of 4 rows and measured 2.4 m x 6 m while the silage corn plots consisted of 2 rows and measured 1.2 m x 6 m. A seeding rate of 47 kernels/row (59,000 plants/ha) and 56 kernels/row (74,000 plants/ha) were used for grain and silage corn respectively. Separate trials were established for grain and silage corn hybrids. All plots received a side band application of 12-51-0 at a rate of 45 kg P_2O_5/ha during the seeding operation. The treatments were arranged in a randomized complete block design and replicated four times.

The trials were seeded on May 20 and harvested on September 25 and October 10 for the silage and grain trials respectively. Growing season rainfall (May 1 to September 30) and irrigation was respectively 129 mm and 365 mm. Cumulative Corn Heat Units were 2489 from May 15 until the first frost of -2^{0}C or greater which occurred on September 30.

Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N (0-60 cm) = 330 kg/ha and P (0-30 cm) = 122 kg/ha. Current soil test recommendations indicated the requirement for 6-11 kg P_2O_5/ha for irrigated corn. As well, an additional 50 kg/ha applied as ammonium nitrate (34-0-0) was broadcast at the six-leaf stage and watered in with an irrigation application.

<u>Silage Corn</u>

Seventeen silage hybrids were tested with CHU maturity rating varying from 2000 to 2700 (Table 11). Plant stand varied among the hybrids ranging from a low of 36 plants/row (72,660 plants/ha) to a high of 47 plants/row (94,862 plants/ha). All plots either met or exceeded the targeted plant population of 74,000 plants/ha.

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[1]CSIDC, Outlook, Sask.
[2]ICDC, Swift Current, Sask.
[3]AAFC, Lethbridge Research Centre, Lethbridge, Alberta

Days to 10% anthesis (range:62-77 days), days to 50% silking (range:64-79 days), harvest whole plant moisture (range:53.2-66.0) and dry yield (range:16.6-27.3 t/ha) showed a general trend of increasing as the CHU maturity rating increased (Table 11).

Grain Corn

Nine grain hybrids were tested with CHU maturity rating varying from 2000 to 2375 (Table 12). Plant stand varied among the hybrids ranging from a low of 32 plants/row (64,587 plants/ha) to a high of 35 plants/row (70,641 plants/ha). All plots exceeded the targeted plant population of 59,000 plants/ha.

Days to 10% anthesis (range:57-71 days), days to 50% silking (range:65-76 days) and grain yield @ 15.5% moisture content (range:9,333-12,023 kg/ha) showed a general trend of increasing as the CHU maturity rating increased (Table 12). Corn grain test weight ranged from a low of 69.5 kg/hl to a high of 80.7 kg/hl but showed no specific trend in relation to CHU maturity rating or grain yield.

The warm growing season conditions together with the high soil fertility and irrigation applications provided excellent growing conditions allowing the high CHU maturity rating hybrids to mature and thus attain a high yield potential for both the silage and grain corn.

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

Table 11. ACC Silage Hybrid Performance Trial - Outlook site.

Company	Hybrid	CHU Maturity Rating	Plant Stand (#/20' row)	10% Anthesis (days)	50% Silking (days)	Harvest Whole Plant Moisture (%)	Dry Yield (t/ha)
Garst	8993	2375	39	66	70	59.5	21.2
Garst	8961 RR	2105	38	71	73	62.9	22.6
Garst	8905 RR	2700	41	73	76	63.0	23.3
Hyland	HL S009	2400	44	74	74	56.3	26.7
Hyland	HL S007	2350	38	64	73	62.3	22.4
Maizex	MZ27-77RR	2650	38	76	75	63.5	22.3
Maizex	MZ27-10RR	2700	41	77	79	64.3	25.2
Maizex	MZ18-02RR	2450	42	69	75	64.6	24.7
Monsanto	DKC27-12	2250	43	62	69	59.3	23.7
Monsanto	DKC27-15	2300	37	66	71	62.1	19.7
Monsanto	DKC32-59	2475	36	68	71	63.0	22.1
Pioneer	39F45	2000	39	57	64	53.2	16.6
Pioneer	39P78	2050	38	58	68	54.3	18.1
Pioneer	39T68	2250	39	61	67	57.3	20.5
Pioneer	39N03	2000	38	71	76	62.3	22.0
Syngenta	N11-F4	2475	42	68	73	63.0	23.9
Syngenta	G4043	2600	47	72	75	66.0	27.3
LSD (0.05)			6	2	2	2.1	2.6
CV (%)			9.7	2.6	2.0	2.4	8.3

Table 12. ACC Grain Hybrid Performance Trial - Outlook site.

Company	Hybrid	CHU Maturity Rating	Plant Stand (#/20' row)	10% Anthesis (days)	50% Silking (days)	Harvest Grain Moisture (%)	Yield @ 15.5% moisture (kg/ha)	Test weight (kg/hl)
Hyland	HL 2093	2225	34	66	70	17.7	11867	74.7
Hyland	HL 2017	2200	33	65	69	18.3	11503	77.8
Hyland	HL 2232	2375	35	71	76	18.4	11290	72.7
Pioneer	39T68	2250	35	65	69	19.0	11804	77.3
Pioneer	39P78	2050	35	59	69	19.6	9960	79.3
Pioneer	39F45	2000	32	57	65	21.1	9333	80.7
Pioneer	39N03	2000	34	71	76	21.9	11384	69.5
Syngenta	N02-K1	2150	34	62	69	23.2	11584	79.5
Syngenta	N06-J6	2350	35	67	70	27.8	12023	80.4
LSD (0.05)			NS[1]	1	1	4.1	1024	2.3
CV (%)			7.8	1.3	1.1	13.6	6.3	2.1

[1] not significant

Agronomic Evaluation

Annual Cereal Forage Yield Potential Trials

T. Hogg[1], D. David[1], R. Pastl[2] and L. Bohrson[3]

Funded by Agriculture and Agri-Food Canada, PFRA

Progress: *Year one of ongoing*

Objective: *To evaluate the forage production potential of selected spring seeded barley, oat and triticale varieties under irrigated conditions.*

A spring seeded annual cereal forage trial was established in the spring of 2003 at the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) located on the SW15-29-08-W3. Treatments consisted of selected barley, oat and triticale varieties. A seeding rate of 250 seeds/m^2 was used for all crops. Separate trials were established for each crop. The entire plot area received a pre-seeding broadcast, soil incorporated application of urea (46-0-0) at a rate of 100 kg N/ha. All plots received a side band application of 12-51-0 at a rate of 45 kg P_2O_5/ha during the seeding operation. The treatments were arranged in a randomized complete block design and replicated four times. Each treatment measured 1.2 m x 5.5 m.

The trials were seeded on May 15 and harvested at the soft dough growth stage on July 30, August 8 and August 13 for the barley, oat and triticale respectively.

Barley

Barley treatments consisted of sixteen varieties representing four types: malt (5), feed (5), forage (4) and hulless (2). Highest forage dry matter yield was obtained for Trochu, a 6-row, smooth awned, normal height feed barley while the lowest forage yield was obtained for Westford, a 6-row, awnless/hooded, normal height forage barley (Table 13). The hulless barley varieties CDC McGwire and Tyto tended to have slightly lower yield than the other barley market classes, however, the differences were not statistically significant. Overall, barley forage dry matter yield for all varieties tested was high ranging from 13642 to 15871 kg/ha.

Plant height ranged from a high of 103 cm for AC Hawkeye (forage) to a low of 76 cm for CDC Bold (semi-dwarf feed). There were significant plant height differences between barley varieties, however, the differences did not show any trend in relation to forage yield. Most varieties had plant height in the range of 80-90 cm.

Days to first head emergence varied from 48 to 53 days for the barley varieties tested, however, there were no significant differences in days to the soft dough growth stage (73 to 76 days).

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[1]CSIDC, Outlook, Sask.
[2]Sask Forage Council, Saskatoon, Sask.
[3]ICDC, Swift Current, Sask.

Lodging resistance of the majority of the barley varieties tested was good as indicated by the low lodge rating scores recorded. Brier and AC Hawkeye had a significantly higher lodge rating score than the other varieties, however, the extent to which they lodged was minimal.

All barley varieties tested showed leaf disease incidence. The greatest extent of leaf disease as indicated by the visual estimations was shown for Newdale, CDC Copeland, Harrington, CDC Yorkton and CDC Bold. However, the visual estimations of disease severity indicated no differences among the varieties tested.

Oat

Oat treatments consisted of nine varieties representing three types: general purpose (3), milling/feed (3) and forage (3). Highest forage dry matter yield was produced by CDC Bell while the lowest forage yield was produced by AC Mustang, both forage type varieties (Table 14). CDC Bell produced significantly higher dry matter yield than AC Morgan, Derby, Triple Crown, CDC Orrin and AC Mustang. There was no significant difference in the dry matter forage yield among CDC Bell, Calibre, Pinnacle or CDC Baler. Overall, oat forage dry matter yield for all varieties tested was high ranging from 13260 to 15983 kg/ha.

Plant height ranged from a high of 148 cm for CDC Baler (forage) to a low of 113 cm for CDC Orrin (milling/feed). There were significant plant height differences between oat varieties, however, the differences did not show any trend in relation to forage yield. Only two varieties had plant height >130 cm while five varieties had plant height ≤120 cm.

Days to first head emergence varied from 50 to 61 days for the oat varieties tested, however, days to the soft dough growth stage showed very little difference (81 to 84 days).

Lodging resistance of the majority of the oat varieties tested was good as indicated by the very low lodge rating scores recorded.

All oat varieties tested showed leaf disease incidence. However, disease was minimal with no distinction between the varieties tested.

Triticale

Triticale treatments consisted of six varieties. Highest forage dry matter yield was produced by Viking while the lowest forage yield was produced by AC Ultima (Table 15). Viking produced significantly higher dry matter yield than Glacier, Pronghorn or AC Ultima. There was no significant difference in the dry matter forage yield among Viking, Banjo or Comet. Overall, triticale forage dry matter yield for all varieties tested was high ranging from 15237 to 18239 kg/ha.

Plant height ranged from a high of 148 cm for Viking to a low of 111 cm for AC Ultima. There were significant plant height differences between triticale varieties with a slight trend in relation to forage yield. Three varieties had plant height >140 cm while only one variety had plant height <120 cm.

Days to first head emergence varied from 50 to 53 days for the triticale varieties tested. AC Ultima reached the soft dough growth stage in 85 days while all other varieties required 89 days.

Lodging resistance of the majority of the triticale varieties tested was good as indicated by the low lodge rating scores recorded. Glacier and Viking, the two tallest triticale varieties, had a significantly higher lodge rating score than the other varieties, however, the extent to which they lodged was minimal. AC Ultima, Banjo, Comet and Pronghorn lodged very little.

All triticale varieties tested showed leaf disease incidence. AC Ultima, Glacier and Viking showed the highest disease extent and severity, as indicated by the visual estimations.

Table 13. Agronomic data for the irrigated barley forage trial.										
Variety	2 or 6 row	Awn Type[1]	Straw[2]	Dry Matter Yield (kg/ha)	Height (cm)	Head Emergence (days)	Soft Dough (days)	Lodge rating (0 = erect; 9 = flat)	Disease	
									Extent (0-5)	Severity (0-5)
Malt										
CDC Copeland	2	R	N	15871	88	50	74	0.5	2.0	1.3
Newdale	2	R	N	15357	80	48	75	0	2.3	1.3
Harrington	2	R	N	14825	82	48	74	0.5	2.0	1.3
CDC Battleford	6	S	N	15742	90	50	74	0.5	1.5	1.0
CDC Yorkton	6	S	N	14610	84	49	74	0	2.0	1.0
Feed										
Trochu	6	S	N	15967	80	48	74	1.5	1.8	1.3
Brier	6	S	N	15649	92	50	75	2.3	1.8	1.0
Vivar	6	R	SD	15306	78	50	74	0	1.5	1.3
AC Rosser	6	S	N	15263	82	49	73	1.0	1.5	1.3
CDC Bold	6	R	SD	14494	76	48	75	0	2.0	1.0
Forage										
AC Ranger	6	S	N	15443	84	48	75	0.5	1.8	1.0
Virden	6	S	N	15136	95	50	75	0	1.5	1.0
AC Hawkeye	6	S	N	14645	103	50	74	2.3	1.5	1.3
Westford	6	A/H	N	13642	95	53	75	0	1.3	1.0
Hulless										
CDC McGwire	2	R	N	14034	89	53	76	0.3	1.3	1.0
Tyto	6	S	SD	14157	85	52	73	0	1.8	1.0
LSD (0.05)				NS[3]	4	1	NS	1.0	0.6	NS
CV (%)				9.8	3.2	1.4	1.3	31.6	9.9	7.2

[1] R = rough; S = smooth; A/H = awnless/hooded

[2] N = normal; SD = semi-dwarf

[3] not significant

Table 14. Agronomic data for the irrigated oat forage trial.							
Variety	Dry Matter Yield (kg/ha)	Height (cm)	Head Emergence (days)	Soft Dough (days)	Lodge rating (0 = erect; 9 = flat)	Disease	
						Extent (0-5)	Severity (0-5)
General Purpose							
Calibre	15833	123	51	81	0.3	1.0	1.0
Derby	14188	120	50	81	0	1.0	1.0
Triple Crown	14062	120	54	84	0	1.0	1.0
Milling/Feed							
Pinnacle	15481	116	52	82	0	1.0	1.0
AC Morgan	14346	114	52	83	0	1.0	1.0
CDC Orrin	13853	113	53	82	0	1.0	1.0
Forage							
CDC Bell	15983	139	59	84	0.8	1.0	1.0
CDC Baler	15401	148	61	84	0.5	1.0	1.0
AC Mustang	13260	129	56	82	0	1.0	1.0
LSD (0.05)	1606	6	2	1	NS[1]	-	-
CV (%)	7.5	3.0	2.3	1.1	27.6	-	-

[1] not significant

Table 15. Agronomic data for the irrigated triticale forage trial.							
Variety	Dry Matter Yield (kg/ha)	Height (cm)	Head Emergence (days)	Soft Dough (days)	Lodge rating (0 = erect; 9 = flat)	Disease	
						Extent (0-5)	Severity (0-5)
Viking[1]	18239	148	51	89	2.8	2.0	2.0
Banjo	17116	127	53	89	0.5	1.5	1.5
Comet[1]	16781	144	50	89	0.8	1.8	1.5
Glacier[1]	15275	148	53	89	3.0	2.3	2.8
Pronghorn	15240	123	50	89	0.8	1.8	1.8
AC Ultima	15237	111	50	85	0	2.3	3.0
LSD (0.05)	1760	5	1	1	2.1	0.5	0.7
CV (%)	7.2	2.4	1.2	0.7	39.1	7.6	10.3

[1] Varieties not registered in Canada. Available only for forage or feed production.

Oilseeds Program

Variety Evaluations

Western Canada Irrigated Canola Co-operative Tests NI1 and NI2

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by the Canola Council of Canada and Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate potential new canola varieties under irrigated conditions in western Canada.*

The canola co-operative tests were conducted on an irrigated site at CSIDC. The NI1 and NI2 tests were seeded on May 20. Plot size was 1.5 m x 6 m. Nitrogen was applied at 112 kg N/ha as 46-0-0 and phosphorus was applied at 56 kg P_2O_5/ha as 12-51-0. All fertilizer was side-banded at the time of seeding.

In the NI1 trial approximately 50% of the new lines had high yield and good lodge resistance comparable to or greater than the check variety 46A65 (Table 1). In the NI2 trial 80% of the new lines had high yield and good lodge resistance comparable to or greater than the check 46A65 (Table 2). Most new lines in both tests had similar maturity to the check and were taller than the check. Line 01N232C in the NI1 trial (Table 1) and lines 6_24, 6803_01, 01N241R, PHS02-562, 02N3961, PR7642 and 02N3921 in the NI2 trial (Table 2) had exceptionally high yield compared to the check variety.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 1. Yield and agronomic data for the irrigated canola co-operative test NI1.					
Entry	Yield (kg/ha)	Yield % of 46A65	Maturity (days)	Height (cm)	Lodging 0=erect; 9=flat
46A65	4138	100	89	124	2.8
Q2	3811	92	92	130	1.0
LOLINDA	3370	81	90	129	0.8
PHS02-536	3581	87	89	142	0.8
PHS02-555	3984	95	90	136	0.8
RHY02/24	4201	102	89	130	0.5
RHY02/32	4195	101	88	134	0.5
CNH1503R	4333	105	91	139	1.3
CNH1504R	4571	110	88	137	1.8
CNH1505R	4549	110	88	132	1.3
CNH1507R	3992	96	90	132	1.3
CNH1604R	4523	109	90	128	3.5
6_54	3443	83	88	133	1.0
6_71	3367	81	88	143	1.0
3140_01	2977	72	89	136	1.3
3631_01	4123	100	88	134	0.8
PR6377	3817	92	88	121	3.0
PR7169	3525	85	91	124	1.0
PR7189	3546	86	89	124	2.0
PR7277	3039	73	89	134	1.0
PR7650	4478	108	89	125	1.0
PR7700	4335	105	89	133	0.8
01N226R	4377	106	88	137	0.8
01N232C	4824	117	89	121	2.8
01N242R	3360	81	91	142	1.0
NO98-5890	3912	95	88	137	2.0
NR00-4493	2606	63	91	132	0.8
SWF5187RR	4031	97	87	120	2.0
SWF5207RR	4204	102	88	124	2.0
SWF5208RR	3960	96	89	129	1.8
LSD (0.05)	470	-	2	10	1.0
CV (%)	8.6	8.6	1.6	5.4	17.5

Table 2. Yield and agronomic data for the irrigated canola co-operative test NI2.					
Entry	Yield (kg/ha)	Yield % of 46A65	Maturity (days)	Height (cm)	Lodging 0=erect; 9=flat
46A65	3868	100	90	126	3.8
Q2	3791	98	90	135	2.3
PHS02-562	4121	107	89	158	1.0
PHS02-563	4522	117	89	134	1.0
PHS02-577	4401	114	90	150	1.3
PHS02-583	3728	96	91	153	2.8
6_24	4893	126	89	121	3.3
7_20	4100	106	91	140	3.5
3458_01	3282	85	91	146	2.0
6195_01	3505	91	90	141	1.8
6803_01	4673	121	90	130	2.5
7077_01	4035	104	91	136	2.3
PR6382	4291	111	91	124	3.0
PR7170	3570	92	90	132	2.3
PR7640	3716	96	90	151	1.0
PR7642	4466	115	90	132	2.0
PR7658	3906	101	91	136	1.8
PR7660	4142	107	90	141	1.3
PR7673	4274	110	89	124	2.0
PR7716	3460	89	91	138	1.5
01N227R	4246	110	92	150	1.3
01N241R	4554	118	91	146	1.3
02N3921	4449	115	90	139	2.0
02N3951	3852	100	91	134	2.5
02N3961	4494	116	90	141	2.8
NO00-4735	3289	85	90	137	2.0
NO98-5930	4062	105	89	130	4.3
NO99-1598	3738	97	90	126	2.3
SWF5203RR	4382	113	91	126	4.0
SWF5205RR	4332	112	88	133	3.0
LSD (0.05)	541	-	2	8	1.4
CV (%)	9.4	9.4	1.7	4.3	17.1

Prairie Canola Regional Variety Trial NL1 and NL2

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by the Canola Council of Canada, Irrigation Crop Diversification Corporation and Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate new canola varieties under irrigated conditions in western Canada.*

The PCVT canola regional tests were conducted on an irrigated site at CSIDC. The NL1 and NL2 tests were seeded on May 20. Plot size was 1.5 m x 6 m. Nitrogen was applied at 112 kg N/ha as 46-0-0 and phosphorus was applied at 56 kg P_2O_5/ha as 12-51-0. All fertilizer was side-banded at the time of seeding.

In the NL1 trial 50% of the entries had high yield and good lodge resistance comparable to or greater than the check variety 46A65 (Table 3). In the NL2 trial 16 out of 18 entries had high yield and good lodge resistance comparable to or greater than the check variety 46A65 (Table 4). Most entries in both tests had similar maturity to the check and were taller than the check. Entries 46H02, RHY01/597 (5020) and 45H21 in the NL1 trial (Table 3) and entries Canterra 1841, LBD644RR, PHS01-403 (5030), PHS01-401 and 46H23 in the NL2 trial (Table 4) had exceptionally high yield compared to the check variety.

The results from these trials are used to update the irrigation variety database at CSIDC and provide information to irrigators on the best canola varieties suited to irrigation conditions.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 3. Yield and agronomic data for the PCVT irrigated canola regional test NL1.					
Entry	Yield (kg/ha)	Yield % of 46A65	Maturity (days)	Height (cm)	Lodging 0=erect; 9=flat
46A65	4293	100	89	132	3.3
SL 13778 (Fortune RR)	4477	104	89	138	2.0
SP Banner	3939	92	89	138	1.5
Canterra 1854	4204	98	90	146	1.0
PR6450	3891	91	89	133	2.5
45H21	4814	112	90	131	3.3
46H02	4978	116	91	128	1.8
SW GladiatoRR	4564	106	89	144	2.5
Prairie 719RR	4507	105	90	133	2.0
LBD588	3581	83	89	140	1.8
LBD422RR	4083	95	88	131	2.5
6045	3891	89	91	129	3.3
IMC 109RR	3333	78	89	137	3.3
IMC 208RR	2599	61	88	131	2.0
SW Razor	4115	96	89	133	4.0
Sw Hymark 3944 RR	4416	103	91	139	2.0
RHY01/597 (5020)	4869	113	88	139	1.3
PR6336	4169	97	90	142	2.3
LSD (0.05)	528	-	NS[1]	8	1.5
CV (%)	9.0	-	1.9	4.0	18.6

[1] not significant

Table 4. Yield and agronomic data for the PCVT irrigated canola regional test NL2.					
Entry	Yield (kg/ha)	Yield % of 46A65	Maturity (days)	Height (cm)	Lodging 0=erect; 9=flat
46A65	3791	100	90	125	2.8
SP Admirable RR	3968	105	89	136	1.5
Canterra 1604 CL	3288	87	91	137	1.8
Canterra 1812	3934	104	91	142	3.0
Canterra 1841	4660	123	91	144	1.0
Canterra 1849	3951	104	90	126	2.0
34-55	4100	108	90	133	1.8
35-85 (3585)	3919	103	89	142	2.3
46H23	4317	114	90	131	2.0
46A76	3887	103	89	140	1.5
LBD644RR	4465	118	90	126	2.3
CNH501R	3905	103	90	135	2.5
SW E5133 (SW WIZZARD)	3801	100	89	143	1.0
Z0705 (512RR)	3914	103	89	138	1.8
Y0276	4187	110	90	136	2.0
PHS01-403 (5030)	4470	118	89	155	1.0
PHS01-401	4466	118	88	149	1.0
IMC209RR	3019	80	91	147	1.5
LSD (0.05)	524	-	NS[1]	8	1.0
CV (%)	9.2	9.2	2.1	3.9	15.0

[1] not significant

Irrigated Canola Regional Variety Trial

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by the Irrigation Crop Diversification Corporation

Progress: *Ongoing*

Locations: *Three soil associations in the Lake Diefenbaker area.*

Objective: *To evaluate registered canola varieties under irrigation.*

The irrigated canola regional tests were conducted at three locations in the Outlook area. Each site and soil type are as follows:

CSIDC off-station (NW12-29-08-W3): Asquith sandy loam
C. Ringdal (SE07-30-05-W3): Hanley loam - clay loam
R. Pederson (NE20-28-07-W3): Elstow loam

Canola varieties were tested for their agronomic performance under irrigation (the CSIDC off-station and Pederson sites on May 14 and the Ringdal site on May 15). Plot size was 1.5 m x 4.0 m. All plots received 112 kg N/ha as 46-0-0 and 56 kg P_2O_5/ha as 12-51-0. Yields were estimated by harvesting the entire plot.

Irrigated canola yield, height and lodge rating varied among the four sites (Table 5). All canola varieties tested except InVigor 2573 had lower yield than the check variety InVigor 2663 averaged over the three test sites.

The results from these trials are used to update the irrigation variety database at CSIDC and provide information to irrigators on the best canola varieties suited to irrigation conditions.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 5. Yield and agronomic data for the irrigated canola regional variety trial.

Variety	Pederson site				Ringdal site				CSIDC off-station site				Mean yield	
	Yield (kg/ha)	Maturity (days)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Maturity (days)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Maturity (days)	Height (cm)	Lodge rating[1]	kg/ha	% of 2663
InVigor 2663	4272	92	113	1	3657	94	107	2.3	6053	98	122	1.8	4661	100
InVigor 2573	4583	92	126	1	3541	93	121	2	6294	97	125	1.3	4806	103
InVigor 2773	4447	90	88	3	2698	94	99	3.3	5015	95	104	2.8	4053	87
SP Banner	3135	91	97	1.5	2385	95	101	3	4649	98	109	1.5	3390	73
SP Admirable	3532	93	109	1.3	3029	93	110	2.8	5531	98	118	2	4031	86
SW Rider	3800	91	106	1.3	2694	93	106	3.3	5147	97	120	2	3880	83
DKL34-55	4045	92	96	1.3	2195	94	98	3	4467	97	104	1.8	3569	77
DKL3235	3766	91	96	2.5	2488	95	98	4.5	4668	96	103	2.5	3641	78
IMC 109RR	3298	93	112	2.5	2152	95	97	5	3819	98	106	5.3	3090	66
45H21	4191	92	96	2.3	2621	94	94	3.8	5422	98	113	2.8	4078	87
46H02	3810	92	94	1.8	3071	94	99	3	5196	99	111	2.8	4026	86
46H23	3903	93	110	2	2593	94	102	4	5153	100	107	2	3883	83
46A65	3645	90	94	3	2121	94	102	3.8	4535	97	104	3	3434	74
46A76	2899	93	126	1	2341	96	108	2.8	4208	100	131	2.3	3149	68
Hylite 289	3352	91	81	5	2406	94	92	5.8	4716	97	99	5.3	3491	75
Hylite 292	3498	92	86	1.8	1970	95	98	3.8	5186	97	102	1.8	3551	76
Hyola 505RR	3225	94	107	0.8	2669	94	112	3	5722	98	123	2	3872	83
Hyola 512RR	3656	92	112	1.8	2301	93	115	2.3	5525	98	120	2.3	3827	82
1841	4190	92	110	0.8	3114	95	113	2.8	5942	97	119	1.3	4415	95
1854	3864	93	110	1.3	2823	93	107	2.5	4847	98	114	2.3	3845	82
Q2	3556	93	100	1	2303	95	101	3	5255	99	114	2	3705	79
LSD (0.05)	638	1	12	0.8	638	2	9	1.2	596	2	11	0.9	-	-
CV (%)	11.7	1.1	8.2	11.4	17.2	1.4	6.2	10.9	8.2	1.4	6.9	10.6	-	-

[1] 0 = erect; 9 = flat

Irrigated Flax and Solin Regional Variety Trial

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by the Irrigation Crop Diversification Corporation

Progress: *Ongoing*

Locations: *Three soil associations in the Lake Diefenbaker area.*

Objective: *To evaluate registered flax and solin varieties under irrigation.*

The irrigated flax and solin regional tests were conducted at three locations in the Outlook area. Each site and soil type are as follows:

CSIDC (SW15-29-08-W3): Bradwell very fine sandy loam
C. Ringdal (SE07-30-05-W3): Hanley loam - clay loam
R. Pederson (NE20-28-07-W3): Elstow loam

Flax and solin varieties were tested for their agronomic performance under irrigation. The Ringdal and Pederson sites were seeded May 14 and 15 while the CSIDC site was seeded on May 22. Plot size was 1.5 m x 4.0 m. All plots received 112 kg N/ha as 46-0-0 and 56 kg P_2O_5/ha as 12-51-0. Yields were estimated by harvesting the entire plot.

Irrigated oilseed flax and solin yield and height varied among the three sites (Table 6). CDC Bethune, Macbeth, Prairie Blue, Taurus, Lightning and CDC Arras oilseed flax varieties and 1084 solin had yield higher than or comparable to the check variety AC McDuff averaged over the three test sites. All other oilseed varieties and solin varieties had yield lower than the check. The lowest yielding entries were CDC Gold solin and CDC Normandy oilseed flax.

The results from these trials are used to update the irrigation variety database at CSIDC and provide information to irrigators on the best oilseed flax and solin varieties suited to irrigation conditions.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 6. Yield and agronomic data for the irrigated flax regional variety trial.											
Variety	Pederson site			Ringdal site			CSIDC site			Mean yield	
	Yield (Kg/ha)	Height (cm)	Maturity (days)	Yield (Kg/ha)	Height (cm)	Maturity (days)	Yield (kg/ha)	Height (cm)	Maturity (days)	kg/ha	% of AC McDuff
Oilseed Flax											
AC McDuff (FP900)	3650	54	104	3088	60	106	2858	51	108	3199	100
AC Carnduff (FP998)	3268	56	105	2482	60	108	2944	50	107	2898	91
AC Watson (FP974)	2980	55	104	2942	58	106	2575	52	106	2832	89
CDC Arras (FP1030)	3671	54	103	3296	59	106	2844	53	106	3270	102
CDC Bethune (FP1026)	3960	56	102	3470	59	106	2511	49	105	3314	104
CDC Mons (FP2044)	3676	53	101	2602	57	106	2648	53	108	2975	93
CDC Normandy (FP966)	2751	65	106	2476	64	108	2061	52	110	2429	76
CDC Valour (FP980)	3050	57	104	2556	58	107	2734	52	108	2780	87
Hanley (FP1094)	3648	50	103	2962	56	105	2784	50	103	3131	98
Lightning (FP1069)	3656	61	103	3052	61	106	3055	55	109	3254	102
Macbeth (FP1096)	3611	56	104	3344	61	105	3065	55	108	3340	104
Prairie Blue (FP2024)	3655	56	105	3622	64	106	2665	52	108	3314	104
Taurus (FP1092)	3638	54	102	3458	62	105	2775	54	108	3290	103
Vimy (FP800)	3132	57	101	2772	66	106	2735	56	108	2880	90
Solin											
1084 (SP1084)	3641	53	104	3017	58	105	2988	53	105	3215	101
2047 (SP2047)	3250	53	105	3742	58	105	2276	49	106	3089	97
2090 (SP2090)	3346	50	105	2927	55	106	2949	46	104	3074	96
CDC Gold (SP2100)	2831	53	104	2039	54	107	2132	49	105	2334	73
LSD (0.05)	319	5	1	759	4	1	307	4	2	-	-
CV (%)	5.6	5	0.8	15.6	3.6	0.8	6.9	4.6	0.9	-	-

Specialty Crops Program

Agronomic Investigations:

Varietal Evaluation:

Specialty Crops Program

Pulse Crop Program

The pulse crop program at CSIDC is designed to evaluate the adaptability of pulse crops for irrigation, and to develop and refine production practices for irrigated conditions. This is achieved by conducting varietal evaluations and agronomic trials.

Agronomic Investigations

Dry Bean Nitrogen Management of Contrasting Growth Habit Pinto Bean Cultivars under Irrigated Conditions

T. Hogg[1], D. David[1] and C. Ringdal[2]

Progress: *Year two of ongoing*

Objective: *To determine the merits of using starter nitrogen with granular inoculant in pinto bean production.*

Dry bean is generally considered a poor nitrogen fixing species and as such requires the application of starter nitrogen fertilizer in order to produce optimum yield. Large nitrogen applications may reduce the nitrogen fixing capacity. Thus, optimizing dry bean yield requires the proper balance between nitrogen fertilizer applications and nitrogen fixation through inoculation with the appropriate *Rhizobium* inoculant.

A dry bean nitrogen and granular inoculant trial was established in the spring of 2003 at CSIDC. Treatments included two pinto bean cultivars (Othello and CDC Pintium pinto bean) and four starter nitrogen rates (0, 25, 50 and 75 kg N/ha) applied as granular urea (46-0-0) in combination with or without granular inoculant. The nitrogen was side banded while the granular inoculant was seed placed during the seeding operation. The dry bean cultivars were seeded at a target plant population of 30 plants/m^2 using a 40 cm row spacing. A factorial arrangement of the pinto bean cultivars, starter nitrogen rates and inoculant treatments in a randomized complete block design with four replicates was used. Normal fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. Each treatment consisted of two passes with the drill and measured 2.4 m x 8 m.

Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N (0-60 cm) = 40 kg/ha and P (0-30 cm) = 22 kg/ha. Current soil test recommendations indicated the requirement for 106-118 kg N/ha and 34-39 kg P_2O_5/ha for irrigated non-inoculated dry bean.

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[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

There was no effect of the starter nitrogen or inoculant treatments on days to 10% flowering. Days to 10% flower for each of the cultivars tested were as follows: CDC Pintium - 48 days; Othello - 56 days. Differences in days to maturity between the varieties was consistent with varietal evaluation and was of the order CDC Pintium (90 days) < Othello (98 days) (Table 1). Maturity was not affected by the nitrogen applications.

Table 1. Effect of starter nitrogen rate and inoculant treatment on the days to maturity of irrigated Othello and CDC Pintium pinto bean.

N Rate (kg/ha)	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	98	98	98	89	94	91	95
25	97	98	98	90	90	90	94
50	98	98	98	90	91	90	94
75	98	99	98	90	90	90	94
Mean	98	98		90	91		
Overall Mean	98			90			

ANOVA	LSD (0.05)
Cultivar (C)	1
N Rate (N)	NS[1]
Inoculant (I)	NS
C x N	2
C x I	NS
N x I	NS
C x N x I	3
CV (%)	1.9

[1] not significant

Plant height at the pod fill growth stage showed no significant effects of cultivar, nitrogen rate or inoculant treatment (Table 2).

There was a trend of increasing bean dry weight biomass yield as the nitrogen application rate increased at the pod fill growth stage, however, the effects were not statistically significant (Table 3). As well, there was a trend of greater biomass yield for Othello compared to CDC Pintium.

There was no significant effect of dry bean cultivar, inoculant or nitrogen application on chlorophyll meter reading (Table 4).

Dry bean yield showed a significant response to cultivar and nitrogen application rate but not to inoculant (Table 5). Othello produced a higher yield than CDC Pintium. Yield increased with each increment in nitrogen fertilizer application with the highest rate producing a significantly higher yield than the control treatment.

Dry bean seed weight showed a trend of increasing with nitrogen application rate but the increases were not significant (Table 6). There was no significant effect of cultivar or inoculant treatments on seed weight.

The number of pods per plant was not affected by cultivar, nitrogen rate or inoculant (Table 7). However, Othello produced more seeds per plant than did CDC Pintium (Table 8) but the differences did not translate into a significantly higher yield.

Table 2. Effect of starter nitrogen rate and inoculant treatment on the plant height (cm) of irrigated Othello and CDC Pintium pinto bean.							
N Rate (kg/ha)	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	39	39	39	37	36	36	38
25	37	37	37	39	40	39	38
50	41	37	39	37	38	38	38
75	39	39	39	38	40	39	39
Mean	39	38		38	39		
Overall Mean	38			38			
ANOVA	LSD (0.05)						
Cultivar (C)	NS[1]						
N Rate (N)	NS						
Inoculant (I)	NS						
C x N	NS						
C x I	NS						
N x I	NS						
C x N x I	NS						
CV (%)	7.3						

[1] not significant

Table 3. Effect of starter nitrogen rate and inoculant treatment on the dry matter yield of irrigated Othello and CDC Pintium pinto bean.							
N Rate (kg/ha)	Dry Matter Yield (kg/ha)						
	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	7538	7569	7553	6388	6666	6527	7040
25	7931	7750	7841	6875	7203	7039	7440
50	8744	7538	8141	7556	7549	7552	7846
75	8038	7744	7891	8461	7228	7933	7903
Mean	8063	7650		7320	7197		
Overall Mean	7856			7241			
ANOVA	LSD (0.05)						
Cultivar (C)	NS[1]						
N Rate (N)	NS						
Inoculant (I)	NS						
C x N	NS						
C x I	NS						
N x I	NS						
C x N x I	NS						
CV (%)	16.1						

[1] not significant

Table 4. Effect of starter nitrogen rate and inoculant treatment on the pod fill growth stage SPAD chlorophyll meter reading of irrigated Othello and CDC Pintium pinto bean.

N Rate (kg/ha)	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	40	38	39	38	37	38	38
25	37	39	38	34	40	37	38
50	39	38	38	38	39	38	38
75	37	38	37	39	39	39	38
Mean	38	38		37	39		
Overall Mean	38			38			

ANOVA	LSD (0.05)
Cultivar (C)	NS[1]
N Rate (N)	NS
Inoculant (I)	NS
C x N	NS
C x I	NS
N x I	NS
C x N x I	NS
CV (%)	6.7

[1] not significant

Table 5. Effect of starter nitrogen rate and inoculant treatment on the seed yield of irrigated Othello and CDC Pintium pinto bean.

N Rate (kg/ha)	Seed Yield (kg/ha)						
	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	3371	3547	3459	3162	3237	3200	3329
25	3536	3535	3536	3282	3385	3333	3434
50	3798	3568	3683	3503	3184	3343	3513
75	3496	3673	3584	3520	3594	3557	3571
Mean	3550	3581		3367	3350		
Overall Mean	3565			3358			

ANOVA	LSD (0.05)
Cultivar (C)	136
N Rate (N)	193
Inoculant (I)	NS[1]
C x N	NS
C x I	NS
N x I	NS
C x N x I	NS
CV (%)	7.8

[1] not significant

Table 6. Effect of starter nitrogen rate and inoculant treatment on the seed weight (mg) of irrigated Othello and CDC Pintium pinto bean.

N Rate (kg/ha)	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	393	387	390	383	388	386	388
25	387	390	388	389	391	390	389
50	398	394	396	392	387	389	393
75	388	388	388	398	396	397	393
Mean	391	390		390	390		
Overall Mean	391			390			

ANOVA	LSD (0.05)
Cultivar (C)	NS[1]
N Rate (N)	NS
Inoculant (I)	NS
C x N	NS
C x I	NS
N x I	NS
C x N x I	NS
CV (%)	2.5

[1] not significant

Table 7. Effect of starter nitrogen rate and inoculant treatment on the number of pods per plant of irrigated Othello and CDC Pintium pinto bean.

N Rate (kg/ha)	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	18	20	19	20	18	19	19
25	22	17	20	19	18	19	19
50	22	21	22	20	19	19	20
75	20	21	20	22	19	20	20
Mean	21	20		20	19		
Overall Mean	20			19			

ANOVA	LSD (0.05)
Cultivar (C)	NS[1]
N Rate (N)	NS
Inoculant (I)	NS
C x N	NS
C x I	NS
N x I	NS
C x N x I	NS
CV (%)	15.7

[1] not significant

Table 8. Effect of starter nitrogen rate and inoculant treatment on the number of seeds per plant of irrigated Othello and CDC Pintium pinto bean.							
N Rate (kg/ha)	Othello			CDC Pintium			Overall Mean
	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	79	81	80	82	67	74	77
25	96	81	88	71	70	71	80
50	89	92	90	75	73	74	82
75	84	86	85	81	76	79	82
Mean	87	85		77	71		
Overall Mean	86			74			
ANOVA	LSD (0.05)						
Cultivar (C)	7						
N Rate (N)	NS[1]						
Inoculant (I)	NS						
C x N	NS						
C x I	NS						
N x I	NS						
C x N x I	NS						
CV (%)	17.1						

[1] not significant

Response of Contrasting Growth Habit Pinto Bean Cultivars to Late Nitrogen Application under Irrigated Conditions

T. Hogg[1], D. David[1] and C. Ringdal[2]

Progress: *Year one of ongoing*

Objective: *To determine the effect of late nitrogen application on the yield and seed quality of contrasting growth habit pinto bean cultivars under irrigated conditions.*

Dry bean is generally considered a poor nitrogen fixing species and as such requires the application of some additional nitrogen fertilizer in order to produce optimum yield. Applying all the nitrogen prior to plant emergence may result in excessive vegetative growth resulting in a reduction in seed yield and a greater chance of the development of diseases such as white mold (sclerotinia). Bean plants may also benefit from increased levels of available soil nitrogen during pod fill if the ability of the plants to acquire nitrogen from symbiotic N_2 fixation or soil uptake is impaired by root disease or nodule senescence. By delaying the application of the additional nitrogen later in the growth stage a greater proportion of the nitrogen may be utilized in seed production, producing more and/or larger seeds, rather than vegetative growth.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

A dry bean late nitrogen fertilizer response trial was established in the spring of 2003 at CSIDC. Treatments included nitrogen applications at seeding, early flower, mid-late flower and early pod fill of 50 kg N/ha applied as granular ammonium nitrate (34-0-0) plus a control. The granular ammonium nitrate was side-band applied for the seeding nitrogen treatment while the late nitrogen applications were broadcast applied just prior to an irrigation application that allowed movement of the nitrogen into the soil. Two pinto bean cultivars of contrasting growth habit (Othello - type III indeterminate sprawling vine and CDC Pintium - type I upright determinate) were seeded at a target plant population of 30 seeds/m^2 using a 40 cm row spacing. A factorial arrangement of the nitrogen fertilizer application times and dry bean cultivars in a randomized complete block design with four replicates was used. Normal fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. Each treatment consisted of two passes with the drill and measured 2.4 m x 8 m.

Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N (0-60 cm) = 50 kg/ha and P (0-30 cm) = 10 kg/ha. Current soil test recommendations indicated the requirement for 101-112 kg N/ha and 45-50 kg P_2O_5/ha for irrigated non-inoculated dry bean.

There was no effect of the late nitrogen application times on days to 10% flower or maturity. Days to 10% flower and maturity for each of the cultivars tested were as follows: Othello - 54 and 100 days; CDC Pintium - 48 and 89 days.

Dry bean physical characteristics showed no significant response to the nitrogen applications (Table 9 and 10). There was no significant effect among the nitrogen application times or between cultivars on the plant height, dry biomass yield, number of pods per plant or the number of seeds per plant.

Dry bean yield and seed weight showed no significant response to the nitrogen applications (Table 11). Nitrogen applied at seeding as well as the late nitrogen applications did not increase yield or seed weight above that of the control treatment.

Table 9. Effect of time of nitrogen application on the plant height and pod fill growth stage dry biomass yield of irrigated Othello and CDC Pintium pinto bean.

Nitrogen Application Time	Plant Height (cm)			Dry Biomass Yield (kg/ha)		
	Othello	CDC Pintium	Mean	Othello	CDC Pintium	Mean
Control	38	38	38	7069	6530	6799
Seeding	39	38	38	7063	7633	7348
Early Flower	37	40	38	6788	7459	7123
Mid-Late Flower	37	41	39	8794	7453	8123
Early Pod Fill	37	40	38	7575	6577	7076
Mean	38	39		7458	7130	
ANOVA	LSD (0.05)			LSD (0.05)		
Cultivar (C)	NS[1]			NS		
Time (T)	NS			NS		
C x T	NS			NS		
CV (%)	70			15.3		

[1] not significant

Table 10. Effect of time of nitrogen application on the pods/plant and seeds/plant of irrigated Othello and CDC Pintium pinto bean.						
Late Nitrogen Application Time	# Pods/Plant			# Seeds/Plant		
	Othello	CDC Pintium	Mean	Othello	CDC Pintium	Mean
Control	18	21	20	73	74	73
Seeding	18	21	20	73	79	76
Early Flower	18	21	20	70	79	75
Mid-Late Flower	18	21	19	72	77	74
Early Pod Fill	19	20	19	80	76	78
Mean	18	21		74	77	
ANOVA	LSD (0.05)			LSD (0.05)		
Cultivar (C)	2			NS		
Time (T)	NS[1]			NS		
C x T	NS			NS		
CV (%)	14.6			15.7		

[1] not significant

Table 11. Effect of nitrogen application time on the yield and seed weight of irrigated Othello and CDC Pintium pinto bean.						
Nitrogen Application Time	Yield (kg/ha)			Seed Weight (mg)		
	Othello	CDC Pintium	Mean	Othello	CDC Pintium	Mean
Control	2935	2934	2934	361	363	362
Seeding	3005	3101	3053	359	363	361
Early Flower	3217	2940	3078	365	332	349
Mid-Late Flower	3012	2926	2969	352	352	352
Early Pod Fill	3562	3099	3331	358	361	360
Mean	3146	3000		359	354	
ANOVA	LSD (0.05)			LSD (0.05)		
Cultivar (C)	NS[1]			NS		
Time (T)	NS			NS		
C x T	NS			NS		
CV (%)	9.2			5.2		

[1] not significant

Interaction of Seeding Rate and Nitrogen Fertilizer during Seed Multiplication of CDC Pintium Pinto Bean under Irrigated Conditions

T. Hogg[1], D. David[1] and C. Ringdal[2]

Progress: *Year two of two*

Objective: *To determine the effect of seeding rate and nitrogen fertilizer application on the yield of CDC Pintium pinto bean during seed multiplication under irrigated conditions.*

The recent development of CDC Pintium pinto bean a new high yielding, early maturing, Type I upright dry bean variety suitable for the short Saskatchewan growing season is seen as a major step in the expansion of dryland production in the thin black soil zone. This expansion in dryland seeded acreage will require the successful production of large quantities of seed of this new variety. The irrigated area around Lake Diefenbaker in Saskatchewan is currently involved in commercial dry bean production and has been identified as a potential area for dry bean seed production. Seed production of this new variety with growth characteristics different than varieties normally grown under irrigated conditions requires the identification of production practices that optimizes yield of quality seed.

A dry bean seeding rate and nitrogen fertilizer response trial was established in the spring of 2002 at CSIDC. Treatments included CDC Pintium pinto bean at four seeding rates (20, 40, 60 and 80 seeds/m^2) in combination with three nitrogen application rates (0, 50 and 100 kg N/ha) side banded during the seeding operation as granular urea (46-0-0). Normal weed control and irrigation practices for irrigated dry bean production were followed. A factorial arrangement of the seeding rates and nitrogen fertilizer application rates in a randomized complete block design with four replicates was used. Each treatment consisted of two passes with the drill using a 40 cm row spacing and measured 2.4 m x 8 m.

Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N (0-60 cm) = 55 kg/ha and P (0-30 cm) = 11 kg/ha. Current soil test recommendations indicated the requirement for 106-118 kg N/ha and 40-45 lbs P_2O_5/ac for irrigated non-inoculated dry bean.

Plant stand increased as the seeding rate increased (Table 12). The targeted plant population was not achieved at any of the seeding rates possibly due to increased plant competition as seeding rate increased. There was no significant effect of nitrogen application rate on plant stand.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Vegetative growth of the CDC Pintium pinto bean was significantly affected by the seeding rate and nitrogen application treatments. The CDC Pintium plants grew taller as both the seeding rate and the nitrogen application rate were increased (Table 12). Plant height increased significantly up to a seeding rate of 60 seeds/m^2 and with the application of 50 kg N/ha. As well, Leaf Area Index (LAI), an indication of vegetative plant growth, at the pod fill growth stage was significantly greater at seeding rates greater than 20 seeds/m^2 (Table 13). There was no significant effect of nitrogen application rate on the LAI, however, there was a trend of increasing LAI with increasing nitrogen application. There was a trend of increasing biomass production as both the seeding rate and nitrogen rate were increased, however, the effects were not significant (Table 13). Taller plants would have an advantage in that pods could be produced higher off the ground. Plants with more vegetative growth, particularly leaf material, would have the potential for greater photosynthetic activity and potentially higher yield.

Table 12. Effect of seeding rate and nitrogen application rate on the plant stand and plant height of CDC Pintium pinto bean.

Seeding Rate (seeds/m^2)	Plant Stand (plants/m^2)				Plant Height (cm)			
	Nitrogen Rate (kg N/ha)				Nitrogen Rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	14	17	19	17	38	39	38	38
40	25	30	28	28	37	41	43	40
60	44	46	43	44	40	43	42	42
80	54	61	59	58	40	42	44	42
Mean	34	38	37		39	41	42	
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding Rate (SR)	4				2			
Nitrogen Rate (N)	NS[1]				2			
SR x N	NS				NS			
CV (%)	14.2				6.8			

[1] not significant

Chlorophyll content as measured with the SPAD-502 chlorophyll meter, an indirect measurement of nitrogen content, showed no relationship with either seeding rate or nitrogen application rate at the early pod growth stage (Table 14). The use of the SPAD-502 Chlorophyll meter requires further work before it can be used as a reliable method of determining nitrogen response in dry bean.

There was no treatment effect on days to flower. Days to maturity decreased as seeding rate increased and showed no effect of nitrogen application (Table 14). The stands with a higher plant population matured one to two days earlier than the thinner stands.

Seed yield was significantly affected by seeding rate but not nitrogen rate (Table 15). Seed yield increased up to a targeted plant population of 40 seeds/m^2 (actual plant population of 28 seeds/m^2).

The size of the CDC Pintium pinto bean seed produced decreased as seeding rate increased (Table 15). The decrease in seed size with an increase in seeding rate coupled with the fact that seed yield increased with an increase in seeding rate would indicate that as seeding rate increased there was a greater quantity of smaller seeds produced. There was no effect of nitrogen rate on seed size.

The production index, a measure of seed multiplication efficiency, decreased as the seeding rate was increased (Table 15), similar to results obtained by other workers (Crothers and Westermann, 1976). Doubling the seeding rate from 20 seeds/m^2 to 40 seeds/m^2 reduced the production index by approximately 30% (Table 15). The number of pods per plant and thus the number of seeds per plant increased as the seeding rate decreased and increased with nitrogen application above the check treatment (Table 16). This would indicate that with limited availability of seed, the greatest efficiency in seed multiplication can be obtained at low seeding rate. The significant effect of nitrogen application indicated that the greatest efficiency in seed multiplication occurred under conditions of low seeding rate and high total available nitrogen. Both seeding rate and nitrogen fertility are important components of efficient seed multiplication.

Table 13. Effect of seeding rate and nitrogen application rate on the dry biomass yield and leaf area index at the pod fill growth stage for irrigated CDC Pintium pinto bean.

Seeding Rate (seeds/m^2)	Dry Biomass Yield (kg/ha)				Leaf Area Index			
	Nitrogen Rate (kg/ha)				Nitrogen Rate (kg/ha)			
	0	50	100	Mean	0	50	100	Mean
20	6311	6241	6461	6338	2.2	2.5	2.7	2.5
40	6414	6347	6992	6584	2.8	3.1	3.1	3.0
60	6048	7166	6811	6675	3.1	3.0	3.1	3.1
80	7007	7623	6879	7170	3.0	3.4	3.3	3.2
Mean	6445	6844	6786		2.8	3.0	3.1	
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding Rate (SR)	NS[1]				0.3			
Nitrogen Rate (N)	NS				NS			
SR x N	NS				NS			
CV (%)	17.9				13.5			

[1] not significant

Table 14. Effect of seeding rate and nitrogen application rate on the chlorophyll meter reading at early pod growth stage and days to maturity of CDC Pintium pinto bean.

Seeding Rate (seeds/m^2)	Chlorophyll meter reading				Days to Maturity			
	Nitrogen Rate (kg N/ha)				Nitrogen Rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	38	39	39	39	89	90	89	89
40	39	39	39	39	89	89	89	89
60	38	39	41	39	87	88	88	87
80	41	40	40	41	87	88	87	87
Mean	39	39	40		88	89	88	
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding Rate (SR)	NS[1]				1			
Nitrogen Rate (N)	NS				NS			
SR x N	NS				NS			
CV (%)	8.9				1.5			

[1] not significant

Table 15. Effect of seeding rate and nitrogen application rate on the yield, seed weight and production index of CDC Pintium pinto bean.

Seeding Rate (seeds/m^2)	Yield (kg/ha)				Seed Weight (mg)				Production Index[1]			
	Nitrogen Rate (kg N/ha)				Nitrogen Rate (kg N/ha)				Nitrogen Rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean	0	50	100	Mean
20	2541	2595	2604	2580	373	375	379	375	25	25	26	25
40	3067	3291	3347	3235	360	369	362	364	15	16	16	16
60	3300	3132	3479	3304	360	353	360	358	11	10	11	11
80	3233	3497	3472	3401	349	359	323	344	8	9	9	8
Mean	3035	3129	3226		360	364	356		15	15	15	
ANOVA	LSD (0.05)				LSD (0.05)				LSD (0.05)			
Seeding Rate (SR)	307				20				2			
Nitrogen Rate (N)	NS[2]				NS				NS			
SR x N	NS				NS				NS			
CV (%)	11.8				6.5				13.9			

[1] Production Index = Yield (kg/ha)/Seeding rate (kg/ha)
[2] not significant

Table 16. Effect of seeding rate and nitrogen application rate on the number of pods per plant and number of seeds per plant of CDC Pintium pinto bean.

Seeding Rate (seeds/m^2)	# Pods/plant				# Seeds/plant			
	Nitrogen Rate (kg N/ha)				Nitrogen Rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	22	23	24	23	74	102	99	91
40	17	18	18	17	66	74	73	71
60	13	15	16	15	53	60	61	58
80	10	12	13	12	40	45	51	45
Mean	15	17	18		58	70	71	
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding Rate (SR)	2				13			
Nitrogen Rate (N)	1				11			
SR x N	NS[1]				NS			
CV (%)	12.0				23.4			

[1] not significant

Improvement of Ascochyta Blight Control in Chickpea through Ground Spray Application Delivery Method

C. Chongo[1], S. Banniza[1], C. Cho[1], T. Wolfe[2], T. Hogg[3], D. David[3] and C. Ringdal[4]

***Progress:** Year three of three*

***Objective:** To study the effects of spray droplet size, carrier volume, fungicides and application time on ascochyta blight control and yield of different chickpea cultivars.*

Chickpeas provide producers with a valuable rotational alternative away from traditional cereal and oilseed based systems, with potentially higher income levels. However, crop losses due to ascochyta blight (*Ascochyta rabiei*) limit the expansion of chickpea acreage. Although genetic resistance is available in some cultivars, it is only partial and breaks down in adult plants and severe infections can appear after flowering. High infection levels and disease pressure in many growing areas in recent years show that ascochyta blight has become more widespread and symptoms are now more common on seedlings than before. Until more resistant varieties become available that do not rely on fungicide applications, there is a need for efficient fungicide application strategies in chickpea.

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Controlling ascochyta blight with foliar fungicide applications requires good canopy penetration to get complete coverage. Spray pattern, droplet size and carrier water volume can affect coverage. Standard conventional spray application technology uses a flat fan fine spray pattern. The introduction of new spray application technology such as the air induction (air bubble jet) Venturi nozzle which produces coarser droplets containing air bubbles that enhance retention of the spray or the Twin nozzle which angles the spray both forward and back may provide better coverage of the fungicide. As well, better coverage may be obtained with higher carrier water volume.

Three chickpea foliar disease management trials were established in the spring of 2002 at CSIDC. Chickpeas were seeded at a target plant population of 45 plants/m^2. Each treatment measured 2.4 m x 6 m. For all trials the first fungicide application was done at the first sign of disease symptoms. The second fungicide application was applied 10-14 days later.

1. <u>Spray Droplet Size Trial</u>

Treatments included three foliar fungicides (Bravo 500 at 1000 g a.i./ha - chlorothalonil; Quadris at 125 g a.i./ha - azoxystrobin; Headline at 100 g a.i./ha - pyrachlostrobin), three spray application delivery methods (Standard Nozzle - XR8002 delivers medium spray; Lurmark Twin Cap Nozzle - delivers a fine spray from two XR8001 tips spraying 30^0 forward and backward from the vertical; Venturi Nozzle - Air Bubble Jet 11002 delivers very coarse spray) and an untreated control. The fungicides were applied using a carrier water volume of 200 l/ha (18 gal/ac). The treatments were arranged in a factorial randomized complete block design plus a control with four replicates. A separate trial was conducted for Sanford (unifoliate leaf type) kabuli and Myles (fern leaf type) desi chickpea.

Irrigation was used only sparingly and only a low level of disease developed. Disease levels reached 20% in desi and 28% in kabuli control plots. Headline gave better disease control than Bravo 500 on desi and Headline was better than Quadris on both chickpea types. On the kabulis, Bravo 500 and Headline gave equivalent disease control.

All fungicide treatments improved yield of both varieties except for the Quadris treatment on the desis. For desis, there were no significant differences in yield among the different fungicide treatments (Table 17).

Table 17. Effects of fungicides and spray droplet size on seed yield and seed weight for Myles desi chickpea.

Fungicide	Droplet Size[1]	Yield (kg/ha)	Seed Weight (mg)
Check	-	2386	159
Bravo 500	Fine	3161	159
Bravo 500	Medium	3212	165
Bravo 500	Coarse	2889	163
Bravo 500 Mean		3087	162
Quadris	Fine	2615	160
Quadris	Medium	2573	159
Quadris	Coarse	3158	166
Quadris Mean		2785	162
Headline	Fine	2941	160
Headline	Medium	3449	163
Headline	Coarse	3340	164
Headline Mean		3243	162
LSD (0.05) Fungicide		325	NS
LSD (0.10) Nozzle		NS[2]	NS
LSD (0.05) Nozzle x Fungicide		NS	NS

[1] Fine - Lurmark Twin Cap XR8001; Medium - Standard XR8002; Coarse - Venturi Air Bubble Jet 11002.

[2] not significant

For the kabuli yields, Headline treatments had the highest yield (525% over control) followed in order by Bravo 500 and then Quadris (Table 18).

Table 18. Effects of fungicides and spray droplet size on seed yield and seed weight for Sanford kabuli chickpea.

Fungicide	Droplet Size[1]	Yield (kg/ha)	Seed Weight (mg)
Check	-	317	242
Bravo 500	Fine	1480	312
Bravo 500	Medium	1589	317
Bravo 500	Coarse	1541	323
Bravo 500 Mean		1536	317
Quadris	Fine	1197	317
Quadris	Medium	1290	319
Quadris	Coarse	1224	312
Quadris Mean		1229	316
Headline	Fine	1905	350
Headline	Medium	2017	352
Headline	Coarse	2016	343
Headline Mean		1979	348
LSD (0.05) Fungicide		160	17
LSD (0.05) Nozzle		NS[2]	NS
LSD (0.05) Nozzle x Fungicide		NS	NS

[1] Fine - Lurmark Twin Cap XR8001; Medium - Standard XR8002; Coarse - Venturi Air Bubble Jet 11002.

[2] not significant

2. Carrier Water Volume Trial

***Trial 1 - Bravo 500/Quadris Combination*:**
Treatments included a combination of Bravo 500 at 1000 g a.i./ha applied as the first application followed by Quadris at 125 g a.i./ha applied as the second fungicide application, three carrier water volumes (100, 200 and 300 L/ha) and an untreated control. The fungicides were applied using standard flat fan nozzles at a pressure of 275 kPa. The treatments were arranged in a randomized complete block design with four replicates. A separate trial was conducted for CDC Yuma kabuli and Myles desi type chickpea.

Disease severity was low with 15% in desis and 9% in kabulis. Water volume treatments did not differ from each other. On the desis, all treatments reduced disease development, but the yield response to fungicide was inconsistent (Table 19). Fungicide application had no effect on kabuli disease development or yield (Table 19).

Table 19. Effects of Bravo 500/Quadris fungicide combination and water volume seed yield and seed weight in Myles desi and CDC Yuma kabuli chickpea.			
Cultivar	Water Volume (L/ha)	Yield (kg/ha)	Seed Weight (mg)
Myles	Check	1493	149
	100	2029	158
	200	2154	157
	300	1925	154
LSD (0.05)		414	NS
CDC Yuma	Check	1172	318
	100	1243	300
	200	1330	313
	300	1099	310
LSD (0.05)		NS[1]	NS

[1] not significant

***Trial 2 - Fungicide*:**
Treatments included four foliar fungicide combinations (Bravo 500/Quadris - 1000 g a.i./ha/125 g a.i./ha; Quadris - 125 g a.i./ha; Headline - 100 g a.i./ha; Headline/Lance (boscalid) - 100 g a.i./ha/ 300 g a.i./ha), three carrier water volumes (100 l/ha, 200 l/ha and 300 l/ha) and an untreated control. The fungicides were applied using standard flat fan jet nozzles at a pressure of 275 kPa (40 psi). The treatments were arranged in a factorial randomized complete block design plus a control with four replicates. CDC Yuma (fern leaf type) kabuli chickpea, was used as the test crop.

Due to seed disease development germination was poor resulting in the requirement to reseed this plot. As a result the plot was very late and there was little disease development.

Disease pressure was moderate with 31% disease in the controls. There was no effect of water volume on disease development or yield (Table 20). Headline and Headline/Lance combination gave better disease control than the Bravo/Quadris combination or Quadris alone. There was no effect of fungicide application on yield (Table 20).

3. Application Time Trial

Treatments included four foliar fungicides (Bravo 500 - 1000 g a.i./ha; Quadris - 125 g a.i./ha; Headline - 100 g a.i./ha; BAS510F (boscalid) - 300 g a.i./ha) and four application times (A = 14th node growth stage; B = 10-14 days after A; C = 10-14 days after B; D = 10-14 days after C) in various combinations and an untreated control. The fungicides were applied using standard flat fan jet nozzles at a pressure of 275 kPa (40 psi). The treatments were arranged in a randomized complete block design with four replicates. CDC Frontier (fern leaf type) kabuli chickpea, was used as the test crop.

Due to seed disease development germination was poor resulting in the requirement to reseed this plot. As a result the plot was very late and there was little disease development.

Disease levels were low and there was no effect of the fungicide timing treatments on yield (Table 21).

Table 20. Effects of fungicide and water volume on seed yield and seed weight for CDC Yuma kabuli chickpea.			
Fungicide	Water Volume (L/ha)	Yield (kg/ha)	Seed Weight (mg)
Check	Check	1696	303
Bravo + Quadris	100	2251	311
Bravo + Quadris	200	2065	319
Bravo + Quadris	300	1531	277
Quadris	100	2025	319
Quadris	200	2073	326
Quadris	300	2382	345
Headline/Lance	100	2314	332
Headline/Lance	200	2035	300
Headline/Lance	300	1611	302
Headline	100	1437	280
Headline	200	2318	343
Headline	300	2224	335
LSD (0.05) Fungicide		NS[1]	NS
LSD (0.05) Water Volume		NS	NS
LSD (0.05) Interaction		515	45

[1] not significant

Table 21. Effects of fungicide and application time on seed yield and seed weight for CDC Frontier kabuli chickpea.			
Fungicide	Application Time	Yield (kg/ha)	Seed Weight (mg)
Check	-	952	253
Headline/Lance	AB/C	824	249
Headline/Bravo 500	AB/C	725	243
Bravo 500/Headline	A/BC	786	249
Bravo 500/Headline	AC/B	693	245
Headline/Lance	AC/B	750	250
Headline/Bravo 500	AC/B	783	257
Bravo 500/Quadris	AC/B	773	245
Headline	AB	1041	257
Headline/Lance	AB/CD	874	244
LSD (0.05)		NS[2]	NS

[1] A = application at the 14th node growth stage
B = 14 days after A
C = 14 days after B
D = 14 days after C
[2] not significant

Varietal Evaluation

Bean and Pea Preliminary Yield Trials

A. Vandenberg[1], S. Banniza[1], T. Warkentin[1] and T. Hogg[2]

Funded by SADF, SPG, AFIF, CDC/U of S

Pea Trials

> ***Progress:*** *Ongoing*
>
> ***Location:*** *Outlook*
>
> ***Objective:*** *To develop high yielding, early, disease resistant green, yellow and specialty pea varieties for Saskatchewan.*

Field pea advanced breeding trials conducted at Outlook identified several high-yielding yellow, green and specialty field pea lines with improved lodging resistance and resistance to powdery mildew. One elite and seven advanced level two-replicate trials of 36 entries of mostly green and yellow types were grown. An additional 18-entry two-replicate trial of specialty pea types were also grown. Most lines were resistant to powdery mildew. Green-seeded lines were evaluated for tolerance to bleaching. Lines with the highest yield, best lodging tolerance, best disease tolerance ratings and above average quality profile were advanced to registration recommendation trials for the 2003 season. Conditions were excellent for full expression of yield potential under irrigated conditions.

Experiments were conducted as part of a project investigating the anatomy of pea stems and the relationships among stem anatomy, lodging resistance and *Mycosphaerella* blight.

Bean Trials

> ***Progress:*** *Ongoing*
>
> ***Location:*** *Outlook*
>
> ***Objective:*** *To develop high yielding, adapted dry bean varieties for Saskatchewan.*

Dry bean trials were conducted at Outlook to identify early-maturing, high yielding breeding lines in the pinto, black, navy, great northern, red, pink and specialty market classes for the narrow row production system. Two 18-entry two-replicate elite trials were successfully grown along with nineteen 36-entry two-replicate advanced trials. Three replicate trials of the 2003 Prairie Dry Bean Narrow Row Co-op A Trial (36 entries) was also grown. Trial A included black, small red, pinto, great northern, pink, and navy market class entries. Conditions were good for full expression of yield potential, maturity, pod clearance and bacterial blight resistance (Table 22). Data from these trials were combined with those from other locations to decide which lines to advance to the 2003 registration and elite trials.

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[1]Crop Development Centre, University of Saskatchewan, Saskatoon, Sask.
[2]CSIDC, Outlook, Sask.

Table 22. Irrigated Narrow Row Prairie Dry Bean Cooperative Trial A.								
Variety	Yield (kg/ha)	Yield % of check	Seed Weight (mg)	Days to Flower	Days to Maturity[1]	Plant Height (cm)	Lodge Rating (0=erect; 5=flat)	Pod Clearance[2] (%)
Black								
Jet (check)	3434	100	195	56	106	52	1.7	85
1264M-8	3565	104	178	52	102	42	1	78
Great Northern								
Crocus	2716	82	335	50	107	33	4.7	70
AC Polaris (check)	3309	100	331	54	108	37	3.6	75
1023T-2	3458	105	366	50	107	35	4.3	70
1287S-5	3298	100	375	50	107	35	4.5	70
L98E212	2799	85	347	49	100	48	1.7	80
L01E288	3301	100	317	48	102	38	3.1	72
Navy								
Envoy (check)	3509	100	193	50	99	39	2.2	75
Whitecap	3814	109	202	54	109	46	2.3	82
1190M-7	2984	85	180	50	103	43	1	78
1190M-21	2960	84	194	49	100	43	2.2	77
Pink								
Viva (check)	3248	100	279	50	101	31	4.2	70
801-3	3111	96	334	53	98	40	4.1	72
799-12	4041	124	338	51	103	38	4	70
801-27	2854	88	331	50	100	37	3.1	72
L98C280	2948	91	282	51	96	40	2.5	75
Pinto								
Pintium (check)	3429	100	337	47	91	38	1	80
Minto	3481	102	434	51	107	41	3.2	72
999s-2A	2901	85	420	48	102	38	3.1	73
828B-9	3608	105	419	49	107	41	2.9	72
828B-3	3340	97	342	51	105	39	4.1	73
786-2	2552	104	392	49	108	38	4.3	73
841-8	3195	93	364	49	96	39	2.6	78
841-1	3133	91	382	52	96	40	2.3	78
955S-1	3197	93	369	48	94	40	1.7	80
1091M-57	3261	95	386	53	101	44	2.3	80
954S/952S-11	3222	94	363	50	101	36	3.1	73
1073M-42	3298	96	424	54	107	52	2.2	78
1073M-46	3135	91	387	50	105	44	2	83
Small Red								
AC Redbond (check)	3348	100	346	51	104	48	1.8	82
804-10	3538	106	323	51	99	34	3.2	72
805-9	2645	79	351	49	95	35	3.3	70
1030S-3	3580	107	370	53	102	43	2.2	83
737-84	3200	96	322	51	98	32	3.7	70
737-22	3337	100	328	52	103	38	2.7	73
LSD (0.05)	719	-	-	2	3	4	0.7	4
CV (%)	16.1	16.1	-	3	2	7	27.7	3.4

[1] 50% of pods are buckskin color
[2] pods > 5 cm (2 in) above ground surface

Dry Bean Narrow Row Regional Variety Trial

T. Hogg[1], D. David[1], C. Ringdal[2] and A. Vandenberg[3]

Progress: *Ongoing*

Objective: *To assess the dry bean production of targeted environments within Saskatchewan using current and newly released varieties.*

The potential for development of the dry bean sector of Saskatchewan's pulse industry has been limited by the lack of adapted varieties. Adapted breeding lines from the Crop Development Centre (CDC), U of S, Saskatoon, Saskatchewan, are at the stage of recommendation for registration. The next step in the development process is regional testing of new varieties. Regional performance trials provide information on the various production regions available in Saskatchewan to assess productivity and risk. This information is used by extension personnel, pulse growers and researchers across Saskatchewan to become familiar with these new pulse crops.

A Dry Bean Narrow Regional variety trial was established in the spring of 2003 at CSIDC. The 2003 Narrow Row Dry Bean Regional Trial (20 cm row spacing) included mainly varieties that were specifically bred for narrow row production systems.

Nineteen dry bean varieties consisting of five market classes (pinto, great northern, navy, black, small red and bay) were evaluated. AC Redbond small red bean produced the highest yield of all varieties while CDC Expresso black bean produced the lowest yield (Table 23). All market classes produced varieties that were relatively high yielding.

Most bean varieties flowered within a range of 50 - 55 days. CDC Pintium pinto bean, CDC Expresso black bean was the earliest varieties to flower taking only 45 days.

CDC Pintium pinto bean matured 7-10 days earlier than most varieties. Most varieties required 95-100 days to mature.

Pod clearance was generally good among the varieties indicating the progress being made in dry bean programs to produce varieties with upright structure and pods held high on the plant. Only two varieties, Othello pinto bean and CDC Crocus great northern bean had pod clearance below 70%. All other dry bean varieties tested had pod clearance greater than 70%.

The highest seed weight was obtained for the pinto variety CDC Minto. Smallest seed weight was obtained for the navy bean variety Morden 003. The high yielding great northern variety AC Polaris had a small seed weight compared to the other varieties in this market class. The highest yielding navy bean variety CDC whitecap had a high seed weight in comparison to the other varieties in this market class. The new black variety AC 316-13 had a high seed weight compared to CDC Expresso and CDC Jet.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.
[3]Crop Development Centre, University of Saskatchewan, Saskatoon, Sask.

Plant height varied among the market classes as well as among varieties within a market class. The shortest varieties was CDC Expresso black bean while the tallest variety was 95-83-10 pinto bean.

Table 23. Irrigated Dry Bean Narrow Row Regional Variety trial.

Variety	Yield (kg/ha)	Yield % of Pintium	Seed Weight (mg)	Days to Flower	Days to Maturity[1]	Plant Height (cm)	Lodge Rating (0=erect; 5=flat)	Pod Clearance[2] (%)
Pinto								
CDC Pintium	3485	100	358	48	90	40	1	85
Othello	4748	136	375	55	100	37	3.7	60
CDC Minto	4711	135	456	54	102	42	3	75
HR99	4276	123	346	52	100	57	1.7	75
SC11745-3	3919	112	379	48	94	37	2.3	75
Great Northern								
AC Polaris	5034	144	353	54	100	37	3	77
CDC Crocus	4691	135	383	49	100	39	3.3	65
Navy								
Envoy	4105	118	184	53	95	40	2.3	75
CDC Whitecap	4805	138	196	55	103	49	2	85
AC Cruiser	4293	123	194	55	106	47	1.7	80
HR100	4113	118	172	53	100	49	1	80
T9601	4813	138	187	53	98	42	2.3	77
T9803/Cirrus	4540	130	181	53	101	41	2	73
L94A001(Morden 003)	3685	106	171	52	97	45	1	77
Black								
CDC Expresso	3124	90	195	45	97	44	1	78
CDC Jet	4354	125	196	57	103	56	2	83
316-13	4512	129	211	48	102	46	1.7	80
Small Red								
AC Redbond	5285	152	343	50	97	43	1.7	78
Bay								
610-23	4762	137	352	53	102	48	1.7	77
LSD (0.05)	739	-	16	2	3	6	0.7	4
CV (%)	10.2	10.2	3.6	2.2	1.6	8.6	8	3.5

[1] 50% of pods are buckskin color
[2] pods > 5 cm (2 in) above ground surface

Dry Bean Wide Row Regional Variety Trial

T. Hogg[1], D. David[1], C. Ringdal[2], A. Mundel[3] and J. Braun[3]

Progress: *Ongoing*

Objective: *To assess dry bean varieties for production under irrigated wide row conditions in western Canada.*

Twenty-five dry bean varieties consisting of six market classes (pinto, great northern, pink, black, small red, Canario Mexicano) were evaluated. Yield varied among the market classes and varieties within the market classes (Table 24). L94C356 (Early Rose) pink bean and AC Scarlet small red bean produced the highest yields of all varieties while CDC Expresso black bean produced the lowest yield.

Most bean varieties flowered within a range of 48-55 days except for Arikara yellow bean which flowered in 45 days.

Maturity varied from 85 days for CDC Pintium pinto bean, Early Rose pink bean and Arikara yellow bean to 94 days for Alert great northern bean, CDC Jet black bean and AC Scarlet small red bean.

Plant height varied among varieties within a market class ranging from 34 cm for US 1140 great northern bean to 44 cm for UI 906 black bean. Plant height for most other varieties was in the range of 35 to 40 cm.

Lodge rating was generally good for the varieties tested with many varieties showing good upright structure. The great northern varieties lodged to the greatest extent.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.
[3]AAFC Research Centre, Lethbridge, Alberta

Table 24. Irrigated Dry Bean Wide Row Regional Variety trial.							
Variety	Yield (kg/ha)	Yield % of Othello	Seed Weight (mg)	Days to Flower	Days to Maturity[1]	Plant Height (cm)	Lodge Rating (0=erect; 5=flat)
Pinto							
Othello (check)	3093	100	359	53	91	40	2.3
CDC Pintium	2466	80	382	48	85	36	1.3
CDC Pinnacle	3222	104	393	54	93	44	2.3
CDC Mimto (958310)	3340	108	435	51	90	41	2.5
Great Northern							
US 1140 (check)	3147	102	333	52	92	34	3
CDC Crocus	2556	83	382	47	86	36	2
AC Polaris	3117	101	337	53	92	39	2.5
CDC Polar Bear	3583	116	381	50	88	34	3.5
Alert	3500	113	371	54	94	51	2
Pink							
Viva (check)	3682	119	282	52	92	38	3.5
CDC Rosalee	2737	89	272	49	86	39	1.8
AC Alberta Pink	2641	85	308	48	87	36	2
L94C356 (Early Rose)	3890	126	349	52	85	39	2.8
Black							
UI 906 (check)	3413	110	165	55	93	49	1.3
AC Black Diamond	3197	103	271	53	93	43	1.8
CDC Nighthawk	2231	72	184	56	93	44	1.3
CDC Expresso	1804	58	213	46	91	37	1
CDC Jet (315-18)	2993	97	197	56	94	49	1
L95F025 (Black Violet)	3420	111	196	56	93	46	1
Small Red							
NW63 (check)	3347	108	327	51	91	37	2.3
AC Redbond	3279	106	338	48	89	44	2
AC Earlired	2890	93	334	51	83	35	2
AC Scarlet	3831	124	351	52	94	43	3
Le Baron	2778	90	366	51	85	36	2
Canario Mexicano							
Arikara Yellow	2627	85	378	45	85	40	1
LSD (0.05)	982	-	26	2	3	5	0.8
CV (%)	22.7	22.7	5.9	2.4	2.7	8.5	12.2

[1] 50% of pods are buckskin color

Wide Row Irrigated Prairie Bean Co-operative Registration Trial

H. Mundel[1], J. Braun[1], T. Hogg[2], D. David[2] and C. Ringdal[3]

Funded by Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate new dry bean germplasm under irrigated wide row conditions in western Canada.*

This project evaluates dry bean germplasm for its adaptation to western Canada under irrigated row crop production conditions. The germplasm sources include advanced lines from the AAFC Lethbridge Research Centre and the Crop Development Centre, University of Saskatchewan. These lines are compared to registered varieties within each market class.

An Irrigated site was conducted at CSIDC. Standard fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. The test consisted of 36 entries in a 6 X 6 lattice design that included four market classes (Pinto, Small Red, Great Northern and Black). Individual plots consisted of two rows with 60 cm row spacing and measured 1.2 m x 3.7 m. All rows of a plot were harvested to determine yield.

All pinto lines flowered earlier, matured earlier and yielded lower than Othello (Table 25). In the small red market class, all lines yielded higher than the check variety AC Redbond. For the great northern market class, all lines had lower yield than the check variety US1140.

For the Black market class, all entries yielded lower than the check variety UI 906.

[1] AAFC Research Centre, Lethbridge, Alberta
[2]CSIDC, Outlook, Sask.
[3]ICDC, Outlook, Sask.

Table 25. Irrigated Wide Row Prairie Bean Co-operative trial.							
Variety	Yield (kg/ha)	Yield % of check	Seed Weight (mg)	Days to Flower	Days to Maturity[1]	Plant Height (cm)	Lodge Rating (0=erect; 5=flat)
Pinto							
Othello (check)	4502	100	376	54	92	40	3.3
CDC Pintium	3723	82	390	48	87	40	1.5
L98B351	4376	97	360	54	92	39	2.8
L01B488	3177	70	419	48	84	36	1.5
L01B518	3269	72	415	49	83	36	1.8
L01B522	3437	76	405	48	84	34	1.8
L01B538	2926	65	416	48	83	37	1.3
L01B539	3251	72	416	49	84	35	2
L01B544	3295	73	419	48	84	36	1.8
L01B558	3674	81	419	48	83	37	1.5
L01B579	3228	71	421	49	84	39	1.5
L01B591	3333	74	405	48	83	37	1.3
L01B600	3272	72	402	48	84	33	1.8
L01B605	3643	80	412	49	85	39	1.5
L01B633	3267	72	408	47	83	33	1.5
L01B636	3369	74	418	48	85	36	1.5
L01B638	3716	82	413	48	83	35	1.3
L01B647	3282	72	408	48	85	38	1.5
L01B651	3259	72	409	48	83	36	1.3
Small Red							
AC Redbond (check)	3583	100	330	47	89	43	2.3
L98D292	3939	110	395	50	88	35	3
L98D347	4039	113	343	50	88	43	2
737-68	3979	111	352	51	86	39	3
1041M-15	3824	107	329	54	91	40	2.5
Great Northern							
US1140 (check)	4502	100	324	51	92	39	3.5
AC Polaris	4019	89	340	54	91	37	3
L98E209	3735	83	374	48	89	39	2.5
L01E279	4017	89	426	51	90	35	2.8
L01E283	4249	94	323	50	86	33	4.3
L01E293	4213	94	380	50	86	45	2
L01E294	3995	89	426	49	88	42	1.8
1006S-1	4312	96	419	49	91	37	2.8
1006S-3	3726	83	402	49	91	36	2.5
Black							
UI 906 (check)	4033	100	179	56	94	52	0.8
AC Black Diamond	3708	92	278	53	93	46	1.8
L01F120	3852	96	383	46	91	36	3.3
LSD (0.05)	883	-	24	1	3	4	0.8
CV (%)	13.2	13.2	4.5	2.1	2.6	8.2	11.9

[1] 50% of pods are buckskin color

Field Pea Co-operative Registration Test A and Test B

T. Warkentin[1], D. Bing[2], A. Sloan[3], T. Hogg[4] and D. David[4]

Progress: *Ongoing*

Objective: *To evaluate new pea germplasm for cropping conditions in western Canada.*

This project evaluates pea germplasm for growing conditions in western Canada. The germplasm sources included advanced lines from the AAFC Morden Research Centre, Crop Development Centre, University of Saskatchewan, Crop Diversification Centre North, Alberta Agriculture and private seed companies. Forty-six candidate entries were divided into two equal tests with 23 entries in each test. Each test had four yellow check varieties, Carrera, Cutlass, Eclipse and CDC Mozart. Test A also had one green check variety, Nitouche.

An irrigated site was conducted at the CSIDC. Standard fertilizer, weed control and irrigation practices for irrigated pea production were followed. Each test was arranged as a randomized complete block design with three replicates. Individual plots measured 1.2 m x 3.7 m. All rows were harvested to determine yield.

In test A, several lines had yield higher than the check varieties except for the check variety Eclipse (Table 26). Most lines had maturity slightly longer than Carrera. Some lines had better lodging than the checks. Highest seed weight was recorded for the yellow lines Ceb4132, CEB4139 and CDC728-8. Most lines had seed weight that was similar to the checks.

In test B, several lines tested yielded greater than the check varieties (Table 27). Three lines CDC0101, MP1826 and CEB4133 had exceptionally high yield. Most lines had maturity equivalent to the checks. Most lines had seed weight similar to the checks with the highest seed weight recorded for the lines Othello and Ceb4133.

[1] Crop Development Centre, University of Saskatchewan, Sask.
[2] AAFC Research Centre, Lacombe, Alta.
[3] AAFC Research Centre, Morden, Man.
[4] CSIDC, Outlook, Sask.

Table 26. Pea Co-operative Registration Test A.					
Entry	Yield (Kg/ha)	Pre-Harvest Lodging 0=erect; 9=flat	Vine Length (cm)	Days to Maturity	Seed Weight (mg)
Yellow					
Eclipse	5859	3.7	73	98	211
Cutlass	3783	2.3	72	98	175
CDC Mozart	4276	7.3	69	99	159
Carrera	3267	8	73	92	178
CEB4129	4090	7	65	98	228
CEB4132	5710	4.7	69	99	234
CEB4136	5866	3	80	97	196
CEB4137	4912	3	63	97	207
CEB4139	4848	4.7	75	97	234
MP1816	4911	8	68	98	181
MP1817	4895	4.3	81	98	199
MP1824	5628	5	87	98	193
MP1828	5046	6	78	98	199
CDC0105	3969	7.3	69	95	158
CDC653-8	4538	3.3	69	91	155
CDC728-8	5739	7.3	68	96	234
CDC985-36	5377	5.7	74	97	184
CDC1101-14	3795	3.7	79	98	139
CDC1097-22	3752	1.3	86	100	136
SWA5097	4327	5	74	95	195
SWA5098	3961	4	70	93	216
Green					
Nitouche	2392	6.7	74	95	153
CEB1090	4670	5.3	75	96	213
CDC672-1	3622	4.7	74	98	146
CDC647-1	3660	4	75	99	155
CDC672-4	4092	5	86	99	148
SWA6145	4130	8	73	98	152
SWA6154	3596	6.3	68	97	152
LSD (0.05)	1168	-	-	-	-
CV (%)	15.7	-	-	-	-

Table 27. Pea Co-operative Registration Test B.					
Entry	Yield (Kg/ha)	Pre-Harvest Lodging 0=erect; 9=flat	Vine Length (cm)	Days to Maturity	Seed Weight (mg)
Yellow					
Eclipse	5431	5.3	76	98	200
Cutlass	4740	1.7	79	99	172
CDC Mozart	4198	8.7	62	99	162
Carrera	3923	4.7	63	93	177
CEB4133	6172	7.3	84	96	231
CEB4134	5789	6	77	94	211
CEB4135	3710	3	73	92	213
CEB4138	3900	2.3	82	93	156
MP1815	4556	4.7	86	96	157
MP1818	5688	7.7	83	98	173
MP1820	5529	3	82	98	210
MP1822	4366	6.7	69	93	182
MP1823	5837	9	77	95	197
MP1825	5317	6	72	96	156
MP1826	6140	2.3	81	96	189
MP1827	5018	5	86	96	199
CDC0101	6320	7.3	79	96	195
CDC651-2	5439	8	71	98	184
CDC715S-4	5506	9	78	94	201
SW975539	5486	3.7	74	94	196
SW985804	3517	8.7	77	95	139
SW995848	5535	6	82	94	196
SWA5130	4929	4	77	96	184
SWA5122	4808	3	78	95	162
Othello	5165	5	79	95	247
DP68-36192	4118	5.3	77	94	201
SB2002-1	3580	2	75	93	153
LSD (0.05)	1171	-	-	-	-
CV (%)	14.3	-	-	-	-

Irrigated Field Pea Regional Variety Trial

T. Hogg[1], D. David[1] and C. Ringdal[2]

Funded by the Irrigation Crop Diversification Corporation

Progress: *Ongoing*

Objective: *To evaluate the agronomic performance of current and newly registered pea varieties under irrigation.*

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

CSIDC off-station (NW12-29-08-W3): Asquith sandy loam
C. Ringdal (SE07-30-05-W3): Hanley loam - clay loam
R. Pederson (NE20-28-07-W3): Elstow loam

Pea varieties were tested for their agronomic performance under irrigation. The Pederson site was seeded on May 14 and the CSIDC Off-station site and the Ringdal site May 15. Plots measured 1.5 m x 4 m. All plots received 28 kg N/ha as 46-0-0 and 45 kg P_2O_5/ha as 12-51-0. The fertilizer was sideband applied during the seeding operation. Yields were estimated by harvesting the entire plot.

Irrigated pea yield, height and lodge rating (Table 28) as well as seed weight (Table 29) varied among the three sites. Maturity was similar among the three sites for each variety. Most of the newer varieties produced lower yield than CDC Mozart. The yellow varieties CDC Mozart and CDC Golden and the green variety Nessie produced high yields with highest overall yield obtained for the yellow variety CDC Golden averaged over the three sites.

The results from these trials are used to update the irrigation variety trial database at CSIDC and provide recommendations to irrigators on the best pea varieties suited to irrigation conditions.

[1]CSIDC, Outlook, Sask.
[2]ICDC, Outlook, Sask.

Table 28. Yield and agronomic data for the irrigated field pea regional variety trial.

Variety	Pederson site				Ringdal site				CSIDC off-station site				Mean yield	
	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Maturity (days)	Lodge rating[1]	kg/ha	% of CDC Mozart
Yellow														
CDC Mozart	5776	57	96	7.7	6101	72	95	6.7	4705	82	97	6.7	5527	100
CDC Bronco	4502	68	97	1.7	4998	83	97	4	3502	87	98	3	4334	78
CDC Golden	5971	72	92	2.3	6360	87	96	3.7	5185	82	95	4.7	5839	106
CDC 0102	5307	63	97	4.7	4770	75	96	5.3	4772	78	98	4.3	4950	90
CDC 0103	4321	69	97	3.7	3960	86	97	5	2861	87	98	4.7	3714	67
Alfetta	3806	58	90	5.7	4203	73	95	4	4253	83	90	1.3	4087	74
Cutlass	5445	64	97	3.7	5616	79	96	2	4266	86	98	1	5109	92
DS Admiral	5672	65	94	4.3	5408	83	95	5	4863	84	96	1.7	5314	96
Miser	5729	72	96	6.3	6151	92	98	7.3	4109	85	97	8	5330	96
MP1811	4957	82	97	4.7	4479	90	99	3.3	4195	90	97	5.7	4544	82
MP1813	4874	77	96	5	4794	90	98	4.3	4997	99	96	3	4888	88
MP1814	5462	73	95	3.7	5174	81	96	2.7	4947	92	96	4	5194	94
SW Belfield	4507	57	90	4	4651	72	94	3	4329	87	92	3	4496	81
SW Circus	3610	56	90	2.3	5438	82	92	3.7	3728	79	88	2	4259	77
SW Prize	3175	69	90	4.7	2784	82	91	4.7	2420	86	88	2.3	2793	51
Green														
Nitouche	3966	71	90	5.3	4800	87	95	3.3	4065	91	96	2	4277	77
CDC Striker	3547	66	91	1.7	2934	75	95	2.7	3516	88	94	2	3332	60
CO96-901	4192	64	90	8.7	4586	84	95	7.7	4018	88	94	7	4599	83
Madoc	4336	58	90	5.7	5062	72	94	4.7	4270	80	94	1.3	4556	82
Nessie	5525	66	96	4	5926	88	96	2.7	5138	86	97	3.7	5530	100
Forage														
CDC Sonata	3533	71	99	8.3	2089	77	100	8.3	2107	83	99	7.7	2576	47
40-10	2400	73	96	8	2299	91	97	7.7	1759	84	98	7.3	2153	39
Maple														
CDC Acer	3810	71	97	7.7	2525	83	99	8.7	2217	84	99	8.7	2851	52
Courier	3071	60	94	8.7	3056	79	95	8.3	2507	86	95	7	2878	52
LSD (0.05)	499	8	2	2.6	733	12	2	1.9	876	NS[2]	2	2.6	-	-
CV (%)	6.8	6.9	1.1	16.6	9.9	8.6	1.4	12.4	13.8	8.1	1.6	18.9	-	-

[1] 0 = erect; 9 = flat
[2] not significant

Table 29. Seed weight data for the irrigated field pea regional variety trial.			
Variety	Seed weight (mg)		
	Pederson site	Ringdal site	CSIDC off-station site
Yellow			
CDC Mozart	223	223	196
CDC Bronco	182	190	166
CDC Golden	212	211	203
CDC 0102	209	205	194
CDC 0103	190	189	171
Alfetta	209	198	184
Cutlass	218	204	194
DS Admiral	236	232	230
Miser	198	184	171
MP1811	205	210	208
MP1813	199	201	201
MP1814	205	203	197
SW Belfield	187	191	168
SW Circus	160	180	165
SW Prize	187	155	134
Green			
Nitouche	209	201	190
CDC Striker	179	176	181
CO96-901	141	147	142
Madoc	211	195	185
Nessie	250	243	216
Forage			
CDC Sonata	216	196	178
40-10	100	105	94
Maple			
CDC Acer	136	120	120
Courier	197	179	151
LSD (0.05)	12	15	14
CV (%)	3.9	4.9	4.8

Horticultural Crops

Potato Research and Development Program

The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) has expanded its potato research and development program to support the needs of this expanding industry. The main objective includes:

- Identify superior cultivars for the 'seed', 'processing', and 'table' markets,
- Develop cost-effective agronomic practices to suit the relatively short and cool growing seasons of Saskatchewan,
- Develop economically viable and sustainable potato-based crop rotations, and
- Identify physiological parameters responsible for superior vigour of seed lots and develop production and storage management practices to maintain productive superiority of seed-tubers.

The potato industry is growing rapidly in Western Canada including Saskatchewan. This includes 'seed', 'processing' and 'fresh market' sectors. It is estimated that the Western Canadian potato industry will expand to approximately 73,000 ha (180,000 ac) valued over $500 million by year 2005.

Saskatchewan has become one of the leading seed potato producers and exporters in North America. This is mainly due the phenomenon of 'Northern Vigour™' and disease-free status of seed tubers produced in this province. Saskatchewan is recognized as one of the few remaining areas in North America that can consistently produce high quality early generation seed potatoes.

The major target markets include the U.S.A, Mexico, and several Canadian provinces. Quality characteristics of a superior seed stock include greater physiological vigour, freedom from tuber-borne diseases, and uniformity tuber size as demanded by the target market. Appropriate production and storage management practices are necessary to produce disease-free, physiologically vigorous seed-tubers of specific size grades to suit market needs. Commercial potato growers demand specific size grades. As such, the seed crop should be raised appropriately, top-killed and harvested at a suitable time to produce high quality seed-tubers of the required size grade as demanded by the buyers. Further, storage management practices should be managed in a manner that they will not negatively impact the advantages derived from 'Northern Vigour'.

The processing potato industry is also expanding in Western Canada. Multi-year research conducted at the University of Saskatchewan and the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) have shown that high quality processing potato can be successfully grown in Saskatchewan. The irrigated area of southern Saskatchewan is ideally suited to the production of high quality processing potatoes.

These projects are conducted jointly with industry partners, Saskatchewan Seed Potato Growers Association and Dr. Dermot Lynch and Dr. Larry Kawchuck (Lethbridge Research Centre, Agriculture and Agri-Food Canada). Partial funding for this project was provided by the Canada-Saskatchewan Agri-Food Innovation Fund, and Agriculture and Agri-Food Canada Matching Investment Initiative.

Field Trials:

The studies were conducted in the field plots of CSIDC. The growing season was relatively warm and dry (Figure 1). Considerable irrigation was applied to maintain soil moisture status at satisfactory level. The growing season received 82 mm of precipitation and 405 mm of irrigation was provided to maintain favourable soil moisture conditions.

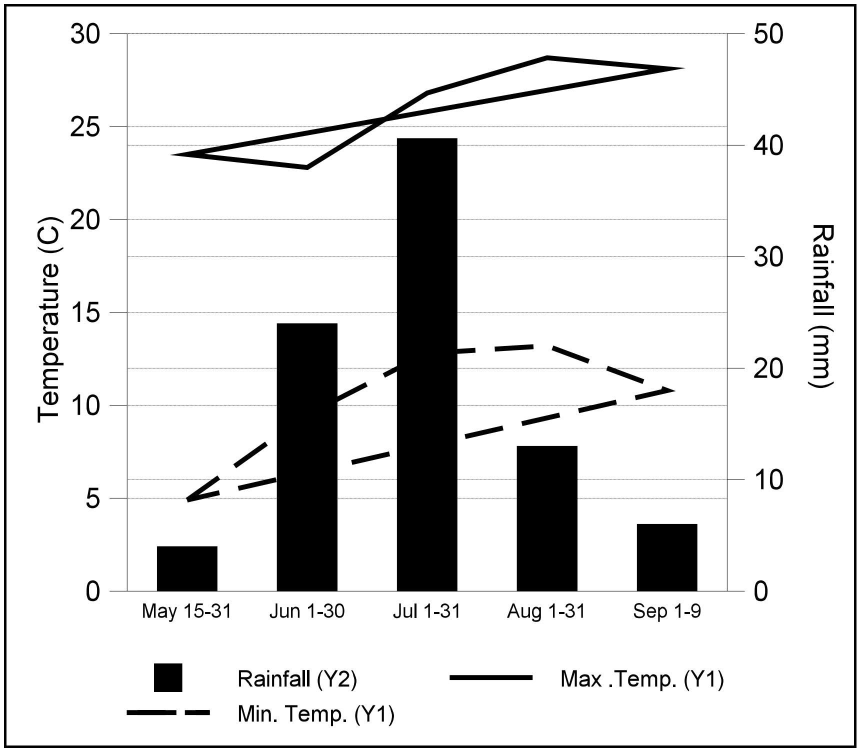

Figure 1. Temperature and rainfall conditions at CSIDC during the 2003 growing season.

Test plots were established May 16 through May 26, 2003. The crop was raised using standard management practices with treatments applied appropriately as required by the different tests. The common production practices included (i) Eptam 8E as pre-plant herbicide, (ii) 90 cm row spacing, (iii) 200 kg N/ha (half at planting and half at hilling), 60 kg P_2O_5/ha, 50 kg K_2O/ha, (iv) insect control using Ripcord and Cygon, and (iv) disease control using Bravo 500, Dithane, and Acrobat MZ. The test plots were top-killed at different dates depending on the test. Top-kill was performed by flailing and/or by Reglone application.

Flailing: Flailing followed by one application of Reglone (1.73 L Reglone/ha in 455 L water), *Chemical desiccation:* Split application of Reglone (first application at 2.2 L Reglone/ha in 455 L water and second application with 1.24 L Reglone in 455 L water approximately seven days later).

Tubers were harvested after proper skin set. The harvested potatoes were graded based on tuber diameter according to Canadian Seed Standards. Seed grades were categorized in the following manner based on tuber diameter:

Oblong tubers:
- Grade B: 30 mm - 45 mm
- Grade A: 45 mm - 70 mm

Round tubers:
- Grade B: 30 mm - 50 mm
- Grade A: 50 mm - 80 mm

Yield estimates were also recorded for tubers larger than the maximum size set by Canadian seed standards. In the following discussion, ‘Seed Grade’ indicates the sum total of both Grade A and B tubers for the round and oblong tubers. The ‘consumption’ category included all tubers larger than 45 mm diameter. Tuber specific gravity and culinary characteristics (boiled, baked, chip, and french fry) were determined using recommended Prairie Regional Variety Testing protocols. Fry colour categories were based on USDA classification.

Cultivar Evaluation

Advanced Adaptation Trial I

J. Wahab[1], G. Larson[1] and D. Lynch[2]

The performance of thirty seven potato clones were evaluated in comparison with seven commercial cultivars (Russet Burbank, Shepody, Amisk, Norland, Sangre, Atlantic, Snowden) under irrigated condition. Test plots contained 12 hills and was replicated two times. Superior clones will be advanced for further evaluation.

Advanced Adaptation Trial II

J. Wahab[1], G. Larson[1] and D. Lynch[2]

The performance of twenty four potato clones were evaluated in comparison with nine commercial cultivars (Russet Burbank, Shepody, Norland, Sangre, Atlantic, Snowden, Ranger Russet, Russet Norkotah, NorValley) under irrigated condition. Test plots contained 12 hills and was replicated four times. Superior clones will be advanced for further evaluation.

Prairie Early Replicated Trial

J. Wahab[1], G. Larson[1] and D. Lynch[2]

The Prairie Early Replicated trial was conducted at CSIDC under irrigation. This test evaluated ten advanced generation clones (2 Fresh market; 1 Chipping; 7 Fresh market/chipping dual purpose) in comparison with industry standards Norland, Atlantic, AC Ptarmigan, NorValley, and Russet Norkotah. Field plots were flailed at 84 and 96 days after planting and harvested the following day. The yield performance and culinary characteristics were determined for the harvested tubers. This information will be used to support registration of new cultivars.

[1]CSIDC, Outlook, Sask.
[2]AAFC Research Centre, Lethbridge, Alta.

Prairie Main Replicated Trial

J. Wahab[1], G. Larson[1] and D. Lynch[2]

The Prairie Main Replicated trial was conducted at CSIDC under irrigation. Twenty-two clones (two Fresh market; two Red-skinned fresh market creamer; ten French fry; seven Chipping; one Fresh market chipping dual purpose) and eight standards (Russet Burbank, Shepody, Snowden, Atlantic, Norland, Russet Norkotah, Sangre, Ranger Russet) were evaluated under irrigated production. The crop was flailed and desiccated 116 days after planting and harvested two weeks later. The yield performance and culinary characteristics were determined for the harvested tubers. This information will be used to support registration of new cultivars.

Western Seed Potato Consortium

J. Wahab[1], G. Larson[1] and D. Lynch[2]

Promising table, french fry, and chipping clones offered to the Western Seed Potato Consortium were grown in single-row plots under standard management practices suited for irrigation. This demonstration included six new french fry clones, six chipping clones, and one fresh market clone. The standard cultivars included Russet Burbank, Shepody, and Amisk for french fry; Atlantic and Snowden for chipping; and Russet Norkotah, Norland, NorValley and Sangre for table market classes. The crop was harvested and displayed to the participants during the Potato Field Day in August.

Genetically Modified Potato

J. Wahab[1], G. Larson[1] and L. Kawchuck[2]

Verticillium wilt or ‘Early dying’ in potato is becoming a major problem for potato producers in Western Canada. Research is being conducted at the AAFC Lethbridge Research Centre to develop potato cultivars resistant to several pests and diseases including Verticillium wilt. The current project is designed to introduce Verticillium resistance to commercial potato cultivars. The Ve gene from tomato has been introduced to Amisk (Ranger Russet), Atlantic, Red Norland, Russet Burbank, Russet Norkotah, Sangre, Shepody, Snowden, Viking, and Yukon Gold. This strategy is similar to that used for late blight resistance that provided 100% late blight control. Results will support the efforts of potato improvement targeted for different markets.

[1]CSIDC, Outlook, Sask.
[2]AAFC Research Centre, Lethbridge, Alta.

Commercial Scale Evaluation of Advanced Clones (MII Project)

J. Wahab[1], G. Larson[1] and D. Lynch[2]

Five improved potato clones were at the Centre. This seed will be utilized for field-scale multiplication in a commercial field. The project partner (Dutch Potato Farms) will carry out most of the production operations under the supervision of CSIDC staff.

Potato Agronomy

Determine Critical Irrigation Stages to Optimize 'Seed' Grade Tubers for Contrasting Cultivars

J. Wahab[1] and G. Larson[1]

Potato responds well to irrigation. Both excess and deficit moisture situations can adversely affect potato yield and quality. Moisture stress can reduce tuber yield and quality characteristics. On the other hand, excess moisture can negatively impact tuber specific gravity and fry colour of processing potato. Timing of irrigation is essential to maximize yields of high quality uniform grade tubers. Moisture stress, depending on the crop growth stage, can reduce tuber yields and/or affect processing quality. For example, transient moisture stress during stolon formation or tuber initiation can reduce tuber set, while moisture stress at tuber bulking stage can reduce tuber size. It should be possible to maximize yields of smaller sized 'seed' grade tubers or larger 'consumption' grade tubers through careful water management. It is likely that the optimum moisture requirement may be different for 'seed' and 'consumption' grade market classes depending on cultivars and plant population.

This study was designed to determine the critical stages of the potato crop at which soil moisture should be maintained at optimum level (approximately 60% Field capacity) to maximize yields of high quality 'seed' and 'consumption' potatoes. The following commercially important potato cultivars were included in this study:

Norland:	Early, table
Russet Burbank :	Very-late, french fry
Russet Norkotah:	Mid-season, table
Ranger Russet:	Very-late, french fry
Shepody:	Mid-season, french fry
Atlantic:	Mid-season, chipping
Alpha:	Very-late, table

[1]CSIDC, Outlook, Sask.
[2]AAFC, Research Centre, Lethbridge, Alta.

Sufficient soil moisture was maintained at three specific crop growth stages using supplemental irrigation. The crop growth stages, irrigation treatments, rainfall, and irrigation are presented in Table 1. The growth stages I & II (planting to stolon formation), growth stage III (stolon formation to tuber initiation/flowering), and growth stage IV (flowering to senescence) were identified based on their distinct physiological phases in the crop growth cycle. In the following discussion, growth stage-I & II will be called 'early', growth stage III as 'mid', and growth stage-IV as 'late'. Field trials were planted on May 16, desiccated on September 8, and harvested on September 23.

Results:
The irrigation periods for the various water management treatments are presented in Table 1. The entire growing season received 82.2 mm rain and it was not uniformly distributed across the season. For example Growth stage-1 (May 16-July 14) received 59.8 mm, growth stage-II (July 15-August 9) 14.8 mm, and growth stage-III (August 10-September 9) 7.6 mm. The full irrigation treatment (III) received a total of 487 mm of water that included 82 mm rain and 405 mm irrigation. Considerable irrigation application is a reflection of the warm dry conditions that prevailed during the 2003 production season.

Table 1. Rainfall, irrigation timing and irrigation amounts for the water management treatments in 2003.

Crop growth stages	Irrigation treatment								
	IDD	IID	III	DII	DDI	DDD	IDI	DID	Rainfall at growth stage (mm)
Planting to stolon formation (May 16-Jul 14)	Irrig	Irrig	Irrig	Dry	Dry	Dry	Irrig	Dry	59.8
Stolon formation to tuber development (Jul 15-Aug 9)	Dry	Irrig	Irrig	Irrig	Dry	Dry	Dry	Irrig	14.8
Tuber development to senescence (Aug 10-Sep 5)	Dry	Dry	Irrig	Irrig	Irrig	Dry	Irrig	Dry	7.6
In-season irrigation (mm)	105	280	405	300	125	0	230	175	
In-season rainfall (mm)	82.2	82.2	82.2	82.2	82.2	82	82.2	82.2	
In-season moisture (mm)	187	362	487	382	207	82	312	257	

D and I indicate dryland and irrigation respectively.
Maintain soil moisture at >65% FC at the prescribed growth stages for the various treatments.

Seed Grade Yield:
All cultivars grown under full-irrigation (III) produced the highest 'seed' grade yield compared to all other irrigation methods (Table 2). On average the full-irrigation treatment produced 76% higher 'seed' grade yield than dryland production. The crop that received irrigation during stage-I and stage-II (i.e. treatment IID) produced overall second highest 'seed' grade yield. Comparing the treatments that received two irrigations, it appears that the crop that received irrigation during growth stage-I produced higher 'seed' grade yields than the treatment that did not receive irrigation during stage-I.

Comparison of treatments that received only one irrigation shows that the crop that received irrigation during stage-I or stage-II produced higher yields than the crop that did not receive irrigation during the first two growth stages.

The yield ranking for the various cultivars tested under different irrigation regimes were different (Table 2). Different cultivars produced similar 'seed' grade yields under full irrigation (i.e. III) and when the crop received irrigation during the two early growth stages. Different cultivars responded differently under limited irrigation. It is likely that commercial cultivars tested have similar yield potential under favourable soil moisture situations. However, under moisture stress conditions, it is likely that different cultivars would respond differently.

Table 2. Irrigation scheduling effects on 'seed' grade tuber yields for commercial potato cultivars.

Treatment	Irrigation treatment							
	I-D-D	I-I-D	I-I-I	D-I-I	D-D-I	D-D-D	I-D-I	D-I-D
	----------------------------------Tuber yield (t/ha)--------------------------------							
Alpha	32.2	46.3	54.9	33.4	23.7	22.3	35.6	44.6
Atlantic	49.9	49.3	59.9	45.5	36.1	45.9	47.7	52.3
Dark Red Norland	46.1	58.8	58.3	55.6	31.4	32.4	50.4	49.9
Russet Burbank	40.3	58.5	61.0	51.5	30.4	29.8	43.7	44.4
Russet Norkotah	34.8	47.2	48.0	41.3	32.8	31.4	43.2	41.7
Ranger Russet	34.3	55.3	60.7	44.2	31.2	27.6	39.6	41.5
Shepody	38.5	46.7	52.9	41.6	34.8	35.3	38.9	45.1
Analyses of Variance								
Source:								
Cultivar	**(9.3)	ns	ns	**(9.6)	ns	***(8.4)	**(7.5)	**(5.8)
CV (%)	15.8	14.8	14.3	14.5	22.0	17.6	11.8	8.6

, *, and ns indicate significance at P<0.01 and 0.001 levels of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of significance.

Consumption Grade Yield:
Atlantic produced the highest and Alpha the lowest 'consumption' grade yields across all irrigation treatments (Table 3). The yield for the other cultivars were different for the various irrigation treatments.

The full-irrigation and dryland crops produced the highest and lowest 'consumption' grade tuber yields respectively (Table 3). On average the full-irrigation crop outyielded the dryland crop by 126%.

The crop that received irrigation during only one growth stage, irrigating the crop during the mid growth stage produced the highest 'consumption' grade yield relative to the crops that received irrigation during the early or late growth stages (Table 3).

The crop that received irrigation during two growth stages, the crop that received irrigation during the early and mid growth stages produced the highest 'consumption' grade yield relative the crops that received two irrigations during the other growth stages (Table 3). It is evident that the potato crop that received irrigation during the early and mid growth stages produced superior 'consumption' grade tuber yields.

Table 3. Irrigation scheduling effects on 'consumption' grade tuber yields for commercial potato cultivars.

Treatment	Irrigation treatment							
	I-D-D	I-I-D	I-I-I	D-I-I	D-D-I	D-D-D	I-D-I	D-I-D
	----------------------------------Tuber yield (t/ha)--------------------------------							
Alpha	19.9	31.3	38.7	21.8	10.6	11.7	19.9	33.1
Atlantic	52.1	59.7	74.4	55.7	37.5	43.5	54.3	60.4
Dark Red Norland	43.0	56.1	56.2	56.5	29.1	30.5	51.6	52.5
Russet Burbank	23.3	45.2	48.1	43.3	9.1	24.0	27.1	32.4
Russet Norkotah	28.9	47.9	45.0	47.5	28.9	11.7	40.8	39.2
Ranger Russet	25.1	50.0	55.1	40.8	23.3	18.0	29.9	38.2
Shepody	39.3	53.0	71.8	45.1	31.9	32.6	39.9	54.4
Analyses of Variance								
Source: Cultivar	***(11.0)	**(13.6)	***(13.8)	***(9.6)	***(8.8)	***(7.1)	***(8.4)	***(8.3)
CV (%)	22.4	18.6	16.7	14.5	24.3	19.4	15.0	12.6

, and * indicate significance at P<0.01 and 0.001 levels of probability respectively.
Values within parentheses are LSD estimates at 5.0% level of significance.

Effects of Top-kill Methods and Harvest Stages on Tuber Yield for Dryland and Irrigated Potato

J. Wahab[1] and G. Larson[1]

Commercial potato growers demand specific size grades. As such, the seed crop should be raised appropriately, top-killed and harvested at a suitable time to produce high quality seed-tubers of the required size grade as demanded by the buyers. Further, storage management practices should be managed in a manner that they will not negatively impact the advantages derived from 'Northern Vigour'.

[1]CSIDC, Outlook, Sask.

This study evaluated six commercial potato cultivars (Dark Red Norland, Russet Burbank, Russet Norkotah, Ranger Russet, Shepody, Atlantic) two top-kill methods (Flail, apply Reglone, and harvest 2 WAD; two Reglone applications seven days apart), and three top-kill stages (90, 97 and 104 days after planting). This study was conducted both under irrigation and dryland conditions.

Results:
Irrigated potatoes produced higher 'seed' and 'consumption' grade tuber yields at all three top-kill dates (Tables 4 and 5).

Potatoes top-killed by flailing or by chemical desiccation produced similar 'seed' and 'consumption' grade yields across all top-kill dates under both growing conditions (Tables 4 and 5).

Table 4. Effects of top-kill method and top-kill timing on 'seed' grade yield for commercial potato cultivars grown under dryland and irrigation.

Treatment	Dryland crop - Top-kill date			Irrigated crop - Top-kill date		
	90 DAP	97 DAP	104 DAP	90 DAP	97 DAP	104 DAP
	---------------------------Tuber yield (t/ha)-------------------------------					
Top-kill:						
Reglone 2X	24.4	28.6	31.0	39.2	43.3	45.6
Flail + Reglone	23.5	29.5	30.7	38.8	45.8	47.2
Cultivar:						
Atlantic	32.3	36.1	34.2	45.9	51.5	50.1
Russet Burbank	20.4	22.1	29.0	30.7	40.5	41.9
Russet Norkotah	22.8	32.4	34.7	41.5	43.9	46.4
Dark Red Norland	35.2	41.5	39.8	52.1	56.2	60.1
Ranger Russet	13.9	19.4	21.1	30.0	34.6	36.8
Shepody	19.4	22.9	26.4	34.0	40.6	43.3
Analyses of Variance						
Source						
Desiccation	ns	ns	ns	ns	ns	ns
Cultivar	**(10.2)	***(3.8)	***(3.5)	***(5.1)	***(5.2)	***(4.3)
Cultivar x Desiccation	ns	ns	ns	ns	ns	ns
CV (%)	41.8	12.7	11.0	12.9	11.6	9.0

, *, and ns indicate significance at P<0.01 and 0.001 levels of probability and not significant respectively.
Values within parentheses are LSD estimates at 5.0% level of significance.

‘Seed’ and ‘consumption’ grade tuber yields increased with delaying of desiccation dates. Yield rankings were somewhat similar across the various desiccation dates under irrigated and dryland production. Dark Red Norland produced the highest yield and Ranger Russet produced the lowest ‘seed’ grade (Table 4) and ‘consumption’ grade (Table 5) yields during all top-kill dates under both growing conditions.

Table 5. Effects of top-kill method and top-kill timing on ‘consumption’ grade yield for commercial potato cultivars grown under dryland and irrigation.

Treatment	Dryland crop -Top-kill date			Irrigated crop - Top-kill date		
	90 DAP	97 DAP	104 DAP	90 DAP	97 DAP	104 DAP
	----------------------------Tuber yield (t/ha)--------------------------------					
Top-kill:						
Reglone 2X	20.3	24.8	27.6	32.1	40.4	44.7
Flail + Reglone	19.4	25.9	27.1	31.7	42.2	47.6
Cultivar:						
Atlantic	32.1	37.9	35.0	44.2	55.2	58.3
Russet Burbank	11.3	12.5	18.3	13.9	25.2	30.0
Russet Norkotah	17.8	27.3	31.2	36.6	44.6	50.0
Dark Red Norland	33.3	40.5	39.8	49.1	55.8	59.7
Ranger Russet	9.6	14.3	15.9	19.8	27.2	31.3
Shepody	15.0	19.7	24.1	27.9	39.9	47.4
Analyses of Variance						
Source						
Desiccation	ns	ns	ns	ns	ns	ns
Cultivar	***(10.6)	***(4.6)	***(3.9)	***(4.9)	***(6.1)	***(5.0)
Cultivar x Desiccation	ns	ns	ns	ns	ns	ns
CV (%)	52.2	17.7	14.1	15.1	14.4	10.6

*** and ns indicate significance at P<0.001 level of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of significance.

Effects of Top-kill Methods, Top-kill Dates, and Growing Condition of the Seed Crop and Seed-tuber Grade on Productivity of the Progeny

J. Wahab[1] and G. Larson[1]

Productivity of seed potato is a function of physiological vigour of the tuber and the presence/absence of tuber-borne diseases. Physiological vigour in turn is a combination of the inherent productivity of the seed-tuber and the influence of external conditions under which the seed crop is grown (environment and agronomic practices) and stored. Physiologically younger seed-tubers are considered to be more productive than physiologically old seed-tubers.

In this study, productivity of Dark Red Norland, Russet Burbank, Russet Norkotah, Ranger Russet, Shepody, and Atlantic seed potatoes raised under a variety of production conditions were evaluated under irrigation.

The following treatments were examined in this study:

Top-kill method:	Flailing + Reglone, chemical desiccation (two applications of Reglone)
Top-kill date:	100, 114 days after planting
Growing condition:	Irrigation, dryland
Seed grade:	Canada Grade A, Canada grade B

Results:

Tables 6 and 7 summarize the effects of the agronomic practices during the seed production season and seed-tuber grade on 'seed' and 'consumption' grade tuber yields respectively of the progeny. Different cultivars responded differently to the effects of seed production agronomy on 'seed' and 'consumption' grade yields.

Following is a summary of the results:

- Seed crops top-killed by flailing or chemical desiccation produced similar 'seed' and 'consumption' grade yields.
- Russet Norkotah seed crop top-killed 100 days from planting produced higher 'seed' and 'consumption' grade yields than the seed crop top-killed 114 days after planting. By contrast, Ranger Russet seed crop top-killed early produced lower tuber yields than the later top-killed crop. Top-kill timing had no effect on Russet Burbank, Dark Red Norland, Shepody, or Atlantic potato.
- Productivity of seed crops raised on dryland or irrigated production conditions were similar for the various cultivars. However, there was an indication that Russet Norkotah seed from the dryland produced higher 'seed' grade yield than seed from irrigated production.
- Grade A seed tubers of all cultivars, except Russet Burbank, produced higher yields than Grade B seed. The yield differences reached significant proportions Ranger Russet, Russet Norkotah, and Shepody with respect to 'seed' grade yield, and for Russet Norkotah and Ranger Russet with respect to 'consumption' grade yield.

[1]CSIDC, Outlook, Sask.

Table 6. Effects top-kill method and timing, growing condition, and seed-tuber grade on 'seed' grade yield of commercial potato cultivars.

Treatment	Russet Burbank	Dark Red Norland	Shepody	Russet Norkotah	Ranger Russet	Atlantic
Top-kill method:						
Flail	32.1	37.1	34.2	43.5	30.1	40.1
Reglone	32.1	37.7	34.7	43.9	30.5	41.0
Top-kill date:						
100 DAP	32.4	36.8	34.7	45.3	28.2	41.0
114 DAP	31.8	37.9	34.2	42.2	32.3	40.1
Growing condition:						
Dryland	31.7	38.2	34.1	44.3	32.1	40.3
Irrigation	32.5	36.6	34.8	43.1	28.5	40.8
Seed grade:						
Grade A	31.3	38.4	35.5	47.2	33.2	41.5
Grade B	32.9	36.4	33.4	40.3	27.3	39.6
Analyses of variance						
Source:						
Top-kill method (M)	ns	ns	ns	ns	ns	ns
Top-kill date (D)	ns	ns	ns	*(2.6)	***(2.0)	ns
Growing condition (G)	ns	ns	ns	ns	***(2.0)	ns
Seed grade (S)	ns	ns	ns	***(2.6)	***(2.0)	ns
M x D	*(3.0)	ns	ns	ns	ns	ns
M x G	ns	ns	ns	ns	ns	ns
M x S	ns	ns	ns	**(3.7)	ns	ns
D x G	ns	ns	*(3.3)	*(3.7)	ns	*(3.4)
D x S	ns	ns	ns	ns	ns	ns
G x S	ns	ns	ns	ns	ns	ns
M x D x G	ns	ns	ns	**(5.2)	ns	ns
M x D x S	ns	ns	ns	ns	ns	ns
M x G x S	ns	ns	ns	ns	ns	ns
D x G x S	ns	ns	ns	*(5.2)	ns	ns
M x D x G x S	*(6.1)	ns	ns	ns	ns	ns
CV (%)	13.3	11.8	13.4	11.7	12.8	11.7

*, **, *** indicate significance at P<0.05, 0.01,0.001 levels of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of significance.

Table 7. Effects top-kill method and timing, growing condition, and seed-tuber grade on 'consumption' grade yield of commercial potato cultivars						
Treatment	Russet Burbank	Dark Red Norland	Shepody	Russet Norkotah	Ranger Russet	Atlantic
Top-kill method:						
Flail	28.3	37.8	32.7	41.2	26.3	43.8
Reglone	28.1	38.5	33.7	41.9	26.9	44.9
Top-kill date:						
100 DAP	28.3	37.7	33.3	43.0	25.3	44.3
114 DAP	28.0	38.5	33.1	40.0	27.9	44.4
Growing condition:						
Dryland	27.6	38.6	33.1	41.8	27.4	44.5
Irrigation	28.8	37.7	33.3	41.2	25.7	44.1
Seed grade:						
Grade A	27.6	38.9	34.4	44.0	29.0	45.0
Grade B	28.7	37.4	32.0	39.1	24.1	43.7
Analyses of variance						
Source:						
Top-kill method (M)	ns	ns	ns	ns	ns	ns
Top-kill date (D)	ns	ns	ns	*(2.6)	**(1.8)	ns
Growing condition (G)	ns	ns	ns	ns	ns	ns
Seed grade (S)	ns	ns	*(3.3)	***(2.6)	***(1.8)	ns
M x D	*(3.0)	ns	ns	ns	ns	ns
M x G	ns	ns	ns	ns	ns	ns
M x S	ns	ns	ns	**(3.7)	ns	ns
D x G	ns	ns	ns	*(3.7)	ns	ns
D x S	ns	ns	ns	ns	ns	ns
G x S	ns	ns	ns	*(3.7)	ns	ns
M x D x G	ns	ns	ns	*(5.2)	*(3.5)	ns
M x D x S	ns	ns	ns	ns	ns	*(4.3)
M x G x S	ns	ns	ns	ns	ns	ns
D x G x S	ns	ns	ns	**(5.2)	ns	ns
M x D x G x S	ns	ns	ns	ns	ns	ns
CV (%)	14.7	11.1	13.8	12.4	13.1	9.5

*, **, *** indicate significance at P<0.05, 0.01,0.001 levels of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of significance.

Nitrogen and Phosphorus Rate and Placement Study

J. Wahab[1], T. Hogg[1] and G. Larson[1]

Potato is a high nutrient requiring crop. Nitrogen and phosphorus are the two most limiting nutrients for potato production. Careful management of these elements is essential to produce superior yields of high quality tubers and optimize returns. Nitrogen management is particularly important for processing potato under the relatively cool and short growing seasons in Saskatchewan. Nitrogen shortage can reduce vigour and predispose the crop to diseases while excess nitrogen can delay maturity and adversely affect yield and quality. Efficient nutrient uptake by crops depends on the proximity of fertilizer to the root zone. This is particularly important for crops that have limited root growth such as potato.

This study compared the effects of broadcasting, side-banding different rates of nitrogen and phosphorus fertilizers for potato cultivars Atlantic, Dark Red Norland, Russet Burbank, Russet Norkotah, Ranger Russet, and Shepody. For the broadcast treatment, the fertilizer was spread evenly in the furrow prior to planting. For side-banding, the fertilizer was placed 5cm away and 2.5 cm above the seed piece. Studies were conducted both under dryland and under irrigation.

Nitrogen:
Pre-plant application of nitrogen (46-0-0) at rates of 50, 75, and 100 kg N/ha, sideband and broadcast applied, was examined in this study. A pre-plant application of 120 kg P_2O_5/ha and 150 kg K_2O/ha, and a top-dressing of 100 kg N/ha was given uniformly across all treatments. Spring soil analysis at the test site indicated soil nutrient levels at 21 kg N/ha, 35 kg P_2O_5/ha, and 535 kg K_2O/ha at 0 cm to 30 cm depth.

Severe moisture stress during the growing season resulted in poor growth and extremely low and variable tuber yields. Consequently, the dryland crop was abandoned and only the irrigated test is reported. The effects of nitrogen rates and placement on 'seed' and 'consumption' grade yields for the various cultivars are summarized in Table 8.

Side-band and broadcast application of nitrogen produced similar 'seed' and 'consumption' grade yields (Table 8).

The nitrogen rates ranging from 50 to 100 kg N/ha applied at planting produced similar 'seed' and 'consumption' grade yields (Table 8).

Among the cultivars tested, Dark Red Norland produced the highest 'seed' and 'consumption' grade yields (Table 8). Ranger Russet produced the lowest 'seed' grade yield and Russet Burbank produced the lowest 'consumption' grade yield.

[1]CSIDC, Outlook, Sask.

Table 8. Nitrogen placement and rate effects on 'seed' and 'consumption' grade tuber yields for commercial potato cultivars.		
Treatment	'Seed' grade yield (t/ha)	'Consumption' grade yield (t/ha)
Nitrogen placement:		
Broadcast	44.0	39.1
Side-band	42.6	38.0
Nitrogen rate at planting:		
50 kg N/ha	43.3	38.7
75 kg N/ha	43.7	37.9
100 kg N/ha	42.9	39.1
Cultivar:		
Atlantic	44.1	46.9
Dark Red Norland	48.2	46.3
Ranger Russet	39.8	32.0
Russet Burbank	44.0	27.8
Russet Norkotah	43.9	38.8
Shepody	39.9	39.5
Analyses of Variance		
Source:		
Nitrogen application (A)	ns	ns
Nitrogen rate (R)	ns	ns
Cultivar (C)	***(2.7)	***(2.7)
A x R	ns	ns
A x C	ns	ns
R x C	ns	ns
A x R x C	ns	ns
CV (%)	11.0	12.3

***, and ns indicate significance at P< 0.001 level of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of significance.

Phosphorus:

Pre-plant application of phosphorus (12-51-0) at the rates of 40, 80, and 120 kg P_2O_5/ha, sideband and broadcast applied, was examined in this study. A pre-plant application of 100 kg N/ha and 150 kg K_2O/ha was given uniformly across all treatments. One hundred kg/ha of nitrogen was top-dressed at second hilling. Spring soil analysis at the test site indicated soil nutrient levels at 19 kg N/ha, 21 kg P_2O_5/ha, and 373 kg K_2O/ha at 0 cm to 30 cm depth.

Severe moisture stress during the growing season resulted in poor growth and extremely low and variable tuber yields. Consequently, the dryland crop was abandoned and only the irrigated test is reported. The effects of phosphorus rates and placement on ‘seed’ and ‘consumption’ grade yields for the various cultivars are summarized in Table 9.

Side-band application of phosphorus produced significantly higher ‘seed’ grade yield than broadcast application (Table 9). However, ‘consumption’ grade yields were similar for the two application methods.

The various phosphorus rates tested produced similar ‘seed’ and ‘consumption’ grade yields (Table 9).

‘Seed’ and ‘consumption’ grade tuber yield ranking for the various cultivars were somewhat similar to yields observed in the nitrogen placement study. Dark Red Norland produced the highest ‘seed’ and ‘consumption’ grade yields (Table 9) . Ranger Russet produced the lowest ‘seed’ grade yield and Russet Burbank produced the lowest ‘consumption’ grade yield.

Table 9. Phosphorus placement and rate effects on 'seed' and 'consumption' grade tuber yields for commercial potato cultivars.

Treatment	'Seed' grade yield (t/ha)	'Consumption' grade yield (t/ha)
Phosphorus placement:		
Broadcast	43.2	38.1
Side-band	44.4	39.0
Phosphorus rate at planting:		
40 kg P_2O_5/ha	42.5	37.8
80 kg P_2O_5/ha	43.8	38.7
120 kg P_2O_5/ha	44.9	39.2
Cultivar:		
Atlantic	46.0	45.3
Dark Red Norland	48.6	46.1
Ranger Russet	38.3	30.2
Russet Burbank	44.4	28.4
Russet Norkotah	44.4	40.2
Shepody	40.8	41.3
Analyses of Variance		
Source:		
Phosphorus application (A)	**(1.5)	ns
Phosphorus rate (R)	ns	ns
Cultivar (C)	***(2.3)	***(2.3)
A x R	ns	ns
A x C	ns	ns
R x C	ns	ns
A x R xC	ns	ns
CV (%)	9.4	10.4

, *, and ns indicate significance at P<0.01 and 0.001 levels of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of significance.

Nitrogen Response Studies for New Potato Clones under Full-Irrigation and Deficit: Irrigation at the Canada Alberta Crop Diversification Initiative Site: 2003

J. Wahab[1], D. Lynch[2] and G. Larson[1]

The potato industry is expanding rapidly in Western Canada. Economic and environmental sustainability are major challenges to potato producers. Suitable cultivars and cost-effective production practices are key to successful potato production. Superior cultivars and suitable agronomic practices, including fertilizer management, are important to optimize yield and quality, thereby maximizing economic returns to the producer.

Agriculture and Agri-Food Canada Lethbridge Research Centre (AAFC/LRC) is embarked upon a potato breeding project to develop superior processing (french fry and chipping) and fresh market potato cultivars adapted to the Western Canada.

This study was conducted at the Canada-Alberta Crop Diversification Initiative site in Lethbridge to examine the performance of selected french fry, chipping, and fresh market clones, developed at AAFC, Lethbridge Research Centre, under different nitrogen levels and moisture regimes. New clones were compared with industry standards from the respective market classes. The cultivars and clones tested are described in Table 10. Nitrogen rates included 80, 160, 240 kg N/ha all applied at planting. A blanket application of 50 kg K_2O/ha and 120 kg P_2O_5/ha were given for all treatments. The irrigation treatments included 'full- irrigation' and 'deficit-irrigation'. Irrigation was applied based on readings from Watermark sensors buried at a depth of 30 cm from the soil surface on the side of the hill. For full-irrigation, the crop was irrigated when the Watermark sensor readings were between 15 and 30 and for deficit-irrigation, when the readings were between 40-50. Field plots were laid out as factorial (cultivar/clone x nitrogen rate) design with four replications for the various market classes and irrigation treatments. The crop was planted on May 21, raised using standard agronomic practices and harvested on October 7th and 8th. The plots were desiccated with two applications of Reglone prior to harvest to promote tuber skin set and to facilitate machine harvesting. The harvested tubers were graded and quality parameters determined according to Canadian grade standards.

[1]CSIDC, Outlook, Sask.
[2] AAFC Research Centre, Lethbridge, Alta.

Table 10. Potato clones and cultivars evaluated at CACDI in 2003.		
French fry	Chipping	Fresh market
CV 87101: Late-season, multi-disease resistance[1] *V 0865-1:* Mid-late season[2] *Russet Burbank:* Late season *Ranger Russet:* Late season *Shepody:* Mid season	*V0056-1:* Early-season, long term chipper V0123-25: Early-mid season, cold chipper *Atlantic:* Mid-season *AC Ptarmigan:* Early-season	*CV 89023-2:* Mid season, red, creamer potential *Dark Red Norland:* Early season *AC Peregrine:* Late season *Russet Norkotah:* Mid season

[1]Clone registered to McCain Produce Inc.
[2]Clone registered to Saskatchewan Seed Potato Growers Association.

Results:
Spring soil analyses for the various test plots are summarized in Table 11. The soil texture at the test site was loam to clay loam. Salinity levels varied from non-saline to slightly-saline. Nutrient levels at 30 cm depth were: nitrogen between 29 and 44 kg NO_3-N/ha, phosphorus between 31 and 68 kg P/ha, and potassium between 614 and 757 kg K/ha.

Table 11. Spring soil test analyses at 0-30 cm soil depth for the various test plots.						
Item	French fry test		Chipping test		Fresh market test	
	Full Irrigation	Deficit Irrigation	Full Irrigation	Deficit Irrigation	Full Irrigation	Deficit Irrigation
Soil texture	Clay loam	Clay loam	Loam	Clay loam	Clay loam	Clay loam
pH	7.7	7.9	7.8	7.9	7.7	8
E.C. Calc. Sat. Extr. (Ms/cm)	1.3	0.3	0.7	0.3	1	0.3
E.C. 1S:2W (Ms/cm)	2.9	0.7	1.6	0.7	2.2	0.7
Salinity	Slight	None	None	None	Slight	None
NO_3-N (kg/ha)	38	33	44	32	40	29
P	68	35	41	38	58	31
K	712	724	739	757	614	637
SO_4-S	>96	61	>108	39	>96	40

The growing season rainfall and irrigation levels are presented in Figure 2. The crop received 117.3 mm rain during the growing season. The deficit-irrigation treatment received 172 mm of irrigation and the full-irrigation treatment received 254 mm of irrigation. The latter part of the growing season was relatively dry and required substantial irrigation to maintain soil moisture at intended levels (Figure 2). Full-irrigation produced considerably higher tuber yields than deficit-irrigation which is a reflection of the dry conditions that prevailed during the latter of the crop season.

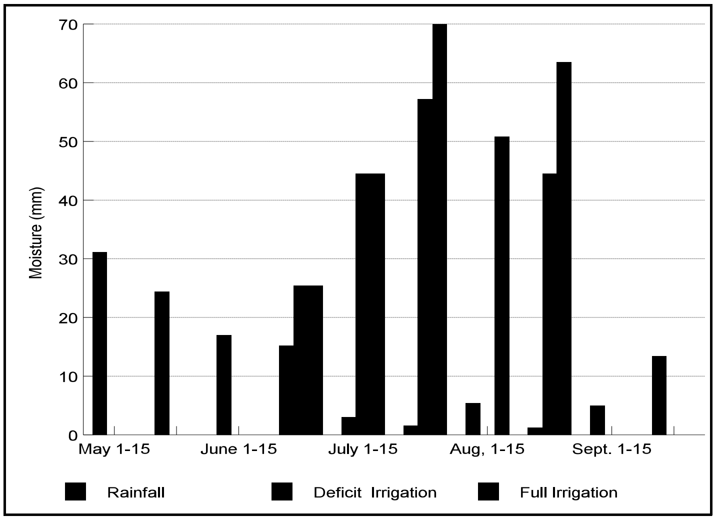

Figure 2. In-season rainfall and the amount of irrigation applied for full-irrigation and deficit-irrigation treatments.

French Fry Potato

On average full-irrigation produced 42% higher tuber marketable yield than deficit irrigation (Table 12). Tuber yields ranged from 41.3 t/ha and 52.3 t/ha under full-irrigation and from 33.6 t/ha and 38.7 t/ha under deficit irrigation (Table 12). Clone V 0865-1 and Ranger Russet produced the highest and the lowest yield respectively under both full and deficit irrigation.

V O865-1 outyielded Ranger Russet by 42% under full-irrigation and by 52% under deficit irrigation. V 0865-1 recorded the highest tuber specific gravity under both irrigation (Table 12). All other clones and cultivars produced tubers with acceptable specific gravity but the gravity rankings were different under the two growing conditions.

Table 12. Nitrogen rate effects on marketable yield and tuber specific gravity for advanced french fry potato clones and standard cultivars grown under 'full-irrigation' and 'deficit-irrigation'.

Treatment	Full irrigation		Deficit irrigation	
	Marketable Yield (t/ha)	Specific gravity	Marketable Yield (t/ha)	Specific gravity
Cultivar/clones:				
CV 87101	34.7	1.0912	24.1	1.0961
V 0865-1	43.2	1.0928	34.6	1.1021
Russet Burbank	32.3	1.0814	24.7	1.0847
Ranger Russet	30.4	1.0848	22.8	1.0911
Shepody	43.1	1.0806	31.9	1.0899
Nitrogen rate:				
80 kg N/ha	37.3	1.0886	27.7	1.0941
160 kg N/ha	37.9	1.0867	29.8	1.0922
240 kg N/ha	35.0	1.0832	25.4	1.092
Analyses of variance				
Source:				
Cultivar (C)	***(1.3)	***(0.0010)	***(1.52)	***(0.0011)
Nitrogen (N)	ns	***(0.0006)	ns	ns
C x N	ns	ns	ns	ns
CV (%)	15.5	0.38	23.1	0.44

*** and ns indicate significance at P<0.001 level of probability and not significant, respectively.
Values within parentheses are LSD estimates at 0.05 level of significance.

The new clones and commercial cultivars did not respond to higher levels of nitrogen application under full-irrigation or under deficit-irrigation (Table 12). This indicates that 80 kg of applied N/ha was sufficient to optimize tuber yields of the french fry clones and cultivars tested. Application of higher rates of nitrogen reduced tuber specific gravity when grown under full irrigation or deficit irrigation. However, the response was not significant under deficit irrigation (Table 12).

The colour of french fries produced by the various cultivars and nitrogen treatment under full-irrigation and deficit-irrigation are presented in Table 13. Generally the two new clones, CV 87101 and CV 0865-1 produced the lightest fries across all nitrogen levels under the two irrigation treatments. Russet Burbank and Shepody produced relatively darker fries than the two new clones and Ranger Russet.

Table 13. Nitrogen rate effects on french fry and chip colour of new potato clones and standard french fry and chipping cultivars grown under full-irrigation and deficit-irrigation.

Cultivar/clone	Full Irrigation			Deficit irrigation		
	80 kg N/ha	160 kg N/ha	240 kg N/ha	80 kg N/ha	160 kg N/ha	240 kg N/ha
French Fry Potato						
CV 87101	1.5	1	1	1	1	1
V 0865-1	1.5	1	2	1.5	1	1
Russet Burbank	2.5	2.5	2	1.5	2.5	2
Ranger Russet	0.5	0.5	2	1	1	1
Shepody	2.5	2.5	2	0.5	1.5	3
Chipping Potato						
V0056-1	0.5	2	2	1	1	2
V0123-25	0.5	0	2	0.5	0	0.5
Atlantic	3	2.5	2	2	2.5	2
AC Ptarmigan	3.5	3	2.5	2	3	2

French fry and chip colour scales based on USDA standards.

Chipping Potato

On average chipping potatoes grown under full-irrigation produced 43% higher marketable yield than the crop grown under deficit irrigation (Table 14). Tuber yields ranged between 42.7 and 48.3 t/ha under full-irrigation and 29.1 and 33.6 t/ha under deficit irrigation. The yields were not significantly different for the cultivars/clones tested under the two irrigation regimes. The various cultivars and clones produced acceptable tuber specific gravity under full and deficit irrigation (Table 14). Atlantic recorded the highest, the two clones intermediate, and AC Ptarmigan the lowest tuber specific gravity under the two growing conditions.

Higher levels of applied nitrogen did not show any added yield benefits under both irrigation conditions (Table 14). This indicates that 80 kg of applied N/ha was sufficient to optimize tuber yields of the various chipping clones or cultivars tested. Application of higher rates of nitrogen significantly reduced tuber specific gravity when grown under full irrigation. However, nitrogen rates had no effect on tuber specific gravity under deficit irrigation (Table 14).

The new clones, V 0056-1 and V 0123-25, produced relatively lighter chips than the standard cultivars Atlantic and AC Ptarmigan under the various nitrogen treatments and irrigation regimes (Table 13).

Table 14. Nitrogen rate effects on marketable yield and tuber specific gravity for advanced chipping potato clones and standard cultivars grown under 'full-irrigation' and 'deficit-irrigation'

Treatment	Full irrigation		Deficit irrigation	
	Marketable Yield (t/ha)	Specific gravity	Marketable Yield (t/ha)	Specific gravity
Cultivar/clones:				
V0056-1	45.2	1.1028	33.6	1.098
V0123-25	48.1	1.0963	29.1	1.0928
Atlantic	42.7	1.1111	33.0	1.1051
AC Ptarmigan	48.3	1.0823	33.1	1.0828
Nitrogen rate:				
80 kg N/ha	47.2	1.0999	33.7	1.0949
160 kg N/ha	44.6	1.0972	31.5	1.0948
240 kg N/ha	46.4	1.0974	31.4	1.0943
Analyses of variance				
Source:				
Cultivar	ns	***(0.0006)	ns	***(0.0008)
Nitrogen	ns	**(0.0004)	ns	ns
C x N	ns	ns	ns	ns
CV (%)	12.3	0.24	20.4	0.30

, * and ns indicate significance at P<0.01 and 0.001 levels of probability and not significant respectively.
Values within parentheses are LSD estimates at 0.05 level of significance.

Fresh Market Potato

On average, the fresh market crop grown under full-irrigation produced 36% higher marketable tuber yield than the crop grown under deficit irrigation (Table 15). Under full-irrigation, CV 89023-2 and Dark Red Norland produced the highest and lowest yields respectively.

CV 89023-2 outyielded Dark Red Norland by 27%. No significant yield responses were observed among the various clones and cultivars under deficit irrigation. Specific gravity of table potato indicate the relative dryness or moistness of the potato tuber. For example, tubers with lower specific gravity are more moist than tubers with higher specific gravity. Accordingly, Dark Red Norland potato is the most moist regardless of its growing condition (Table 15).

Higher levels of applied nitrogen did not show any added yield benefits under both irrigation conditions (Table 15). This indicates that 80 kg of applied N/ha was sufficient to optimize tuber yields of the various fresh market clones or cultivars tested. Application of higher rates of nitrogen significantly reduced tuber specific gravity when grown under full irrigation. However, nitrogen rates had no effect on tuber specific gravity under deficit irrigation (Table 15).

Further work is necessary to validate cultivar/clone performance, nitrogen responses, and irrigation scheduling for southern Alberta soil and climatic conditions.

Table 15. Nitrogen rate effects on marketable yield and tuber specific gravity for advanced fresh market potato clones and standard cultivars grown under 'full-irrigation' and 'deficit-irrigation'.

Treatment	Full irrigation		Deficit irrigation	
	Marketable yield (t/ha)	Specific gravity	Marketable yield (t/ha)	Specific gravity
Cultivar/clones:				
CV 89023-2	52.3	1.0857	34.4	1.0869
Dark Red Norland	41.3	1.0797	33.6	1.0784
AC Peregrine	49.7	1.088	38.7	1.0886
Russet Norkotah	45.6	1.0878	32.8	1.0864
Nitrogen rate:				
80 kg N/ha	49.8	1.0884	36.1	1.0857
160 kg N/ha	46.4	1.0841	33.9	1.0857
240 kg N/ha	45.7	1.0834	34.6	1.0839
Analyses of variance				
Source:				
Cultivar (C)	***(1.4)	***(0.0011)	ns	***(0.0009)
Nitrogen (N)	ns	**(0.0007)	ns	ns
C x N	ns	ns	ns	ns
CV (%)	10.9	0.43	15.9	0.37

, * and ns indicate significance at P<0.01 and 0.001 levels of probability and not significant, respectively. Values within parentheses are LSD estimates at 0.05 level of significance.

Demonstration of Improved Vegetable Production and Storage Techniques for Saskatchewan

Season Extension Demonstration

B. Vestre[1], T. Hogg[1], J. Wahab[1], D. David[1] and L. Tollefson[1]

Progress: *Ongoing*

Objective: *To demonstrate the effect on: i) plant population on pepper yield, and ii) plant population and planting material (direct seeding and transplanting) on cantaloupe yield.*

Background:

Warm season high value crops such as cantaloupe and peppers are difficult to produce under Saskatchewan climatic conditions without utilizing some form of season extension techniques. High tunnels significantly alter the growing conditions of crops. Growing Degree Days are higher in the high tunnel compared to growing crops outside the tunnels (Figure 2). In order to maximize production with these modified growing conditions, agronomic practices such as plant populations, fertility management, planting date(s), direct seeding/transplanting need to be addressed.

Summary:

Season extension techniques for the production of warm season vegetable crops are becoming more prominent in Saskatchewan. In 2003, the Canada-Saskatchewan Irrigation Diversification Centre conducted demonstrations to maximize production and economic return for cantaloupe and pepper utilizing a method of season extension commonly referred to as a “high tunnel”. High tunnels are essentially plastic covered greenhouses constructed in the field with no artificial heating or ventilation (Figure 1). Ventilation is achieved by rolling up the sides of the high tunnel. A small cucumber demonstration was also conducted in 2003 in the high tunnel.

Agronomic demonstrations included a green pepper plant population study and cantaloupe plant population and planting material (transplant vs. direct seeding) studies. The green pepper study consisted of 6", 12", and 24" in-row spacing with 24" between row spacing. The cantaloupe study consisted of 12" and 24" in-row spacing with a 24" between row spacing comparing direct seed and transplants. Irrigation of the crops was applied with trickle tape. Due to the warm conditions in 2003, the cantaloupe and pepper yields were excellent.

As in 2002, pepper yields increased with closer in-row spacings. Yields were 7.18 kg/m row, 5.24 kg/m row, and 3.88 kg/m row for the 6", 12", and 24" in-row spacings respectively. These yields included all market classes of peppers with the majority in the red market class. This is significant as the market price for red market class peppers is two to three times higher than other classes. The high percentage of red peppers is directly related to the very warm summer. The same demonstration will be conducted in 2004.

The cantaloupe also benefited from the warm spring and summer. The early transplants and direct seeding produced yields of 5 kg/m² and 6 kg/m² respectively. Yields declined dramatically with later seeding dates with a yield of 1 kg/m² for the June 6th seeding date. There was no significant difference in 2003 between the 12" and 24" spacings. This demonstration will be conducted again in 2004.

[1]CSIDC, Outlook, Sask.

Cabbage/Celery Storage Demonstration

B. Vestre[1], T. Hogg[1], J. Wahab[1], D. David[1] and L. Tollefson[1]

> ***Progress:*** *Ongoing*
>
> ***Objective:*** *To demonstrate long-term storage techniques for cabbage and other selected vegetables for extending marketing period.*

Background:

Saskatchewan imports over 90% of its cabbage requirement. Saskatchewan can produce high yields of quality fresh market and storage cabbage. One key factor limiting expansion is the lack of proper storage. Many of the current producers' storage are basic cold cellar-type facilities that cannot keep the cabbages in a marketable condition past early December. The demand for fresh market and processing cabbage continues throughout the winter with prices after double of those in the fall. To capture a portion of this market, producers need to be able to store their cabbage longer into the winter considering the additional costs associated with this storage.

Summary:

In 2003, the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) conducted a cabbage storage demonstration and an observational celery storage demonstration. This was the second of a three year demonstration. Three cultivars of cabbage (Cecile, Bravo, Lennox) grown in CSIDC fields were stored in three separate storages. The three storages included a filacel cooler, a more common evaporative cooler with a humidifier, and an insulated storage with no artificial cooling or humidification. All storages are located in the new Vegetable Storage and Handling Facility at CSIDC.

The varieties of cabbage used in this study were recommended by producers and industry. The cabbage was grown to maturity, harvested, yields recorded, and sub-samples of each variety placed in the coolers. Cabbage samples were removed from the storages after 60, 120, and 180 days. Due to the excellent growing conditions in 2003, the cabbage yields were very good and matured earlier than normal, especially for the 'Cecile' and 'Bravo' varieties. These varieties were harvested in early to mid-August. Early harvested, 'Cecila' and 'Bravo', did not store well in any of the coolers. 'Lennox' a later maturing storage variety, stored much better than the 'Cecile' or 'Bravo'. Initial results indicate the cabbage in the filacel and evaporative coolers stored much longer and retained higher marketable weights than the cabbage stored with no artificial cooling or humidification. 'Lennox' held up better than 'Cecile' or 'Bravo' in all cooler types. This demonstration will continue in 2004 to obtain additional data and determine the economic feasibility of the various storage options.

The celery storage demonstration was observational only. A small area of celery was produced with the majority sold at harvest. A portion of the crop was placed in the filacel cooler and monitored to determine storability. The celery remained in a marketable condition for approximately three to four weeks after harvest, greatly extending the marketing period.

[1]CSIDC, Outlook, Sask.

Pumpkin Irrigation Scheduling Demonstration

B. Vestre[1], T. Hogg[1], J. Wahab[1], D. David[1] and L. Tollefson[1]

Progress: *Ongoing*

Objective: *To demonstrate irrigation scheduling and determine total water use and water use efficiency of pumpkin grown using trickle irrigation and IRT plastic mulch under Saskatchewan growing conditions.*

Background:

Moisture requirements for vegetables is high and therefore areas with limited water supply are restricted in their cropping decisions. Plasticulture techniques can lower the total water requirements of a crop. Data is required to determine water consumption and water efficiencies under Saskatchewan conditions for plasticulture techniques. This will help producers with limited water supplies and producers with adequate supplies make sound irrigation and production management decisions.

Summary:

A pumpkin irrigation scheduling demonstration trial was conducted at the Canada-Saskatchewan Irrigation Diversification Centre in 2003. This is year two of a three-year project, to determine the total water use and water use efficiency of pumpkin grown using trickle irrigation and plastic mulch under Saskatchewan growing conditions. Pumpkin was grown using T-Tape trickle tape and IRT plastic mulch in rows 135 m long with a 3 m row spacing. The Lower Quarter Distribution Uniformity, a measurement of water application uniformity, indicated that the uniformity of the trickle tape used at this site was considered excellent.

Irrigation treatments consisted of irrigation initiation at a soil available water (A.W.) content of 85% A.W. (Water Treatment 1) and 70% A.W. (Water Treatment 2) and a dryland comparison. Irrigations were scheduled based on soil available water in the top 30 cm of the profile utilizing tensiometers. Soil moisture monitoring was conducted using a neutron moisture meter at varying intervals throughout the growing season.

Soil water content from plant emergence to harvest decreased for all treatments with the largest decrease occurring in the 30-60 cm soil interval. Cumulative water use throughout the growing season increased as the quantity of irrigation water applied increased and was of the order Water Treatment 1 (406 mm) > Water Treatment 2 (310 mm) > Dryland Treatment (143 mm).

Pumpkin yield increased with increasing water application. Yields were 22.06 kg/m double row, 19.83 kg/m double row and 13.74 kg/m double row (73.5 Mg/ha, 66.1 Mg/ha and 45.8 Mg/ha based on a row spacing of 3 m) for Water Treatment 1, Water Treatment 2 and the Dryland Treatment respectively. Yield differences were due to pumpkin size but not the number of pumpkins produced. Water use efficiency (kg pumpkin produced/mm water use) decreased as the quantity of water applied was increased.

The efficiency with which water is used to produce dry matter must be balanced with the availability of water for irrigation when deciding on the best use of the water supply.

[1]CSIDC, Outlook, Sask.

New Crops Program

Develop Cost-Effective Agronomic Practices for Large Scale Production of Economically Important Herbs in Saskatchewan

J. Wahab[1] and G. Larson[1]

Background:

Increasing health care costs, and individuals taking more responsibility for their own health, has lead consumers to seek alternate approaches to treat and prevent diseases. Consequently, natural products (nutraceuticals, functional foods, and dermaceuticals) represent one of the expanding industries in the developed countries.

To meet the demand of this growing industry, the medicinal and aromatic plant production and processing sectors are growing Saskatchewan. For commercial production, effective agronomic practices are essential to consistently produce superior yields of high quality herbs. Agronomic research for commercially important herbs were carried out at the Canada-Saskatchewan Irrigation Diversification Centre in Outlook.

Progress: *Ongoing*

Focus of CSIDC's herb research include:

- *Development of management practices for mechanized commercial production.*
- *Development of labour saving agronomic practices.*
- *Comparison of dryland and irrigated production in relation to yield and quality.*
- *Assessment of the feasibility of direct seeding and transplanting under dryland and irrigated conditions.*
- *Determination of stage and method of harvesting practices (primary processing) to increase recovery and to maintain quality.*

The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) with funding from the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF), and SAFRR Agriculture Development Fund conducted research to develop cost-effective agronomic practices for commercial scale production of promising medicinal herbs such as *Echinacea angustifolia*, milk thistle, stinging nettle, feverfew, and St. John's Wort.

The 2003 studies were designed to refine production practices for commercially important herbs such as *Echinacea angustifolia*, milk thistle feverfew, and St. John's Wort.

[1]CSIDC, Outlook, Sask

Feverfew

Effects of plant population and cutting stage on productivity and quality of transplanted feverfew.

Different herb buyers prefer feverfew harvested at different growth stages such as (i) prior to flowering, (ii) during early flowering, or (iii) at full bloom. This study examined the interactive effects of plant spacing and harvest stage on herbage yield and quality characteristics for transplanted feverfew grown under dryland and irrigated conditions. Treatments included two within-row spacings (15, 30 cm), three harvest timings (pre-flower, 10%-flower, 100%-flower) and two growing conditions (dryland, irrigation).

Results:
The pre-flower harvest was taken six weeks after planting and the two subsequent harvests were taken one week apart. The crop received 49 mm of rain during the growing season (transplanting to 100% flower). The soil moisture status for the irrigated crop was maintained approximately above 50% Field Capacity through supplemental irrigation using overhead sprinklers.

The crop growing season was relatively warm and dry (Figure 1).

Irrigated feverfew on average produced 48% higher fresh herb yield or 32% higher dry herb yield than the dryland crop (Table 1).

Under dryland production, plant spacing and harvest timing had no effect on fresh herb or dry herb yield (Table 1).

However, under irrigation closer (15 cm) spacing produced significantly higher fresh and dry herb yields compared to wider (30 cm) spacing. Delaying harvest from pre-flowering to 100% flowering produced higher herb yields and the differences were significant only for dry herb yield (Table 1).

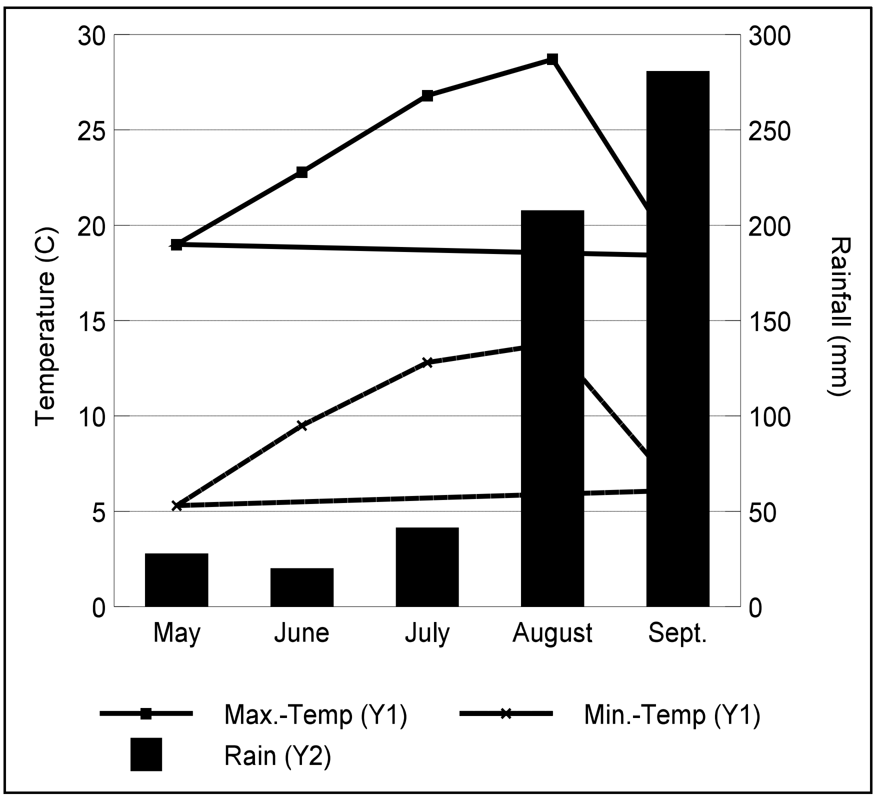

Figure 1. Growing season temperature and rainfall at CSIDC test site.

Table 1. Plant spacing effects on fresh and dry herbage yields for 'Wild' feverfew grown under dryland and irrigation.				
Treatment	Dryland crop		Irrigated crop	
	Fresh herb yield (t/ha)	Dry herb yield (t/ha)	Fresh herb yield (t/ha)	Dry herb yield (t/ha)
Plant spacing:				
15 cm	3.35	0.85	5.72	1.27
30 cm	3.4	0.85	4.28	0.97
Harvest stage:				
Pre-flower	3.53	0.82	4.57	0.87
10%-flower	3.45	0.8	5.07	1.11
100%-flower	3.14	0.94	5.35	1.37
Analyses of variance				
Source:				
Spacing	ns	ns	***	***
Harvest stage	ns	ns	ns	***(0.20)
Spacing x Harvest stage	ns	ns	ns	ns
CV (%)	21.7	24.5	14.6	16.6

***, and ns indicate significance at P<0.001 level of probability and not significant respectively.
Value within parenthesis indicate significance at 5.0% level of probability.

St. John's Wort

St. John's Wort is a perennial. Flowering tops are harvested for commercial use as the flowers and leaves are found to contain higher levels of hypericin. Plant growth characteristics and harvest height can affect yield and quality. Plant growth and flowering habit can be a function of various factors including genotype, population density, and growing conditions. This study examined the effects of mulching, harvest timing and harvest height on yield and quality attributes of the biotype Topas grown under irrigation. Treatments included two cutting heights (Top-1/3, Top-2/3) and two cutting frequencies (one cut, two cuts), with and without straw mulch.

Results:
The effects of cutting height (Top-1/3 or Top-2/3), cutting frequency (one or two cuts per year), and mulching (straw mulch or no mulch) on the incidence of winter-kill, and herb yields under dryland and irrigated production is summarized in Table 2 and Table 3, respectively.

Table 2. Effects of cutting height, cutting frequency and mulching on winter-kill incidence and herbage yield for Topas St. John's Wort grown under dryland.

Treatment	Winter-kill (%)	Fresh herb yield (t/ha)			Dry herb yield (t/ha)		
		Cut-1	Cut-2	Total	Cut-1	Cut-2	Total
Cutting height:							
Top-1/3	51.8	0.69	1.3	1.99	0.24	0.66	0.9
Top-2/3	54.4	1.71	1.18	2.89	0.6	0.54	1.14
Cutting frequency:							
1-cut/year	48.2	1.08	-	1.08	0.38	-	0.38
2-cuts/year	58.1	1.32	2.48	3.8	0.46	1.2	1.66
Mulching:							
No mulch	64.1	0.56	0.94	1.5	0.2	0.46	0.66
Straw mulch	42.2	1.84	1.54	3.38	0.64	0.74	1.382
Analyses of variance							
Source:							
Cutting height (H)	ns	**	ns	ns	**	ns	ns
Cutting frequency (F)	ns	ns	***	***	ns	***	***
Mulching (M)	***	***	ns	**	***	ns	**
H x F	ns	ns	ns	ns	ns	ns	ns
H x M	ns	**	ns	ns	**	ns	ns
F x M	ns	ns	ns	ns	ns	ns	ns
H x F x M	ns	ns	ns	ns	ns	ns	ns
CV (%)	31.5	74.0	88.1	69.3	71.8	88.3	71.3

, *, and ns indicate significance at P<0.01, 0.001 levels of probability and not significant respectively.

The winter-kill incidence was lower under irrigation than under dryland. Under dryland the winter-kill ranged between 42% and 64% (Table 2), whereas, under irrigation the winter-kill incidence ranged between 33% and 40% (Table 3). Mulching significantly reduced winter-kill under dryland production, while mulching had no effect on winter-kill under irrigated production. Cutting height and cutting frequency did not affect winter-kill under both dryland or irrigated production.

Straw mulching resulted in higher total herb yields relative to no mulching under both dryland (Table 2) and irrigation (Table 3). This yield increase was due to greater production during the first cut for the mulched treatment. The second cut produced similar herb yields for mulch and no-mulch treatments.

Under dryland, lower cutting height (i.e. Top-2/3) produced higher herb yields relative to higher cutting height (i.e. Top-1/3) during the first cut under dryland (Table 2). By contrast, herb yields were similar for both cutting heights during the second cut. Under irrigation, cutting height had no effect on herb yield.

For both dryland and irrigated production, the two-cut crop produced higher herb yields than the crop harvested only once.

Table 3. Effects of cutting height, cutting frequency and mulching on winter-kill incidence and herbage yield for Topas St. John's Wort grown under irrigation.							
Treatment	Winter-kill (%)	Fresh herb yield (t/ha)			Dry herb yield (t/ha)		
		Cut-1	Cut-2	Total	Cut-1	Cut-2	Total
Cutting height:							
Top-1/3	37	2.97	2.3	5.27	1.02	0.84	1.86
Top-2/3	35.9	3.77	3.52	7.29	1.28	1.11	2.39
Cutting frequency:							
1-cut/year	36.7	3.36	-	3.36	1.17	-	1.17
2-cuts/year	36.2	3.38	5.82	9.2	1.13	1.95	3.08
Mulching:							
No mulch	39.8	2.09	2.78	4.87	0.69	0.96	1.65
Straw mulch	33.1	4.65	3.04	7.69	1.61	1	2.61
Analyses of variance							
Source:							
Cutting height (H)	ns	ns	ns	ns	ns	ns	ns
Cutting frequency (F)	ns	ns	***	***	ns	***	***
Mulching (M)	ns	***	ns	**	***	ns	*
H x F	ns	ns	ns	ns	ns	ns	ns
H x M	ns	ns	ns	ns	ns	ns	ns
F x M	ns	ns	ns	ns	ns	ns	ns
H x F x M	ns	ns	ns	ns	ns	ns	ns
CV (%)	33.0	66.3	28.0	60.4	67.6	82.1	58.6

*, **, ***, and ns indicate significance at $P<0.05$, 0.01, 0.001 levels of probability and not significant respectively.

Effect of plant spacing and harvest height on winter-kill and productivity of St. John Wort, biotypes; Anthos, Elixir, Standard, New Stem and Topas, grown under irrigation and dryland.

This study examined five biotypes (Standard, New Stem, Elixir, Topaz, Helos) and two within-row spacings (15, 30 cm). The crop was grown under irrigation. A spacing of 60 cm was maintained between rows.

Results:
St. John's wort cultivar Elixir suffered the lowest incidence of winter-kill compared to the other cultivars (Table 4). The crop that was planted at 30 cm within-row spacing suffered greater winter-kill than the crop planted at 15 cm plant spacing.

Elixir produced the highest and Tapas the second highest yield compared to the other cultivars (Table 4). The higher yield responses for Elixir and Topas appears to be a function of less winter-kill in these cultivars.

Closer plant spacing of 15 cm within-row produced significantly higher herb yields than wider plant spacing of 30 cm (Table 4).

Table 4. Plant spacing effects on winter-kill incidence and herbage yield for St. John's Wort grown under irrigation

Treatment	Winter-kill (%)	Fresh herb yield (t/ha)	Dry herb yield (t/ha)
Cultivar:			
Elixir	30.1	6.06	2.16
Helos	54.4	2.22	0.75
New Stem	53.7	2.69	0.91
Standard	49.2	2.66	0.87
Topas	47.1	3.78	1.25
Plant spacing			
15 cm	40	4.59	1.54
30 cm	54.2	2.38	0.83
Analyses of variance			
Source:			
Cultivar	**(14.0)	***(1.47)	***(0.55)
Spacing	***(8.9)	***(0.93	***(0.35)
Cultivar x Spacing	ns	ns	ns
CV (%)	29.1	41.2	45.0

, *, and ns indicate significance at P<0.01, 0.001 levels of probability and not significant respectively. Values within parentheses indicate significance at 5.0% level of probability.

Milk Thistle

Relatively short growing season and the uneven maturity poses major challenges for milk thistle production and once-over machine harvesting in Saskatchewan. The crop has to be desiccated to facilitate mechanical harvest. Reglone can be used successfully to desiccate milk thistle. However, the demand for organic milk thistle necessitates organic desiccants for top-kill milk thistle. The present study is designed to develop cost-effective agronomic practices for large scale mechanized production of milk thistle under Saskatchewan growing conditions.

The following studies were conducted to address these objectives.

Nitrogen and phosphorus effects on yield and quality for milk thistle grown on dryland when desiccated with Reglone at two different stages.

Three nitrogen rates (0, 50, 100 kg N/ha) three phosphorus rates (0, 60, 120 kg P_2O_5/ha) were examined in this study. Fertilizer mixture was applied (seed placed) at seeding. The crop was desiccated with Reglone (2.7l/ha @ 1000 l water/ha) to facilitate machine harvesting. Yield responses were observed at two desiccation periods, i.e.

'Early': When approximately 50-60 % of the flower heads are mature.
'Late': Approximately one week after first desiccation.

Seeding rate and row spacing effects on yield for milk thistle desiccated with vinegar.

Treatments included six seeding rates (25, 50, 75,100, 125, 150 seeds / m^2) and two row spacings (20, 60 cm). The crop was desiccated using vinegar (14% acetic acid) at 1000 l/ha.

Results:
The growing season was relatively warm; and dry during the early stages and wet during the later stages of growth (Figure 1).

Reglone was an effective top-kill agent as sufficient dry-down occurred with only one application of Reglone. With Reglone application, it was possible to combine the crop three-four days after spraying. By contrast, vinegar was not an effective means of top-kill. Even after two applications, the dry-down was insufficient for proper machine harvesting.

Seed yields for the various nitrogen and phosphorus treatments at the two harvest dates are summarized in Table 5. Seed yields for 0 and 50 kg N/ha was approximately 800 kg/ha for 'early' desiccation and 1100 kg/ha for 'late' desiccation. Application of 100 kg seed-placed N/ha caused significant decrease in plant stand that resulted in substantially lower seed yields compared to the lower nitrogen rates. Phosphorus application rates had no effect on seed yield at both desiccation periods.

On average, 'early' desiccation produced 625 kg/ha milk thistle seed. Delaying desiccation by six days resulted in a 65% higher yield relative to 'early' desiccation.

Seed yields for the various seeding rate and row spacing effects for milk thistle when harvested after desiccation with vinegar (14% acetic acid) is summarized in Table 6. Seed yields ranged between 500 and 800 kg/ha. Seeding rate or row spacing had no effect on seed yield.

Table 5. Nitrogen and phosphorus rate effects on milk thistle seed yield when desiccated with Reglone at two different times.		
Treatment	Seed yield (kg/ha)	
	'Early' desiccation	'Late' desiccation
Nitrogen (kg N/ha)		
0	808	1121
50	782	1291
100	287	683
Phosphorus (kg P_2O_5/ha)		
0	655	996
60	573	998
120	649	1102
Analyses of Variance		
Source:		
Nitrogen (N)	***(166)	***(230)
Phosphorus (P)	ns	ns
N x P	ns	ns
CV (%)	32.1	26.9

*** and ns indicate significance at P<0.001 level of probability and not significant respectively. Values within parentheses are LSD estimates at 5.0% level of probability.

Table 6. Seeding rate and row spacing effects on seed yield for milk thistle desiccated with vinegar			
Seeding rate	Seed yield (kg/ha)		**Mean**
	20 cm row spacing	60 cm row spacing	
25 seeds/m^2	661	570	**615**
50 seeds/m^2	636	763	**699**
75 seeds/m^2	797	697	**747**
100 seeds/m^2	691	673	**682**
125 seeds/m^2	671	534	**602**
150 seeds/m^2	685	736	**710**
Mean	**690**	**992**	
Analysis of variance			
Source:			
Seeding rate (R)	ns		
Row spacing (S)	ns		
R x S	ns		
CV (%)	22.3		

ns indicates non-significant treatment effects.

Field Demonstration Program

Field Demonstrations:

Field Demonstrations

*The **Irrigation Crop Diversification Corporation** (ICDC) is the provincial organization responsible for irrigation research, demonstration, and extension. It was formed under The Irrigation Act 1996.*

ICDC is a private company directed by a board of Saskatchewan irrigators. ICDC is supported by a check-off of irrigated acres and also receives support from Saskatchewan Agriculture, Food and Rural Revitalization in personnel and administration. It conducts research, demonstration, and extension on behalf of irrigators, as outlined by the Irrigation Act 1996.

ICDC conducts field demonstrations across the province in order to field-test ideas that come from irrigators, industry, research at CSIDC, and other sources. ICDC also conducts and co-operates with other agencies in conducting research projects. Many of ICDC's projects are conducted on private land in co-operation with irrigation producers. These co-operators are reimbursed for their expenses in hosting demonstration plots or projects and also pay a $50 commitment fee to ICDC. The purpose of all research and demonstration projects is to increase the value and profitability of irrigated acres.

ICDC runs a *"value for money R&D"* program using levy money raised from irrigators. The projects were selected from a long list supplied by all Irrigation Districts in 1999 and published by ICDC. Each year Irrigation District delegates are asked to approve the R&D program and the use of their funds. In 2003 the following projects were conducted by the ICDC staff seconded from SAFRR in partnership with cooperating irrigators, commodity groups, agri-business and other governments.

ICDC Irrigated Forage Centres

Friesen's Marksview Farms at Warman & Peter J. Fehr's at Osler, Dairy Quality Forage Centre

Fourteen alfalfas and 14 grass varieties were seeded in four replications in 2003 at Fehr's. SeCan Cereal selection and silage quality trials were also on display. The July 21st ICDC Field Day attracted irrigators and dairy producers.

SPARC, Forage and Cereal Crop Scientists, Swift Current

SPARC operated 300 acres of unrestricted irrigation in 2003. ICDC coordinated the SeCan Cereal selection and silage quality trials at SPARC. SPARC Research Scientist, Dr. Grant McLeod, ran 64 plots of winter and spring irrigated annual forages. Jeff Wiebe has a demonstration of six new alfalfa varieties to compare with his previous ICDC on-farm demonstration's winning variety: Absolute.

On July 29, the SPARC Irrigated Forage and Grazing Tour was hosted in cooperation with SAFRR, SeCan, CWB and the Southwest Forage Association.

ICDC maintains a solid working relationship with SPARC, and will work to increase these productive linkages with SPARC. An annual review is held with ICDC and SPARC staff participating.

CSIDC Forage Centre at Outlook

The Sask Forage Council in partnership with ICDC completed harvest on 14 varieties of alfalfa and 14 varieties of grass all under irrigation. The alfalfa plots topped 8 tons/acre. Hay, grazing and export-opportunity varieties are being demonstrated and may be compared directly to ICDC's Warman Dairy Quality Forage Centre. These ICDC plots are adjacent to AAFC Saskatoon's forage plots at CSIDC and make for a comprehensive irrigated forage demonstration at CSIDC.

Haywatch Saskatchewan

ICDC Agrologist, Korvin Olfert, successfully completed an M. Sc. on the subject of Infield Prediction of Alfalfa Quality. As a result an ICDC stock stick has been produced and calibrated to measure Total Digestible Nutrients and Relative Feed Value based upon the stick-measured height of alfalfa in the field. Here's a simple, accurate quality control method for irrigated hay producers.

Timothy Production for Export Markets

ICDC Agrologists have assisted The Canadian Hay Association (CHA) in compiling its Timothy Production Handbook. Saskatchewan Timothy Field Days were hosted in Outlook in cooperation with CHA and ICDC. Growers from across the prairies viewed both irrigated production and processing.

A Matching Investments Initiative project was approved between ICDC and Dr. Bruce Coulman, AAFC Saskatoon.

ICDC's Timothy work currently underway includes: timing of N application, timing of first cut, P requirements and seeding rate and date (at CSIDC). Emphasis in all these trials is not only on yield but also on market quality.

Pocket Gopher Control

A pocket gopher control report was widely distributed. Approximately 3,000 acres of pocket gopher baiting were done in 2003 by two private practitioners charging $3.50/acre/season and by ICDC staff. ICDC hosted another pocket gopher control demonstration field day on October 6. ICDC had a third party evaluate this program by surveying participants: 600 reports "Pocket Gopher Management Program Evaluation" were widely distributed in February, 2004 to clients and participants in extension events.

Optimum Ryegrass for Grazing and Forage

ICDC is working with irrigators to hone the production package for this relatively new, productive, flexible forage crop. ICDC is helping irrigators to manage their mixed annual and Italian ryegrass fields for optimum yield and quality. Establishment success has been variable and so ICDC got Grant McLeod, Research Scientist at SPARC, to add ryegrass to his research on forage establishment using cereal cover crops.

Irrigated Grain Corn/Silage

ICDC's irrigated corn database is already in its fourth year and is providing key evidence for top yield and quality management techniques.

ICDC was pleased to have the Alberta Corn Committee (ACC) variety tests at The Irrigation Centre, Outlook. The Outlook site (2300 CHU) was added to Bow Island (2400 CHU), Vauxhall (2300 CHU), Brooks (2250 CHU) and Lethbridge (2100 CHU). Six of the nine major Canadian corn companies paid to enter their varieties.

The ICDC Saskatchewan Corn Selection and Silage Field Day, September 11 attracted a prairie-wide audience of 130 people. On October 14, Baildon irrigator Rick Swenson hosted a corn grain harvesting field demonstration at which he pulled off an impressive 127 bu/acre of dry grain.

ICDC's corn management program will be featured at the 2004 Crop Production Show and has been covered by Top Crop Manager, FarmGate, The Western Producer and other media.

Bean Agronomy

Irrigated dry bean yields over 3000 lb/ac were reported in 2003. Disease pressure was lower due to the hot, dry conditions in July and August. ICDC's blight control demonstrations using copper bactericide did not, therefore, show a yield or quality advantage. ICDC is the Saskatchewan participant in a national bean blight control trial.

ICDC held a Bean Production, Selection and Pedigreed Seed field day on August 7 in cooperation with the Crop Development Centre, CSIDC, AAFC Lethbridge and SAFRR. Dr. Henning Mundel, bean breeder at AAFC Lethbridge, was very impressed with a field of his AC Redbond which ultimately yielded over 3600 lb/ac.

Fusarium Prevention, Management and Awareness

ICDC participated in the SAFRR Fusarium Head Blight (FHB) survey to determine the prevalence and severity of FHB in irrigated crops. This survey also monitors the disease movement in Irrigation Districts and determines the disease species. ICDC also participated in the Cereal Leaf Disease survey. Irrigated conditions lend themselves to higher crop disease pressure. Disease levels were lower in 2003 due to a hot, dry summer. Results and recommendations will be disseminated by ICDC to irrigators.

Potato Varieties

ICDC provides in-kind support for potato variety testing at CSIDC done by a "Consortium". ICDC also paid the Saskatchewan Seed Potato Growers (SSPGA) annual membership for Consortium B, the industry group developing new novel trait varieties.

Crop Varieties for Irrigation

ICDC is a major contributor to the production of this publication which provides irrigators with independent testing under high input irrigated management. This publication will be printed by ICDC and available at the Crop Production Show, January 2004.

Manure Management

Irrigation Districts offer intensive livestock operations an ample, reliable source of good quality water and an opportunity for increased utilization of crop nutrients sourced from manure. ICDC, therefore, is involved in demonstrating optimum utilization of manure for environmentally sustainable, profitable, irrigated crop production. Site benchmarking and monitoring plus crop, soil and effluent measurements are providing the evidence for profitable and responsible management by both the supplier and the recipient.

Water Use Efficiency

The ultimate in water use efficiency in Saskatchewan is demonstrated each year at Treasure Valley Market Garden, Cadillac. The Irrigated Market Garden and Fruit Crop Field Day was held July 8 and again attracted a large crowd. ICDC combines with SAFRR to host this event.

The Saskatchewan Vegetable Growers Field Day featured irrigation at Moon Lake, along Valley Road southwest of Saskatoon on June 27.

Options for upgrading irrigation project technology in Southwest Saskatchewan continue and were featured at the Annual Irrigation Conference. Increases in water use efficiency of over 400% have been consistently demonstrated by ICDC and PFRA and almost 900 acres were converted from gravity to sprinkler irrigation at Maple Creek as a result.

ICDC assists in water and effluent quality monitoring work done by SAFRR for irrigation sustainability and management purposes. ICDC also assisted the Swift Current Creek Stewardship Group with articles on irrigated forage production, water quality, effluent irrigation and sustainability.

Call ICDC (306) 867-5527 for your copy of the *2003 ICDC DEMONSTRATION PROGRAM FINAL REPORT* (December, 2003).

ICDC Highlights 2003

Annual Irrigation Conference 2003 in Outlook

ICDC co-hosts the Annual Irrigation Conference with the Saskatchewan Irrigation Projects Association (SIPA). This year marks the first-ever meeting of the three prairie province Irrigation Associations: The Alberta Irrigation Projects Association (AIPA), Association of Irrigators in Manitoba (AIM) and SIPA. The federal and Saskatchewan provincial governments were also part of the session. Significant irrigation development opportunities were discussed and a keynote address was: “Why in the heck would you move from Alberta to Saskatchewan?” delivered by B.J. Boot of Boot Hay Producers, Outlook.

The Push for Provincial Irrigation Policy Continues…

ICDC has again been actively pursuing irrigation policy development. ICDC has made two formal irrigation funding requests to both Federal and Provincial governments in March 1997 and again in April 2000. Both have been unsuccessful to this point. Meanwhile the existing PAWBED agreement ended in 2000 and so did irrigation program funding. ICDC has operated on their member’s levy money ($0.35/acre) ever since.

Both SIPA and ICDC were represented at a March 26 meeting in Outlook with The Hon. Clay Serby, Deputy Premier and Minister of SAFRR. The Minister had the opportunity for a quick tour of irrigation-based processing in SSRID and was impressed with the amount of value-added activity in the area.

A credit to the efforts of both ICDC and SIPA was the inclusion of irrigation in both the NDP and Sask Party platforms in the 2003 provincial election. Irrigation has subsequently featured prominently in Minister Serby’s comments on his agenda as Minister of SAFRR in the new provincial government.

ICDC met with the new PFRA Director General, Carl Neggers on March 14. ICDC is a co-chair alongside PFRA and SAFRR at The Irrigation Centre in Outlook.

ICDC has been invited to the consultations regarding amendments to *The Irrigation Act*, *1996*.

ICDC's Irrigation Education Initiative

The ICDC Board has been an advocate for improved irrigation education opportunities in Saskatchewan. The Irrigator, July 2002, documented the existing options for irrigation education and training:

School system	Project WET, Ag In The Classroom
SIAST Moose Jaw	Irrigation course
Green Certificate Farm Training Program	Irrigated Crop Production Technician
ICDC and The Irrigation Centre	Extension, field days, website, newsletters, etc.
University of Saskatchewan	Work Experience, some irrigation course content

ICDC has been active in the development of Ag In The Classroom irrigation material. ICDC is working through The Irrigation Centre to promote The Green Certificate Program. Work by ICDC on irrigation curriculum at the U of S continues. ICDC has mentored seven coop students over five years from the College of Agriculture working on irrigation R & D projects for the past four years. ICDC was involved in hosting SAFRR's Dutch consultant in Outlook on July 3. Hopes are for an expanded exchange program between students from Holland and Canada.

Water: The Economic Driver of the Future

ICDC was pleased to sponsor and help organize the Saskatchewan Agrivision Corporation (SAC) conference held in Saskatoon on March 20. The conference brought together a broad spectrum of vested interests in water and highlighted Saskatchewan's golden opportunity for water-based economic development. The conference significantly raised water's profile in the public eye. Follow-up included a proposal for developing a 50-year Water Development Strategy for Saskatchewan which awaits funding approval. The Conference proceedings are available on SAC's website: www.agrivision.sk.ca**.**

Website: www.irrigationsaskatchewan.com (a joint ICDC/SIPA Project)

This farmer-friendly gateway to irrigation information and contacts on the prairies and around the world is being updated and gradually upgraded. The website is subject-driven following ICDC's and SIPA's philosophy that the website will take you to relevant information, wherever it is. This website is a work in progress as more relevant irrigation links as sources are discovered.

ICDC Winter Seminar Series

Each seminar applied the three major publications; 2003 ICDC Demonstration Report, 2004 Crop Varieties for Irrigation, and 2004 Irrigation Economics and Agronomics for Saskatchewan. One or two guest speakers at each seminar enabled local themes that addressed the concerns of local irrigators.

-Swift Current and Riverhurst: "Irrigation Production and your 2004 Beef Enterprise"
-Warman: "2004 Irrigation Crop Production, Economics and Development"
-Outlook and Lucky Lake: "Making Irrigation Pay – Using Knowledge and Networking to build your Farm"
-This series attracted interest and partnering from local Agri-business.

Publications

The Irrigator, Saskatchewan's irrigation newsletter from ICDC to all irrigators.
Irrigation Economics and Agronomics, Saskatchewan 2004.
Crop Varieties for Irrigation (mailed out to all irrigators).
ICDC R & D Annual Report (R & D results and recommendations to irrigators).

CSIDC Support

ICDC, Industry Co-Chair of The Irrigation Centre, Outlook

ICDC appoints one of its Directors as the industry's co-chair of The Irrigation Centre's Executive Management Committee. Initiatives pursued by this group include co-locating provincial irrigation staff at The Centre in 2004 for improved client service, promoting irrigation education opportunities, integrating the Green Certificate requirements into summer student activities, developing Capital replacement and R & D workplans including ICDC's R & D Priorities, and the establishment of an irrigation publications review team.

CSIDC Field Day

ICDC assisted in the organization of the July 9th annual field day and trade show. ICDC organized a forage and a pulse specialty tour in the afternoon. This event is summer's irrigation focal point for irrigators, commodity groups, media, agri-business, government, international visitors and the general public. CBC's Bob McDonald was there taping information for an upcoming documentary on water.

ICDC wishes to thank SAFRR for their continued support, the producer cooperators for committing themselves to the extra work and effort to get results and all the many agri-business partners who provide product and services to make ICDC's program *"value for money R & D".* Thank you all very much for supporting Saskatchewan's irrigation industry.