Canada-Saskatchewan Irrigation Diversification Centre

901 McKenzie St. S., Box 700
Outlook, Saskatchewan
S0L 2N0
Phone (306)867-5400; Fax (306)867-9656
e-mail: csidc@agr.gc.ca

Annual Review

April 1, 2002 to March 31, 2003

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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 2002-2003.

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

The year 2002/2003 saw many changes occur at the Centre. Federally, a horizontal team approach to support the Agriculture Policy Framework and the theme and national study approach are being utilized. Federal staff have been placed on the Sustainable Production Systems team (SPS) led by Dr. Steve Morgan Jones. A national study was developed entitled "Sustainable Systems for Irrigated Crop Production".

Provincially, SAFRR replaced Sask Water as the provincial 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 existing MOU will be fine-tuned to reflect these changes.

The year 2002/2003 will be remembered for the severe drought conditions in much of western Canada. Irrigated crop production looked particularly promising. Requests for irrigated production information were at an all time high. In addition, irrigation allowed good results to be obtained from agronomic studies which otherwise would have yielded limited information. This has sparked interest and requests from other researchers desiring irrigated experimental sites at CSIDC.

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.

CSIDC received research 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 it applies to irrigation.

International activity at the Centre continues to expand. This is largely through staff 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).

CSIDC staff were involved with the organizing committee for ICID 2002, a scientific and technical congress held in Montreal, Quebec, in July 2002. AAFC was a major sponsor of this event that included 940 participants from 75 countries and 22 international organizations. Over 400 technical papers were presented. CSIDC staff presented technical papers, chaired sessions and organized the western study tour portion of this event.

Internationally, sustainable irrigation and water management are viewed as critical to the world's future. CSIDC technical and managerial expertise has been used to provide support to CIDA-funded projects in Egypt, China, Ethiopia and Romania. A highlight of this work was hosting two graduate students from Inner Mongolia from July to September. They studied irrigation and water savings technology. CSIDC staff presented a two-week training course in Inner Mongolia prior to the students coming to Canada.

CSIDC 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. David
Admin. Assistant:	J. Clark	Maintenance:	A. MacDonald
Clerical:	D. Greig	YMCA Trainees:	H. Anderson
Market Analyst:	H. Clark		S. Coffey
Irrigation Agronomist:	T. Hogg		A. Lawson
Horticultural Crops Agronomist:	J. Wahab		C. Minchin
Technician:	G. Larson		E. Skaalid
Technician:	C. Ringdal	Summer Staff:	R. Johnson
Technology Transfer:	J. Harrington		K. Lee
ICDC Agrologists:	J. Linsley		B. Nixon
	L. Bohrson		G. Pederson
	L. Shaw		D. Prokopiw

Activities

Presentations

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

- Herb Production. Saskatchewan Nutraceutical Network Annual Research Day, Saskatoon, Saskatchewan
- Potato Presentation. Canada- Alberta Crop Diversification Initiative Field Day, Lethbridge, Alberta
- Technical presentations. CSIDC Annual Field Day, Outlook, Saskatchewan
- Conference Presentations. ICID 18th Congress, Montreal, Quebec:
    1) Irrigation Advisory Services: A Canadian Model
    2) Participatory Irrigation Research and Demonstration in Canada
- Potato Presentation. CSIDC Potato Field Day, Outlook, Saskatchewan
- Evaluating Vine-Kill Methods for Producing Seed Tubers of Contrasting Potato Culitvars on the Canadian Prairies. IHC 2002 Congress Canada Horticulture, Toronto, Ontario
- Demonstration of Narrow-row Dry Bean Swathing. Outlook, Saskatchewan
- Demonstration of Durum Fusarium Harvesting. Birsay, Saskatchewan
- CSIDC and Irrigation in Canada. Iranian Delegation. CSIDC, Outlook, Saskatchewan
- Trickle Irrigation and Higher Value Crop Production. Alberta Horticultural Congress, Edmonton, Alberta
- CSIDC and Irrigation History. Outlook and Division School Career Day, Outlook, Saskatchewan
- Water Use Efficiency. Environmentally Sustainable Agriculture Conference. Hebei, China
- Herb Research. AAFC Special Crops Meeting, Outlook, Saskatchewan
- Herb Research at CSIDC. Herb and Spice Association annual meeting
- Ag Policy Framework Presentation. Industry Meeting, Outlook, Saskatchewan
- Bean Seed Production in Canada. 4th Canadian Research Workshop, Edmonton, Alberta
- Potato Irrigation. Saskatchewan Seed Potato Growers. Saskatoon, Saskatchewan
- Sustainable Irrigation. Veterinary/Medical students, University of Saskatchewan, Saskatoon
- International Irrigation. Agriculture and Bioresource Engineering students, University of Saskatchewan, Saskatoon, Saskatchewan
- Irrigation Scheduling. Agronomy students, College of Agriculture, University of Saskatchewan, Saskatoon
- Conquest Irrigation Meeting

CSIDC Display

CSIDC presented a display at the following events:

- Crop Production Show, Saskatoon
- CSIDC Annual Field Day, Outlook
- ICID Congress, Montreal, Quebec
- Trade Show, Outlook
- Saskatchewan Irrigation Projects Association Meetings, Outlook
- Trade Show, Beechy
- Herb & Spice annual meeting, Saskatoon
- Irrigation Meeting - Conquest

Tours

A large number of tours of the Centre and of the field programs are conducted each year at the CSIDC. Noteworthy groups touring the Centre in 2002 included:

-	Australian Research Centre personnel	May 17
-	Egyptian Scientists Delegation	May 28
-	Alberta Agriculture Extension Group	June 6
-	LCBI Agriculture Students	June 13
-	Inner Mongolia Technical Group	June 14
-	Forage Council	June 18
-	Egyptian Irrigation Specialists	June 20
-	Egyptian Scientists Delegation	July 3
-	Techni Tuber International Group	July 9
-	CSIDC Annual Field Day Tour	July 11
-	Ethiopian Delegation	July 12
-	Inner Mongolia Delegation	July 16
-	ICID 2002 Irrigation Western Study Tour	July 29
-	Disease Tour of Irrigated Durum and Beans	July 29
-	NAWQAM Trainees	July 29
-	Potato Field Day	August 8
-	University of Saskatchewan Agriculture Instructors	August 13
-	BASF Chickpea Tour	August 19
-	SAFRR Deputy Minister Tour	August 22
-	Mexican Irrigation Delegation	August 25
-	Barley Breeders	September 3
-	ICDC Timothy Fertility Demo Tour	September 4
-	Ag & Bioresource Engineering Irrigation Class	September 9
-	Egyptian Study Tour	September 22-29
-	Milden School Group	October 7
-	Iranian Delegation	October 10

Additional tours were held for private industry, and numerous other producers, agricultural professionals, industry groups, association representatives and visitors who requested tours.

Committees

L. Tollefson
- CSIDC Executive Management Committee
- CSIDC MOU Review Committee
- Canada-Alberta Crop Diversification Initiative (CACDI)
- AAFC Sustainable Production Systems Team
- National Study Co-leader, Sustainable Systems for Irrigated Crop Production
- National Agri-Environmental Health Analysis Reporting Program (NAHARP) Planning Committee
- Canadian National Committee on Irrigation and Drainage (CANCID), Executive member
- International Commission on Irrigation and Drainage (ICID) Crops and Water Use subcommittee
- ICID Conference Organizing Committee, 18th Congress and 35th International Executive Council, Montreal 2002
- AAFC International Team
- National Water Quality and Availability Management Project (NAWQAM), Egypt Headquarters Co-ordinator; Executive Committee member
- Sustainable Agriculture Development Project, Inner Mongolia
- Agri-Food Innovation Fund Horticulture Committee, Federal Co-chair
- Prairie Crop Diversification Task Force
- Dept. of Agriculture and Bioresource Engineering, University of Saskatchewan, Research Associate
- Minor Use Registration Committee
- Drought Communications Implementation Committee

T. Hogg
- Prairie Regional Recommendation Committee on Grains
- Saskatchewan Advisory Council of Grain Crops
- AAFC Pesticide Review Committee
- Steering Committee - AFIF Minor Use Registration Fund

J. Wahab
- Saskatchewan Herb and Spice Association, Herb Production Manual Review
- Saskatchewan Seed Potato Growers Association technical advisor
- Soils and Crops Organizing Committee
- Western Potato Council
- Saskatchewan Herb and Spice Association - Director/Treasurer
- Steering Committee of the Herb Program, Department of Plant Sciences, University of Saskatchewan
- AAFC Potato Network

H. Clark
- Price Consultations for Farm Income Programs Directorate
- AAFC National Pilot Project for Herb and Spice Delivered Prices

B. Vestre
- Joint Occupational Health and Safety Committee
- PFRA Pesticide Review Committee

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 Scal eProduction 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

Potato:

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

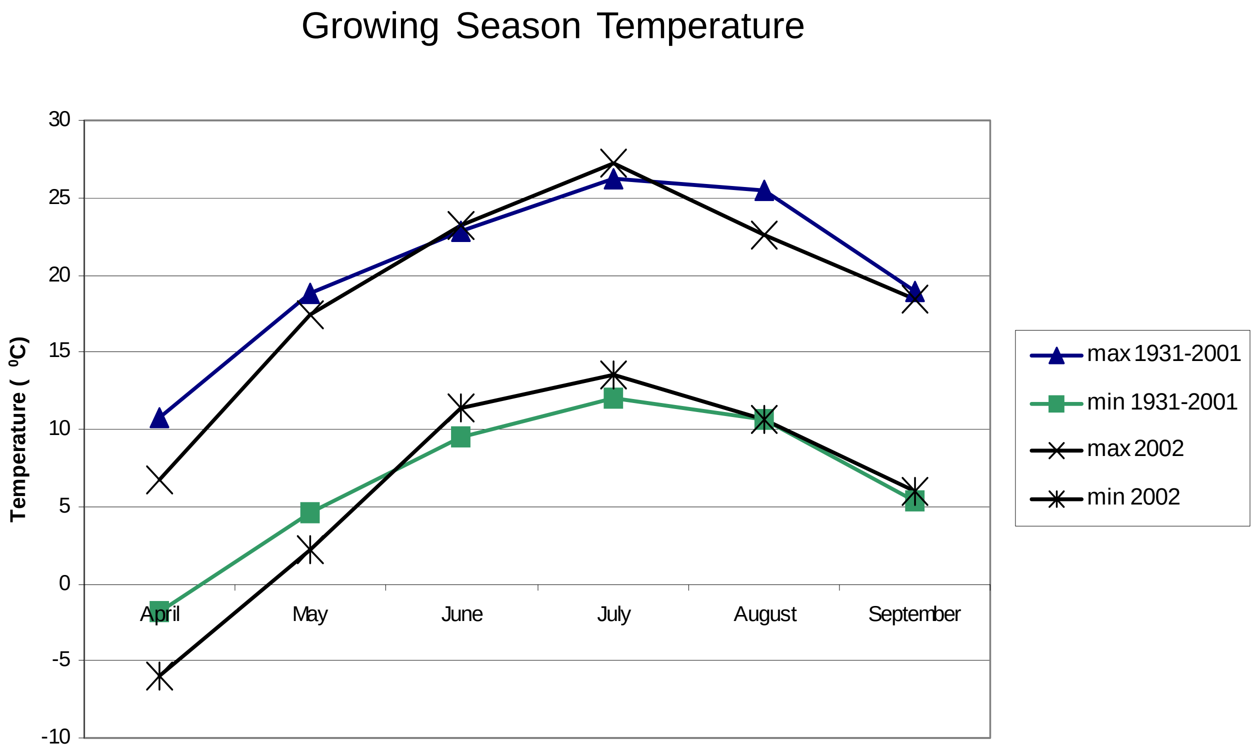
Soils and Fertilizers:

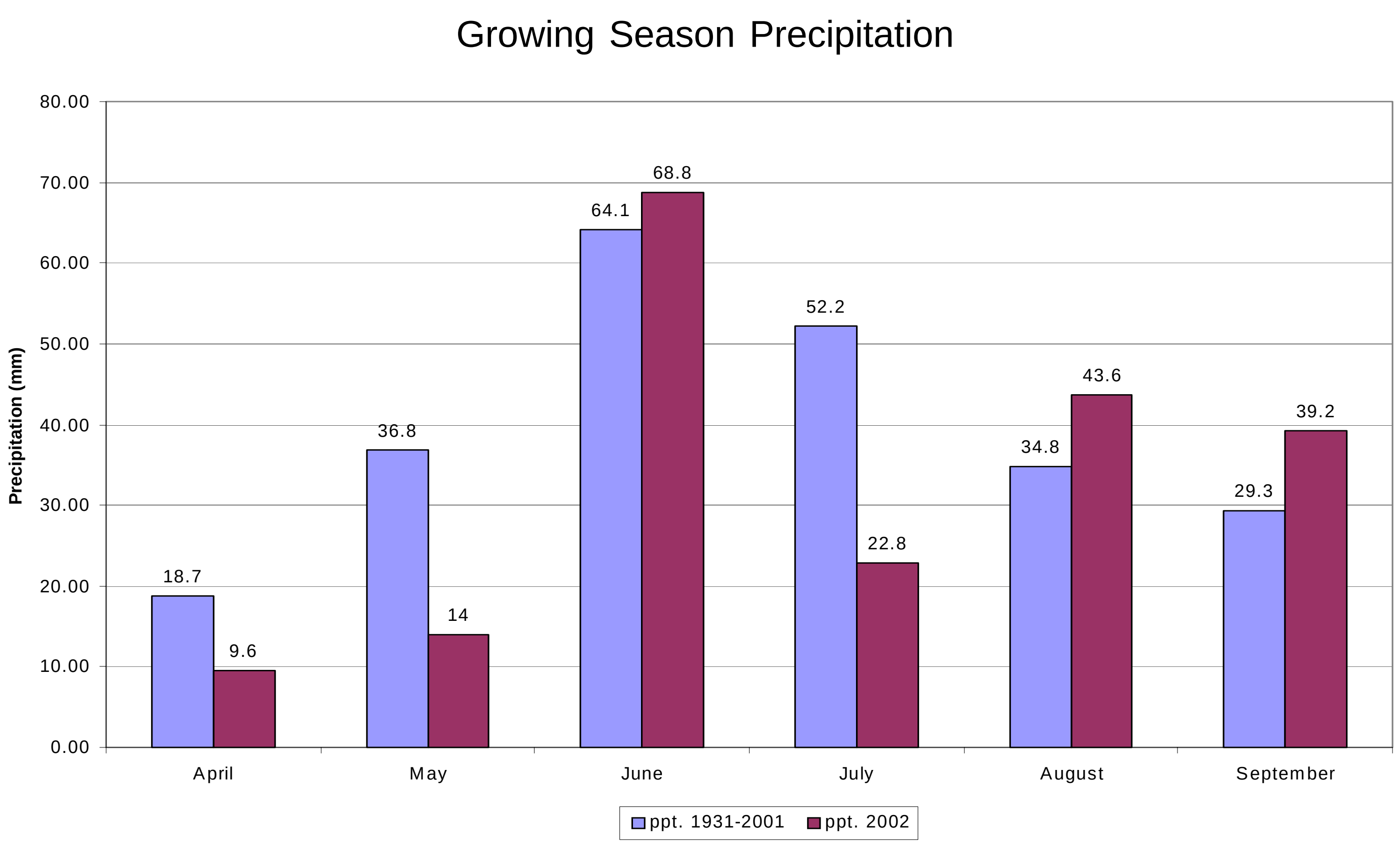
Reclamation of a Saline Field using Subsurface Drains
Rate and Placement Effects of P and K Fertilizer on Peas
Fertility Management of Irrigated Alfalfa
Canola Fertilization Trials at CSIDC
Hog Effluent Research and Demonstration

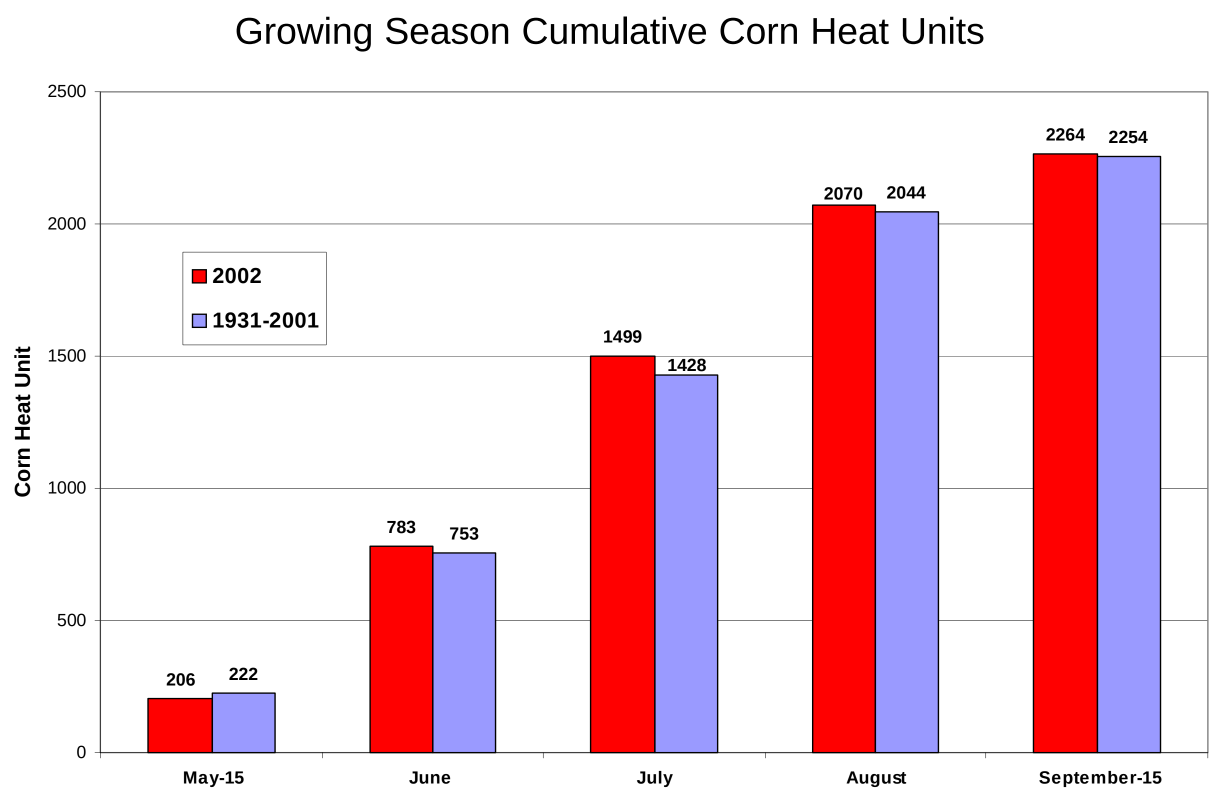
Other:

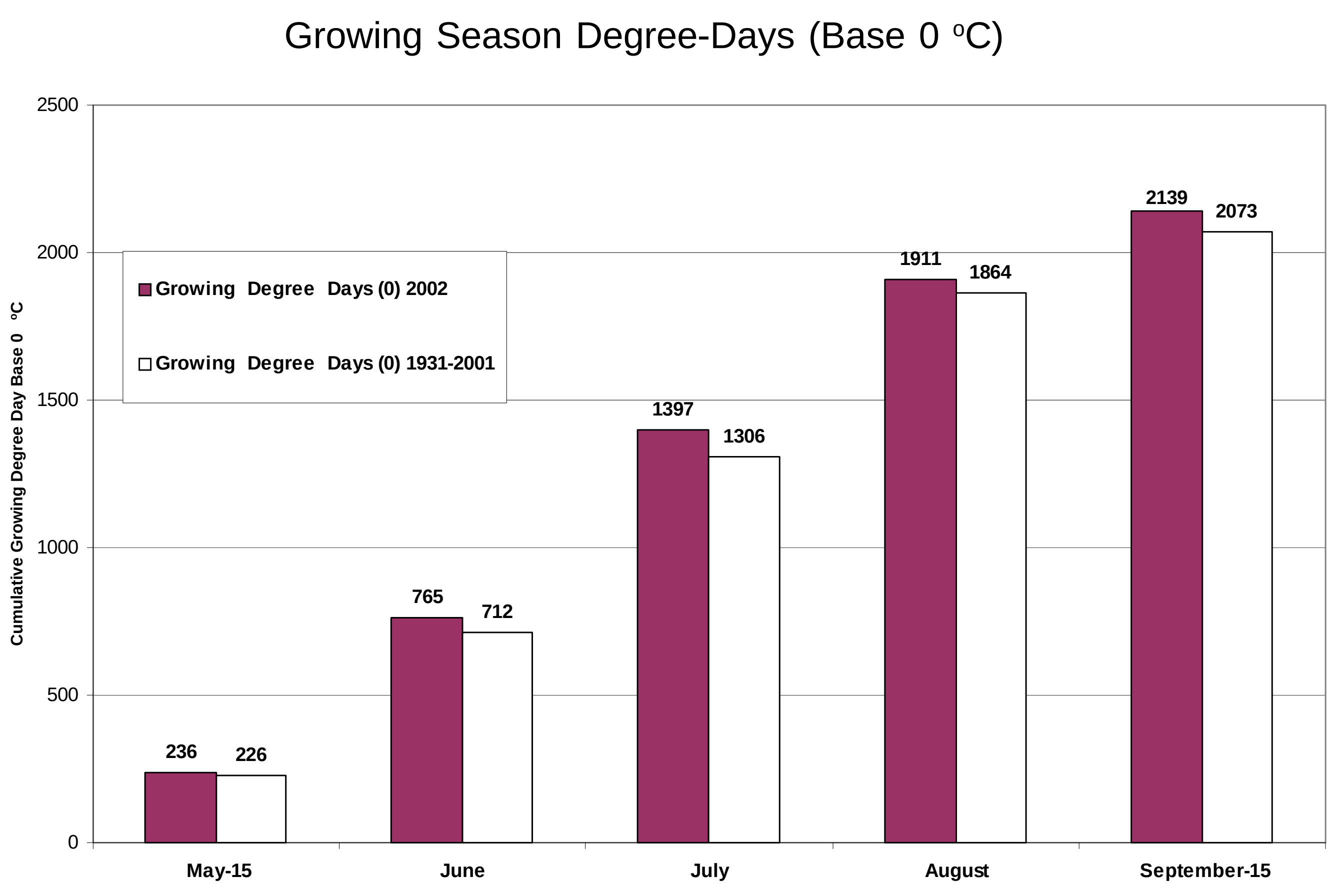
Crop Varieties for Irrigation
Plastic Mulches for Commercial Vegetable Production
Northern Vigor™ in Seed Potato
Overview of CSIDC
Xeriscape Demonstration Project at CSIDC
Fruit Crops in Saskatchewan
Ethanol: Fact or Fiction
ICDC Irrigation Economics and Agronomics
ICDC Crop Manager Report
Irrigation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

2002 Weather Summary






Growing Season Cumulative Corn Heat Units
Corn Heat Unit
2500
2000
1500
1000
500
0
2002
1931-2001
206
222
783
753
1499
1428
2070
2044
2264
2254
May-15
June
July
August
September-15


Growing Season Degree-Days (Base 0 °C)
Cumulative Growing Degree Day Base 0 °C
2500
2000
1500
1000
500
0
Growing Degree Days (0) 2002
Growing Degree Days (0) 1931-2001
236
226
765
712
1397
1306
1911
1864
2139
2073
May-15
June
July
August
September-15

2002 Irrigation Data

Field	Crop	Irrigation (mm)					Total Irrigation		Fall Irrigation mm
		May	June	July	Aug.	Sept.	mm	inches	
CSIDC									
1	Durum Wheat	55	55	175	25	0	310	12.2	
1	Carrots	55	55	150	75	50	385	15.2	
1	Cabbage	75	55	150	75	50	385	15.2	
1	Celery	55	55	150	75	50	385	15.2	
1	Beans	55	40	150	25	0	270	10.6	
2	Durum	25	50	150	0	50	275	10.8	50
4	Canola	50	35	105	25	25	240	9.4	25
5	Canola	50	35	105	25	25	240	9.4	25
6	Chickpeas	50	50	150	0	0	250	9.8	
6	Durum	0	100	150	0	0	250	9.8	
7	Lentils	60	25	75	25	25	210	8.3	25
7	Durum	60	50	100	50	25	285	11.2	
8	Potatoes	30	50	175	75	25	355	14.0	
8	Irr. Scheduling Potatoes	30	50	175	75	50	380	15.0	
8	Durum	60	50	175	50	50	385	15.2	50
8	Herbs & Spices (irrigated only)	45	50	180	50	25	350	15.0	25
9	ICDC Varieties	30	50	175	25	0	280	11.0	
9	Durum	30	50	175	0	25	280	11.0	25
10	Grasses/Alfalfa	55	75	200	50	25	405	15.9	
10	Sask. Forage Council	55	50	175	50	25	355	14.0	
11	Durum	20	50	125	0	25	220	8.7	
12	Potatoes	15	75	150	100	25	365	14.4	
12	Bean Trials	15	75	150	75	0	315	12.4	
12	Alfalfa	0	25	150	0	25	200	7.9	
12	Timothy	0	50	175	0	25	250	9.8	
12	Durum	0	50	150	50	25	275	10.8	
Off-station Site									
	Northwest	30	60	120	0	0	210	8.3	
	Northeast	30	60	195	15	0	300	11.8	
	Southeast	30	60	195	15	0	300	11.8	
	Southwest	30	60	120	0	0	210	8.3	

Cereals and Oilseeds Variety Evaluation Program

Cereals:

Oilseeds:

Cereals

Irrigated Wheat Variety Test

T. Hogg[1], C. Ringdal[1],

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 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

Wheat varieties from different market classes were tested for their agronomic performance under irrigation. The CSIDC site was seeded May 13, the Pederson site May 14, the CSIDC off-station site May 16 and the Ringdal site May 26. Plot size was 1.5 m x 4.0 m (5 ft x 13 ft). All plots received 112 kg N/ha (100 lb N/ac) as 46-0-0 and 45 kg P_2O_5/ha (40 lb P_2O_5/ac) as 12-51-0 sideband at seeding. Yields were estimated by harvesting the entire plot. The results are presented in Table 1.

Irrigated wheat yield, height and lodge rating varied among the four sites (Table 3). The highest yielding wheat variety averaged over the four test sites was AC Andrew soft white spring wheat. All other wheat varieties tested had yield equal to or lower than the check variety AC Barrie averaged over the four test sites.

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

[1]*CSIDC, Outlook*

Table 1. Yield and agronomic data for wheat cultivars grown under irrigation.

	Pederson site			Ringdal site		CSIDC off-station site			CSIDC site			Mean yield		
Variety	Yield (kg/ha)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Yield (kg/ha)	Height (cm)	Lodge rating	Yield (kg/ha)	Height (cm)	Lodge rating	kg/ha	bu/ac	% of AC Barrie
Hard Red Spring														
AC Barrie	3618	60	1.0	3197	63	6930	85	1.8	4396	65	1.0	4535	67.4	100
Superb	3792	61	1.0	2910	60	6536	80	1.5	4770	65	1.0	4502	67	99
CDC Bounty	3613	68	2.8	3019	64	6786	86	3.0	4644	72	2.3	4516	67.2	100
Prodigy	3427	65	1.0	3184	66	5855	89	2.3	3604	63	1.0	4018	59.8	89
McKenzie	3686	63	2.0	3173	59	6545	82	3.5	4345	69	2.0	4437	66	98
Alsen	3748	61	1.0	2188	54	5179	77	1.0	3609	60	1.0	3681	54.7	81
PT416	3220	65	2.0	3093	67	5624	86	2.8	3895	68	1.8	3958	58.9	87
AC Snowbird	3342	65	1.0	2772	65	5963	87	1.8	3854	67	1.0	3983	59.2	88
Durum														
AC Avonlea	3630	62	1.0	3082	61	6404	82	1.5	3716	65	1.0	4208	62.6	93
AC Morse	3702	61	1.5	3214	56	6970	78	1.0	4134	62	1.0	4505	67	99
AC Napolean	3879	63	1.0	2337	60	6858	84	2.0	4796	73	1.0	4468	66.5	99
AC Navigator	4133	57	1.0	2539	57	6413	78	2.8	4523	62	1.0	4402	65.5	97
DT707	3765	60	1.0	3238	64	6675	84	1.0	4537	69	1.0	4554	67.7	100
DT712	3987	65	1.0	3187	62	6434	83	2.5	3900	66	1.8	4377	65.1	97
CPS-Red														
5700PR	3602	55	1.5	2337	52	6824	66	1.3	4510	60	1.0	4318	64.2	95
CPS-White														
AC2000	2857	58	1.0	2905	56	6183	72	1.5	4084	60	1.0	4007	59.6	88
Canada Western Extra Strong														
Amazon	3617	73	1.0	2291	68	4843	91	1.8	3424	72	1.0	3544	52.7	78
ES21	3675	68	1.0	2570	64	4802	89	2.5	4616	77	1.0	3916	58.2	86
Soft White Spring														
AC Andrew	4665	60	1.5	3118	58	6636	74	1.0	5372	61	1.0	4948	73.6	109
SWS285	4133	64	3.3	3120	62	7109	76	1.8	3985	60	1.0	3657	54.4	81
CV (%)	15	4.9	57	20.6	8.4	7.8	5.3	26.7	16.7	6.9	16.2	-	-	-

[1]0=no lodging; 9=completely lodged

Western Canada High Yield Wheat Co-operative Test

R. De Pauw[1], C. Ringdal[2], T. Hogg[2]

Progress: *Ongoing*

Objective:
To evaluate potential new Canada Prairie Spring wheat varieties under irrigated conditions in western Canada.

The High Yield Wheat co-operative test was sown mid May in 1.5 m x 4.0 m (5 ft x 13 ft) plots. Nitrogen (46-0-0) was applied at a rate of 112 kg N/ha (100 lb N/ac) and phosphorus (12-51-0) was applied at a rate of 45 kg P_2O_5/ha (40 lb P_2O_5/ac). All fertilizer was side-banded at the time of seeding. The entire plot was harvested for yield estimation.

Results of the test are presented in Table 2. Several lines exhibited high yield with good lodging resistance and short stature.

Table 2. Yield and agronomic data for CPS wheat germplasm: High Yield Wheat Co-operative Test, Outlook.

Entry	Identity	Yield % of market Class check[1] (days)	Maturity (days)	Height (cm)	Lodge rating[2]
CPS-Red					
HY417	AC Crystal (check)	100	119	64	1.5
HY962	5701PR (check)	134	119	63	1.8
HY482	P9613-AA10A1A	98	121	62	1.8
HY483	P9613-AA10A1C	80	118	63	1.8
HY484	P9613-AA10A1E	108	119	63	1.3
HY663	99W 19	73	121	65	1.3
HY664	99W 21	83	122	70	1.0
HY665	99W 58	71	120	58	1.0
HY666	99W 73	147	124	59	1.0
HY971	N98-3020	142	122	61	1.0
HY972	N99-3065	120	124	70	1.0
CPS-White					
HY413	AC Vista (check)	100	119	65	1.0
HY446	AC2000	107	117	61	1.5
HY473	9425-AC02C	121	120	62	2.0
HY475	9525-FM15	151	118	66	1.5
HY476	P9711-PAE03B1	65	118	63	1.0
HY477	9425-DA03A2	124	120	66	2.3
HY478	9428-BQ04C4	111	120	62	1.3
HY479	9522-GP06E	179	125	74	1.8
HY480	9525-DW03D	95	120	62	1.3
HY481	9629D-024	136	124	57	1.0
HY485	S9626-AV09B	158	122	69	1.0
HY530	UA15-23	101	121	65	1.3
HY662	99W 430	166	122	71	1.0
HY973	BR1005W	73	119	55	1.3
CV (%)		43.8	2.1	7.7	28.3

[1]Yield of check: AC Crystal = 2693 kg/ha (40.0 bu/ac); AC Vista = 3265 kg/ha (48.5 bu/ac)
[2]0=no lodging; 9=completely lodged

[1]*Semi-Arid Prairie Agriculture Research Centre, Swift Current*
[2]*CSIDC, Outlook*

Western Canada Soft White Spring Wheat Co-operative Test

R. S. Sadasivaiah[1], C. Ringdal[2], T. Hogg[2]

Progress: *Ongoing*

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

Table 3. Yield and agronomic data for Soft White Spring Wheat germplasm: Soft White Spring Wheat Co-operative Test, Outlook.

Entry	Yield % of AC Andrew[1]	Maturity (days)	Height (cm)	Lodge rating[2]
AC Andrew (check)	100	117	55	1.0
AC Phil (check)	86	115	55	1.3
AC Reed (check)	80	116	56	1.3
00-9012	123	117	61	1.0
00B-62	105	116	61	1.0
01PR-0216	110	117	60	1.3
01PR-0526	123	116	63	1.5
01PR-0527	124	117	63	1.0
01PR-0609	116	118	58	1.0
01PR-0818	129	119	62	1.0
01PR-0822	108	116	58	1.0
01PR-0825	129	116	60	1.3
01PR-1009	104	116	63	1.5
01PR-1014	114	116	67	1.0
01PR-1405	129	117	61	1.3
01PR-1408	123	118	62	1.0
01PR-1414	101	116	62	1.8
01PR01418	122	117	62	1.0
98B-196	93	117	61	1.3
99DH-222	94	116	58	1.0
CV (%)	20.5	0.8	7.8	29.9

[1]AC Andrew yield = 4438 kg/ha (65.9 bu/ac)
[2]0=no lodging; 9= completely lodged

The Soft White Spring Wheat co-operative test was sown mid May in 1.5 m x 4.0 m (5 ft x 13 ft) plots. Nitrogen (46-0-0) was applied at a rate of 112 kg N/ha (100 lb N/ac) and phosphorus (12-51-0) was applied at a rate of 45 kg P_2O_5/ha (40 lb P_2O_5/ac). All fertilizer was side-banded at the time of seeding. The entire plot was harvested for yield estimation.

Results of the test are presented in Table 3. Several lines showed high yield with good lodging resistance and short stature.

[1]*Lethbridge Research Centre, Lethbridge, Alberta*
[2]*CSIDC, Outlook*

Saskatchewan Advisory Council Irrigated Wheat and Barley Regional Tests

R. De Pauw[1], C. Ringdal[2], T. Hogg[2]

Progress: *Ongoing*

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

The Saskatchewan Advisory Council wheat regional test was seeded on May 13. The barley test was seeded on May 16. Plot size was 1.5 m x 4.0 m (5 ft x 13 ft). All plots received 112 kg N/ha (100 lb N/ac) as 46-0-0 and 45 kg P_2O_5/ha (40 lb P_2O_5/ac) as 12-51-0. All fertilizer was side-banded at the time of seeding. Each market class was conducted as a separate test. Yields were estimated by harvesting the entire plot.

Results for the CWRS, CWAD, SWSW, CPS and CWES market classes are shown in Tables 4,5,6,7 and 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 taller lines. 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 (Table 5), all CPS lines except AC2000 (Table 7) and all CWES lines (Table 8). All SWS 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, for both the malting and feed market classes, several lines yielded higher than the check variety Harrington (Table 9). All 2-Row lines had better lodging resistance than the check variety Harrington. In the 6-Row Test, there were three malting lines (BT954, Legacy and Lacey) and one feed line (AC Rosser) that produced yield higher than the check variety CDC Sisler (Table 10). Most 6-Row lines had lodging resistance equal to or greater than the check variety CDC Sisler.

Table 4. Saskatchewan Advisory Council Irrigated Hard Red Spring Wheat (CWRS) Regional Test, Outlook: Yield potential and growth characteristics of germplasm.

Variety	Yield % of AC Barrie[1]	Height (cm)	Maturity (days)	Lodge rating[2]
AC Barrie (BW661)	100	75	116	1.3
5500HR (BW245)	92	71	118	1
5600HR (BW238)	79	74	117	1
CDC Bounty (BW720)	84	73	115	3
Superb (BW252)	104	72	118	1
AC Ivory (BW263)	71	69	116	1
AC Snowbird (BW264)	71	70	117	1.3
BW243	85	69	118	1
BW256	73	67	118	1
BW259	68	65	116	1
BW282	75	65	116	1
BW758	82	68	116	1.3
BW776	88	72	117	1.8
BW781	79	66	115	2.3
PT205	89	76	115	1.5
PT206	81	67	117	1.3
PT416	86	70	116	2.5
PT421	69	65	115	1.8
PT555	91	68	117	1.3
PT558	81	65	118	1
PT559	72	74	117	1.8
PT560	73	70	116	1.8
CV (%)	16.2	7.7	1	30.9

[1]Yield of AC Barrie = 5736 kg/ha (85.2 bu/ac)
[2]0=erect; 9=flat

[1]*Semi-Arid Prairie Agriculture Research Centre, Swift Current*
[2]*CSIDC, Outlook*

Table 5. Saskatchewan Advisory Council Irrigated Canada Western Amber Durum Wheat (CWAD) Regional Test, Outlook: Yield potential and growth charateristics of germplasm.				
Variety	Yield % of AC Barrie[1]	Height (cm)	Maturity (days)	Lodge rating[2]
AC Barrie (check)	100	68	111	1
Kyle (DT375)	78	76	112	1
AC Avonlea (DT661)	75	64	110	1
AC Navigator (DT673)	84	63	112	1
AC Napolean (DT494)	88	69	11	1
DT707	75	67	112	1
DT712	70	63	109	1
CV (%)	10.5	3.7	1	-

[1]Yield of AC Barrie = 4653 kg/ha (69.1 bu/ac)
[2]0=no lodging; 9=completely lodged

Table 6. Saskatchewan Advisory Council Irrigated Soft White Spring Wheat (SWSW) Regional Test, Outlook: Yield potential and growth characteristics of germplasm.				
Variety	Yield % of AC Barrie[1]	Height (cm)	Maturity (days)	Lodge rating[2]
AC Barrie (check)	100	71	112	1
AC Phil (SWS89)	109	61	115	1
AC Reed (SWS87)	106	60	113	1
AC Nanda (SWS179)	116	68	115	1
AC Meena (SWS234)	142	67	116	1
AC Andy (SWS241)	125	62	115	1
SWS285	106	63	115	1
CV (%)	15.6	4.6	1.2	-

[1]Yield of AC Barrie = 4409 kg/ha (65.5 bu/ac)
[2]0=no lodging; 9=completely lodged

Table 7. Saskatchewan Advisory Council Irrigated Canada Prairie Spring Wheat (CPS) Regional Test, Outlook: Yield potential and growth characteristics of germplasm.				
Variety	Yield % of AC Barrie[1]	Height (cm)	Maturity (days)	Lodge rating[2]
AC Barrie (check)	100	76	119	1
AC Vista (HY413)	97	67	120	1.8
AC2000 (HY446)	104	67	119	1.5
AC Crystal(HY417)	94	68	120	1.5
5700PR (HY961)	91	64	123	1
5701PR (HY962)	100	64	120	2
CV (%)	4.5	4	1.2	26.8

[1]Yield of AC Barrie = 5736 kg/ha (85.2 bu/ac)
[2]0=no lodging; 9=completely lodged

Table 8. Saskatchewan Advisory Council Irrigated Canada Western Extra Strong Wheat (CWES) Regional Test, Outlook: Yield potential and growth characteristics of germplasm.

Variety	Yield % of AC Barrie[1]	Height (cm)	Maturity (days)	Lodge rating[2]
AC Barrie (check)	100	72	110	1
Amazon (ES04)	84	78	112	1
AC Corrine (ES07)	97	77	113	1
AC Glenavon (ES13)	98	78	112	1
CDC Rama (ES21)	88	76	112	1
ES41	90	74	112	1
ES54	79	73	111	1
CV (%)	7.8	3.7	1	-

[1]Yield of AC Barrie = 4577 kg/ha (68.0 bu/ac)
[2]0=no lodging; 9=completely lodged

Table 9. Saskatchewan Advisory Council Irrigated 2-Row Barley Regional Test, Outlook: Yield potential and growth characteristics of germplasm.

Variety	Yield % of Harrington[1]	Height (cm)	Maturity (days)	Lodge rating[2]
Malting				
Harrington (TR441)	100	82	115	7
AC Bountiful (TR243)	116	83	120	1.7
CDC Copeland (TR150)	109	90	117	3.7
CDC Kendall (TR133)	125	82	117	4
Merit (TR970)	103	89	118	3.7
AC Metcalfe (TR232)	122	88	118	4.3
Newdale (TR258)	158	83	117	3.7
CDC Select (TR153)	123	83	118	3
CDC Stratus (TR128)	125	79	116	3
TR166	124	90	119	4.3
TR262	100	84	117	5.3
Feed				
CDC Bold (SD422)	133	79	116	5.3
CDC Dolly (TR318)	118	80	118	6.7
CDC Freedom (HB329)	88	86	119	2.7
CDC Gainer (HB326)	100	88	118	3.3
CDC Helgason (TR346)	116	84	117	3
CDC McGwire (HB335)	88	85	119	3.7
Xena (TR475)	129	88	116	5.7
TR256	124	83	118	2.7
TR359	149	87	117	2.3
TR361	142	80	117	3
TR651	119	86	118	5
CV (%)	12.5	3.1	1.1	31.7

[1]Yield of Harrington = 3995 kg/ha (74.2 bu/ac)
[2]0=no lodging; 9=completely lodged

Table 10. Saskatchewan Advisory Council Irrigated 6-Row Barley Regional Test, Outlook: Yield potential and growth characteristics of germplasm.

Variety	Yield (% of CDC Sisler[1])	Height (cm)	Maturity (days)	Lodge rating[2]
Malting				
CDC Sisler (BT433)	100	87	120	2.7
CDC Battleford (BT456)	83	77	121	2.3
Excel (M52)	94	70	121	1.7
Lacey (BT965)	106	74	121	1.7
Legacy (BT950)	119	78	121	1.7
CDC Tisdale	70	80	121	2.7
CDC Yorkton (BT459)	96	81	121	2
BT478	99	84	119	3.3
BT483	85	80	121	2.7
BT954	126	78	118	1.7
Feed				
AC Bacon (HB105)	71	69	119	2.3
Niska (SD513)	96	68	117	2
Peregrine (HB504)	55	54	115	3
AC Rosser (BT377)	120	76	122	3
Trochu (BT558)	91	76	122	2
Vivar (SD516)	99	69	118	2
CV (%)	11.9	6	1	39.4

[1]Yield of CDC Sisler = 4351 kg/ha (80.8 bu/ac); [2]0=no lodging; 9=completely lodged

Evaluation of Durum Breeding Lines for Irrigation

J.M. Clarke[1], T. Hogg[2], C. Ringdal[2]

Progress: *Ongoing*

Location: *Swift Current and Outlook*

Objective: *To identify superior durum wheat lines for production under irrigation in Saskatchewan.*

The Durum Central 'A' test was planted under irrigation at Outlook in 2002, in addition to an irrigated site at Lethbridge, Alberta, and non-irrigated tests at Brandon, Indian Head, Regina and Swift Current. This test consisted of short and semi-dwarf durum lines with potential adaptation to irrigated and high rainfall environments. There was a total of 55 experimental lines and five check cultivars, replicated twice to make a total of 120 plots. Twenty-three lines were selected from this test, and will enter the 2003 Durum 'B' Test, the final test prior to the Durum Cooperative Test.

In addition, we were able to expand our irrigated testing at Outlook to include three trials of F_7 and F_8 breeding lines, consisting of a total of 896 lines. These experimental lines come from crosses with semi-dwarf parents, and have potential for improvement of yield, straw strength, disease resistance, and protein content compared to AC Navigator, the only registered semi-dwarf variety. The best lines from these trials will be grown under irrigation in 2003. We hope to continue testing of new early-generation semi-dwarf lines at Outlook in 2003. Testing of this material under irrigation permits selection for straw strength and leaf diseases, and increases the chance of identification of good semi-dwarf varieties.

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

Oilseeds

Western Canada Irrigated Canola Co-operative Tests NI1 and NI2

R. Gadaou[1], C. Ringdal[2], T. Hogg[2]

***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 13. Due to poor emergence and severe flea beetle damage the tests were re-seeded on June 14. Plot size was 1.5 m x 6 m (5 ft x 20 ft). Nitrogen was applied at 112 kg/ha (100 lb/ac) as 46-0-0 and phosphorus was applied at 45 kg/ha (40 lb/ac) as 12-51-0. All fertilizer was side-banded at the time of seeding.

In the NI1 trial 00N269C, PHS01-412, RHY01/897, SWE5133 and PHS01-403 produced high yield and had better lodge resistance than the check variety Q2 (Table 1). In the NI2 trial RHY01/899, PR6327, PR6530, 00N304R, 00N276C and PHS01-401 had high yield and lodge resistance compared to the check Q2 (Table 2). Most new lines in both tests were later maturing and taller than the check.

Irrigated Canola Regional Variety Trial

C. Ringdal[2], T. Hogg[2]

The irrigated canola regional 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 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

***Progress**: Ongoing*

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

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

[1]Canola Council of Canada
[2]CSIDC, Outlook

Table 1. Yield and agronomic data for canola lines in the irrigated canola co-operative test NI1.

Entry	Yield % of Q2[1]	Maturity	Height (cm)	Lodge 0=erect; 9=flat
Q2	100	91	111	3.9
LoLinda	105	95	120	4.5
S9087	83	94	119	4.5
Z0715	81	93	120	8.8
6140	96	92	101	2.3
SWE5133	115	95	136	5.0
PR6284	99	95	114	2.8
46A65	100	93	107	4.0
PHS01-412	119	94	122	2.8
00N311R	107	94	119	4.8
RHY01/897	120	93	124	2.5
3609	99	91	104	4.0
G0118	108	91	115	1.0
PR6561	95	97	128	4.5
PR6309	98	94	107	2.5
CNH604R	99	97	118	4.0
CNH605R	107	96	124	4.0
00N269C	123	95	118	4.8
6757	88	93	112	1.5
NR00-1040	88	92	99	7.3
PHS01-403	113	96	139	3.3
CNH602R	85	96	126	1.8
PR6450	84	92	105	5.0
PR6003	67	95	108	8.7
PR6744	94	92	108	1.8
CV (%)	10.9	1.7	5.1	41.4

[1]Q2 yield = 4057 kg/ha (3615 lb/ac)

Canola varieties were tested for their agronomic performance under irrigation. The CSIDC site was seeded May 13, CSIDC off-station and Pederson sites on May 14, and the Ringdal site on May 24. The CSIDC off-station site was re-seeded on May 24 due to poor emergence. Plot size was 1.5 m x 4.0 m (5 ft x 13 ft). All plots received 112 kg N/ha (100 lb N/ac) as 46-0-0 and 45 kg P_2O_5/ha (40 lb P_2O_5/ac) as 12-51-0. Yields were estimated by harvesting the entire plot.

Table 2. Yield and agronomic data for the irrigated canola co-operative test NI2.

Entry	Yield % of Q2[1]	Maturity	Height (cm)	Lodge 0=erect; 9=flat
Q2	100	91	109	2.5
46A65	102	93	103	3.6
00N276C	114	94	111	2.5
00N296R	104	94	113	2.8
00N297R	104	94	104	3.0
00N304R	115	94	113	2.5
01N326R	103	94	120	3.3
3588	101	91	106	2.5
6045	88	94	107	3.5
NR00-1301	102	93	109	3.8
NR00-4026	93	92	107	1.0
PHS01-401	111	91	125	1.5
PR6327	116	92	115	1.5
PR6336	92	93	104	4.8
PR6366	82	93	108	2.3
PR6519	99	94	120	3.0
PR6530	115	92	109	2.5
PR6565	97	95	119	1.8
PR6572	82	95	123	2.0
PR6757	95	93	111	2.0
RHY01/1997	106	96	133	1.5
RHY01/597	99	94	107	2.0
RHY01/899	122	93	117	2.5
Y0318	102	92	108	3.0
CV (%)	14.2	1.9	6.2	54.4

[1]Q2 yield = 3756 kg/ha (3347 lb/ac)

Irrigated canola yield, height and lodge rating varied among the four sites (Table 3). Averaged over the four test sites, all canola varieties tested had lower yield than the check variety InVigor 2663.

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

Table 3. Yield and agronomic data for canola cultivars in the irrigated regional canola variety trials.

	Pederson site			Ringdal site			CSIDC off-station site			CSIDC site			Mean yield		
Variety	Yield (kg/ha)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Lodge rating[1]	kg/ha	bu/ac	% of InVigor 2663
InVigor 2663 (check)	3549	102	1.5	2779	88	3.0	4970	118	3.5	2626	96	2.8	3481	62.1	100
InVigor 2573	2812	112	1.8	3112	97	3.5	5470	120	3.5	2378	103	3.8	2793	49.8	80
InVigor 2773	3263	96	4.5	2688	101	2.5	4640	113	4.5	2583	90	5.8	3294	58.7	95
SP Admire	2559	95	2.0	2602	100	4.5	4920	107	3.8	2366	96	3.8	3112	55.5	89
SP Bobcat	2743	105	2.3	2225	92	2.3	4773	112	5.5	1062	110	1.8	2701	48.2	78
45A55	2869	97	4.5	1828	99	3.0	4501	109	5.8	1822	91	5.8	2755	49.1	79
45A77	3032	103	2.5	1725	97	3.5	4523	115	3.5	2074	95	3.3	2839	50.6	82
46A76	1908	101	2.0	1966	101	2.8	5167	115	1.5	1028	94	1.8	2517	44.9	72
IMC105	2592	88	3.3	2036	96	4.3	4232	105	6.0	2149	91	3.8	2752	49.1	79
IMC109	2550	88	2.8	2178	97	3.3	3978	110	8.8	1649	91	5.3	2589	46.2	74
DKL3235	2359	96	4.5	2130	98	3.8	4178	102	5.3	1569	86	4.5	2559	45.6	74
DKL34-55	2679	94	2.3	2607	90	3.5	4059	110	4.3	1909	87	3.8	2814	50.2	81
Hyola 519	1800	99	1.8	2321	104	3.5	4326	107	5.0	2478	98	3.0	2731	48.7	78
Hyola 505	2215	101	2.3	2517	97	4.3	5121	119	3.0	2560	107	3.0	3103	55.3	89
Hylite 289	2588	89	4.5	2353	97	4.5	4448	108	5.3	1788	92	6.8	2794	49.8	80
Q2	2209	90	2.5	1760	100	3.3	3907	109	6.3	1509	92	4.3	2346	41.8	67
CV (%)	12.4	4.9	32.6	31.4	10.4	44.9	9.9	5.9	29.6	20.3	4.8	25.4	-	-	-

[1]0 = erect; 9 = flat

Irrigated Flax and Solin Regional Variety Trial

C. Ringdal[1], T. Hogg[1]

***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 CSIDC and Pederson sites were seeded May 13 and 14 while the Ringdal site was seeded on May 24. Plot size was 1.5 m x 4.0 m (5 ft x 13 ft). All plots received 112 kg N/ha (100 lb N/ac) as 46-0-0 and 45 kg P_2O_5/ha (40 lb P_2O_5/ac) as 12-51-0. Yields were estimated by harvesting the entire plot.

Yield and height for irrigated oilseed flax and solin varied among the three sites (Table 4). Oilseed flax varieties, AC Lightning and CDC Normandy, had higher yield than the check variety CDC Bethune averaged over the three test sites. All other oilseed varieties and solin varieties had yield lower than the check. The solin varieties tested were lower yielding than the oilseed varieties.

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

Table 4. Yield and agronomic data for flax and solin cultivars in the irrigated regional flax and solin variety trials.

Variety	Pederson site Yield (kg/ha)	Pederson site Height (cm)	Ringdal site Yield (kg/ha)	CSIDC site Yield (kg/ha)	CSIDC site Height (cm)	Mean yield kg/ha	Mean yield bu/ac	Mean yield % of CDC Bethune
Oilseed Flax								
CDC Bethune (check)	2887	64	1872	3379	62	2713	43.2	100
AC Carnduff	2671	55	1649	3002	58	2441	38.9	90
AC Lightning	3273	62	1372	2885	57	2177	34.7	80
AC Watson	2848	56	1812	3264	52	2641	42.0	97
CDC Arras	2688	55	1961	3163	58	2604	41.4	96
CDC Normandy	3040	62	2015	3252	56	2769	44.1	102
CDC Valour	2717	58	1708	2661	54	2362	37.6	87
AC Hanley	2603	54	1883	3102	52	2529	40.3	93
Macbeth	2749	60	1685	3011	57	2482	39.5	91
FP2024	2813	61	2111	3256	59	2727	43.4	101
CDC Mons	2727	53	2440	3060	54	2742	43.6	101
Taurus	2612	57	1978	3113	60	2568	40.9	95
Vimy	2657	57	2330	3091	55	2693	42.9	99
Solin								
Linola 1084	2298	59	1567	2831	61	2232	35.5	82
Linola 989	2288	61	1716	2384	57	2129	33.9	78
Linola 2047	2184	53	2169	3006	55	2453	39.0	90
SP2099	2515	59	1343	3144	62	2334	37.2	86
SP2100	2330	54	1657	2894	50	2294	36.5	95
CV (%)	10.7	5.4	19.6	10.3	4.9	-	-	-

Specialty Crops

Specialty Crops

Pulse Crop Program

The pulse crop program at the 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

Irrigated Dry Bean Agronomy: Nitrogen Management for Contrasting Cultivars

T. Hogg[1], C. Ringdal[1]

***Progress**: Year one of two*

***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. As such, it requires the application of starter nitrogen fertilizer in order to promote early growth and produce optimum yield. Large nitrogen applications may reduce the nitrogen fixing capacity of the *Rhizobium* (bacterial inoculant). 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 2002 at the 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; 0, 22, 44 and 66 lb N/ac) 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 (3-4 plants/ft^2) using a 40 cm (16 in) 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 (8 ft x 24 ft).

[1]*CSIDC, Outlook*

Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N (0-60 cm; 0-24 in) = 35 kg N/ha (32 lbs/ac). Current soil test recommendations indicated the requirement for 22-33 kg N/ha (20-30 lbs N/ac) for irrigated dry bean.

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 - 47 days; Othello - 53 days. Differences in days to maturity between the varieties was consistent with varietal evaluation observations and was 98 days for CDC Pintium and 109 days for Othello (Table 1). For CDC Pintium, maturity was delayed 1 to 2 days by the nitrogen applications. By contrast, nitrogen application had no effect on maturity of Othello.

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		Othello			CDC Pintium			Overall mean
(kg/ha)	(lb/ac)	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	109	109	109	96	96	96	102
25	22	109	110	110	99	99	99	104
50	44	109	109	109	98	98	98	104
75	66	109	109	109	97	97	97	103
Mean		109	109		98	98		
Mean		109			98			
CV (%)		1.5						

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

[1]not significant

Plant height at pod fill was significantly affected by cultivar, nitrogen rate and inoculant (Table 2). Othello produced significantly taller plants than CDC Pintium. There were no obvious trends in plant height among the nitrogen-inoculant treatment combinations for each cultivar.

The addition of nitrogen produced healthier and greener plant growth as indicated by the higher chlorophyll meter readings associated with the highest nitrogen application rate (Table 3). Chlorophyll meter readings were higher for Othello compared to CDC Pintium possibly indicating a difference in chlorophyll content and thus green color between the two cultivars.

There was no effect of the cultivar, nitrogen rate or inoculant treatments on dry bean dry matter yield (Table 4). Even though there were height differences among the treatments, this did not translate into differences in dry matter 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		Othello			CDC Pintium			Overall mean
(kg/ha)	lb/ac	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	65	77	71	41	49	45	58
25	22	76	77	77	49	60	54	65
50	44	63	70	66	48	55	51	59
75	66	71	69	70	50	48	49	59
Mean		69	73		47	53		
Overall mean		71			50			
CV (%)		3.6						

ANOVA	LSD (0.05)
Cultivar (C)	1
N Rate (N)	2
Inoculant (I)	1
C x N	2
C x I	2
N x I	2
C x N x I	3

Table 3. Effect of starter nitrogen rate and inoculant treatment on the SPAD chlorophyll meter reading of irrigated Othello and CDC Pintium pinto bean at the pod fill growth stage.

N rate		Othello			CDC Pintium			Overall mean
kg/ha	lb/ac	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	43.3	41.5	42.4	38	38.5	38.3	40.3
25	22	42	41.8	41.9	38.5	37	37.8	39.8
50	44	41.8	43	42.4	37.8	37	37.4	39.9
75	66	42.5	44.8	43.6	41.5	38.8	40.1	41.9
Mean		42.4	42.8		38.9	37.8		
Overall mean		42.6			38.4			
CV (%)		5.2						

ANOVA	LSD (0.05)
Cultivar (C)	1.1
N Rate (N)	1.5
Inoculant (I)	NS[1]
C x N	NS
C x I	NS
N x I	NS
C x N x I	NS

[1]not significant

Table 4. Effect of starter nitrogen rate and inoculant treatment on the dry matter yield of irrigated CDC Pintium pinto bean.

N rate		Othello						CDC Pintium						Overall Mean	
		Control		Inoculant		Mean		Control		Inoculant		Mean			
(kg/ha)	(lb/ac)	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
0	0	5169	4606	5094	4539	5131	4572	5756	5129	5113	4556	5434	4842	5283	4707
25	22	4891	4358	5650	5651	5316	4737	5750	5123	5675	5056	5713	5090	5514	4913
50	44	5819	5185	5500	4901	5659	5042	5988	5335	5856	5218	5922	5277	5791	5160
75	66	4956	4416	4956	4416	4956	4416	6431	5730	5875	5235	6153	5482	5555	4950
Mean		5231	4661	5300	4722	5266	4692	5981	5329	5630	5016	5806	5173		
CV (%)		20.3													

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

[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		Othello						CDC Pintium						Overall Mean	
		Control		Inoculant		Mean		Control		Inoculant		Mean			
kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
0	0	2696	2402	2691	2398	2694	2400	2696	2402	2256	2010	2476	2206	2585	2303
25	22	3005	2677	2440	2174	2722	2425	2867	2554	2924	2605	2896	2580	2809	2503
50	44	2541	2264	2684	2391	2613	2328	2674	2383	3038	2707	2856	2545	2734	2436
75	66	2779	2476	2803	2497	2791	2487	3099	2761	2770	2468	2935	2615	2863	2551
Mean		2755	2455	2654	2365	2705	2410	2834	2525	2747	2448	2791	2487		
CV (%)		13.1													

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

[1]not significant

Dry bean showed no significant yield response to cultivar, nitrogen application rate or inoculant (Table 5). There was a general trend of increased seed yield for the nitrogen applications over that of the control treatment. Current soil test recommendations for nitrogen application for irrigated dry bean indicated soil available nitrogen at this site to be insufficient, requiring the addition of 20-30 lb N/ac. The lack of response to higher nitrogen and inoculant treatments may have been influenced by cooler conditions later in the growing season.

Dry bean seed weight was significantly affected by cultivar (Table 6). CDC Pintium had higher seed weight compared to Othello. There was no significant effect of the starter nitrogen or inoculant treatments on seed weight. The cultivar seed weight differences were consistent with varietal evaluation observations.

The number of pods and seeds per plant were significantly affected by cultivar but not by nitrogen rate or inoculant. Othello produced more pods (Table 7) and seeds per plant (Table 8) than CDC Pintium. The higher seed weight for CDC Pintium probably compensated for the lower number of seeds produced thus resulting in no seed yield difference between the two cultivars.

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		Othello			CDC Pintium			Overall mean
(kg/ha)	lb/ac	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	350	343	346	401	397	399	373
25	22	350	345	347	394	397	395	371
50	44	346	340	343	386	389	387	365
75	66	347	349	348	397	385	391	369
Mean		348	344		394	392		
Overall Mean		71			50			
CV (%)		3.1						

ANOVA	LSD (0.05)
Cultivar (C)	6
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

[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		Othello			CDC Pintium			Overall mean
kg/ha	lb/ac	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	13	12	12	11	12	11	12
25	22	13	14	14	11	13	12	13
50	44	15	12	14	11	15	13	13
75	66	13	14	14	13	13	13	13
Mean		13	13		12	13		
Overall Mean		13			12			
CV (%)		14.4						

ANOVA	LSD (0.05)
Cultivar (C)	1
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

[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		Othello			CDC Pintium			Overall mean
kg/ha	lb/ac	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	56	53	54	45	49	47	50
25	22	58	63	60	45	52	48	54
50	44	64	51	57	45	63	54	56
75	66	59	63	61	54	52	53	57
Mean		59	57		47	54		
Overall Mean		58			50			
CV (%)		14.3						

ANOVA	LSD (0.05)
Cultivar (C)	4
N Rate (N)	NS[1]
Inoculant (I)	NS
C x N	NS
C x I	6
N x I	NS
C x N x I	11

[1]not significant

Irrigated Dry Bean Agronomy: Nitrogen Application Timing for Contrasting Cultivars

T. Hogg[1], C. Ringdal[1]

***Progress**: Year one of two*

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

Dry bean is generally considered a poor nitrogen fixing species. As such, it 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 development of diseases including 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 by nodule senescence. By applying 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 excessive vegetative growth.

A dry bean nitrogen fertilizer application time trial was established in the spring of 2002 at the CSIDC. Treatments included nitrogen applications at seeding, early flower, mid-late flower and early pod fill. Fifty kg N/ha (45 lbs N/ac) was 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 (3-4 seeds/ft^2) using a 40 cm (16 in) 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 (8 ft x 24 ft). Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N 0-60 cm (0-24 in) = 47 kg/ha (42 lbs/ac). Current soil test recommendations indicated the requirement for 6-17 kg N/ha (5-15 lb N/ac) for irrigated dry bean.

There was no effect of the nitrogen application times on days to 10% flower or maturity. Days to 10% flower and to maturity for each of the cultivars tested were as follows: Othello - 54 and 106 days, respectively; CDC Pintium - 48 and 98 days, respectively.

Dry bean morphological characteristics showed a significant response to the nitrogen applications (Table 9). Plant height, the number of pods per plant and the number of seeds per plant increased when nitrogen was applied at seeding as well as with the late nitrogen applications. The nitrogen applied at seeding produced significantly taller plants than the late nitrogen applications. There was no difference in plant height among the late nitrogen application times. Cultivar plant height differences were consistent with those observed in variety evaluation trials. There was no significant effect among the nitrogen application times or between cultivars on the number of pods per plant or the number of seeds per plant.

[1]*CSIDC, Outlook*

Table 9. Effect of nitrogen application time on the plant height, pods/plant and seeds/plant of irrigated Othello and CDC Pintium pinto bean.

Nitrogen application time	Plant Height (cm)			# Pods/Plant			# Seeds/Plant		
	Othello	CDC Pintium	Mean	Othello	CDC Pintium	Mean	Othello	CDC Pintium	Mean
Control	63	44	53	10	12	11	41	47	44
Seeding	76	53	64	13	14	13	51	55	53
Early Flower	68	50	59	13	13	13	51	51	51
Mid-Late Flower	68	51	59	12	14	13	49	56	53
Early Pod Fill	70	47	58	12	13	13	50	49	50
Mean	69	49		12	13		48	52	
CV (%)	4.9			9.2			12.1		
ANOVA	LSD (0.05)			LSD (0.05)			LSD (0.05)		
Cultivar (C)	2			NS			NS		
Time (T)	3			1			6		
C x T	NS[1]			NS			NS		

[1]not significant

Dry bean yield and seed weight showed a significant response to the nitrogen applications (Table 10). Nitrogen applied at seeding as well as the late nitrogen applications increased yield and seed weight above that of the control treatment. Highest seed yield was obtained when nitrogen was applied at early pod fill. The seed yield for the late nitrogen application at early pod was significantly higher than the seed yield when the nitrogen was applied at seeding or at early flower. Seed weight was highest for the nitrogen application at early flower and early pod fill. These results indicate that the increase in yield with nitrogen application was probably due to both an increase in the number of seeds produced as well as an increase in seed size. Othello pinto bean produced higher yield and lower seed weight than CDC Pintium pinto bean consistent with results observed in variety evaluation trials. These results indicate that the current soil test guidelines for nitrogen application for irrigated dry bean may need to be adjusted to obtain maximum yield.

Table 10. Effect of nitrogen applicaton time on the yield and seed weight of irrigated Othello and CDC Pintium pinto bean.

Nitrogen application time	Yield						Seed weight (mg)		
	Othello		CDC Pintium		Mean				
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	Othello	CDC Pintium	Mean
Control	2710	2415	2183	1945	2446	2179	325	370	347
Seeding	2829	2521	2710	2415	2769	2467	332	381	356
Early Flower	2956	2634	2575	2294	2766	2465	337	393	365
Mid-Late Flower	2943	2622	2655	2366	2799	2494	324	388	356
Early Pod Fill	3089	2752	2842	2532	2965	2642	338	391	364
Mean	2905	2588	2593	2310			331	384	
CV (%)	6.5						2.0		
ANOVA	LSD (0.05)			LSD (0.05)			LSD (0.05)		
Cultivar (C)	115 kg/ha			102 lb/ac			5		
Time (T)	182 kg/ha			162 lb/ac			7		
C x T	NS[1]			NS			NS		

[1]not significant

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

T. Hogg[1], C. Ringdal[1]

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

***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 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 the CSIDC. Treatments included CDC Pintium pinto bean at four seeding rates (20, 40, 60 and 80 seeds/m^2; 2.1, 4.3, 6.4 and 8.5 seeds/ft ^{2}) in combination with three nitrogen application rates (0, 50 and 100 kg N/ha; 0, 45 and 90 lb N/ac) 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 (16 in) row spacing and measured 2.4 m x 8 m (8 ft x 24 ft).

Soil analysis of samples collected in the spring prior to plot establishment indicated soil available NO_3-N (0-60 cm; 0-24 in) = 39 kg N/ha (35 lbs/ac). Current soil test recommendations indicated the requirement for 17-28 kg N/ha (15-25 lbs N/ac) for irrigated dry bean.

Plant stand increased as the seeding rate increased (Table 11). The targeted plant population was not achieved at the higher seeding rates possibly due to increased plant competition at higher plant densities. Nitrogen application rate had no effect on plant stand.

Vegetative growth of the CDC Pintium pinto bean was significantly affected by nitrogen rate but not by seeding rate. The CDC Pintium plants grew taller as the nitrogen application rate was increased (Table 11). Plant height increased significantly with each 50 kg N/ha (45 lb N/ac) increment. Dry matter yield and Leaf Area Index (LAI), an indication of vegetative plant growth, at the pod fill growth stage increased with each 50 kg N/ha (45 lb N/ac) increment of applied nitrogen fertilizer (Table 12). 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 higher photosynthetic activity and potentially higher yield.

[1]*CSIDC, Outlook*

Table 11. Effect of seeding rate and nitrogen application rate on the plant stand and plant height of CDC Pintium pinto bean.								
	Plant Stand (plants/m²)				Plant Height (cm)			
	Nitrogen rate (kg N/ha)				Nitrogen rate (kg N/ha)			
Seeding rate (seeds/m²)	0	50	100	Mean	0	50	100	Mean
20	22	24	24	23	43	49	55	49
40	32	31	33	32	39	54	58	50
60	40	39	46	41	42	51	53	49
80	45	46	50	47	45	51	54	50
Mean	34	35	38		42	51	55	
CV (%)	22.8				7.5			
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	7				NS			
Nitrogen rate (N)	NS[1]				3			
SR x N	NS				NS			

[1]not significant

Table 12. Effect of seeding rate and nitrogen application rate on the dry matter yield and leaf area index at the pod fill growth stage for irrigated CDC Pintium pinto bean.												
	Dry matter yield (kg/ha)				Dry matter yield (lb/ac)				Leaf area index			
	Nitrogen rate (kg N/ha)				Nitrogen rate (lb N/ac)				Nitrogen rate (kg N/ha)			
Seeding rate (seeds/m²)	0	50	100	Mean	0	45	90	Mean	0	50	100	Mean
20	5819	6550	7488	6619	5185	5836	6672	5898	2.3	3.3	3.3	2.9
40	4681	6475	7138	6098	4171	5769	6360	5433	2.5	3.0	3.8	3.1
60	5575	5863	7013	6150	4967	5224	6249	5480	2.5	3.0	3.8	3.1
80	5275	6369	7138	6260	4700	5675	6360	5578	2.8	3.0	3.8	3.2
Mean	5338	6314	7194		4756	5626	6410		2.5	3.1	3.6	
CV (%)	13.2				13.2				17.1			
ANOVA	LSD (0.05)				LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	NS[1]				NS				NS			
Nitrogen rate (N)	598				532				0.4			
SR x N	NS				NS				NS			

[1]not significant

Days to flower showed a slight decrease with increased seeding rate and no effect of nitrogen application rate. The stands with a higher plant population matured one to two days earlier than the thinner stands (Table 13). More lush vegetative growth associated with the higher nitrogen applications delayed maturity by four to five days.

Seed yield was significantly affected by both seeding rate and nitrogen rate (Table 14). Seed yield increased up to a targeted plant population of 80 seeds/m² (8-9 seeds/ft²) (actual plant population of 47 plants/m² {5 plants/ft²}) . This plant population is higher than that recommended for Type III indeterminate sprawling vine growth habit dry bean varieties that are currently grown for commercial production under irrigated conditions. This indicates that dry bean varieties with Type I determinate upright growth habit, such as CDC Pintium pinto bean, may require a higher seeding rate to achieve maximum yield under irrigated growing conditions. Seed yield increased with each 50 kg N/ha increment applied. The first 50 kg N/ha (45 lb N/ac) increment, from 0 to 50 kg N/ha (0 to 45 lb/ac), produced a 12% seed yield increase while the second 50 kg N/ha (45 lb N/ac) increment, from 50 to 100 kg N/ha (45 to 90 lb N/ac), produced a 7% seed yield increase. The response to nitrogen was greater than that predicted by the current soil test recommendations indicating that these guidelines may have to be adjusted for some of the new varieties that are being released.

The size of the CDC Pintium pinto bean seed produced decreased as seeding rate increased and increased as nitrogen application 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. Seed size increased as the rate of nitrogen applied increased indicating that part of the increase in seed yield could probably be attributed to an increase in seed size.

Table 13. Effect of seeding rate and nitrogen application rate on the days to flower and days to maturity of CDC Pintium pinto bean.

Seeding rate (seeds/m^2)	Days to Flower				Days to Maturity			
	Nitrogen rate (kg N/ha)				Nitrogen rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	48	49	49	49	97	100	101	99
40	47	47	48	47	95	99	100	98
60	47	47	47	47	95	99	99	98
80	47	47	47	47	95	97	99	97
Mean	47	48	48		95	99	100	
CV (%)	2.9				1.2			
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	1				1			
Nitrogen rate (N)	NS[1]				1			
SR x N	NS				NS			

[1]not significant

Table 14. Effect of seeding rate and nitrogen application rate on the yield of CDC Pintium pinto bean.

Seeding rate (seeds/m^2)	Yield (kg/ha)				Yield (lb/ac)			
	Nitrogen rate (kg N/ha)				Nitrogen rate (kg N/ha)			
	0	50	100	Mean	0	45	90	Mean
20	1845	2233	2499	2192	1644	1990	2227	1953
40	2370	2630	3030	2677	2112	2343	2700	2385
60	2634	2911	2928	2824	2347	2594	2609	2516
80	2896	3142	3217	3085	2580	2800	2866	2749
Mean	2436	2729	2918		2170	2432	2600	
CV (%)	6.5				6.5			
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	146				130			
Nitrogen rate (N)	126				112			
SR x N	NS[1]				NS			

[1]not significant

The production index, a measure of seed multiplication efficiency, decreased as the seeding rate was increased (Table 15). Doubling the seeding rate from 20 to 40 seeds/m^2 (2-4 seeds/ft^2) reduced the production index by approximately 40% (Table 15). The number of pods per plant and thus the number of seeds per plant increased as the seeding rate decreased (Table 16). This would indicate that with limited availability of seed, the greatest efficiency in seed multiplication can be obtained at low seeding rate. A significant interaction between seeding rate and 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 15. Effect of seeding rate and nitrogen application rate on the seed weight and production index of CDC Pintium pinto bean.

Seeding rate (seeds/m^2)	Seed weight (mg)				Production index			
	Nitrogen rate (kg N/ha)				Nitrogen rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	386	392	402	393	23	28	31	27
40	377	377	387	380	15	16	19	17
60	365	376	379	373	11	12	12	12
80	374	372	371	372	9	10	10	10
Mean	376	379	385		14	16	18	
CV (%)	2.2							
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	1				1			
Nitrogen rate (N)	6				1			
SR x N	NS[2]				2			

[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	14	19	19	17	54	70	81	68
40	9	12	12	11	38	45	47	42
60	9	11	9	9	34	40	32	36
80	7	7	8	7	27	30	30	29
Mean	9	12	12		37	46	48	
CV (%)	12.3				13.2			
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	1				5			
Nitrogen rate (N)	1				4			
SR x N	2				8			

Seed Production of CDC Pintium Pinto Bean under Irrigated Conditions: Timing of Fungicide Application for White Mold Control

T. Hogg[1], C. Ringdal[1]

***Progress**: Year two of two*

***Objective:** To determine the effect of timing of fungicide application for the control of white mold during seed multiplication of CDC Pintium pinto bean under irrigated conditions.*

The requirement of fungicide application for white mold control on Type I, determinate upright dry bean varieties grown under irrigated conditions is not known. The shorter flowering period during the growing season and the upright growth habit may require only one fungicide application compared to the current practice of using two fungicide applications on high yielding Type III dry bean varieties that have indeterminate growth habit. This would result in lower production costs and higher returns for the irrigation producer.

A dry bean white mold control trial was established in the spring of 2002 at the CSIDC. Treatments included four fungicide application times (control, 10% flower, 50% flower and 10% + 100% flower). The fungicide, Benlate (benomyl), was applied at a rate of 0.9 kg/ac (0.4 lb/ac) in a carrier water volume of 45 L/ac (10 gal/ac). CDC Pintium pinto bean was row crop seeded at a target plant population of 30 plants/m^2 (2.8 plants/ft^2) using a 40 cm (16 in) row spacing. The fungicide application treatments were arranged in a randomized complete block design with four replicates. Standard fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. Each treatment measured 2.4 m x 12.2 m (8 ft x 40 ft).

White mold was present in the trial probably as a result of the cool, moist conditions during part of the growing season. The incidence and severity of white mold was significantly greater for the control treatment where no fungicide was applied compared to the treatments that received fungicide application (Table 17). There was no significant difference in white mold incidence or severity for the treatments that received a fungicide application. There was no significant difference in seed yield or seed weight among the treatments. However, fungicide application tended to produce higher yields and larger seeds compared to the control treatments.

Further work is required before recommendations can be made regarding the application timing of fungicide for white mold control on Type I upright determinate dry bean varieties grown under irrigated conditions.

Table 17. Effect of fungicide application time on the white mold disease rating, yield and seed weight of irrigated CDC Pintium pinto bean.

Fungicide application time	White mold disease rating[1]		Yield (kg/ha)	Seed weight (mg)
	Incidence (0-5)[2]	Severity (0-5)		
Control	2.5	3.7	1711	349
10% Flower	0.7	1.3	1906	371
50% Flower	0.3	1.0	1767	373
10% + 100% Flower	0.3	0.7	1831	369
LSD (0.05)	0.8	1.4	NS[3]	NS
CV (%)	70.2	66.9	19.3	4.2

[1]ANOVA performed using $\sqrt{(x+0.5)}$ transformation
[2]0=no disease; 5=total infection
[3]not significant

[1]CSIDC, Outlook

Control of Common Blight and Halo Bacterial Blight in Dry Bean during Seed Multiplication

T. Hogg[1], L. Shaw[2], C. Ringdal[1]

Progress: *Year three of three*

Objective: *To evaluate the effect of chemical control on common blight and halo blight during seed multiplication of dry bean grown under sprinkler irrigation conditions.*

Bacterial blight (common blight, halo blight and brown spot) can be carried in the dry bean seed. The use of quality pedigree, disease-free seed is the best means of control. Wind and water droplets spread bacteria rapidly through a field. Plants grown under dry conditions generally have minimal bacterial infection. Thus, disease free seed is more likely to be produced under semi-arid conditions or in irrigated areas with low humidity, such as furrow irrigation. Under sprinkler irrigation conditions, the use of foliar copper bactericide applications may help prevent the development and spread of bacterial blight.

A dry bean blight control trial was established in the spring of 2002 at the CSIDC. Several Kocide 101 (50% metallic copper equivalent) treatments were examined in this study:

1. Control - no Kocide application
2. One application - applied when conditions conducive to disease development at pre-flower growth stage
3. Two applications - applied when conditions conducive to disease development at pre-flower growth stage + a 2nd application 7-10 days later
4. Three applications - applied when conditions conducive to disease development at pre-flower growth stage + two subsequent applications at 7-10 day interval.
5. Four applications - applied when conditions conducive to disease development at pre-flower growth stage + three subsequent applications at 7-10 day interval.

The Kocide foliar application treatments were arranged in a randomized complete block design with six replicates. The Kocide was applied at a rate of 1.3 kg/ha in 90 L/ac water (1.2 lb/ac in 20 gal/ac) using a small plot push type CO_2 propellant sprayer. The Kocide applications were initiated at the pre-flower growth stage and continued at 7-10 day intervals until the total number of applications indicated in the treatments were applied. A commercial seed lot of Othello pinto bean was seeded at a target plant population of 35 plants/m^2 (3.3 plants/ft^2) using a 40 cm (16 in) row spacing. Each treatment consisted of two passes with the drill and measured 2.4 m x 8 m (8 ft x 24 ft).

A visual estimation of bacterial blight during the growing season indicated the presence of blight on the leaves and pods of the irrigated Othello pinto bean. The incidence of bacterial blight as indicated by the leaf area infected at maturity showed a significant effect of the foliar Kocide applications (Table 18). There was a trend of decreasing leaf blight incidence with an increase in the number of Kocide applications (Figure 1). The % leaf area infected with bacterial blight was significantly reduced with one application of Kocide compared to the control treatment. There was a further significant reduction with a second application of Kocide. Leaf blight incidence although lower for three and four Kocide applications was not significantly reduced compared to two applications. The incidence of bacterial blight as

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

indicated by the pod area infected at maturity showed no significant effect of the foliar Kocide applications. Blight infection on pods was low compared to that on the leaves.

There was no significant effect of the foliar Kocide application on the yield or seed weight of the irrigated Othello pinto bean (Table 18).

Dome Test disease results for blight infection in the Othello pinto bean seed indicated a slightly higher rating for the control treatment than that for the Kocide treatments, however, the difference was not significant (Table 19). All treatments had a relatively low Dome Test rating indicating low blight infection.

Even though bacterial blight was present on the foliage and pods of the Othello pinto bean, the bacteria did not appear to be transferred to any great extent to the seed. Further work is needed to determine the conditions required to control bacterial blight during dry bean seed multiplication under sprinkler irrigated conditions.

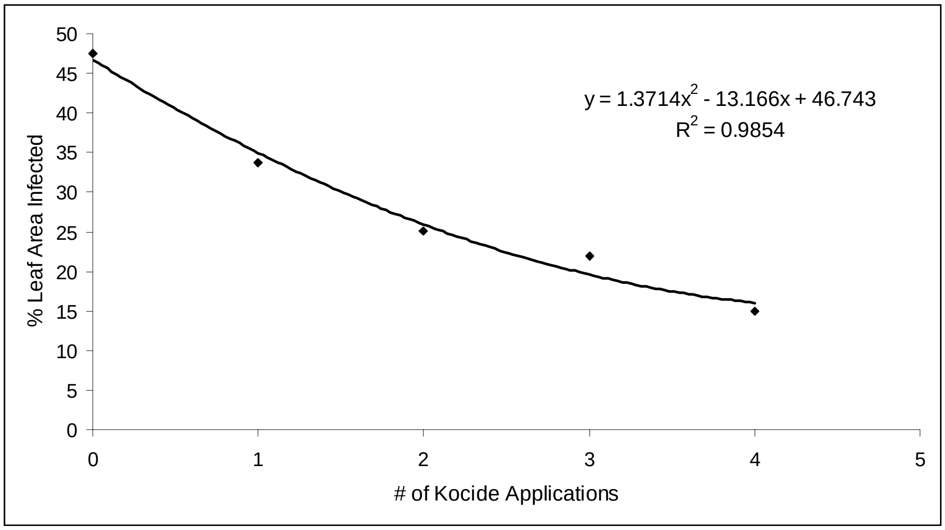


Figure 1. Effect of the number of Kocide applications on leaf blight infection of Othello pinto bean.

Table 18. Effect of Kocide applications on bacterial blight incidence on leaves and pods, seed yield and seed weight of irrigated dry bean.

Kocide Treatment	Bacterial Blight Incidence		Seed Yield		Seed Weight (mg)
	% Leaf Area[1]	% Pod Area[1]	kg/ha	lb/ac	
Control	47.5	0.5	3149	2806	343
1 application	33.7	0.4	3322	2960	348
2 applications	25.1	0.2	3189	2841	346
3 applications	21.9	0.4	3207	2857	347
4 applications	15	0.2	3067	2733	340
CV(%)	16	15.2	6		2.5
LSD (0.05)	11	NS[2]	NS		NS

[1]ANOVA performed using $\sqrt{(x+0.05)}$ transformation
[2]not significant

Table 19. Effect of Kocide applications on Dome Test disease rating of irrigated dry bean seed.

Kocide Treatment	Dome Test				
	Total # leaves developed (range)	Total # infected leaves (range)	Total # samples with Blight	Rating[1]	
				Range	Mean
Control	14-58	0-7	3	0-3	0.8
1 application	54-60	0-2	1	0-1	0.2
2 applications	54-60	0	0	0	0
3 applications	50-60	0-8	2	0-1	0.3
4 applications	30-56	0-3	2	0-1	0.3
CV (%)	-	-	-	-	0.3
LSD (0.05)	-	-	-	-	NS[2]

[1]ANOVA performed using $\sqrt{(x+0.05)}$ transformation
[2]not significant

Ascochyta Blight in Chickpea: Effects of Ground Spray Application Delivery Method on Disease Control

G. Chongo[1], S. Banniza[1], T. Wolfe[2], T. Hogg[3], C. Ringdal[3]

Progress: *Year two of two*

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

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. 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 improved varieties become available that do not rely on fungicide applications, there is a need for efficient fungicide application strategies for chickpea.

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. Better coverage may also be obtained with higher carrier water volume.

Two chickpea foliar disease management trials were established in the spring of 2002 at the CSIDC. Chickpeas were seeded at a target plant population of 45 plants/m^2 (4.2 plants/ft^2). Each treatment measured 2.4 m x 10 m (8 ft x 33 ft). For all trials the first fungicide application was given at the first sign of disease symptoms. The second fungicide application was done 10-14 days later.

1. Spray Droplet Size Trial

Treatments included three foliar fungicides: Bravo 500 (chlorothalonil) at 1000 g a.i./ha; Quadris (azoxystrobin) at 125 g a.i./ha; Headline (pyrachlostrobin) at 100 g a.i./ha; 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 with four replicates. Separate trials were conducted for Sanford (unifoliate leaf type) kabuli and Myles (fern leaf type) desi chickpea.

[1]*Dept. of Plant Sciences, University of Saskatchewan, Saskatoon*
[2]*AAFC, Research Centre, Saskatoon*
[3]*CSIDC, Outlook*

2. Carrier Water Volume Trial

Trial 1 - Bravo 500/Quadris Combination
Treatments included a combination of Bravo 500 (chlorothalonil) at 1000 g a.i./ha applied as the first application followed by Quadris (azoxystrobin) at 125 g a.i./ha applied as the second fungicide application, three carrier water volumes (100, 200 and 300 L/ha; 9 gal/ac, 18 gal/ac, 27 gal/ac) and an untreated control. The fungicides were applied using standard flat fan nozzles at a pressure of 275 kPa (40 psi). The treatments were arranged in a randomized complete block design with four replicates. Separate trials were conducted for Sanford kabuli and Myles desi type chickpea.

Trial 2 - Fungicide
Treatments included four foliar fungicides (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; BAS510F (boscalid) - 300 g a.i./ha), three carrier water volumes (100 l/ha, 200 l/ha and 300 l/ha; 9 gal/ac, 18 gal/ac, 27 gal/ac) and an untreated control. The fungicides were applied using standard flat fan nozzles at a pressure of 275 kPa (40 psi). The treatments were arranged in a factorial randomized complete block design with four replicates. CDC Yuma (fern leaf type) kabuli chickpea, was used as the test crop.

The cool and dry spring conditions resulted in late seeding, delayed emergence and subsequently slow development of ascochyta blight. Ascochyta blight was low at the first two ratings conducted in late June and early July, but increased rapidly at the fourth rating conducted in early August. The late increases in blight severity resulted from cool and wet weather with frequent rains at the end of the growing season. Ascochyta blight severities in the untreated plots reached a level of 78% in Myles desi chickpea (Table 20) and 100% in Sanford kabuli chickpea (Table 21). Fungicide treatments reduced disease severity in Myles desi chickpea to 33-48% but was 100% in Sanford kabuli chickpea regardless of fungicide. Fungicide treatments also significantly increased seed yield compared to the check with Myles desi chickpea producing higher yields than Sanford kabuli chickpea.

Table 20. Effects of fungicides and spray droplet size on ascochyta blight percent, seed yield and seed weight in Myles desi chickpea.

Fungicide	Droplet Size[1]	Disease Severity (%)[2]					Yield		Seed weight (mg)
		June 26[3]	July 8	Aug 2	Aug 19	Sept 11	kg/ha	lb/ac	
Check	-	2	24	53	79	78	235	209	84
Bravo 500	Fine	2	17	11	38	48	856	762	107
Bravo 500	Medium	2	16	14	44	44	903	804	105
Bravo 500	Coarse	2	12	15	40	45	1073	955	112
Quadris	Fine	2	16	5	16	38	952	847	110
Quadris	Medium	2	14	5	19	37	1099	978	120
Quadris	Coarse	2	19	8	27	39	1235	1099	102
Headline	Fine	2	8	3	7	24	1551	1380	130
Headline	Medium	2	9	3	9	29	1374	1223	129
Headline	Coarse	2	11	4	18	33	1411	1256	116
LSD (0.05) Fungicides		--	4	3	5	4	247	220	5
LSD (0.05) Nozzle		--	4	3	5	4	247	220	5
LSD (0.05) Interaction		--	9	7	10	9	493	439	11

[1]Fine -Lurmark Twin Cap XR8001; Medium -Standard XR8002; Coarse -Venturi Air Bubble Jet 1002.
[2]Disease ratings were assessed through visual ratings using the 0-11 Horsfall-Barratt scale then converted to percent severity
[3]Plots seeded May 17. Fungicides applied June 27 and July 10

Table 21. Effects of fungicides and spray droplet size on ascochyta blight percent, seed yield and seed weight in Sanford Kabuli chickpea.

Fungicide	Droplet size[1]	Disease severity (%)[2]					Yield		Seed weight (mg)
		June 26[3]	July 8	Aug 2	Aug 19	Sept 11	kg/ha	lb/ac	
Check	-	2	24	88	97	100	31	28	66
Bravo 500	Fine	2	17	29	81	100	81	72	89
Bravo 500	Medium	2	16	32	89	100	80	71	92
Bravo 500	Coarse	2	12	46	89	100	137	122	99
Quadris	Fine	3	16	20	72	100	151	134	114
Quadris	Medium	3	14	16	67	100	216	192	107
Quadris	Coarse	2	19	17	67	100	151	134	107
Headline	Fine	3	8	4	28	100	271	241	110
Headline	Medium	2	9	5	33	100	272	242	121
Headline	Coarse	3	11	6	63	100	230	205	116
LSD (0.05) Fungicides		0.2	4	6	6	-	6	5	14
LSD (0.05) Nozzle		0.2	4	6	6	-	6	5	14
LSD (0.05) Interaction		0.3	9	13	13	-	12	11	28

[1]Fine -Lurmark Twin Cap XR8001; Medium -Standard XR8002; Coarse -Venturi Air Bubble Jet 11002.
[2]Disease ratings were assessed through visual ratings using the 0-11 Horsfall-Barratt scale then converted to percent severity
[3]Plots seeded May 17. Fungicides applied June 27 and July 10

Generally, no significant differences were observed in disease severity by using different spray droplet sizes/nozzle types in both Myles desi and Sanford kabuli chickpea.

In the water volume trials, in the untreated plots, the final blight severity was high with a rating of 77% for Myles desi chickpea and 100% for Sanford kabuli chickpea (Table 22) and 92% for CDC Yuma kabuli chickpea (Table 23) in the untreated plots. These blight levels were reduced significantly with the fungicide applications to 48-52% for the Myles desi and 27-53% for the CDC Yuma kabuli chickpea. Sanford kabuli chickpea final disease severity was 100% one month before harvest regardless of fungicide treatment. Each fungicide significantly reduced blight and increased yield in all cultivars relative to that of the check, however, yields were relatively low (0-789 kg/ha; 0-703 lb/ac) due to unfavourable weather conditions at the end of the growing season. A relative best performance ranking of fungicides in controlling blight was Headline > Quadris > Bravo 500, BAS510F. Increasing water volume from 100 to 300 L/ha significantly reduced blight severity for each fungicide on CDC Yuma kabuli chickpea and Myles desi chickpea at the final disease rating due to better coverage. However, this did not result in increased yields because of the cool wet weather which negatively affected pod fill and maturity at the end of the growing season. The ranking of carrier volume in controlling blight was 100 L/ha < 200 L/ha < 300 L/ha.

These results indicate that the fern type desi (Myles) and Kabuli (CDC Yuma) chickpeas are less susceptible to blight than the unifoliate kabuli (Sanford) chickpeas. These differences also influence the effectiveness of each fungicide. Under high disease pressure, two applications of any fungicide are not adequate to protect Sanford kabuli chickpea. In addition, these results also indicate that increasing the fungicide carrier volume improves disease control through better spray coverage and therefore, carrier volume is more important than spray droplet size.

Attention to cultivar selection and spray volume should be important factors to chickpea growers if they are to reduce costs and maximize returns.

Table 22. Effects of Bravo 500/Quadris fungicide combination and water volume on ascochyta blight percent, seed yield and seed weight in chickpea.									
Cultivar	Water volume (L/ha)	Disease severity (%)[1]					Yield		Seed weight (mg)
		June 26[2]	July 8	Aug 2	Aug 19	Sept 11	kg/ha	lb/ac	
Myles	Check	2	4	60	76	77	245	218	67
	100	2	3	10	34	52	663	590	95
	200	2	2	5	24	43	704	627	101
	300	2	2	3	15	38	789	702	122
LSD (0.05)		--	2	6	11	8	312	278	8
Sanford	Check	3	20	94	98	100	8	7	59
	100	3	15	35	89	100	173	154	98
	200	4	13	27	88	100	96	85	92
	300	3	8	15	81	100	270	240	116
LSD (0.05)		1	9	9	5	--	132	117	10

[1]Disease ratings were assessed through visual ratings using the 0-11 Horsfall-Barratt scale then converted to percent severity

[2]Plots seeded May 17. Bravo 500 applied at 1000 g a.i./ha on June 27 followed by Quadris at 125 g a.i./ha on July 10

Table 23. Effects of fungicides and water volume on ascochyta blight percent, seed yield and seed weight in CDC Yuma kabuli chickpea.									
Fungicide	Water volume (L/ha)	Disease severity (%)[1]					Yield		Seed weight (mg)
		June 26[2]	July 8	Aug 2	Aug 19	Sept 11	kg/ha	lb/ac	
Check	Check	2	3	88	89	92	38	34	144
Bravo + Quadris	100	2	5	11	36	54	245	218	203
Bravo + Quadris	200	2	4	14	36	49	228	203	240
Bravo + Quadris	300	2	4	6	33	38	166	148	212
Quadris	100	2	3	16	34	53	240	214	236
Quadris	200	2	4	7	25	42	324	288	231
Quadris	300	2	5	3	16	38	439	391	271
BAS510F	100	2	3	19	35	53	265	236	219
BAS510F	200	2	4	8	31	44	240	214	218
BAS510F	300	2	3	9	37	44	257	229	204
Headline	100	2	4	4	19	42	421	375	212
Headline	200	2	4	4	14	33	418	372	236
Headline	300	2	2	2	12	27	301	268	238
LSD (0.05) Fungicide		--	1	4	7	3	96	85	14
LSD (0.05) Water Volume		--	1	3	6	3	86	76	13
LSD (0.05) Interaction		--	2	8	14	6	192	171	28

[1]Disease ratings were assessed through visual ratings using the 0-11 Horsfall-Barratt scale then converted to percent severity

[2]Plots seeded May 17. Fungicides applied June 27 and July 10

Varietal Investigations

Bean and Pea Preliminary Yield Trials

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

***Progress**: Ongoing*

***Location:** Outlook*

***Objective:** To develop high yielding, early maturing, disease resistant yellow, green, and specialty pea varieties for Saskatchewan.*

Pea Trials

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

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 2002 Prairie Dry Bean Narrow Row Co-op Trials (A with 18 entries; B with 36 entries) were also grown. Trial A included black and small red market class entries while Trial B included pinto, great northern, pink, bayo and sapito market class entries. Conditions were good for full expression of yield potential, maturity, pod clearance and bacterial blight resistance (Tables 24 and 25). Data from these trials were combined with those from other locations to decide which lines to advance to the 2003 registration and elite trials.

***Progress**: Ongoing*

***Location:** Outlook*

***Objective:** To develop high yielding, dry bean varieties adapted for Saskatchewan.*

[1]Crop Development Centre, U of S, Saskatoon, Saskatchewan
[2]CSIDC, Outlook

Table 24. Irrigated Narrow Row Prairie Dry Bean Co-operative Trial A: Yield potential and growth characteristics of 'black' and small red drybean germplasm.

Variety	Yield % of check[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 0=erect 5=flat	Pod clearance[3] (%)
Black							
CDC Nighthawk (check)	100	157	55	103	64	1	78
AC Black Diamond	178	242	52	100	63	1	78
316-11	92	183	52	104	47	1	78
316-13	118	197	53	103	46	1	78
Small Red							
AC Redbond (check)	100	282	51	100	58	1	80
L98D347	98	292	56	105	53	2	75
737-7	91	286	52	100	56	3	67
737-84	94	291	51	101	50	3	68
737-22	98	285	52	102	60	2	70
1045T-3	106	304	51	102	58	3	67
802-22	91	294	54	100	49	3	68
804-10	92	276	52	98	56	2	68
804-6	103	285	52	98	49	3	68
805-9	96	305	51	97	52	2	70
855-2	88	300	51	99	60	2	68
855-3	85	315	51	100	54	3	70
1030S-3	103	340	55	102	68	2	77
859-14	103	287	51	100	59	2	67
SE	190	-	-	-	-	-	-
CV (%)	9.5	-	3.1	1.6	4.7	21.0	5.5

[1]Yield of CDC Nighthawk = 2000 kg/ha (1782 lb/ac); Yield of AC Redbond = 3165 kg/ha (2820 lb/ac)
[2]50% of pods are buckskin color
[3]Pods>5 cm (2 in) above ground surface

Table 25. Irrigated Narrow Row Prairie Dry Bean Co-operative Trial B: Yield and growth characteristics of new dry bean germplasm.

Variety	Yield % of check[1]	Seed weight (mg)	Days to flower	Days to maturity[3]	Plant height (cm)	Lodging 0=erect 5=flat	Pod clearance[4] (%)	Seed Quality (1-5)
Pink								
Viva (check)	100	238	54	105	48	2.0	54	2
504AA-8	107	253	52	106	58	2.0	63	2
L98C280	129	267	52	101	64	2.0	63	3
722-8	106	381	50	105	58	2.0	70	3
1046-2	125	278	51	102	48	3.0	62	3
1042S-1	118	273	54	102	47	3.0	65	3
799-12	119	297	52	106	40	3.0	65	2
801-27	90	286	54	104	64	2.0	75	2
Pinto								
CDC Pintium (check)	100	333	48	98	47	1.0	85	3
Othello	112	369	54	107	61	2.0	57	2
95-83-10	106	412	52	104	58	2.0	68	2
335-8	79	318	54	102	54	1.0	78	3
SC11745-3	110	382	49	101	44	2.0	70	2
657-3-2	107	368	48	100	48	1.0	72	3
699-77	101	345	50	100	54	1.0	75	3
610-8	100	330	47	96	42	1.0	75	3
794-1	95	333	52	104	60	3.0	72	2
828A-4	101	328	52	104	64	2.0	78	2
892M-3	105	313	51	102	59	2.0	77	3
841-8	106	353	50	100	49	1.0	80	2
810-78	71	353	49	100	51	1.0	74	2
841-14	107	322	54	102	59	1.0	75	2
841-20	97	344	55	107	64	2.0	76	1
786-9	115	333	51	104	46	3.0	63	2
841-1	104	328	51	101	55	1.0	78	2
564-3	72	340	55	106	52	1.0	70	1
Great Northern								
CDC Crocus (check)	100	175	49	102	55	2.0	64	2
AC Polaris	99	270	51	101	48	2.0	73	2
L98E212	95	292	51	102	65	1.0	75	2
L99E244	76	305	56	105	60	2.0	72	2
L99E247	84	309	55	104	57	3.0	75	2
L99E255	91	308	54	104	57	3.0	72	2
Sapito[2]								
SC11745-24	72	268	49	96	38	1.0	77	-
Bayo[2]								
DC11730-21	76	261	49	98	44	1.0	67	-
610-23	107	303	52	104	55	1.0	78	-
534-2	108	377	48	102	47	1.0	63	-
SE	298	-	1	1	1	0.5	-	-
CV (%)	23.5	-	3.3	1.7	4.0	26.0	6.5	-

[1]Yield of check: Viva = 2538 kg/ha (2261 lb/ac); CDC Pintium = 2833 kg/ha (2524 lb/ac); CDC Crocus = 3205 kg/ha (2856 lb/ac)
[2]CDC Pintium used as check
[3]50% of pods are buckskin color
[4]Pods>5 cm (2 in) above ground surface

Dry Bean Narrow Row Regional Variety Test

T. Hogg[1], C. Ringdal[1], A. Vandenberg[2]

***Progress**: Ongoing*

***Objective:** To assess the production of current and newly relased varities under targeted environments within Saskatchewan.*

The potential for development of the dry bean sector of Saskatchewan's pulse industry has been limited by the lack of suitable 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 2002 at the CSIDC. The 2002 Narrow Row Dry Bean Regional Trial, 20 cm (8 in) 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) were evaluated. AC Polaris and CDC Crocus Great Northern Bean and CDC Pintium and 95-83-10 pinto bean produced the highest yield of all varieties while TR9803 navy bean produced the lowest yield (Table 26). All market classes produced varieties that were relatively high yielding.

Most bean varieties flowered within a range of 50 - 60 days. CDC Pintium pinto bean, CDC Expresso black bean and CDC Crocus great northern bean were the earliest varieties to flower taking only 47, 48 and 49 days, respectively.

CDC Pintium pinto bean matured 7-10 days earlier than most varieties. Most varieties required 106-115 days to mature. Some of the later maturing navy and black bean varieties had low yield probably due to the cool growing conditions later in the growing season.

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. Three pinto varieties, three great northern varieties and one navy dry bean variety 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 95-83-10. Smallest seed weight was obtained for the Navy bean variety HR100. The high yielding great northern variety AC Polaris had a small seed weight compared to the other varieties in this market class. All navy bean varieties had low yield. The new black variety, AC Black Diamond, had a high seed weight compared to CDC Expresso.

[1]*CSIDC, Outlook*
[2]*Crop Development Centre, U of S, Saskatoon, Saskatchewan*

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 26. Irrigated Dry Bean Narrow Row Regional variety trial: Yield and growth characteristics for different dry bean market classes.

Variety	Yield % of Pintium[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 0=erect 5=flat	Pod clearance (%)[3]
Pinto							
CDC Pintium	100	373	47	98	46	1.0	83
Othello	98	366	57	109	63	2.0	63
CDC Pinnacle	91	382	54	107	66	2.0	63
95-83-10	106	412	55	109	70	1.3	67
HR99	85	295	57	107	60	1.0	72
Great Northern							
AC Polaris	110	190	55	106	61	2.3	68
CDC Crocus	105	359	49	106	53	2.0	60
CDC Polar Bear	92	361	55	106	62	2.0	65
Navy							
Envoy	59	195	54	107	49	1.0	73
CDC Whitecap	52	179	59	110	59	1.3	75
AC Cruiser	55	180	56	109	64	1.0	75
T9601	52	196	56	107	52	1.0	75
T9803	28	184	58	110	55	1.0	57
HR100	44	167	56	107	53	1.0	73
Black							
CDC Expresso	38	208	48	102	37	1.0	70
AC Black Diamond	98	251	55	107	57	1.0	80
315-18	65	176	59	108	57	1.0	83
318-51	37	205	59	109	55	1.0	82
Small Red							
AC Redbond	95	335	52	102	60	1.3	75
SE	348	10	2	1	4	0.2	4
CV (%)	19.1	4.5	3.6	1.5	8.1	18.1	7.3

[1]Yield of CDC Pintium = 3018 kg/ha (2689 lb/ac)
[2]50% of pods are buckskin color
[3]Pods >5 cm (2 in) above ground surface

Dry Bean Wide Row Regional Variety Test

T. Hogg[1], C. Ringdal[1], H. Mundel[2], J. Braun[2]

***Progress**: Ongoing*

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

Twenty-five dry bean varieties consisting of six market classes (pinto, great northern, pink, black, small red, mantequila) were evaluated. Yield varied among the market classes and varieties within the market classes (Table 27). AC Polaris, Great Northern, AC Alberta pink bean and AC Earlired 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 55 - 60 days except for CDC Pintium pinto bean, CDC Expresso black bean and Arikara yellow bean which flowered in 50 days.

Maturity varied from 100 days for CDC Pintium pinto bean to 116 days for Othello pinto bean, US1140 great northern bean, CDC 315-18 black bean and NW63 small red bean. Maturity was delayed compared to previous years probably due to the cool wet conditions later in the growing season.

Plant height varied among varieties within a market class ranging from 24 cm for CDC Expresso black bean to 38 cm for AC Scarlet small red bean. Plant height for most other varieties was in the range of 30 to 35 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*
[2]*AAFC Research Centre, Lethbridge, Alberta*

Table 27. Irrigated Dry Bean Wide Row Regional variety trial: Yield and growth characteristics of different dry bean market classes.						
Variety	Yield % of Othello[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 1=erect 5=flat
Pinto						
Othello (check)	100	372	62	116	28	3.0
CDC Camino	117	352	59	112	33	1.3
CDC Pinnacle	118	375	58	110	30	2.7
CDC Pintium	129	389	50	100	30	1.0
Great Northern						
US 1140 (check)	84	331	59	116	23	4.0
CDC Crocus	122	373	59	105	30	2.5
AC Polaris	167	334	58	105	35	2.5
CDC Polar Bear	102	382	57	109	30	2.8
Alert	94	335	61	109	33	2.0
Pink						
Viva (check)	84	272	60	116	30	4.0
CDC Rosalee	141	281	55	107	28	2.0
AC Alberta Pink	159	268	56	105	30	3.8
L94C356	109	307	54	104	30	2.0
Black						
UI 906 (check)	94	159	61	110	30	1.2
AC Black Diamond	118	281	56	105	35	1.0
CDC Nighthawk	67	183	57	108	28	1.3
CDC Expresso	48	198	50	106	24	1.0
CDC 315-18	79	171	64	116	28	1.0
L95F025	76	189	59	107	30	1.5
Small Red						
NW63 (check)	80	318	56	115	30	3.8
AC Redbond	127	302	55	102	33	1.5
AC Earlired	153	307	55	103	25	2.0
AC Scarlet	134	353	59	110	38	2.3
Le Baron	124	340	58	105	28	2.5
Mantequila						
Arikara Yellow	135	478	50	105	28	1.0
SE	339	18	2	2	4	0.3
CV (%)	14.8	7.3	4.1	2.4	11.1	17.0

[1]Yield of Othello = 1815 kg/ha (1617 lb/ac)
[2]50% of pods are buckskin color

Irrigated Prairie Dry Bean Wide-Row Co-operative Registration Test

T. Hogg[1], C. Ringdal[1], H. Mundel[2], J. Braun[2]

***Progress**: Ongoing*

***Location**: Outlook*

***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. 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 the CSIDC. Standard fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. The test consisted of 20 entries in a 4 x 5 lattice design that included three market classes (Pinto, Small Red, Great Northern) and one unique class (Mantequillas). Individual plots consisted of two rows with 60 cm (24 in) row spacing and measured 1.2 m x 3.7 m (4 ft x 12 ft). All rows of a plot were harvested to determine yield.

Cool wet conditions late in the growing season delayed maturity of some entries resulting in fall frost damage which affected yields.

All pinto lines flowered later, matured later and yielded lower than Othello (Table 28). In the small red market class, all lines yielded much higher than the check variety NW63 which was later maturing and affected by frost. Most small red lines were 10-14 days earlier maturing than NW63. For the great northern market class, all lines except L99E247 had higher yield than the check variety US1140 which was later maturing and affected by frost.

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

Table 28. Irrigated Wide Row Prairie Bean Co-operative trial: Yield potential and growth characteristics of dry bean lines.

Variety	Yield % of check[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 0=erect 5=flat
Pinto						
Othello (check)	100	341	58	112	52	3.1
L98B335	86	341	59	114	57	3.2
L98B336	78	344	57	118	52	3.6
L98B351	87	348	61	117	47	3.0
L98B354	71	348	60	116	53	3.2
L99B445	72	349	61	116	48	3.2
Small Red						
NW63 (check)	100	349	59	117	51	3.5
AC Earlired	166	356	55	103	38	2.1
AC Redbond	141	331	57	106	48	1.3
AC Scarlet	153	352	61	114	60	2.5
L98D292	208	344	56	101	40	2.0
L98D347	185	349	58	104	52	1.6
737-68	204	347	57	102	43	2.2
737-48	194	350	59	103	40	2.6
Great Northern						
US1140 (check)	100	357	61	118	50	3.9
AC Polaris	143	346	61	113	47	2.8
Alert	206	352	59	111	50	2.8
L98E207	115	344	61	114	43	2.1
L98E209	195	352	57	108	49	2.7
L99E247	93	350	63	114	39	1.9
SE	434	7	1	2	1	0.4
CV (%)	23.6	2.3	2.9	2.5	4.1	16.9

[1]Yield of check: Othello = 2094 kg/ha (1866 lb/ac); NW63 = 1374 kg/ha (1224 lb/ac); US 1140 = 1229 kg/ha (1095 lb/ac)
[2]50% of pods are buckskin color

Desi and Kabuli Chickpea Regional Variety Tests

T. Hogg[1], C. Ringdal[1], T. Warkentin[2]

Progress: *Ongoing*

Location: *Outlook*

Objective: *To assess current and newly released chickpea varieties in targeted environments within Saskatchewan.*

The potential for development of the chickpea sector of Saskatchewan's pulse industry has been limited by the lack of suitable 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 productivity and risk in the various production regions of Saskatchewan. This information is used by extension personnel, pulse growers and researchers across Saskatchewan to become familiar with this new pulse crop.

Chickpea Regional variety trials were established in the spring of 2002 at the CSIDC. Separate trials were conducted for kabuli and desi type chickpeas. Cool and wet weather with frequent rains during August resulted in excessive vegetative growth, delayed maturity and frost damage on some varieties.

Yield for the kabuli type chickpea varieties was low with CDC Chico and 95177-47 having the highest yields, 280% and 230% respectively of the check variety Sanford (572 kg/ha), and CDC Diva having the lowest yield, 96% of the check (Table 29). Yield for the desi type chickpea varieties was also low ranging from a high of 176% of the check variety Myles (1238 kg/ha) for 222B-11 to a low of 32% of the check for 92117-14 (Table 30). Several desi varieties yielded less then the check.

Days to flower ranged from 48 to 53 days for the kabuli type chickpea varieties and from 46 to 52 days for the desi type chickpea varieties. Most varieties did not mature before the first fall frost.

Seed weight was generally greater for the kabuli type chickpea than for the desi chickpea. Seed weight was generally lower than normal, especially for the kabuli type chickpea varieties probably due to the cool growing conditions in August and incomplete maturity of many of the varieties. CDC Yuma had the largest overall seed size while Amit, CDC Xena and 95NN-1 had the lowest seed size for the kabuli type chickpeas. CDC Nika had the largest overall seed size for the desi type chickpeas while the smallest seed size was observed for 92117-14, 222B-11 and Myles.

Plant height varied between the chickpea types as well as among varieties within each type. For the kabuli chickpeas, Sanford was the tallest variety while CDC Xena was the shortest variety. For the desi chickpeas, 92056-22 and DH27-4, were the tallest varieties while CDC Desiray was the shortest variety.

Lodge rating indicated that the desi type chickpeas lodged to a greater extent than the kabuli type chickpeas probably a result of the excessive vegetative growth observed in the desi chickpea varieties.

[1]*CSIDC, Outlook*
[2]*Crop Development Centre, U of S, Saskatoon, Saskatchewan*

Table 29. Kabuli Chickpea Regional variety trial: Yield and growth characteristics of chickpea germplasm.					
Variety	Yield % of Sanford[1]	Seed weight (mg)	Days to flower	Plant height (cm)	Lodging 0=erect 5=flat
Sanford	100	200	53	57	1.3
Evans	101	190	52	59	1.3
Amit	165	169	51	51	2.3
CDC Yuma	102	300	49	54	2
CDC Chico	280	182	48	56	2
CDC Xena	139	173	52	46	2
CDC Diva	96	230	51	48	2
CDC ChiChi	110	223	50	49	2
95NN-1	100	185	52	54	2
95NN-29	127	198	52	54	2
95NN-11	133	193	52	59	2
95177-47	230	198	48	54	2
S.E.	238	11	1	3	0.2
CV (%)	36.3	6.8	2.6	7.6	15.1

[1]Yield of Sanford = 572 kg/ha (510 lb/ac)
[2]75% of pods are yellow color

Table 30. Desi Chickpea Regional variety trial: Yield and growth characteristics of chickpea germplasm.					
Variety	Yield % of Myles[1]	Seed weight (mg)	Days to flower	Plant height (cm)	Lodging 0=erect 5=flat
Myles	100	115	50	56	2.3
CDC Desiray	123	137	50	41	2
CDC Anna	92	139	49	54	2.7
CDC Nika	94	212	46	56	2.7
92073-40	77	191	46	59	1.3
BS1-43	151	184	50	58	2
92117-14	32	105	52	60	2.3
92117-25	77	152	52	60	2
92056-22	90	135	52	61	2.7
DH27-4	73	119	52	61	2
222B-11	176	114	49	54	2.3
294-20	117	164	49	50	2
S.E.	228	10	1	2	0.3
CV (%)	22.6	8.6	3.5	4.7	17.1

[1]Yield of Myles = 1238 kg/ha (1103 lb/ac)
[2]75% of pods are yellow color

Field Pea Co-operative Registration Test A and Test B

T. Warkentin[1], D. Bing[2], A. Sloan[2], T. Hogg[3], C. Ringdal[3]

***Progress**: Ongoing*

***Location**: Outlook*

***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-two candidate entries were divided into two tests. Relatively later maturing entries were placed in Test A. There were four check cultivars in each test (three yellow and one green): Carrera, Eclipse, CDC Mozart and 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 5 x 5 lattice with three replicates. Individual plots measured 1.2 m x 3.7 m (4 ft x 12 ft). All rows were harvested to determine yield.

In Test A, four yellow lines and one green line had yields lower than the check variety Carrera (Table 31). Most lines had matured slightly later than Carrera. Some lines had better lodging than the checks. Highest seed weight was recorded for the yellow line Ceb4120. Most lines had seed weight less than the checks.

In Test B, all the lines tested out-yielded the check variety Carrera (Table 32). One yellow line CDC651-2 had exceptionally high yield. The one green line tested yielded higher than the green check variety Nitouche. Most lines had maturity equivalent to the checks. Five yellow lines had seed weights higher than the checks, Carrera and Eclipse. The highest seed weight recorded for the yellow line Ceb4118.

[1]Crop Development Centre, U of S, Saskatoon, Saskatchewan
[2]Agriculture and Agri-Food Canada, Morden Research Centre, Morden, Manitoba
[3]CSIDC, Outlook

Table 31. Yield and growth characteristics of pea: Pea Co-operative Registration Test A.

Entry	Yield % of Carrera[1]	Lodging 0 = erect 9 = flat	Vine length (cm)	Days to maturity	Seed weight (mg)
Yellow					
Carrera	100	5.7	63	106	284
Eclipse	122	2	76	113	271
CDC Mozart	125	6	69	108	241
CDC0103	161	6.7	86	107	259
CDC0104	129	2.3	76	101	254
CDC0105	129	9	74	103	241
CDC0108	155	6.3	86	102	271
CDC653-8	151	4	83	102	233
CEB4120	43	4	58	114	343
CEB4124	107	5.3	68	107	338
SW985745	99	3.3	69	102	260
SW985704	116	3.7	68	102	268
SW996096	119	4.7	80	108	220
SW995846	103	3	63	108	278
MP1811	106	2.3	81	108	283
MP1812	79	2.7	77	110	273
MP1816	93	4.3	69	112	262
MP1817	111	1.7	82	110	263
Green					
Nitouche	107	2	79	109	281
CDC0106	127	7.7	70	101	189
CDC0107	136	8.7	81	107	190
CDC672-1	143	6.7	75	102	236
CDC647-1	152	7	83	112	235
CEB1080	86	2.7	60	112	286
CEB1081	124	3	82	113	297

[1]Carrera yield = 4942 kg/ha (4403 lb/ac)

Table 32. Yield and growth characteristics of pea: Pea Co-operative Registration Test B.

Entry	Yield % of Carrera[1]	Lodging 0 = erect 9 = flat	Vine length (cm)	Days to maturity	Seed weight (mg)
Yellow					
Carrera	100	5.3	61	106	272
Eclipse	110	2.3	73	114	271
CDC Mozart	142	8	79	108	233
CDC0101	148	8.3	82	102	259
CDC0102	168	9	78	106	246
CDC651-2	188	8	78	106	245
CDC728S-7	168	9	79	103	283
CDC715S-4	181	7.3	83	107	285
CEB4118	100	6.3	69	110	337
CEB4119	145	3.3	82	106	324
CEB4127	104	4.3	72	109	269
SW985755	138	4	70	102	271
SW985812	130	4.3	77	103	249
SW995848	163	8.3	81	102	276
SW985804	143	7	76	102	223
SW975539	134	6	73	102	233
MP1813	120	5.7	79	109	237
MP1814	130	7	74	103	262
MP1815	178	6.3	90	109	243
MP1818	177	7	90	110	261
MP1819	124	8	72	108	268
MP1820	146	3.3	81	106	263
SB2002-1	167	5.7	82	107	255
Green					
Nitouche	115		77	107	267
CO96-901	136		75	75	214

[1]Carrera yield = 4452 kg/ha (3967 lb/ac)

Irrigated Field Pea Regional Variety Trials

C. Ringdal[1], T. Hogg[1]

Progress: *Ongoing*

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

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

CSIDC (SW15-29-08-W3): Bradwell very fine sandy loam
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 CSIDC site was seeded on May 13, Pederson site May 14, CSIDC off-station site May 16 and the Ringdal site May 26. Plots measured 1.5 m x 4 m (5 ft x 13 ft). All plots received 28 kg N/ha (25 lb N/ac) as 46-0-0 and 45 kg P_2O_5/ha (40 lb P_2O_5/ac) 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 varied among the four sites (Table 33). Most of the newer varieties produced lower yield than CDC Mozart. The yellow varieties CDC Mozart and CDC0009 produced high yields with highest overall yield obtained for the yellow variety CDC0009 averaged over the four sites. All green varieties produced yield lower than CDC Mozart. The results from these trials are used to update the irrigation variety trial database at the CSIDC and provide recommendations to irrigators on the best pea varieties suited to irrigation conditions.

Table 33. Yield and agronomic data for the irrigated field pea regional variety trial.

	Pederson site			Ringdal site		CSIDC off-station site			CSIDC site			Mean yield		
Variety	Yield (kg/ha)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Yield (kg/ha)	Height (cm)	Lodge rating[1]	Yield (kg/ha)	Height (cm)	Lodge rating[1]	kg/ha	bu/ac	% of CDC Mozart
Green														
Nitouche	3385	52	2.8	2061	60	4621	65	2.3	2568	46	3.5	3159	46.9	73
Madoc	3398	51	4	2370	49	4706	56	2.3	2831	42	3.5	3326	49.4	76
Cruiser	3776	54	4	2586	63	3779	64	2.8	3041	46	3.5	3296	49	76
Yellow														
CDC Mozart	3777	49	7.5	3875	59	5725	59	5.3	4027	45	3.8	4351	64.6	100
Alfetta	3699	49	8.8	2720	51	4506	57	7.3	2972	40	7.8	3474	51.6	80
CDC Handel	3521	52	8	3578	59	4592	64	6.3	3893	47	4	3896	57.9	90
DS Stalwart	4150	56	3	3436	63	4118	63	2.8	3108	50	2.8	3703	55	85
DS Admiral	3493	59	1.8	2055	58	3344	59	2.5	2439	47	3	2833	42.1	65
Eclipse	3956	50	3.8	4636	64	4615	67	2.3	3793	47	1.8	4250	63.1	98
SW Belfield	3793	50	5.5	3583	56	5586	57	1.5	2902	41	3.5	3966	58.9	91
SW Circus	3748	52	5.5	2671	53	4757	59	3.3	3398	45	3.5	3644	54.1	84
CDC0007	3749	56	4.5	3499	64	4709	66	2	3416	50	2	3843	57.1	88
CDC0009	4551	53	3	4243	62	5037	65	4.3	4050	47	2.8	4470	66.4	103
MP1807	3587	54	4.5	3538	70	4764	66	5.5	3643	50	2.8	3883	57.7	89
SB2000-2	4090	51	4.8	3691	66	3855	65	2.8	3825	46	2	3865	57.4	89
CV (%)	10.2	9.7	24.3	17.9	17	15.5	8.5	32.1	16.5	7.4	25.6	-	-	-

[1]0=erect; 9=flat

[1]*CSIDC, Outlook*

Horticultural Crops

Potato Development

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

Objectives:

- *To identify promising cultivars for the 'seed', 'processing' and 'table' markets,*
- *To develop cost-effective agronomic practices to suit the relatively short and cool growing seasons of Saskatchewan,*
- *To develop economically viable and environmentally sustainable potato-based crop rotations,*
- *To identify physiological parameters responsible for the 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. It is estimated that the potato industry will expand to approximately 73,000 ha (180,000 ac) valued over $500 million by 2005. Saskatchewan has become one of the leading seed potato producers and exporters in North America. This is mainly due to 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 U.S.A, Mexico, and several Canadian provinces.

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 grown in Saskatchewan. The irrigated area of southern Saskatchewan is ideally suited for the production of high quality processing potatoes.

The potato research and development projects are conducted jointly with the Saskatchewan Seed Potato Growers Association, Dr. Dermot Lynch (Lethbridge Research Centre, Agriculture and Agri-Food Canada), and Dr. Doug Waterer (Department of Plant Sciences, University of Saskatchewan). Partial funding for this project was provided by the Canada-Saskatchewan Agri-Food Innovation Fund.

The tests were conducted in the field plots of the CSIDC. Test plots were established May 21 through May 27, 2002. The crop was raised under irrigation 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 (36 in) row spacing, (iii) 200 kg N/ha (180 lbs N/ac) (half at planting and half at hilling), 60 kg P_2O_5/ha (54 lb P_2O_5 /ac), 50 kg K_2O/ha (45 lb K_2O/ac), (iv) insect control using one application of Ripcord, (v) disease control using Bravo 500, Dithane, Acrobat, and (vi) top-kill by flailing followed by one application of Reglone. The crop received 145 mm (5.7 in) of rain during the growing season and 365 mm (14.4 in) of supplemental irrigation to maintain soil moisture status at approximately 60% above Field Capacity. Most trials were flailed on September 12 and harvested between September 30 and October 4. Agronomic practices for the specific water management and time of top-kill studies were applied based on the protocol for the various tests. The harvested tubers were graded according to tuber diameter of the different shaped potatoes.

Seed grades were categorized in the following manner based on the Canadian Seed Standards:

Oblong tubers:
- Grade A: 45 mm (1.8 in) - 70 mm (2.8 in)
- Grade B: 30 mm (1.2 in) - 45 mm (1.8 in)

Round tubers:
- Grade A: 50 mm (2.0 in) - 80 mm (3.2 in)
- Grade B: 30 mm (1.2 in) - 50mm (2.0 in)

The 'consumption' category included tubers larger than 45 mm (1.75 in) diameter. Tuber specific gravity and culinary characteristics (boiled, baked, chip, and french fry) were determined using Prairie Regional Variety Testing protocols. Fry colour categories were based on USDA classification.

Cultivar Evaluation

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

Prairie Early Replicated Trial

The Prairie Early Replicated trial was conducted at the CSIDC under irrigation. This test included eight advanced generation clones and industry standards Norland, Atlantic, AC Ptarmigan, and Russet Norkotah. Field plots were harvested at 89 and 99 days after planting. The yield performance and culinary characteristics were determined for the harvested tubers. This information will be used to support registration of new cultivars.

Prairie Main Replicated Trial

The Prairie Main Replicated trial was conducted at the CSIDC under irrigation. Twenty-eight entries (19 clones and nine standards) were tested in this trial. The crop was desiccated 112 days after planting and harvested three 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

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 evaluated five new french fry clones, nine 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, and Sangre for table market classes. The crop was harvested and displayed to the members of the Saskatchewan Seed Potato Growers Association during the CSIDC Potato Field Day in August.

[1]*CSIDC, Outlook*
[2]*Agriculture and Agri-Food Canada Research Centre, Lethbridge, Alberta*

Genetically Modified Potato

Verticillium wilt or 'Early dying' in potato is becoming a major problem for potato producers. The potato breeding program at the AAFC Lethbridge Research Centre is conducting research to develop potato cultivars resistant to various 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.

An observational field study was conducted to compare the yield potential of modified (tomato Ve incorporated) cultivars with the original parent cultivars. Paired 't' test showed that the potatoes with the Ve gene produced similar tuber yields to the corresponding unmodified cultivar (Table 1).

Table 1. Yield potential of potato cultivars with Ve gene relative to unmodified cultivars.

Cultivar	Market class	Total yield (g/hill)	
		Control	Modified
Viking	Fresh market	1501	1204
Sangre	Fresh market	942	1124
Yukon Gold	Fresh market	1403	1267
Norland	Fresh market	1643	1463
Russet Norkotah	Fresh market	1305	1294
Snowden	Chipping	1305	1421
Atlantic	Chipping	1471	1281
Ranger Russet	French fry	1075	1042
Shepody	French fry	1003	1260
Russet Burbank	French fry	1100	931

Paired 't' test: T=0.8, P = 0.442

Effect of Timing of Irrigation on Yield and Tuber Size Distribution

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

Potato responds well to irrigation. Moisture stress can adversely affect tuber yield and quality characteristics. On the other hand, excess moisture can lower tuber specific gravity and fry colour of processing potato. Timing of irrigation is essential to ensure superior yields and to maintain uniform tuber size grades. 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 above 60% Field capacity) to maximize yields of high quality 'seed' and 'consumption' potatoes. The following commercial potato cultivars were included in this study:

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

Sufficient soil moisture was maintained at three specific crop growth stages using supplemental irrigation. The crop growth stages, irrigation treatments, rainfall, and irrigation amounts are presented in Table 2. The growth stages I & II (planting to stolon formation), III (stolon formation to tuber initiation/ flowering), and IV (flowering to senescence) were identified based on their distinct physiological phases in the crop growth cycle for irrigation treatments. 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 25, desiccated on September 13, and harvested on October 3. The 'early' (May 25-July 16), 'mid' (July 17-August 21),and 'late' (August 22-September 23) crop growth stages received a total (rainfall and irrigation) of 228, 163, and 119 mm water respectively (Table 2). This was comprised of 63.4 mm rainfall and 165 mm irrigation during the 'early' stage, 62.8 mm rain and 100 mm irrigation during the 'mid' stage, and 18.8 mm rain and 100 mm irrigation during the 'late' stage (Table 2). The amount of water received by the various treatments are also indicated in Table 2.

'Seed' and 'consumption' grade tuber yields for the various potato cultivars in response to the different irrigation treatments are presented in Tables 3 and 4, respectively.

Dryland (Treatment N-N-N) produced the lowest 'seed' and 'consumption' grade yields. The treatment that received irrigation during the early and late stages (Treatment I-N-I) produced the highest 'seed' and 'consumption' grade yields.

[1]*CSIDC, Outlook*

Table 2. Potato crop growth stages at which irrigation was applied and maintained dryland.

Irrigation treatment	Potato crop growth stages			
	Stage 2 Planting to stolon formation	**Stage 3** Stolon formation to flowering (tuber initiation)	**Stage 4** Flowering to senescence	Total water received (mm)
I-N-N	Irrigation	No irrigation	No irrigation	310
I-I-I	Irrigation	Irrigation	No irrigation	410
I-I-I	Irrigation	Irrigation	Irrigation	510
N-I-I	No irrigation	Irrigation	Irrigation	345
N-N-I	No irrigation	No irrigation	Irrigation	245
N-N-N	No irrigation	No irrigation	No irrigation	145
I-N-I	Irrigation	No irrigation	Irrigation	410
N-I-N	No irrigation	Irrigation	No irrigation	245
No. of rainy days	22	15	12	
Total rainfall (mm)	63.4	62.8	18.8	
Total irrigation (mm)	165	100	100	

For dryland production, the average ‘seed’ grade yield was 23.3 t/ha (180 Cwt/ac) (Table 3) and ‘consumption’ grade yield was 15.8 t/ha (141 Cwt/ac) (Table 4). Full irrigation produced 56% higher ‘seed’ grade yield and approximately double the ‘consumption’ grade yield than the dryland crop.

Among the three treatments that received irrigation only during one growth stage, the highest response was observed for ‘late’ irrigation compared to ‘early’ or ‘mid’ irrigation. The corresponding yield increases averaged approximately 23% for the ‘seed’ class and 44% for the ‘consumption’ class.

Maintaining adequate soil moisture during two crop growth stages on average produced 34% higher ‘seed’ grade yield and 62% higher ‘consumption’ grade yield than when sufficient soil moisture was provided during only one growth stage (Tables 3 and 4). Where optimal soil moisture was maintained during two growth phases, it was observed that ‘seed’ and consumption’ grade yields were highest for the irrigation-dryland-irrigation treatment followed by dryland-irrigation-irrigation and irrigation-irrigation-dryland. The corresponding yield progression were 33.1, 36.4, and 41.3 t/ha (295, 324, and 368 Cwt/ac) for ‘seed’ grade tubers, and 26.7, 31.4, and 38.8 (238, 280, and 345 Cwt/ac) for ‘consumption’ grade tubers.

Potato cultivars responded differently depending on the crop stage during which the crop experienced moisture shortage. The yield ranking of ‘seed’ grade tubers were different for the various irrigation treatments (Table 3). However, Alpha produced the lowest and Russet Norkotah produced the highest ‘consumption’ grade yield across all irrigation treatments (Table 4).

Table 3. 'Seed' grade yield of potato cultivars grown under different irrigation regimes.								
Cultivar	Irrigation treatment							
	I-N-N	I-I-N	I-I-I	N-I-I	N-N-I	N-N-N	I-N-I	N-I-N
Yield (t/ha)								
Alpha	22.2	27.6	38.3	34.5	25.4	20.0	46.7	21.7
Atlantic	29.0	32.9	42.6	42.9	36.5	24.4	45.9	26.3
Russet Burbank	22.9	30.7	26.3	32.1	30.4	23.4	33.9	24.1
Russet Norkotah	29.7	36.9	37.7	34.8	34.1	24.3	34.4	29.2
Dark Red Norland	27.0	35.5	35.8	37.5	36.9	24.1	40.8	28.3
Ranger Russet	27.1	35.1	34.5	31.3	27.1	22.5	42.0	25.8
Shepody	26.8	33.2	38.6	41.4	35.2	24.4	45.3	27.7
Analyses of variance								
Source:								
Cultivar	**(3.8)	*(5.8)	**(7.3)	***(5.1)	***(5.0)	ns	**(7.8)	*(4.2)
C.V. (%)	9.6	11.7	13.6	9.5	10.4	10.1	12.7	10.8
Yield (Cwt/ac)								
Alpha	198	246	342	308	227	178	417	194
Atlantic	259	293	380	383	326	218	409	235
Russet Burbank	204	274	235	286	271	209	302	215
Russet Norkotah	265	329	336	310	304	217	307	261
Dark Red Norland	241	317	319	335	329	215	364	252
Ranger Russet	242	313	308	279	242	201	375	230
Shepody	239	296	344	369	314	218	404	247

*, **, *** and ns 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% significance.

Table 4. 'Consumption' grade yield of potato cultivars grown under different irrigation regimes.

Cultivar	Irrigation treatment							
	I-N-N	I-I-N	I-I-I	N-I-I	N-N-I	N-N-N	I-N-I	N-I-N
Yield (t/ha)								
Alpha	8.3	11.8	21.4	19.2	12.8	6.2	27.3	8.5
Atlantic	24.1	30.5	40.5	40.4	33.0	19.5	46.9	20.9
Russet Burbank	15.1	21.9	20.0	25.6	25.0	14.2	27.5	16.1
Russet Norkotah	28.5	41.0	45.3	41.5	39.2	22.5	48.3	28.6
Dark Red Norland	18.9	25.8	29.3	30.5	29.5	15.3	34.5	18.4
Ranger Russet	21.9	29.3	34.7	28.7	22.5	16.7	41.1	19.9
Shepody	20.2	26.4	37.4	33.8	28.9	16.1	46.1	20.2
Analyses of variance								
Source:								
Cultivar	***(3.9)	***(6.8)	***(8.0)	***(6.1)	***(4.9)	***(4.0)	***(7.8)	***(5.1)
CV (%)	13.5	17.2	16.5	13.0	12.0	16.9	13.0	18.2
Yield (Cwt/ac)								
Alpha	74	105	191	171	114	55	244	76
Atlantic	215	272	361	360	294	174	418	186
Russet Burbank	135	195	178	228	223	127	245	144
Russet Norkotah	254	366	404	370	350	201	431	255
Dark Red Norland	169	230	261	272	263	137	308	164
Ranger Russet	195	261	310	256	201	149	367	178
Shepody	180	236	334	302	258	144	411	180

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

Yield distribution of the different size grades for the various cultivars are presented in Figure 1.

Alpha**:** Alpha produced only seed-size (Canada Grade-A and Grade-B) tubers and no large or over-size tubers under all irrigation regimes. Depending on the irrigation treatment, the size profile consisted of 31% to 59% Grade A seed-tubers and 41% to 63% Grade B seed-tubers. Higher proportion of Grade A tubers were obtained when irrigation was supplied during the 'late' or 'mid'+'late' crop growth stages.

Atlantic**:** Atlantic produced Seed Grade-A, Grade-B, large and oversize tubers with all irrigation treatments. Depending on the irrigation treatment, the size profile consisted of 70% to 81% Grade A seed-tubers, 12% to 25% Grade B seed-tubers, 2% to 6% large tubers, and 2% to 9% oversize tubers. Higher proportion of Grade A and larger tubers were obtained when irrigation was supplied during the 'late' or 'mid'+'late' crop growth stages.

Russet Burbank: Russet Burbank produced mainly Seed Grade-A, Grade-B, and large tubers with all irrigation treatments. Depending on the irrigation treatment, the size profile consisted of 58% to 76% Grade A seed-tubers, 21% to 41% Grade B seed-tubers, and 1% to 7% large tubers. Higher proportion of Grade A and larger tubers were obtained when irrigation was supplied during the 'late' or 'mid'+'late' crop growth stages.

Russet Norkotah: Russet Norkotah produced Seed Grade-A, Grade-B, large and oversize tubers with all irrigation treatments, except for the dryland treatment where no oversize tubers were formed. Depending on the irrigation treatment, the size profile consisted of 59% to 80% Grade A seed-tubers, 7% to 14% Grade B seed-tubers, 7% to 27% large tubers and 0% to 7% oversize tubers. Higher proportion of Grade A and larger tubers were obtained when irrigation was supplied during the 'late' or 'mid'+'late' crop growth stages.

Ranger Russet: Ranger Russet produced mainly Seed Grade-A, Grade-B, and large tubers. Depending on the irrigation treatment, the size profile consisted of 72% to 80% Grade A seed-tubers, 11% to 26% Grade B seed-tubers, 0% to 10% large tubers and 0% to 2% oversize tubers. Generally, higher proportion of Grade A and larger tubers were obtained when irrigation was supplied during the 'late' or 'mid'+'late' crop growth stages.

Shepody: Shepody produced mainly Seed Grade-A, Grade-B, and large tubers. Depending on the irrigation treatment, the size profile consisted of 61% to 78% Grade A seed-tubers, 19% to 37% Grade B seed-tubers, and 1% to 11% large tubers. Higher proportion of Grade A and larger tubers were obtained when irrigation was supplied during the 'late' or 'mid'+ 'late' crop growth stages.

Dark Red Norland: Dark Red Norland produced Seed Grade-A, Grade-B, large and oversize tubers. Depending on the irrigation treatment, the size profile consisted of 62% to 78% Grade A seed-tubers, 21% to 35% Grade B seed-tubers, 0% to 2% large and oversize tubers. Generally, higher proportion of Grade A and larger tubers were obtained when irrigation was supplied during the 'late' or 'mid'+ 'late' crop growth stages.

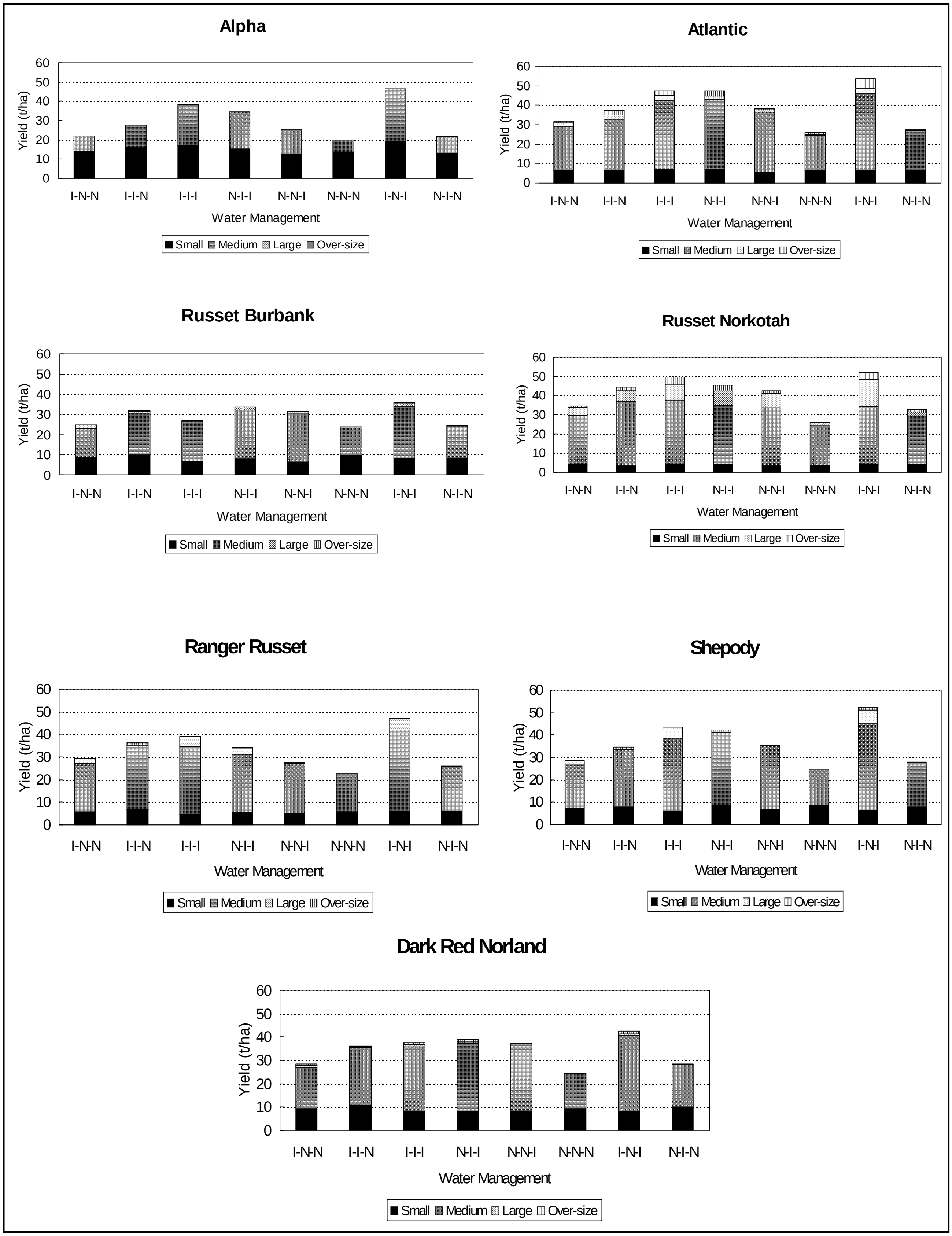


Figure 1. Effects of water management on tuber size distribution for contrasting potato cultivars.

Nitrogen and Phosphorus Rate and Placement Study

J. Wahab[1], G. Larson[1], T. Hogg[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 while optimizing returns. Nitrogen management is particularly important for processing potato under the relatively cool and short growing season in Saskatchewan. Nitrogen shortage can reduce vigour and predispose the crop to diseases while excess nitrogen can delay maturity and adversely affect tuber yield and quality. Efficient nutrient uptake by crops depends on the proximity of fertilizer to the root zone. This is particularly important for crops, such as potato, that have limited root growth.

This study compared the effects of broadcasting, side-banding of 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 5 cm (2 in) away and 2.5 cm (1 in) above the seed piece. Studies were conducted under dryland and irrigation. Crop nitrogen levels were estimated by analysing petiole sap extract using a Cardi-Meter at flowering and four weeks after flowering . Spring soil analysis at the test site indicated soil nutrient levels of 40 kg N/ha (36 lb N/ac), 14 kg P_2O_5/ha (13 lb P_2O_5/ac), and 582 kg K_2O/ha (524 kg K_2O/ha) at 0 cm to 30 cm (0-12 in) soil depth.

Nitrogen

Nitrogen (46-0-0) rates at planting included 50, 75, and 100 kg N/ha, (i.e. 45, 68, 90 lb N/ac). A pre-plant application of 120 kg P_2O_5/ha (108 lb P_2O_5/ac) and 150 kg K_2O/ha (135 lb K_2O/ac) was given uniformly across all treatments. A top dressing of 100 kg N/ha (90 lb N/ac) was applied to all treatments at hilling.

The effects of nitrogen rates and placement on ‘seed’ and ‘consumption’ grade yields for the various cultivars are summarized in Table 5 and Table 6, respectively.

Table 5. Nitrogen placement and rate effects on 'seed' grade yield for potato cultivars grown under irrigation and dryland.

Treatment	Irrigation		Dryland	
	Yield (t/ha)	Yield (Cwt/ac)	Yield (t/ha)	Yield (Cwt/ac)
Nitrogen application method:				
Broadcast	40.0	356	24.4	217
Side-band	40.2	358	25.1	224
Nitrogen rate:				
50 kg N/ha	40.0	356	25.0	223
75 kg N/ha	41.3	368	24.9	222
100 kg N/ha	39.0	347	24.3	216
Cultivar:				
Atlantic	39.2	349	24.4	217
Russet Burbank	40.9	364	25.5	227
Russet Norkotah	39.7	353	25.8	230
Dark Red Norland	41.1	366	28.1	250
Ranger Russet	38.1	339	23.1	206
Shepody	41.6	370	21.6	192
Analyses of Variance				
Source:				
Application method (A)	ns		ns	
N rate (R)	ns		ns	
A x R	***(2.1)		***(2.3)	
A x C	ns		ns	
R x C	ns		ns	
A x R x C	ns		ns	
CV (%)	9.2		16.5	

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

[1]CSIDC, Outlook

Under irrigation, Shepody produced the highest 'seed' grade yield (41.6 t/ha, i.e. 370 Cwt/ac) and Russet Norkotah produced the highest 'consumption' grade yield (45.8 t/ha, i.e. 409 Cwt/ac). Under dryland, Dark Red Norland produced the highest 'seed' grade yield (28.1 t/ha, i.e. 250 Cwt/ac) and Russet Norkotah produced the highest 'consumption' grade yield (23.0 t/ha, i.e. 205 Cwt/ac). Dark Red Norland produced the second highest 'consumption' grade yield under dryland. The yield difference between Dark Red Norland and Russet Norkotah were not statistically significant (Table 6).

Side-band and broadcast application of nitrogen produced similar 'seed' (Table 5) and 'consumption' (Table 6) grade yields under both irrigation and dryland. The nitrogen rates ranging from 50 to 100 kg N/ha (45 to 90 lb N/ac) applied at planting produced similar 'seed' and 'consumption' grade yields under both irrigation and dryland (Tables 5 and 6). Significant nitrogen placement x rate interactions (Tables 5 and 6) did not show any logical responses with respect to 'seed' and 'consumption' grade yields.

Petiole nitrate levels for the various cultivars in response to the rates and methods of nitrogen application for the irrigated and dryland crops are summarized in Table 7. The petiole sap of the dryland crop contained more nitrate-N than the irrigated crop at flowering and four weeks after flowering.

Table 6. Nitrogen placement and rate effects on 'consumption' grade yield for potato cultivars grown under irrigation and dryland.

Treatment	Irrigation		Dryland	
	Yield (t/ha)	Yield (Cwt/ac)	Yield (t/ha)	Yield (Cwt/ac)
Nitrogen application method:				
Broadcast	40.3	360	19.2	171
Side-band	40.3	360	19.5	174
Nitrogen rate:				
50 kg N/ha	39.7	354	20.0	178
75 kg N/ha	41.1	367	18.9	169
100 kg N/ha	40.0	357	19.1	170
Cultivar:				
Atlantic	44.5	397	21.1	188
Russet Burbank	35.8	319	16.5	147
Russet Norkotah	45.8	409	23.0	205
Dark Red Norland	38.3	342	21.2	189
Ranger Russet	41.3	369	17.1	153
Shepody	36.0	321	16.9	151
Analyses of Variance				
Source:				
Application method (A)	ns		ns	
Nitrogen rate (R)	ns		ns	
A x R	***(2.2)		***(2.3)	
A x C	ns		ns	
R x C	ns		ns	
A x R x C	ns		ns	
C.V. (%)	9.5		21.0	

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

At flowering, significant differences in sap nitrate levels were observed among cultivars in both the irrigated and dryland crops. Russet Burbank and Shepody contained the highest levels of sap nitrate under irrigation and dryland respectively. Dark Red Norland contained the lowest amount of sap nitrate under both growing conditions.

The post-flowering sap analysis showed no significant differences in sap nitrate levels among cultivars for the irrigated crop and significant differences in sap nitrate for the dryland crop. Under dryland, Shepody and Dark Red Norland exhibited the highest and the lowest amounts of sap nitrate respectively.

Table 7. Nitrogen placement and rate effects on petiole sap nitrate levels and tuber specific gravity for potato cultivars grown under irrigation and dryland.						
Treatment	Petiole NO_3 at flowering ppm)		Petiole NO_3 at 4 weeks after flowering (ppm)		Tuber specific gravity	
	Irrigation	Dryland	Irrigation	Dryland	Irrigation	Dryland
Nitrogen application method:						
Broadcast	4961	7494	1219	2561	1.0927	1.0817
Side-band	5249	7458	1750	2456	1.0909	1.0821
Nitrogen rate:						
50 kg N/ha	5042	7323	1399	2527	1.0933	1.0823
75 kg N/ha	4379	7462	1069	2440	1.0923	1.0823
100 kg N/ha	5893	7644	1985	2557	1.0899	1.0810
Cultivar:						
Atlantic	4313	7683	1493	2345	1.1009	1.0924
Russet Burbank	5812	7117	1876	2476	1.0935	1.0760
Russet Norkotah	5538	7467	1242	2775	1.0878	1.0868
Dark Red Norland	3659	7096	1496	1958	1.0828	1.0747
Ranger Russet	5529	7341	1396	2492	1.0973	1.0816
Shepody	5779	8154	1402	3004	1.0886	1.0798
Analyses of Variance						
Source:						
Application method (A)	ns	ns	ns	ns	**(0.0090)	ns
Nitrogen rate (R)	*(452)	ns	**(475)	ns	**(0.0011)	ns
Cultivar (C)	***(784)	*(640)	ns	***(311)	***(0.0016)	***(0.0030)
A x R	ns	ns	ns	ns	ns	ns
A x C	ns	ns	ns	ns	ns	ns
R x C	ns	ns	ns	ns	ns	ns
A x R x C	ns	ns	ns	ns	ns	ns
CV (%)	27.1	15.1	80.0	21.8	0.3	0.5

*, **, ***and ns 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% significance.

Under irrigation, the highest nitrogen application (100 kg N/ha, i.e. 90 lb N/ac) showed the highest level of sap nitrate compared to the lower levels (e.g. 50 and 75 kg N/ha, i.e. 45 and 68 lb N/ac) during both sampling periods. It is not clear why the sap nitrate levels for the 50 kg/ha (45 lb N/ac) nitrogen treatment was generally higher than the 75 kg N/ha (68 lb N/ac) treatment.

Broadcast and side-band fertilizer application methods showed no difference in sap nitrate levels during both sampling periods under irrigation or dryland.

Tuber specific gravity is one of the main attributes that is used to determine culinary property of potato. For example, chipping and french fry potatoes have higher tuber specific gravity, whereas, moist table potatoes have relatively low tuber specific gravity. In this study, Dark Red Norland, a table potato, had the lowest specific gravity and the chipping potato Atlantic had the highest specific gravity under both irrigation and dryland (Table 7). Under dryland, fertilizer rate or method of application had no effect on tuber specific gravity (Table 7). By contrast, under irrigation, broadcast application and lower rate of nitrogen produced tubers with higher specific gravity compared to tubers that received side-banded and higher levels of nitrogen.

Fry colour for the processing (chipping and french fry) cultivars were evaluated using standard procedures adopted by the industry. Generally, the fry colour for the various cultivars, nitrogen rates (150 to 200 kg N/ha, i.e. 135 to 180 lb N/ac) or methods of nitrogen application (broadcast or side-band) had no effect on fry colour. All cultivars grown under irrigation or dryland, except for dryland Shepody exhibited acceptable fry colour (Table 8).

Table 8. Nitrogen placement and rate effects on fry colour for potato cultivars grown under irrigation and dryland.

Treatment	Irrigation	Dryland
Nitrogen application method:		
Broadcast	2	2
Side-band	2	3
Nitrogen rate:		
50 kg N/ha	2	2
100 kg N/ha	2	2
Cultivar:		
Atlantic	2	1
Russet Burbank	2	2
Russet Norkotah	2	2
Ranger Russet	2	2
Shepody	2	4

French fry colour rating done according to USDA standards.

Phosphorus

Phosphorus (12-51-0) was applied during planting at the rates 40, 80, and 120 kg P_2O_5/ha (i.e. 36, 72, and 108 lb P_2O_5/ac). A pre-plant application of 100 kg N/ha (90 lb N/ac) and 150 kg K_2O/ha (135 lb K_2O/ac) was given uniformly across all treatments. One hundred kg N/ha (90 lb N/ac) was applied at hilling.

'Seed' and 'consumption' grade tuber yields for the various cultivars grown under irrigation and dryland were somewhat similar to yields observed in the nitrogen placement study. Dark Red Norland produced the highest 'seed' grade yield under both irrigated and dryland production (Table 9). Russet Norkotah and Atlantic produced the highest 'consumption' grade yields under irrigation and dryland respectively (Table 10). Russet Norkotah produced similar 'consumption' grade yield to Atlantic under dryland.

Broadcast and side-band application of phosphorus produced similar 'seed' and 'consumption' grade yields both under irrigation and dryland (Tables 9 and 10).

Significant application method x phosphorus rate interactions were observed for 'seed' and 'consumption' grade potato under dryland production (Tables 9, 10 and Figures 3, 4). For example side-banding produced higher 'seed' and 'consumption' grade yields with 40 and 120 kg P_2O_5/ha rates relative to broadcasting. By contrast, with 80 kg P_2O_5/ha, side-banding produced lower 'seed' and 'consumption' grade yields than broadcast application of phosphorus. The reason for this differential response is not clear at present. Further work is needed to demonstrate interactive influence of phosphorus rates and placement on productivity of commercial potato cultivars grown under irrigation and dryland.

Under irrigated production, phosphorus rates or placement had no effect on tuber specific gravity, whereas, under dryland, side banding resulted in higher tuber specific gravity than broadcasting (Table 11). Chipping potato (Atlantic) and french fry potato (Russet Burbank, Ranger Russet, Shepody) tubers recorded higher specific gravity than the table cultivars (Dark Red Norland, Russet Norkotah) under both growing conditions.

Table 9. Phosphorus placement and rate effects on 'seed' grade yield for potato cultivars grown under irrigation and dryland.				
Treatment	Irrigation		Dryland	
	Yield (t/ha)	Yield (Cwt/ac)	Yield (t/ha)	Yield (Cwt/ac)
Phosphorus application method:				
Broadcast	38.7	345	22.9	204
Side-band	37.7	336	24.9	222
Phosphorus rate:				
40 kg P_2O_5/ha	38.4	343	24.0	214
80 kg P_2O_5/ha	38.5	344	24.2	216
120 kg P_2O_5/ha	37.8	337	23.5	210
Cutlivar:				
Atlantic	35.8	319	24.4	218
Russet Burbank	38.6	344	24.9	222
Russet Norkotah	37.0	330	23.1	206
Dark Red Norland	41.1	367	25.8	230
Ranger Russet	36.6	327	23.8	212
Shepody	40.1	358	21.5	192
Analyses of Variance				
Source:				
Application method (A)	ns		ns	
Phosphorus rate (R)	ns		ns	
Cultivar (C)	***(2.2)		***(1.8)	
A x R	ns		*(5.8)	
A x C	ns		ns	
R x C	ns		ns	
A x R x C	ns		ns	
CV (%)	9.8		12.8	

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

Table 10. Phosphorus placement and rate effects on 'consumption' grade yield for potato cultivars grown under irrigation and dryland.

Treatment	Irrigation		Dryland	
	Yield (t/ha)	Yield (Cwt/ac)	Yield (t/ha)	Yield (Cwt/ac)
Phosphorus application method:				
Broadcast	34.4	307	17.9	160
Side-band	33.2	296	19.4	173
Phosphorus rate:				
40 kg P_2O_5/ha	33.6	300	18.9	169
80 kg P_2O_5/ha	34.0	303	19.3	172
120 kg P_2O_5/ha	33.9	303	17.8	159
Cultivar:				
Atlantic	36.3	324	21.9	195
Russet Burbank	28.4	253	17.2	154
Russet Norkotah	38.7	345	21.1	188
Dark Red Norland	34.3	306	18.0	161
Ranger Russet	31.5	281	18.1	162
Shepody	33.8	302	15.6	139

Analyses of Variance

Source:		
Application method (A)	ns	ns
Phosphorus rate (R)	ns	ns
Cultivar (C)	***(2.1)	***(1.8)
A x R	ns	*(6.9)
A x C	ns	ns
R x C	ns	ns
A x R x C	ns	ns
CV (%)	11.0	16.8

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

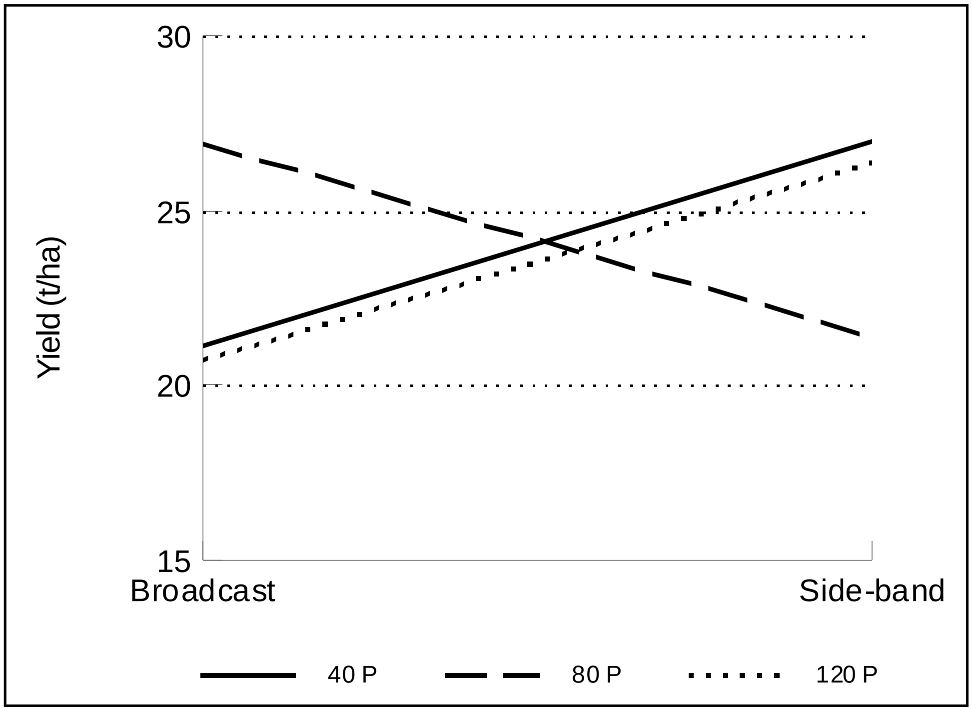


Figure 2. Phosphorus rate and placement interaction effects on 'seed' grade potato tuber yield under dryland production.

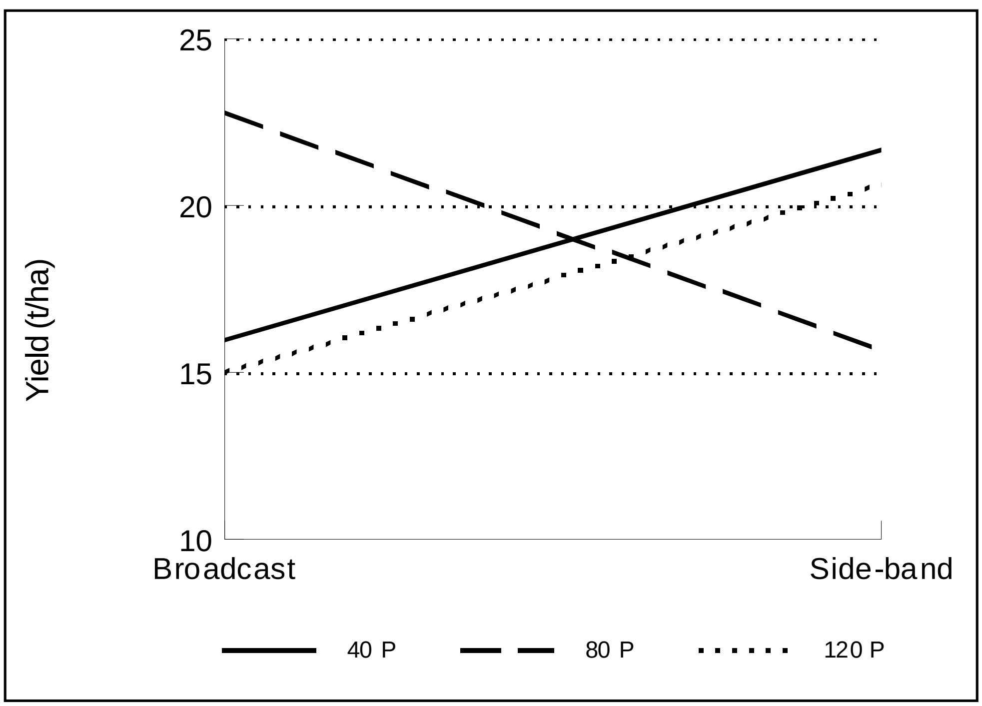


Figure 3. Phosphorus rate and placement interaction effects on 'consumption' grade potato tuber yield under dryland production.

Table 11. Phosphorus placement and rate effects on tuber specific gravity for potato cultivars grown under irrigation and dryland.

Treatment	Tuber specific gravity	
	Irrigation	Dryland
Phosphorus application method:		
Broadcast	1.0843	1.0793
Side-band	1.0853	1.0809
Phosphorus rate:		
40 kg P_2O_5/ha	1.0842	1.0807
80 kg P_2O_5/ha	1.0838	1.0786
120 kg P_2O_5/ha	1.0864	1.0810
Cultivar:		
Atlantic	1.0913	1.0850
Russet Burbank	1.0858	1.0765
Russet Norkotah	1.0818	1.0848
Dark Red Norland	1.0775	1.0739
Ranger Russet	1.0899	1.0819
Shepody	1.0825	1.0785
Analyses of Variance		
Source:		
Application method (A)	ns	*(0.0009)
Phosphorus Rate (R)	ns	ns
Cultivar (C)	**(0.0027)	**(0.0037)
A x R	ns	ns
A x C	ns	ns
R x C	ns	ns
A x R x C	ns	ns
CV (%)	0.4	0.6

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

Generally, the fry colour for the various cultivars, phosphorus rates (40 to 120 kg P_2O_5/ha) or method of application (broadcast or side-band) had no effect on fry colour (Table 12).

Table 12. Phosphorus placement and rate effects on fry colour for potato cultivars grown under irrigation and dryland.

Treatment	Irrigation	Dryland
Phosphorus application method:		
Broadcast	3	2
Side-band	2	2
Phosphorus rate:		
40 kg P_20_5/ha	2	2
120 kg P_20_5/ha	2	2
Cultivar:		
Atlantic	1	0
Russet Burbank	2	2
Russet Norkotah	3	1
Ranger Russet	2	3
Shepody	3	3

Note: French fry colour rating done according to USDA standards.

Seed Piece Form Study

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

In Saskatchewan, potato is planted into relatively cool soils in the spring. Soil temperatures are even lower at greater depths. Cooler soil temperatures can delay or inhibit emergence leading to seed piece decay, thereby reducing plant stand. It is likely that whole-seed and cut seed-pieces may respond differently with respect to emergence and yield characteristics when planted.

This study examined the effect of planting different forms of seed such as whole-tuber, half-tuber, or quarter-tuber in cooler soils on tuber grade yields for Dark Red Norland, Russet Burbank, Russet Norkotah, Ranger Russet and Shepody potato. The study was conducted under irrigation.

[1]*CSIDC, Outlook*

Shepody and Dark Red Norland had superior yield with respect to ‘seed’ grade tuber yield (Table 13). These cultivars produced approximately 58% higher ‘seed’ grade yield than the lowest yielding Russet Burbank. Russet Norkotah produced the highest and Russet Burbank the lowest ‘consumption’ grade yield (Table 13).

The various seed-piece types tested produced comparable ‘seed’ and ‘consumption’ grade yields under both irrigated and dryland production (Table 13). This indicates that there is no added advantage to using whole seed over cut pieces. The lack of cultivar x seed piece type interaction indicates that the various cultivars responded similarly to the different seed piece types used.

Table 13. Effect of seed-piece type on 'seed' and 'consumption' grade yield for commercial potato cultivars.

Treatment	'Seed' grade		'Consumption' grade	
	Yield (t/ha)	Yield (Cwt/ac)	Yield (t/ha)	Yield (Cwt/ac)
Cultivar:				
Russet Burbank	22.4	200	20.0	178
Dark Red Norland	35.1	313	35.8	319
Russet Norkotah	28.3	252	40.1	358
Ranger Russet	29.0	259	29.4	262
Shepody	35.4	316	35.2	314
Seed piece type:				
Half-tuber	31.6	282	32.7	292
Quarter-tuber	28.6	255	31.3	279
Whole-tuber	29.9	267	32.3	288
Analyses of Variance				
Source:				
Cultivar (C)	***(4.0)		***(3.7)	
Seed type (T)	ns		ns	
C x T	ns		ns	
CV (%)	16.0		13.9	

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

Methods and Stage of Top-Kill for Contrasting Cultivars

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

Top-kill prior to harvest is a standard practice in commercial potato production in short growing season environments such as Saskatchewan. Pre-harvest top-kill ensures target tuber size grades, controls disease spread, and promotes proper skin set to facilitate mechanical harvest. Seed potato crops are harvested early, when the shoot is still vigorous and green, to maximize the proportion of smaller seed-grade tubers. However, processing and table crops that target larger tubers are harvested relatively late in the season to allow adequate tuber bulking. Top kill dates should be adjusted to maximize yields of target tuber size grades for seed potato, and size grade and culinary characteristics for processing potato. Timing of top kill can vary with maturity classes of cultivars, growing conditions (e.g. irrigation or dryland), and agronomic practices.

This study examined the effects of two methods of top kill (Flailing + Reglone, and standard two Reglone applications) performed at three crop growth stages (103, 109, and 116 days after planting) for six contrasting potato cultivars (Atlantic, Dark Red Norland, Russet Burbank, Russet Norkotah, Ranger Russet, and Shepody). The top-kill treatments were as follows:

Flailing:

Flail + Reglone (1.73 l/ha, i.e. 0.7 l/ac) sprayed immediately after flailing

Chemical Desiccation:

Reglone first application (2.22 l/ha, i.e. 0.9 l/ac). Reglone second application 5-7 days later (1.24 l/ha, i.e. 0.5 l/ac)

This trial was conducted under both irrigation and under dryland. The crop was planted on May 23, 2002 and top killed on September 3, 9, 16. Adequate skin-set was noticed approximately two weeks after top-kill regardless of the date and method utilized to top-kill the crop.

The various cultivars responded alike to flailing and chemical desiccation across all harvest dates and growing conditions (Table 14, 15). Non-significant cultivar x top-kill treatment interaction indicates that effects of top-kill methods were similar for all cultivars during all top-kill dates under irrigation and dryland.

The tuber size profiles for the various cultivars grown under irrigation and dryland when top-killed at different times are presented in Figure 4. In this figure 'Small' corresponds to Seed Grade B, 'Medium' corresponds to Seed Grade-A. Consumption potatoes include the 'Medium', 'Large' and 'Oversize' categories. The tuber size distribution for the various cultivars are summarized below:

Atlantic: During the first top-kill, irrigated Atlantic produced 33 t/ha (294 Cwt/ac). Delaying top-kill resulted in higher yields. The yield increases between the first and the second top-kill and between the second and the third top-kill were 16% and 11% respectively. Canada Grade-A seed-tubers constituted about 70-72% of the total yield across all top-kill dates Canada Grade-B tubers made up 14% to 19% of the total yields

[1]*CSIDC, Outlook*

Table 14.	Effects of timing of top-kill on 'seed' grade yields for potato cultivars grown under irrigation and dryland.											
Treatment	Irrigation yield (t/ha)						Dryland yield(t/ha)					
	100 DAP		107 DAP		114 DAP		100 DAP		107 DAP		114 DAP	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ha
Top-kill method:												
Reglone	28.5	254	29.9	267	34.4	307	21.1	188	23.6	211	27.4	245
Flail	28.8	257	32.1	286	34.0	303	22.5	201	28.5	254	28.9	258
Cultivar:												
Atlantic	30.6	273	33.6	300	35.9	320	24.3	217	29.1	260	32.5	290
Russet Burbank	24.0	214	25.0	223	25.3	226	16.6	148	20.5	183	18.7	167
Russet Norkotah	31.5	281	30.2	269	32.4	289	26.2	234	28.4	253	30.5	272
Dark Red Norland	30.8	275	34.4	307	39.0	348	22.6	202	27.3	244	31.4	280
Ranger Russet	26.5	236	28.1	251	33.4	298	20.2	180	24.2	216	28.5	254
Shepody	28.4	253	34.9	311	39.1	349	21.1	188	27.1	242	27.5	245
Analyses of Variance												
Source:												
Treatment (T)	ns		ns		ns		ns		ns		ns	
Cultivar (C)	**(3.7)		***(3.6)		***(4.0)		***(2.5)		***(3.0)		***(4.3)	
T x C	ns		ns		ns		ns		ns		ns	
CV (%)	12.7		11.5		11.5		11.3		11.4		15.3	

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

The dryland crop produced 26 t/ha (232 Cwt/ha) total yield. The yield increases between the first and the second top-kill and between the second and the third top-kill were 25% and 15%, respectively. Canada Grade-A seed-tubers constituted about 70-72% of the total yield across all top-kill dates. Grade-B tubers accounted for 14% to 25% of the total yield.

There was a small percentage of large and over-size tubers and their proportion increased with delay in top-kill.

Table 15. Effects of timing of top-kill on 'consumption' grade yields for potato cultivars grown under irrigation and dryland.

Treatment	Irrigation yield (t/ha)						Dryalnd yield (t/ha)					
	100 DAP		107 DAP		114 DAP		100 DAP		107 DAP		114 DAP	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ha
Top-kill method:												
Reglone	25.5	227	28.2	252	33.3	297	15.4	137	19.7	176	26.2	234
Flail	25.2	224	31.7	283	33.6	300	16.3	145	24.3	217	26.1	233
Cultivar:												
Atlantic	27.1	241	32.5	290	36.9	329	19.3	172	25.7	229	31.5	281
Russet Burbank	16.4	146	19.2	171	19.4	173	7.8	70	13.0	116	13.4	120
Russet Norkotah	36.7	327	40.0	357	44.1	394	23.7	212	29.2	261	34.3	306
D. Red Norland	24.9	222	29.0	259	34.4	307	14.0	125	21.5	192	28.7	256
Ranger Russet	23.8	212	28.0	250	32.1	286	14.8	132	19.1	170	25.0	223
Shepody	22.9	204	30.8	275	33.9	303	15.3	137	23.4	209	23.9	213
Analyses of Variance												
Source:												
Treatment (T)	ns		ns		ns		ns		ns		ns	
Cultivar (C)	***(3.1)		***(3.4)		***(4.1)		***(2.6)		***(3.5)		***(4.2)	
T x C	ns		ns		ns		ns		ns		ns	
CV (%)	12.0		11.3		12.1		16.4		15.7		15.8	

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

Russet Burbank: Irrigated Russet Burbank produced 24 t/ha (214 Cwt/ac) total yield during the first top-kill date with a slight yield increase for delayed top-kill. Grade-A and Grade-B tubers constituted 66-72% and 25-33% of the total yield, respectively.

The dryland crop produced 17 t/ha (152 Cwt/ac) total yield at 103-day top-kill. The 109-day top-kill produced 24% higher total yield than the 103-day top-kill. A further seven-day delay in top-kill did not result in any yield advantages. The first top-kill day recorded 47% Grade-A yield and 53% Grade-B yield. Delay in top-kill date produced more Grade-A tubers and less Grade-B tubers.

Russet Norkotah: Irrigated Russet Norkotah produced 40 t/ha (357 Cwt/ac) total yield during the first top-kill date with a slight yield increase for later top-killed crops. Approximately a 10% yield increase was obtained per (approximately) seven-day delay in top-kill. The highest proportion of Grade-A seed-tubers were obtained at the 103-day top-kill. Delay in top kill produced tubers more suited for consumption needs and too large to be used as seed.

The dryland crop produced 28 t/ha (250 Cwt/ac) total yield at 103-day top-kill. The 109-day top-kill produced 18% higher total yield than the 103-day top-kill and 116 day top-kill produced 12% higher total yield than 107-day top-kill. The proportion of Grade-A seed-tubers were similar (72-76%) over the three top-kill dates. Delay in top-kill produced more larger consumption grade tubers.

Dark Red Norland: Irrigated Dark Red Norland produced 32 t/ha (286 Cwt/ac) total yield during the first top-kill date with 14% yield increase between the successive top-kill dates. Grade-A seed-tubers comprised approximately 75% of the total yield during the three top-kill stages. Grade-B seed-tubers accounted for approximately 17-21% of the total yield during the various top-kill dates.

The dryland crop produced 23 t/ha (205 Cwt/ac) total yield at 103-day top-kill. The 109-day top-kill produced 18% higher total yield than the 103-day top-kill, and 116-day top-kill produced 12% higher total yield than 109-day top-kill. The proportion of Grade-A seed-tubers were 59%, 72%, and 77%, respectively, during the three successive top-kill dates.

Ranger Russet: Irrigated Ranger Russet produced 28 t/ha (250 Cwt/ac) total yield during the first top-kill date with 12% and 16% yield increases between the successive top-kill dates. Grade-A seed-tubers comprised approximately 75-77% and Grade-B accounted for 12-15% of the total yield during the three top-kill stages.

The dryland crop produced 21 t/ha (187 Cwt/ac) total yield at 103-day top-kill. The 109-day top-kill produced 19% higher total yield than the 103-day top-kill, and 116 day top-kill produced 24% higher total yield than 109-day top-kill. The proportion of Grade-A seed-tubers were 70% to 76% during the various top-kill dates.

Shepody: Irrigated Ranger Russet produced 29 t/ha (259 Cwt/ac) total yield during the first top-kill date with 13% and 16% yield increases between the successive top-kill dates. Grade-A seed-tubers comprised approximately 74-76% of the total yield during the three top-kill stages. The proportion of Grade-B tubers ranged from 17% to 22% of the total yield across the three top-kill dates.

The dryland crop produced 22 t/ha (196 Cwt/ac) total yield at 103-day top-kill. The 109-day top-kill produced 33% higher total yield than the 103-day top-kill, while delaying top-kill by a further six days did not change total tuber yields. The proportion of Grade A seed-tubers ranged between 68% and 78% during the various top-kill dates. The percentage of Grade B tubers were 29%, 19 and 17% of the total yield, respectively, during the successive top-kill dates.

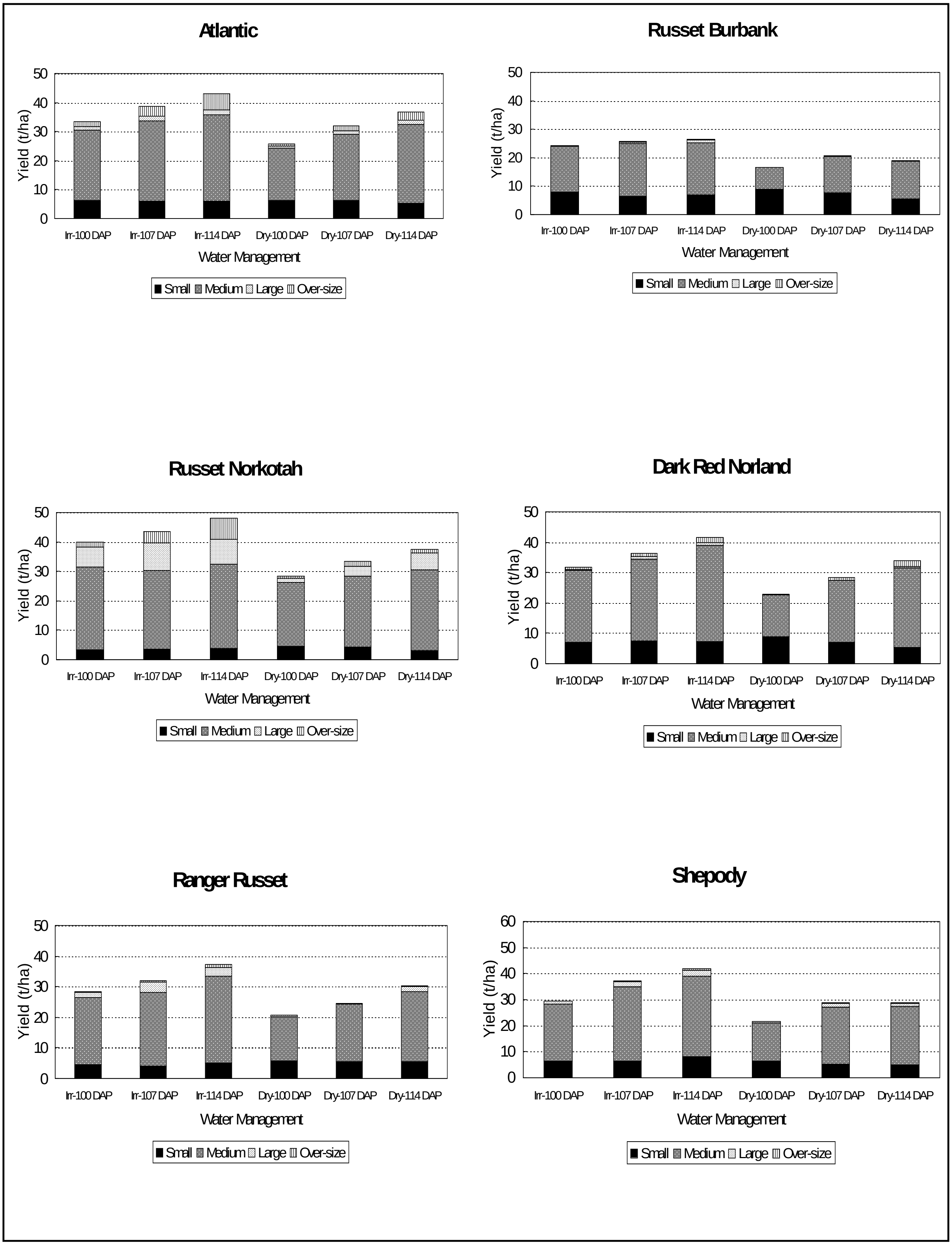


Figure 4. Tuber size distribution for contrasting potato cultivars as influenced by method and timing of top-kill under irrigated and dryland production.

Demonstration of Improved Vegetable Production and Storage Techniques for Saskatchewan

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

Progress: *Year one of three*

Objective: *To demonstrate commercial scale vegetable production using new technologies under Saskatchewan conditions.*

Season Extension Demonstration

Season extension techniques for the production of warm season vegetable crops are becoming more prominent in Saskatchewan. In 2002, 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. Ventilation is achieved by rolling up the sides of the high tunnel. A small cucumber demonstration was also conducted in 2002 in the high tunnel.

Agronomic demonstrations included a plant population study of green peppers and a plant population and planting material study (transplant vs. direct seeding) of cantaloupe. The green pepper study consisted of 15, 30 and 60 cm (6, 12, and 24 inch) in-row spacing with a 60 cm (24 inch) between row spacing. The cantaloupe study consisted of 30 and 60 cm (12 and 24 inch) in-row spacing with a 60 cm (24 inch) between row spacing along with direct seed and transplants. Irrigation of the crops was applied with trickle tape. Cool conditions in the spring of 2002 delayed the planting of the crops until late May.

Pepper yields increased with closer in-row spacings. Yields were 4.48 kg/m row, 3.42 kg/m row, and 2.27 kg/m row for the 15, 30 and 60 cm (6, 12, and 24 inch) in-row spacings, respectively. The yield difference is attributed to the total number of fruit harvested as the fruit size was similar for all spacings. Production problems at the beginning of the season such as late planting and cool temperatures may have negatively affected yields. Similar demonstrations will be conducted in 2003 and 2004.

[1]*CSIDC, Outlook*

Cabbage/Celery Storage

In 2002, the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) conducted a cabbage storage demonstration and an observational celery storage demonstration. Three cultivars of cabbage (Cecile, Bravo, Lennox) grown in the CSIDC field plots were stored in three separate storage types. The three storage types included a filacel cooler, evaporative cooler with a humidifier, and insulated storage with no artificial cooling or humidification. All storage types are located in the vegetable storage and handling facility at the 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. 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 slightly better than Cecile and Bravo in all cooler types. This demonstration will continue in 2003 and 2004 to obtain additional data and determine 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 three to four weeks after harvest, greatly extending the marketing period.

Pumpkin Irrigation Scheduling

A pumpkin irrigation scheduling demonstration was conducted at the CSIDC in 2002 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 RoDrip 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 good.

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 0-30 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 (322 mm) > Water Treatment 2 (178 mm) > Dryland Treatment (101 mm).

Pumpkin yield increased as the quantity of water applied was increased. Yields were 23.13 kg/m double row, 19.53 kg/m double row and 13. 55 kg/m double row (77.1 Mg/ha, 65.1 Mg/ha and 45.2 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.

Native Fruit Cultivar Trials

R. St-Pierre[1]

Native fruit cultivar evaluation trials were initially established in the fall of 1994 at Outlook (co-operator - CSIDC) and Saskatoon (University of Saskatchewan). All cultivar trials consisted of three replications of five plants per cultivar per replication. The cultivars in the trials varied with location and year of trial establishment, and included : a) chokecherry - cultivars Copper Schubert, Garrington, Goertz, Lee, Maxi, Mini Schubert, Mission Red, Robert, and Yellow; b) pincherry - cultivars Jumping Pound, Lee # 4, and Mary Liss; c) highbush cranberry - cultivars Alaska, Andrews, Espenant, Garry Pink, Manito, Phillips, and Wentworth; and d) black currant - cultivars Ben Alder, Ben Lomond, Ben Nevis, Ben Sarek, Black Giant, Boskoop Giant, Consort, Coronet, Crusader, McGinnis Black, Magnus, Noir de Bourgogne, Titania, Topsy, Wellington, Willoughby, and selections 4-24-9, 5-23-42, 5-24-9, and 25-23-23. Data collection included survival, growth, sucker production, yield per plant and fruit size. Observations of flowering time, susceptibility to disease and insect problems were also collected.

Chokecherry

Yield, fruit size, shoot growth and suckering data were collected from trials located at the University of Saskatchewan and at the CSIDC in Outlook (Table 1). Shoot growth and sucker production did not differ substantially among cultivars and sites. Fruit production of all cultivars increased relative to the 2001 season except for the cultivar Boughen Yellow planted at Outlook, which decreased by approximately one half. The highest yielding cultivars were Garrington, Lee Red and Espenant (planted at the University of Saskatchewan only). The average yield of these cultivars was 19.68 Mg/ha (14,000 lbs/ac) based on a plant density of 1928 plants/ha (800 plants/ac).

Table 1. Choke Cherry Cultivar Trials 2002 mean growth, yield and fruit size (+/- standard error).

Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook	Boughen Yellow	16.2 +/- 3.02	1.85 +/- 1.0	306 +/- 24.1
	Garrington	19.0 +/- 4.02	10.5 +/- 1.4	226 +/- 8.99
	Lee Red	19.5 +/- 1.16	6.53 +/- 1.4	202+/- 12.8
U of S	Boughen Yellow	17.0 +/- 1.42	4.39 +/- 1.4	233 +/- 13.0
	Copper Schubert	22.5 +/- 3.56	4.48 +/- 1.5	229 +/- 5.24
	Espenant	14.8 +/- 0.76	8.97 +/- 2.1	250 +/- 10.2
	Garrington	16.4+/- 1.51	8.3 +/- 0.6	217 +/- 2.60
	Goertz	17.1 +/- 2.37	3.58 +/- 0.7	199 +/- 19.4
	Lee Red	18.0 +/- 1.44	6.12 +/- 1.4	204 +/- 7.42
	Mission Red	11.6 +/- 0.61	4.01 +/- 1.3	262 +/- 50.5
	Robert	14.4 +/- 1.85	3.02 +/- 0.28	215 +/- 6.74

[1]*Dept. of Plant Sciences, U of S, Saskatoon*

Pincherry

Shoot growth, yield and fruit size data were collected from the pincherry cultivar trials located at the University of Saskatchewan and the CSIDC in Outlook.

The cultivar Lee #4 yielded the most fruit, averaging 15.26 Mg/ha (4,700 lbs/ac) over both trial sites based on a plant density of1928 plants/ha (800 plants/ac). This cultivar was also the highest yielding during the 2001 season although yield was down by approximately 12% during the previous season. Fruit yields at the University of Saskatchewan location were lower than at Outlook but the fruit at the U of S were larger (Table 2).

Table 2. Pincherry Cultivar Trials 2002 - mean growth, yield and fruit size (+/- standard error).

Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook	Jumping Pound	29.3 +/- 3.5	0.98 +/- 0.48	439 +/- 52.3
	Lee #4	23.3 +/- 2.3	2.38 +/- 0.87	351 +/- 34.9
	Mary Liss	26.1 +/- 1.4	0.97 +/- 0.19	392 +/- 21.0
U of S	Jumping Pound	17.9 +/- 0.7	1.75 +/- 0.47	269 +/- 11.1
	Lee #4	18.2 +/- 1.0	3.04 +/- 0.85	273 +/- 0.85
	Mary Liss	18.4 +/- 0.24	1.71 +/- 0.43	276 +/- 3.53

Highbush Cranberry

Shoot growth, yield and fruit size data were collected from the highbush cranberry cultivar trials located at the University of Saskatchewan and the CSIDC trial locations (Table 3). Yields of highbush cranberry at Outlook increased from the 2001 season. Yields at the University of Saskatchewan were similar to the previous season. Fruit size was similar at both sites and fruit size generally increased from the 2001 season. The cultivar Phillips continues to under-perform the other cultivars in these trials. It seems likely that this American cultivar is not well-adapted to our region. The highest yielding cultivars at the U of S (Alaska, Garry Pink, Manito and Wentworth), yielded an average of 3.86 Mg/ha (3,450 lbs/ac) between them based on a plant density 1928 plants/ha (800 plants/ac). Yield of these four cultivars increased slightly from the 2001 value of 3.64 Mg/ha (3,250 lbs/ac). Shoot growth was similar at both locations and among cultivars.

Table 3. Highbush Cranberry Cultivar Trials 2002 - mean growth, yield and fruit size (+/- standard error).

Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook	Alaska	27.6 +/- 1.6	1.36 +/- 0.18	213 +/- 3.2
	Phillips	28.4 +/- 1.4	0 +/- 0	na
	Wentworth	24.6 +/- 3.5	1.68 +/- 0.39	206 +/- 3.5
U of S	Alaska	21.3 +/- 1.0	2.31 +/- 0.55	183 +/- 4.9
	Andrews	21.7 +/- 2.7	0.35 +/- 0.35	na
	Espenant	31.2 +/- 2.5	1.82 +/- 0.06	318 +/- 31
	Garry Pink	28.3 +/- 5.5	2.15 +/- 0.31	203 +/- 11.1
	Manito	30.5 +/- 0.9	2.11 +/- 0.84	171 +/- 2.40
	Phillips	21.6 +/- 0.7	0 +/- 0	na
	Wentworth	27.9 +/- 3.9	1.76 +/- 0.23	198 +/- 8.74

Black Currant

Yield, fruit size and growth data were collected from two sites at the University of Saskatchewan and from the cultivar trial located at the CSIDC (Outlook) (Table 4). Yields generally increased from the 2001 season. The top three yielding cultivars during 2002 season were Ben Alder, Ben Lomond & Ben Sarek. Assuming a 1300 plant per acre planting density, yields were 3.91 Mg/ha (3,490 lbs/ac) for Ben Alder, 5.54 Mg/ha (4,950 lbs/ac) for Ben Lomond and 4.58 Mg/ha (4,090 lbs/ac) for Ben Sarek. It is worth noting that Ben Alder was also among the top producing cultivars during the 2001 season. The size of fruit produced during the 2002 season was generally similar to the size observed during the 2001 harvest.

Table 4. Black Currant Cultivar Trials 2002 - mean growth, yield and fruit size (+/- standard error).

Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook[1]	Consort	9.7 +/- 1.0	1.04 +/- 0.14	380 +/- 6.43
	Wellington	11.1 +/- 1.1	0.96 +/- 0.05	260 +/- 13.2
	Willoughby	16.3 +/- 0.5	0.16 +/- 0.06	384 +/- 18.2
U of S site 1[1]	Black Giant	21.1 +/- 1.2	0 +/- 0	na
	Boskoop Giant	12.7 +/- 2.9	0 +/- 0	na
	Consort	13.2 +/- 1.0	0.52 +/- 0.15	310 +/- 49.9
	Coronet	14.8 +/- 1.4	0.26 +/- 0.03	392 +/- 50.0
	Crusader	14.6 +/- 2.3	0.28 +/- 0.11	387 +/- 10.9
	Magnus	14.7 +/- 1.4	0.23 +/- 0.06	295 +/- 15.5
	25-23-23	12.7 +/- 1.1	0.16 +/- 0.02	216 +/- 7.21
	52008	9.2 +/- 0.8	0.43 +/- 0.08	218 +/- 15.3
	39956	13.2 +/- 0.4	0.04 +/- 0.04	na
	Topsy	15.1 +/- 0.6	0.26 +/- 0.10	260 +/- 16.6
	Wellington	13.1 +/- 1.8	0.23 +/- 0.07	308 +/- 72.3
	Willoughby	18.3 +/- 3.8	0 +/- 0	na
U of S site 2[2]	Ben Alder	11.0 +/- 1.0	1.22 +/- 0.51	211 +/- 16.6
	Ben Lomond	15.4 +/- 1.1	1.74 +/- 0.75	232 +/- 40.4
	Ben Nevis	13.6 +/- 1.8	0.25 +/- 0.19	127 +/- 64.3
	Ben Sarek	8.6 +/- 0.2	1.43 +/- 0.52	141 +/- 7.27
	Consort	20.0 +/- 2.4	0.63 +/- 0.10	309 +/- 9.96
	Crusader	13.4 +/- 2.0	0.34 +/- 0.19	200 +/- 100
	Magnus	13.6 +/- 1.4	0.45 +/- 0.08	244 +/- 35.3
	McGinnis Black	14.3 +/- 2.1	0.67 +/- 0.22	167 +/- 13.5
	Noir de Bourgogne	14.1 +/- 1.1	0.27 +/- 0.08	329 +/- 21.4
	47231	13.0 +/- 1.0	0.07 +/- 0.07	na
	Titania	13.4 +/- 0.5	0.19 +/- 0.08	237 +/- 6.01
	Wellington	16.9 +/- 2.9	0.91 +/- 0.17	219 +/- 22.3

[1]Note: the Outlook site and U of S Site 1 were planted in 1994.
[2]U of S Site 2 was planted in 1998.

Herb Agronomy

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

Progress: *Ongoing*

Location: *CSIDC, Outlook*

Objectives:
- *To evaluate the adaptability of promising medicinal and culinary herbs for Saskatchewan conditions,*
- *To develop management practices for mechanized commercial production,*
- *To develop labour saving agronomic practices,*
- *To compare dryland and irrigated production in relation to yield and quality.*

The shrinking budgets for mainstream health care has lead to the resurgence of alternative medicine. Natural products are increasingly being used as food flavouring, cosmetics, and for medicinal purposes. The medicinal and aromatic plant production and processing are fast growing industries in Canada, including Saskatchewan. The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) has expanded its herb research program to support the needs of this rapidly expanding industry. Agronomic studies are being conducted for several herb species that are considered to be commercially important.

Feverfew

Objective: *To study the effects of plant spacing and harvest stage on productivity and processing quality.*

This study examined the effects of two within-row plant spacing (15, 30 cm; i.e. 6, 12 in) and three harvest stages (pre-flower, 10% flower, 100% flower) for 'Wild' feverfew grown under irrigation and dryland. Field plots were established using transplants. Rows were spaced 60 cm (24 in) apart. For the irrigated study, soil moisture status was maintained above approximately 50% F.C. using sprinkler irrigation. The whole plant was harvested using a forage harvester for yield estimation.

Under irrigated production, closer spacing produced significantly (10%) higher dry herb yield than wider spacing (Table 1). Spacing had no effect on herb yield under dryland.

Harvesting at pre-flower, and at 10% flower produced similar yields under both growing conditions. Harvesting at 100% flower produced higher dry herb yields than harvesting at the two earlier stages.

[1]CSIDC, Outlook

Table 1. Plant spacing and harvest stage effects on dry herb yields of irrigated and dryland 'wild' feverfew.

Treatment	Irrigation Dry herb yield		Dryland Dry herb yield	
	t/ha	ton/ac	t/ha	ton/ac
Plant spacing:				
15 cm	2.19	0.87	1.52	0.61
30 cm	1.99	0.79	1.50	0.60
Harvest stage:				
Pre-flower	1.78	0.71	1.36	0.54
10% flower	1.76	0.70	1.31	0.52
100% flower	2.74	1.09	1.87	0.75
Analyses of Variance				
Source:				
Spacing (S)	*(0.16)		ns	
Harvest (H)	***(0.19)		***(.34)	
S x H	ns		ns	
CV (%)	8.8		21.3	

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

Milk Thistle

Objective: *To study the seeding rate and row spacing effects on plant stand, seed yield, and quality.*

Milk thistle was grown under three seeding rates (50, 100, 200 seed/m^2; i.e.15, 30 60 seeds/ft^2) and three row spacings (20, 40, 60 cm; i.e 8,16, 24 in). The crop was grown under dryland conditions.

Cool and moist conditions experienced during the fall of 2002 delayed flowering and maturity. This resulted in no seed harvest taken during this season. However, vegetative shoot was harvested to examine the seeding rate and row spacing effects on dry shoot yield.

Higher seeding rates produced higher dry herb yields relative to lower seeding rates (Table 2). Row spacing had no effect on dry herb yields (Table 2).

Table 2. Seeding rate and row spacing effects on dry shoot yield of milk thistle grown under dryland.

Treatment	Dry shoot yield t/ha	Dry shoot yield ton/ac
Seeding rate:		
50 seeds/m^2	11.54	4.60
100 seeds/m^2	14.70	5.86
200 seeds/m^2	15.75	6.28
Row spacing:		
20 cm	14.15	5.64
60 cm	14.01	5.59
80 cm	13.83	5.51
Analyses of Variance		
Source:		
Seeding rate (R)	***(1.08)	
Row spacing (S)	ns	
R x S	ns	
CV (%)	3.4	

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

St. John's Wort

The winter of 2001/2002 and the 2002 growing season was quite unfavourable for St. John's Wort production. The crop suffered severe winter-kill and adversely affected the vigour of remaining plants. Winter-kill also caused an uneven stand. Weak crop growth, resulted in poor herb yields for both the current season's crop and the second-year crop.

The following studies were conducted in 2002:

Study I: Effect of cutting frequency and straw mulching on productivity and winter-kill incidence of St. John's Wort grown under irrigation.

Treatments:

Biotype:	Standard, Elixir, Topaz, New Stem, Helos
Cutting height:	Top-1/3, Top-2/3
Cutting frequency:	One cut, two cuts
Mulching:	No mulch, straw mulch

Study II: Effects of plant population, harvest methods and mulching on yield, quality, and winter-kill incidence for different biotypes.

Treatments:	Biotype:	Standard, New Stem, Elixir, Topaz, Helos
	Within-row spacing:	15, 30 cm (6, 12 in)
	Cutting height:	Top-1/3, Top-2/3
	Mulching:	Straw mulch, no mulch

It was not possible to obtain accurate data and derive viable conclusions due to variable plant stand and due to poor plant growth. However, some basic observations were taken on the winter-kill incidence and herb yields. Following are some general observations:

- The winter-kill incidence was between 92% and 100% for unmulched irrigated and dryland St. John's Wort (Table 3). Straw mulch reduced winter-kill by 10% to 60% depending on the cultivar and growing condition (Table 3).
- Herb yields were extremely low with variable cultivar response (Table 4).

Table 3. Effect of straw mulch on winter-kill incidence for St. John's Wort grown under irrigation and dryland.

Cultivar	Winter-kill (%)			
	Irrigation		Dryland	
	No mulch	Straw mulch	No mulch	Straw mulch
Standard	98	90	98	54
Topas	92	45	100	45
Elixir	97	64	100	47
Anthos	99	84	100	37

Table 4. Effect of straw mulch on dry herb yield for St. John's Wort grown under irrigation and dryland.

Cultivar	Irrigation				Dryland			
	No mulch		Straw mulch		No mulch		Straw mulch	
	t/ha	ton/ac	t/ha	ton/ac	t/ha	ton/ac	t/ha	ton/ac
Standard	0.01	0.004	0.30	0.12	0.06	0.02	1.08	0.43
Topas	0.15	0.06	1.52	0.61	0	0	1.81	0.72
Elixir	0.05	0.02	1.33	0.53	0	0	1.11	0.44
Anthos	0.03	0.01	0.69	0.28	0	0	1.81	0.72

Soil and Water Management

Soil and Water Management

Agrochemicals in the Soil and Groundwater under Intensively Managed Irrigated Crop Production

J. Elliott[1], A. Cessna[1], E. Zoski[1], D. Gallen[1], T. Hogg[2], J. Wahab[2], L. Tollefson[2], B. Vestre[2]

Progress: *Year five of six*

Objectives:
- *To quantify the effect of agro-chemical use under intensive irrigated potato production on soil and groundwater,*
- *To assist in the development of environmentally sustainable best management practices for potatoes.*

In this study, potatoes are grown in a three-year rotation followed by canola and a cereal. Nitrate (NO_3) leaching is monitored throughout the rotation by measuring concentrations in soil and groundwater under different fertilizer regimes for potatoes and groundwater is analysed for the applied pesticides. In 2001, a potato crop was grown on Field 4 and 5 as part of this study. The rates of fertilizer application for the potato crop are given below.

Nitrogen Fertilizer Treatments in the Potato Year of the Rotation

300	300 kg N/ha incorporated prior to seeding
200	200 kg N/ha incorporated prior to seeding
SPLIT	100 kg N/ha incorporated prior to seeding and 100 kg N/ha applied at hilling
FERT	100 kg N/ha incorporated prior to seeding and the balance applied through fertigation according to petiole analysis

In 2002, the study continued at the CSIDC with canola grown on all treatments. There were difficulties experienced in establishing the crop and the yield was low and variable. After an initial rise in the water table in May, the level dropped throughout the growing season. There were no obvious trends in NO_3 concentrations in shallow groundwater. Phorate sulphone, a degradation product of the insecticideThimet, was detected twice in quantifiable amounts (0.38 and 0.31 µg L^{-1}) in shallow groundwater samples. The detections were made in two different piezometers on two different dates in the spring of the year. Phorate sulphone had also been detected in quantifiable amounts on four occasions in late summer and fall of 2001. None of the other pesticides were detected in quantifiable amounts in 2002. There were occasional trace detections (<0.05 µg L^{-1}, the limit of quantification) of a single pesticide in some 2002 samples but 75% of the samples had no detectable pesticides (<0.01 µg L^{-1}, the detection limit).

[1]*National Water Research Institute, Saskatoon*
[2]*CSIDC, Outlook*

Market Analysis and Economics

Market Analysis and Economics

H. Clark[1]

***Progress**: Ongoing*

Objectives:

- *To assist producers to diversify by identifying higher value market opportunities,*
- *To help direct the CSIDC applied research and demonstration program.*
- *To assist the establishment of value-added processing by identifying markets,*
- *To assist rural development by evaluating crop diversification and value-added opportunities.*

The objectives of the market analysis and economics program are met, in part, by gathering and analysing price, cost, and return data for irrigated and specialty crops. The analyses are used to evaluate the economic potential of these crops as a means of providing input for research and demonstration priority planning at the CSIDC. The potential for value- added enterprises are determined to help facilitate this planning process.

The planning and information analysis involve a wide variety of subjects related to irrigation, agriculture, marketing, and value-added industry. Some of the subjects investigated in the past year include: (1) the market prospects for irrigation crops in the coming year; (2) an update of irrigated vegetable crop alternatives for Saskatchewan; (3) developments in the expansion of ethanol processing in Saskatchewan; and (4) estimating water use for irrigation.

Market Prospects for Irrigated Crops in 2003

A comparison of the expected irrigated crop returns in the Outlook area using the higher of current or long term price averages, and the cost data provided by the Irrigation Crop Diversification Corporation (ICDC) updated with fertilizer, seed and land costs for 2003 is presented in Table 1. It indicates the better crop options for 2003 are alfalfa, timothy grass, corn and barley silage, mustard, dry beans, potatoes and vegetables (to be discussed separately).

Many farmers are looking to plant oilseeds in 2003, due to falling prices for cereals in spite of two years of drought. A sharply higher Canadian dollar has caused some market prices to fade. Wheat is under threat from the introduction of countervailing duties in the U.S., although stronger currencies elsewhere in the world could restore some of Canada’s competitive position off-shore. Barley and feed grains face uncertain demand from the livestock sector with temporary halts to Canadian beef and cattle exports.

Canola, flaxseed and sunflower appear to be average options, which could also be favored in rainfed areas, with flaxseed more prominent in the eastern prairies, and sunflowerseed in southern Manitoba.

[1]CSIDC, Outlook

Table 1. Expected Irrigated Crop Returns - Outlook, Saskatchewan - 2003.									
		Expected Yield							
Crop	Unit of yield/price	tonnes/ha	unit/acre	Price[2] ($/unit)	Gross returns ($/acre)	Investment ($/acre)	Total cost ($/acre)	Return on investment[3] (%)	Net return[1] ($/acre)
Alfalfa	ton	9.99	4.5	81	360	1335	274	13%	144
Timothy Grass	ton	9.88	4.4	123	544	1663	367	18%	235
Corn Silage	ton	35.88	16.0	31	523	1278	358	18%	177
Barley Silage	ton	29.15	13.0	34	495	1198	267	21%	210
Barley	bushel	5.67	105.4	2.72	305	1172	320	3%	5
Oats (milling)	bushel	4.73	124.0	1.80	249	1172	325	-2%	-48
Triticale	ton	5.35	2.2	124	309	1172	315	3%	6
CPS Wheat	bushel	5.04	75.0	3.76	312	1172	315	4%	20
SWS Wheat	bushel	5.04	75.0	3.81	312	1172	317	4%	22
CWRS Wheat	bushel	4.13	61.4	4.38	269	1172	318	3%	4
Durum Wheat (2CW)	bushel	4.53	67.4	5.31	358	1172	320	10%	91
Green Peas	bushel	4.04	60.0	6.45	355	1213	340	8%	68
Yellow Peas	bushel	4.04	60.0	5.17	284	1213	336	3%	1
Fababean	lb	3.66	3264	0.097	315	1100	298	9%	70
Flaxseed	bushel	2.43	38.7	8.23	329	1174	317	8%	65
Brown Mustard	lb	2.24	1999	0.209	418	1174	310	16%	161
Yellow Mustard	lb	1.68	1498	0.252	377	1174	300	14%	130
Canary Seed	lb	1.91	1699	0.200	339	1172	325	8%	67
Canola	bushel	2.60	46.4	7.85	353	1174	354	7%	52
Sunflower Birdseed	lb	2.58	2301	0.181	416	1252	370	11%	99
Dill Seed	lb	1.29	1150	0.360	414	1382	351	12%	132
Eston Lentil	lb	2.00	1784	0.179	323	1213	320	7%	56
Kabuli Chickpea	lb	1.57	1399	0.253	354	1213	404	3%	6
Pinto Beans[4]	lb	2.42	2154	0.239	515	1273	431	14%	137
Pink Beans[4]	lb	2.45	2183	0.254	554	1273	435	16%	172
Small Red Beans [4]	lb	2.55	2275	0.252	573	1273	437	18%	189
Great Northern Beans	lb	2.44	2173	0.254	552	1273	435	16%	170
Black Beans[4]	lb	2.17	1936	0.273	529	1273	436	14%	146
Seed Potatoes	cwt	26.69	238	16.33	3888	3932	1761	61%	2397
Table Potatoes	cwt	27.68	247	12.52	3091	3932	1601	45%	1760
Processing Potatoes [5]	cwt	26.69	238	8.35	1987	4186	1528	18%	609

[1] Returns to Land, Management and Investment.
[2] Prices are the highest of prices expected for the coming year or long term averages (five years).
[3] Does not include interest on fixed investment.
[4] Dry bean yields are 75% of yields for earlier maturing varieties from the CSIDC Crop Varieties for Irrigation, January 2003.
[5] Manitoba.

A significant difference in feed wheat prices appears to be developing between irrigated and dryland areas. Feed wheat prices in Outlook stayed higher, closer to the higher costs of production for irrigated CPS wheat, while feed wheat prices in Lanigan where ethanol is produced, have fallen. This partly reflects the lower margins for ethanol production with falling gasoline prices, and the prospects for higher yields with improved moisture levels on the prairies.

While imported corn has become more common for ethanol and feed usage, irrigated grain corn is still more costly to produce than in Ontario or rainfed areas of southern Manitoba. Corn grown under irrigation is more likely to be used for silage. Grain corn in irrigated areas will likely carry a higher price than in southern Manitoba or Ontario.

Alfalfa prices have fallen from the drought period, but still appear competitive with many other irrigated options.

While dry beans remain one of the better irrigated options among the pulse crops, dry bean prices were pressured in 2002/2003 by good yields in southern Manitoba increased production in the U.S., and being mostly produced under irrigation in southern Alberta and south central Saskatchewan. Combining good yields in Canada with a record area planted lead to a record production, 39% above the previous year. New crop prices are better than current prices for dry beans, and the favorable outlook for dry beans is based mostly on historical prices.

While the seeded area for dry peas is expected to be steady or slightly higher, price prospects have also fallen with an expected recovery in production. Expected returns are below average for irrigated areas, and equally unattractive for dryland areas. There has not been much enthusiasm for pulse crops this year as farmers seemed to be attracted to forage, feed, and oilseed crops.

Canaryseed prices have fallen to more normal levels leaving this as a less attractive crop for irrigators. Brown mustard prices have risen above yellow mustard making this one of the more attractive crops for irrigators and dryland farmers in the brown soil zone.

Laird lentil and Eston lentil appear to be good crop options for dryland growers, but Eston lentil has below average expectations for growers with irrigation. Markets for chickpeas, both desi and kabuli, appear threatened by lower prices and low yields caused by disease problems for irrigators and last year’s drought for dryland growers.

Potatoes, both seed and table, remain good options for irrigators. Prices have been strong this year, although falling from their peaks of the last two years. Harvest problems were experienced by some growers with the poor and cold weather in October. As of May 1, Saskatchewan seed potato supplies were 10% higher than the previous year, and larger than all the remaining seed potato supplies of Western Canada and Ontario combined.

Irrigated Vegetable Crop Comparison

Raising the vegetable costs of production by 2% (the rate of inflation in Canada) from the AFIF budget results of 2001, and calculating new target prices from the wholesale vegetable prices for 2002 and the costs of production[2], gives the updated summary of returns on vegetables presented in Table 2.

Pumpkins still lead the list, and the CSIDC field tests did verify the pumpkin yields once again.

From the census data, there was a slight expansion in the production of asparagus, spinach, and green peas in Saskatchewan from 1996 to 2001. While there appears to be a significant drop in the area planted to most other vegetables, this may have been partly due to a major wholesaler relocating to Calgary. Some growers have located other markets, and many are selling more to farmer's markets.

According to Table 2, cantaloupe, green peppers, and spinach are among the vegetables that appear to have better returns. Onions have proven to be more challenging as production on a larger scale has proven more successful in the Pacific North West and Ontario.

Sweet corn, carrots, cabbage and tomato continue to be among the higher acreage vegetable crops in Saskatchewan, but each have their marketing and production challenges.

Table 2. Summary of key data on vegetables, 2002 (in order of returns/acre).

Order	Vegetable	Marketable yield (t/ac)	Target price (cents/lb)	Return on investment	Cost per pound	Net Returns/ acre
(1)	Pumpkins	26.7	0.197	128%	0.13	3972
(2)	Cantaloupe	14.1	0.381	84%	0.26	3881
(3)	Spinach	4.3	0.830	119%	0.45	3602
(4)	Green Peppers	8.8	0.699	67%	0.52	3576
(5)	Onions	12.0	0.324	92%	0.19	3518
(6)	Beets	9.1	0.470	108%	0.30	3500
(7)	Zucchini	10.6	0.470	108%	0.33	3363
(8)	Parsnips	4.0	1.050	71%	0.69	3179
(9)	Broccoli	7.8	0.580	82%	0.40	3122
(10)	Celery	16.4	0.340	68%	0.25	3034
(11)	Radishes	3.4	0.840	80%	0.45	2973
(12)	Green Onions	4.9	0.750	222%	0.48	2894
(13)	Carrots	18.1	0.276	61%	0.22	2448
(14)	Potatoes (Red)	13.3	0.138	80%	0.08	2313
(15)	Squash	8.1	0.420	69%	0.30	2244
(16)	Cabbage	26.1	0.154	68%	0.12	2175
(17)	Rutabagas	14.4	0.290	60%	0.22	2079
(18)	Corn	6.0	0.298	86%	0.15	1991
(19)	Brussel Sprouts	5.0	0.750	42%	0.58	1843
(20)	Tomatoes	5.5	0.692	76%	0.55	1743
(21)	Romaine Lettuce	9.3	0.390	42%	0.31	1659
(22)	Green Peas	2.4	1.240	55%	0.95	1530
(23)	Snow Peas	2.0	1.470	54%	1.13	1488
(24)	Green Beans	3.0	0.940	68%	0.74	1336
(25)	Cauliflower	7.9	0.473	35%	0.40	1364
(26)	Cucumbers	16.7	0.259	40%	0.23	1101
Average returns/acre						2383

[2] *The target price in this case is the geometric mean of the wholesale price and the cost of production.*

Sweet corn must compete with a more established Alberta industry which will now be closer to processors and major wholesale markets.

Carrots must compete with major producers in southern Manitoba and Alberta. Saskatchewan production costs are higher on a limited scale of production, and are further from major markets. Storage is also a problem for most growers, as carrots are sold mostly to local markets and have a depressed price during the major harvest in October.

Farm cash receipts for vegetables in Saskatchewan were reported to be 3% higher in 2002 compared to 2001, while farm cash receipts for vegetables in all of Canada were up by 2%, down in Alberta, and 7% higher in Manitoba.

Herb and Spice Prices

CSIDC assisted Agriculture and Agri-Food Canada and the Saskatchewan Herb and Spice Association (SHSA) in collecting selected herb and spice price information in 2001. This initiative has been continued and growers can find the prices posted at the AAFC/MISB(Marketing and Industry Services)/ InfoHort website (http://www.agr.gc.ca/misb/infohort). The SHSA provides input on herbs and spices covered.

Irrigation Water Use in Canada

Under the National Agri-Health Analysis and Reporting Program (NAHARP), information was collected to estimate water use in the Canadian provinces. These estimates, and changes in irrigation water use from the 1996 to the 2001 census are presented in Table 4.

Table 4. Estimation of Canadian Water Use for Irrigation

Province	Irrigated Area - Acres			Water use (acre inches)	Total Water use irrigation (ac/ft)	Total water use irrigation (000 m^3)	% change in irrigated area from 1996 Census (9)
	Province	Census 2001	Weighted				
British Columbia	465,731	274,735	402,066	20.5	686,862	847,313	-3.6%
Alberta	1,581,138	1,233,649	1,465,308	14.1	1,717,145	2,118,270	-3.4%
Saskatchewan	335,255	169,243	279,918	9.4	219,969	271,353	-29.7%
Manitoba	67,981	69,548		3.5	20,285	25,023	26.8%
Ontario		121,752		7.1	72,158	89,014	-25.4%
Quebec		55,792		5.3	24,650	30,408	-32.8%
New Brunswick		2,827		4.4	1,037	1,279	-19.5%
Nova Scotia		8,627		6.9	4,932	6,084	55.9%
Prince Edward Island		1,827		4.4	670	827	-32.0%
Newfoundland		465		3.5	136	167	32.4%
Canada		2,408,130		13.7	2,747,843	3,389,739	-8.4%

ICDC 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 extention 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 the 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 committment fee to ICDC. The purpose of all reseach and demonstration projects is to increase the value and profitability of irrigated acres.

Cereal Forage Demonstration

L. Bohrson[1]

Cereal silage and hay are important forages for the Saskatchewan livestock industry and will help to fuel its expansion. ICDC co-operated with SeCan to plant an irrigated forage cereal demonstration at Warman and Swift Current. The irrigated cereals and annual grasses were cut at four different sampling dates and the yields were averaged for total yield. The yields were adjusted to a hay equivalent of 15% moisture content. Field days were hosted at the early dough stage of the green feed on July 29 and July 31, respectively.

The "forage cereals" include oats, triticale and two new forage barleys.

[1]*ICDC, Swift Current*

Barley

AC Ranger, a six-row, smooth-awned forage barley, has good forage capabilities and good lodging resistance. Westford, a Montana irrigated six-row, hooded (awnless) variety, is later maturing and has a tendency to lodge. A combination of other barley varieties were compared. AC Rosser is the top irrigated six-row, smooth-awned barley at the CSIDC. Trochu brings that same reputation from Alberta. Vivar, a semi-dwarf, six-row feed barley with strong straw, responds to intensive management. CDC McGwire, a two-row hulless variety, has improved straw strength that fared very well in 2001. AC Metcalfe, a two-row, rough-awned, malting barley is seeded beside the exciting new CDC Copeland, that could be the next two-row malt barley.

Table 1. Average cereal forage yield quality.

Crop	Yield[1] (tons/ac)	RFV	TDN[2]	CP[2]
Barley				
Trochu	4.7	110	55	13.4
CDC Copeland	4.3	90	50	13.1
AC Ranger	4.2	99	54	15.1
Vivar	4.0	102	54	12.9
AC Rosser	4.1	99	53	13.6
Westford	3.8	90	50	15.4
Oats				
Murphy	4.5	81	47	11.2
CDC Baler	4.3	97	51	14.0
AC Morgan	3.8	87	47	12.2
Others				
AC Ultima	4.1	93	50	11.4
AC 2000	4.0	93	50	14.0
Pasture				
Foxtail Millet	3.5	88	49	10.8
Winter Triticale	2.9	134	57	22.0
Fall Rye	2.6	129	59	22.2
Annual Ryegrass	2.6	101	52	16.8
Summary				
Ave Silage	3.8	100	52	14.5
Ave Greenfeed Hay	3.8	80	47	12.6
Ave Yellowfeed Hay	3.3	89	50	12.8

[1]Numbers adjusted to hay equivalent at 15% moisture.
[2]Hand sampled with no harvest loss and optimum quality.

Oats

Two forage oat varieties have also been seeded. CDC Baler and AC Murphy are known for producing good leafy forage yields. CDC Baler is later maturing than AC Murphy, but is reported to retain its green color better when baled. AC Morgan is adapted to high moisture environments and is a superior milling oat.

Spring Triticale

AC Ultima is a popular spring triticale grain variety offering improved milling quality over the old triticale. AC Ultima also has improved disease resistance and has dry matter yield comparable with other forage varieties. Pika winter triticale is planted along the boarders and pathways in the demonstration sites. Pika and Dakota fall rye display the leafy, vegetative yield that will be achieved with aggressive fertility for extended grazing this fall and next spring.

"Golden German" Foxtail Millet

It is a late-maturing, warm season crop with a small round seed. It should be seeded shallow in warm soil (early June). It has out yielded both oats and barley in Brandon, with quality similar to oats. The windrow is often dense and slow to dry, but has potential as swath grazing in early winter. SW Botrus annual ryegrass is also included for comparison.

Wheat

Three varieties of CWRS wheat (AC Barrie, AC Superb and PT205) were compared as silage crops. AC Barrie is the standard for comparison. AC Superb yields more than AC Barrie and has good resistance to leaf and stem rust. PT205 may offer the same yield as AC Superb but reaches maturity in fewer growing days. AC Crystal and AC 2000 are CPS wheat varieties with high irrigated yield potential. AC Crystal, a red CPS wheat, provides improved milling and marketing opportunities. AC 2000, a white CPS variety, has good lodging resistance and performed well as a silage crop in 2000 and 2001. AC Morse and AC Avonlea durum wheats were also compared.

Trochu, an irrigated six-row, smooth-awned feed barley from Lacombe Research Centre, was the top performer in 2002. CDC Baler and Murphy Forage Oats had relatively good yields but the forage quality was not as high as barley.

There was a serious shortage of pasture and forage in spring of 2002. Many producers used vegetative cereals and annual grasses on irrigation for emergency grazing. Corn, spring-seeded fall rye, foxtail millet and annual ryegrass. Some also used a portion of the production for silage or hay.

Corn Energy

Corn is the top feed grain and silage crop in the world. The combination of high energy content value and yield potential makes corn a valuable crop to both beef and dairy producers. The recent development of early-maturing hybrids has improved the suitability and attractiveness of corn to Saskatchewan irrigators. Corn is an “energy production” crop. Comparisons between grain corn and barley illustrate the energy advantage corn provides. Corn silage offers higher beef feed efficiency as compared to barley silage. In addition to these quality advantages, corn silage yields can exceed those of barley silage by as much as 50 percent.

In 2002, ICDC recorded irrigated corn results at 48 locations on 1800 acres including nine Pioneer Hi-Bred and eight DeKalb/Monsanto varieties. Tassel stage was achieved in 65% of our corn fields and in all varieties requiring less than 2250 corn heat units (CHU) to mature. Ten cob samples collected from each field were analyzed on September 10th (simulating an early killing frost) for average grain weight, kernels and cob length. The grain yield estimate dropped from 82 bushels per acre in 2001 to 46 bushels per acre in 2002. Two thirds of the corn fields would have suffered a serious silage yield loss. All the corn fields would have had poor grain yields with a September 10th frost.

Silage yields were 2 to 2.5 tons/acre lower than in 2001. Yields ranged from 8 to 19 tons per acre with an average yield of 13.5 tons per acre at 65% moisture. Corn heat unit accumulation through the 2002 growing season was about 100 CHU or 5% short of the long term average on the southern prairies. On a dry matter basis, our corn silage objective is to deliver more than 70% TDN. Corn silage average 68% TDN which is still better than typical cereal silage quality, but below the target of 70% TDN. ICDC hosted three corn field days this fall; October 2nd at Kim Watts and Estuary Hutterite Colony; October 4th at Philip Enns, Jason Wildeboar and Larry Friesen and October 7th at Rick Swenson in the Baildon I.D. These field days were well attended by the media and resulted in several articles and features.

The Roundup Ready Corn comparison allowed five growers to use a cheap and available herbicide that was already required for several other applications on their farms. Roundup can be applied twice on the corn, if required, with no impact on recropping options. The current DeKalb brand Roundup Ready Corn varieties are only suitable for silage production with Saskatchewan’s CHU.

Table 2. Irrigated cob development ranked by digestible energy - September 10, 2002.								
Variety	CHU	Protein (%)	Energy TDN (%)	DE (mcal/kg)	Bushel weight	10 Cob Kernel wt.	Ave Yield (bu/ac)	Stalk Height September
Large Acreage Varieties								
PH 39N03	2100	11.1	72	3.2	52.8	497.5	54.7	91
PH 39W54	2200	11.0	72	3.2	53.4	568.4	53.3	114
DKC 27-12	2250	13.2	71	3.1	43.4	271.8	30.4	102
PH 3921	2600	15.1	69	3.0	33.2	214.0	46.4	110
New Varieties								
PH 39J26	2500	10.0	73	3.2	52.4	532.8	66.3	94
DKC 26-75	2200	10.8	73	3.2	51.2	539.6	82.1	97
DKC 27-15	2250	11.7	72	3.2	52.2	446.5	51.2	105
PH 39M27	2250	10.9	72	3.2	52.9	620.1	50.1	100
PH 39T71	2350	10.9	72	3.1	47.3	427.4	48.9	104
DKC 29-95	2350	11.6	72	3.1	44.5	487.5	59.5	98
DK 221	2250	11.9	72	3.1	46.0	394.1	49.9	109
PH Blend	2350	13.0	71	3.1	44.0	350.0	64.2	107
EXP 230	2400	15.8	70	3.1	42.9	305.6	37.6	104
DKC 32-59	2475	14.5	70	3.1	38.4	257.2	38.0	78
DKC 35-50	2550	14.5	69	3.1	33.0	249.5	45.9	53
PH 38K06	2800	13.8	69	3.0	30.8	202.4	31.4	90
Pioneer	2650	16.7	67	3.0	23.2	175.1	29.1	97

Table 3. Irrigated corn silage harvest summary - October, 2002.													
						Nutrients (%)							
Producer	Moisture (%)	Protein (%)	Nitrate (%)	NDF (%)	ADF (%)	Na	P	K	Ca	Mg	DE (Mcal/kg)	Energy TDN (%)	RFV
Watts	67.3	8.9	0.23	51.9	27.3	0.02	0.20	0.92	0.17	0.21	3.1	70	122
Friesen	69.9	8.0	0.13	52.3	28.1	0.02	0.24	0.81	0.15	0.18	3.0	69	120
Estuary HC	72.1	8.5	0.23	52.7	28.7	0.02	0.17	1.09	0.22	0.18	3.0	68	118
Enns	63.4	8.1	0.19	54.2	29.1	0.03	0.20	0.91	0.13	0.19	3.0	68	111
Swenson	61.4	7.6	0.06	50.4	29.4	0.03	0.24	1.12	0.13	0.17	2.9	67	111
Sawatzky	67.1	7.8	0.14	52.7	31.9	0.02	0.19	1.04	0.10	0.17	2.8	65	107
Typical 2002 Corn Silage Average	66.9	8.1	0.16	52.4	29.1	0.02	0.21	0.98	0.15	0.18	3.0	68	115

Silage yields ranged from 8-19 tons per acre with an average yield of 13.5 tons per acre at 65% moisture.

Pocket Gopher Management Demonstration

L. Bohrson[1]

Progress is being made at the Grainland Irrigation District in controlling pocket gophers in irrigated perennial forages. Clint Bjolverud was again contracted as the pocket gopher control agent for the district. Fourteen irrigators leveled 590 alfalfa acres, removing old mounds. Burrow Oat Bait (zinc phosphide) was used to bait new mounds in these fields. Fields with more than 66 fresh mounds in 2001 were considered "high population" for the purposes of evaluation. Fields with 48 to 66 fresh mounds were considered "mid" and those with 8 to 47 fresh mounds were considered "low" infestations.

Greg Sommerfeld of Outlook also contracted Clint Bjolverud to bait 526 acres of pivot irrigated processing alfalfa in 2002.

Table 4. Plot baiting summary.

	2001 Mounds Baited	2002 Spring Baiting
High population average	162	21
Mid population average	114	22
Low population average	90	28

A total of 2225 burrows were baited in this demonstration in 2001. Only 318 fresh mounds required baiting this spring (2002). However, the pocket gopher population on neighboring acres will serve as a steady source of new colonizers. Both Sommerfeld and our Grainland irrigators reported that very few fresh mounds had appeared by first cut in the spring of 2002, but that fresh digging was present after the rain season in July and August. The ICDC program reported growth from 800 irrigated acres in 2001 to 1116 irrigated acres in the spring of 2002.

The total cost per acre of the spring baiting operation averaged $4.00 as compared with $3.00 in 2001. This increase represents cost increases and a fair return to Clint Bjolverud's skills and services. It is also similar to the rate charged in Nebraska for pocket gopher control.

In September 2002, ICDC extended support for this demonstration to 1496 acres, where a network of 990 fall bait stations were installed by Clint Bjolverud. The bait in the stations will be viable until moisture reaches the bait in spring 2003 and will likely produce multiple kills over the winter and spring. The adult pocket gophers do not hibernate and will potentially even move some of the bait into their wintering quarters.

In cooperation with Loveland Industries and SAFRR, ICDC hosted Pocket Gopher Field Demonstrations at St. Louis, Blaine Lake, Macrorie, Elbow, Arcola and Oxbow in October. The field demonstration featured Elton Weich from Nebraska and Brodie Blair from Manitoba, training in cost-effective pocket gopher control methods and a "hands-on" demonstration in an alfalfa field.

[1]*ICDC, Swift Current*

ICDC Timothy Research and Demonstration

L. Shaw[1], D. Oram[2], B. Coulman[3]

State of the Irrigated Timothy Industry in Saskatchewan

The timothy industry has experienced phenomenal growth since 2001. There were about 4500 acres of timothy in 2001. In the fall of 2002, there were about 7000 acres of timothy established or seeded in Saskatchewan under irrigation. There are now two timothy compressing plants in the Outlook area. ICDC is committed to facilitating the expansion of the timothy industry in helping to answer agronomic management questions. The two projects initiated in 2002 were a cutting date trial and a phosphate rate demonstration.

Cutting Date Trial

Second cut yields have been disappointing in the past. First cut quality deteriorates when taken off late. If the first cut is taken off too early, yield is lost. ICDC agrologists worked with Ag Canada and two local timothy producers to determine the best stage for cutting timothy. A cutting date trial was started in co-operation with AAFC and ICDC in the Outlook area on two established timothy co-operator fields: Boot's and Eliason's. ICDC agrologists Deb Oram and Lana Shaw compared three different first cutting dates for yield and quality of first and second cut. The purpose of this research was to determine the optimum timothy cutting stage and, at the same time, demonstrate this to the growers.

Methods:

On each field, small areas or plots of timothy were cut early, mid and late for first cut. Cutting dates corresponded with R3 (pre-anthesis), R5 (post-anthesis), and S1 (milk) of the Moore scale (Moore et al, 1991). The plots were set up in a randomized design with each cutting date repeated four times on each field. Plots were cut either by hand or with small plot forage equipment. Yields were measured for each plot and adjusted for moisture. Samples were sent for feed analysis at EnviroTest (protein, potassium, ADF, TDN), for color with a color spectrometer (Elcan Forage) and for total sugar content (Crop Diversification Centre South, Brooks, AB). Results were analyzed using statistical methods (95% confidence) and differences are discussed as significant or consistent if they have passed statistical tests. Trends or tendencies are mentioned when there is a lack of data to do statistical tests but a strong pattern is apparent.

Results:

First Cut:
At Eliasons, the highest first-cut yield was achieved with the middle cutting date (Figure 1). Early and late cutting resulted in similar yield. There was no consistent difference in yields of first cut at Boots (no graph). Quality (protein and greenness) tended to drop when cutting date was delayed. At Eliasons, commercial grade went from Premium Dairy to #1 to Low #2 as cutting was delayed. At Boots, grade went from Premium Dairy to Good #2 to Low #2 as cutting was delayed. The value of the hay decreased with time to cutting (from $205 down to $135 per tonne). All quality factors tended to drop as cutting date was delayed except for potassium content.

[1]*ICDC, Outlook*
[2]*Bloomfield Consulting, Central Butte*
[3]*Agriculture & Agri-Food Canada Research Centre, Saskatoon*

Second Cut:
There were no differences in yield of second cut for the different first cutting dates for either field, likely because of variable fertility, a lack of available moisture during critical stages of growth, and poor growing conditions in August and September. The early-cut plots were more mature (headed and flowering) than the late-cut plots at Boots' (boot stage or earlier). Cutting date had no consistent effect on ADF or TDN for second cut. The greenness and grade of the second cut was good (Premium Dairy) and there were no differences with first-cut dates.

Total yield (first and second cut) was best for the middle cutting date (post-anthesis) at Eliasons (Figure 2). The early cut also had consistently higher yield than the late cut treatment. There were no consistent differences at Boots for total yield. There were large, consistent differences in the **gross returns** with the different cutting dates. For first cut at Boots, the drop in value per acre with later cutting dates reflects a rapid drop in quality and not a difference in yield (Figure 3). Quality dropped because of a lack of irrigation while the producer's hay was curing. At Eliasons, the value per acre for first cut is realistic and reflects differences in yield and quality. The gross dollars per acre are calculated based on a price of $135 to $205 for Low #2 to Premium Dairy quality.

Total yield (first and second cut) was best for the middle cutting date (post-anthesis) at Eliasons (Figure 2). The early cut also had consistently higher yield than the late cut treatment. There were no consistent differences at Boots for total yield. There were large, consistent differences in the gross returns with the different cutting dates. For first cut at Boots, the drop in value per acre with later cutting dates reflects a rapid drop in quality and not a difference in yield (Figure 3). Quality dropped because of a lack of irrigation while the producer's hay was curing. At Eliasons, the value per acre for first cut is realistic and reflects differences in yield and quality. The gross dollars per acre are calculated based on a price of $135 to $205 for Low #2 to Premium Dairy quality.

Conclusions:

The take home message from this exercise is to plan on cutting once the anthers are out. Then adjust that date back or forward based on the weather forecast and the time it will realistically take to get all the hay cut. The key is to be ready to go when the opportunity comes and to get the hay off as fast as possible. The dollar difference, at least according to these results, is substantial. The earliest cutting date (pre-anthesis) turned out to be similar in profit to the middle cutting date (post-anthesis) because of high quality. The late cutting date had lower yield, quality, and net returns

Phosphate Rate Demonstration

The P Rate Demonstration consisted of medium-sized fertilizer strips (approximately 30 by 100 ft) with no replication in two timothy fields. Nitrogen and potassium were added to soil-test specifications, so there was little or no deficiency in those nutrients. The following observations are based on one year of unreplicated investigation in two fields and are not meant to be taken as recommendations.

There appeared to be a yield response at both Boots and Eliasons to the 200 lb/ac of P compared with 50 and 100 lb P applied in the spring. This increase was large enough at Eliasons to cover the cost of the additional P fertilizer. At Boots, this is a small yield difference and may very well be a coincidence. It is debatable whether we are seeing a real response to P fertility. It could have been chance or a response to the N put down with the 11-51-0. Eliasons started out with low soil P (15 lb/ac) and had the most consistent response to the extra P. Crop phosphate removal (based on yield and % P in hay) for the lowest application rate ranged from 42 to 49 lb/ac. Crop removal at the highest P rate (200 lb/ac) ranged from 58 to 60 lb/ac. Maturity and development rate were not noticeably affected by P treatment.

Acknowledgements

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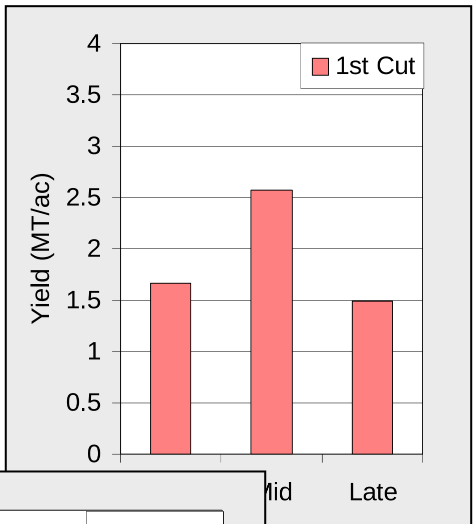
- Jody Rysavy
- Greg Sommerfeld
- Dan Willms
- Kelvin Bagshaw



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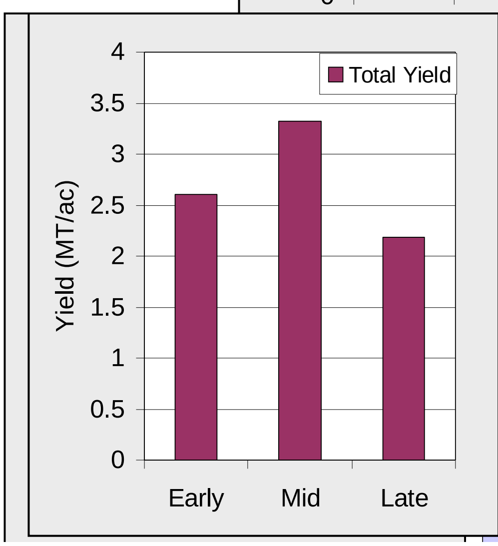


Figure 2: Total yield at Eliasons for different cutting dates.

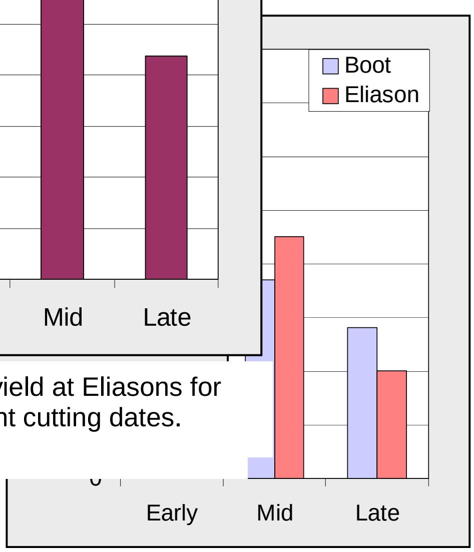


Figure 3: First cut gross for different first cutting dates.

ICDC Ryegrass Demonstration

L. Shaw[1], D. Oram[2]

Introduction

Annual ryegrass (Lolium multiflorum) is gaining popularity as a highly productive, nutritious (high protein, non-bloating) and flexible forage crop for beef production. The Italian and Westerwolds ryegrasses are both annuals in Saskatchewan. The Italian-type ryegrass is a biennial and will not set seed or overwinter in our climate. It is lush and well suited for grazing. Westerwolds ryegrass is an annual that will produce seed and re-seed itself. Westerwolds annual ryegrass is suited for hay and silage production. Various combinations of both ryegrasses can be used depending on the producer's use of hay, silage and/or grazing. ICDC agrologists and five co-operators shared production information and ideas of how to best utilize this productive forage.

Five irrigated ryegrass fields (which involved 610 acres and over 1600 cattle) were chosen for the demonstration. A few things over the course of the year:

- Ryegrass seed is inexpensive and widely available
- Needs a firm seedbed for rapid, even germination
- Slow to establish (6 – 8 weeks); great for summer hay and fall grazing
- Slower to dry down in a swath than other forages; consider silage, bale wrap or grazing for harvesting
- Meets and exceeds beef cattle requirements for protein

Table 1. Comparison of five irrigated ryegrass fields, 2002.

Co-operator	Previous crop	Ryegrass mix (W:I)[1]	Total water (mm)	Total available N (lb/ac)	Harvested product	Yield (ton/ac)
Follick	Ryegrass	50:50 70:30	350	211	Hay/Graze	3.4
A & L Grazeland Ranch	Triticale	50:50	370	>236	Graze	4.0
Jones	Canola	50:50	490	200	Hay/Silage	4.5
Sawatsky	Oats	100:0	370	76	Silage/Graze	3.1
Willms	Cereal	50:50	350	122	Hay/Graze	5.8

Nutritional Information

Ryegrass is highly palatable. Whatever the harvest method, annual ryegrass is an excellent feed source that can meet or exceed the daily requirement for protein and energy for calves, yearlings, cows and cow/calf pairs. Nutrient requirements vary depending on the group being fed (i.e. growing heifers vs milking cows).

[1]ICDC, Outlook
[2]Bloomfield Consulting, Central Butte

Table 2. Quality of ryegrass forage from 2003 demonstration.					
Co-operator	Crop	Protein %	TDN %	K %	Nitrate %
Follick	Hay - 1st	20	63	2.7	1.0
	Hay - 2nd	15	61	3.2	0.8
A & L Grazeland Ranch	Grazing	29	70	3.9	1.5
	Grazing	19	58	3.5	1.7
Jones	Hay	12	55	2.3	0.2
	Silage	14	60	3.6	0.0
Sawatsky	Haylage	14	56	3.3	0.5
	Grazing	14	56	2.7	0.4
Willms	Hay	25	63	3.6	1.4
	Haylage	18	58	n/a	n/a
Average		18	60	3.2	0.8

Potassium

Potassium is an essential mineral required in the range of 1.0 to 1.24% of the ration dry matter. Potassium levels range from 2.31% to 3.94% in annual ryegrass. Feeds with high potassium levels (>3%) may need to be fed with a mineral salt high in calcium and magnesium to avoid problems with grass tetany. Have your feed tested and then consult with your local extension or livestock agrologist to help balance your herd's nutrition.

Nitrates

The average amount of nitrates in the feed was 0.8 %, somewhat higher than the recommended safe limit of 0.5%. Actual sample values ranged from 0 to 1.7%. High soil nitrogen levels in the field seemed to have contributed to the high nitrate level in the forage sample from A&L Grazeland Ranch. Annual forage crops such as the ryegrasses tend to accumulate more nitrates than perennial forages. Over 1600 cattle grazed or were fed ryegrass in the five ICDC ryegrass demonstrations. There were no incidents of nitrate poisoning in the co-operator's cattle. Most feeds that contain nitrate can be fed to cattle if managed properly, especially if the animal has time to adjust to the feed.

Summary

Irrigated ryegrass is an excellent annual crop choice for hay, silage and grazing. Producers working with ICDC's crop management demonstration in 2002 shared information and ideas on ryegrass production.

Ryegrass removed approximately 43 lb of N/ton (16% protein) and 7 lb P/ton of ryegrass forage (at 15% moisture) from the field, and, therefore, a similar amount should be available for the crop throughout the year. Grazing recycles some of the nutrients in the field, so that more will be available for the next crop.

Production-limiting factors are harvest management, irrigation, fertility, and weed and insect control. Of these, harvest management is the most critical. Getting the first cut off the field quickly is important for ensuring good regrowth and productivity for second cut and grazing. Weather in late July or early August will generally be more conducive to putting up hay than in late June. For this reason, it is prudent to consider taking the first cut off as silage or haylage.

Both haylage and traditional pit silage were keeping and feeding well over the winter. Haylage and loose silage in tubes needs to be at a lower moisture content (under 70%) than traditional pit silage to keep from freezing. The ryegrass should, therefore, be cut and allowed to wilt before baling and wrapping.

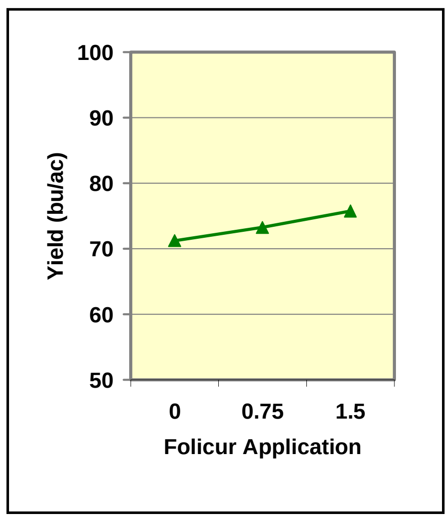
Fall grazing potential of ryegrass is one of the major reasons why cow-calf producers are including annual ryegrass in their operation, especially because it coincides with weaning of calves. All of the ICDC co-operators utilized ryegrass for grazing.

ICDC Fusarium Management Demonstration

D. Oram[1], L. Shaw[2]

Fusarium head blight reduces the yield and quality of wheat, barley and oat crops. Grain is downgraded based on the percentage of fusarium damaged kernels (FDK). It can survive in the soil and prey on seedlings of many crops, causing fusarium root rot. There are several different types of fusarium head blight (FHB), which are caused by different fungal pathogens. The type causing the most concern is ***Fusarium graminearum***, which produces the DON vomitoxin. Tolerance for DON in non-ruminant feed and human food is low.

Irrigated acres in south and central Saskatchewan are definitely at risk for this disease. Durum has been a solid performer in irrigated rotations. However, durum is very susceptible to fusarium head blight. ICDC initiated a demonstration of Folicur, a new locally-systemic fungicide for control of fusarium on four irrigated durum fields within a three-mile radius. Donated product (Bayer, Midwest Agro, Gardiner Dam Terminal) was applied to fields using a high-clearance sprayer with twin-jet nozzles. A split application was compared with a single application at anthesis and with no application. The three treatments (0X, 0.75X, 1.5X split) were sprayed in large strips across the field. Yields (weigh wagon) and seed samples were taken from each of the three strips. Production techniques were typical of irrigated durum production. Irrigation and rainfall totalling one to two inches accompanied by hot, humid weather during anthesis (flowering) created ideal conditions for the development of fusarium in the four durum fields. Wet August and September conditions allowed the fusarium to spread in the heads. The differences between fungicide treatments were checked using statistical analysis (90% confidence). Only real, consistent differences are discussed.



Folicur significantly increased yields by 4.5 bu/ac for the split application over no application. However, at a grade of #5 durum, the yield increase was not enough to pay for the product. The yield increase may also be an effect on leaf diseases rather than fusarium reduction. There is already a serious problem with fusarium on some irrigated acres in Saskatchewan. The fusarium present was a mixture of different types, but *Fusarium graminearum* was found in a

[1]*ICDC, Outlook*
[2]*Bloomfield Consulting, Central Butte*

substantial portion of the durum from all demonstration fields. Up to 65% of durum kernels were infected with some type of fusarium, and up to 52% of kernels were infected with *Fusarium graminearum*.

The % FDK, as measured at an inland grain terminal, was high enough to cause downgrading in almost every case. Sprouting and frost damage were more typical grading factors for the area in 2002. Producers were able to blend their durum off with dryland durum to improve the grade. There is no consistent indication that Folicur increased the quality or reduced the incidence of fusarium in durum. Folicur is most effective on wheats with some resistance to fusarium.

Summary

Fusarium is already a problem in one irrigation district that we know of. Prudent producers in these areas will grow cereals with some resistance to the disease, which means not growing durum for the foreseeable future. Use of Folicur in combination with cereals having some resistance to fusarium head blight may offer additional protection to irrigated producers. However, it would make already unprofitable cereal crops even less attractive. The advent of this disease in irrigation districts may prompt a move out of cereal grain production. No one knows for sure which other irrigation districts are seriously infected. Irrigated acres have not been included in the provincial fusarium survey. Irrigated acres will be included in a special provincial survey conducted by ICDC in 2003.

Bacterial Blight Management in Irrigated Bean Seed Production

L. Shaw[1], D. Oram[2]

Seed growers Grant Carlson, Dale Ewen, Merle and Robert Larson, and commercial grower Kevin Langer worked with ICDC on the Bean Blight Prevention Demonstration. ICDC facilitated CFIA inspections of bean seed fields for bacterial blight. ICDC also looked into innovative commercial seed health tests.

Bacterial blights of beans are a serious problem. Yield losses due to bacterial pathogens may range from a trace to 100 percent. Blight reduces yield by defoliating plants and damaging pods. It also reduces quality by changing the color of the seed and causing shriveling. The best way of protecting beans from these diseases is planting low-pathogen seed. Controlling bacterial blights in seed fields is, therefore, important. The in-crop chemical products currently available in Saskatchewan for prevention of bacterial blights are all similar copper-based chemicals.

[1]*ICDC, Outlook*
[2]*Bloomfield Consulting, Central Butte*

A copper-based bactericide was applied three times between mid-July and mid-August to four bean fields, leaving strips of untreated area each time. The demonstration strips in one field were not harvested because of very poor harvest weather and late maturity. Yields were determined by weighing harvested beans from strips in a weight wagon. Seed samples from two of the seed fields were sent for a 'dome test' to determine seed-borne bacterial blight levels.

Summary

The copper application at flowering appeared to reduce bacterial blight leaf symptoms that developed after the application. The second and third applications (approximately 14 and 28 days after the first application) did not seem to reduce the incidence or severity of blight symptoms or seed infection of bacterial blight. There was no strong indication that Kocide reduced the levels of bacterial blight in the seed, based on results of a dome test. Seed infection, as measured by the 'dome test', remained low as a result of the control measures the seed growers took to prevent the multiplication of bacterial blight in bean seed. Seed with a dome rating of 0 to 2 is considered 'clean'. There were also no consistent yield differences with the copper applications for the three seed fields. Preliminary results indicate that Kocide had reduced the symptoms of bacterial blight in a research trial at the CSIDC in 2001 and 2002, but did not consistently have an effect on pod symptoms, yield or 'dome test' rating, as there was low disease pressure in both years. Yields of the seed fields monitored by ICDC in this demonstration ranged from 1300 lb/ac for a hailed field to 2350 lb/ac (net) for the highest-yielding of the three fields. The highest-yielding demo field had good plant density, adequate water, and was swathed and combined with little harvest loss. Total costs (fixed and variable) were under $400 per acre, depending on the grower. At an arbitrary price of $0.45/lb, these seed grower stood to gain at least $180 to $650 per acre of bean seed. One problem with some beans produced in 2002, including the three seed fields, was the presence of beans with a yellowish color. Bacterial wilt was isolated from the yellow seeds in samples from two of the three fields.

ICDC Manure Management Demonstratoin

L. Shaw[1], D. Oram[2]

Irrigators in the Birsay area began receiving liquid swine effluent from the Birsay Pork Farm in fall, 1999. Producers immediately saw this as an opportunity to take advantage of this extra fertility for their irrigated crops. In this win-win situation, the hog barn operator was provided with a convenient disposal of their effluent and the irrigator received free fertilizer. ICDC has been involved with this nutrient management demonstration since 1999. ICDC encourages irrigators and hog barns to be responsible in the use of effluent as a resource. Farmers are primarily interested in the **agronomic value** of effluent as a source of crop nutrients. There are also **environmental concerns** with manure use. Applicators prefer to travel less than two miles from the lagoon for reasons of cost. Therefore, high amounts of effluent are often loaded onto a small land base. Potential risks include surface and ground water contamination with nutrients, salts and pathogens, as well as soil nutrient loading. Effluent has **economic value** as a fertilizer. It also represents a cost to hog barns. If hog effluent is used efficiently as a crop nutrient and irrigators are realizing an economic benefit in the effluent, some cost recovery may be possible.

[1]*ICDC, Outlook*
[2]*Bloomfield Consulting, Central Butte*

At the Tullis breeding and farrowing barn of Birsay Pork Farms, effluent is collected in a two-cell lagoon system, allowing separation of liquids for irrigation application. Two producers have piped the liquid effluent from the lagoon to their pivots and are able to apply effluent with their irrigation water. Three sites were sampled for analysis: the lagoon, the pivot point (where effluent is diluted with irrigation water), and under the pivot. With a seasonal application of 8 inches of water, the fields would receive 40 lb N, 16 lb P_2O_5, and 11 lb K_2O. This application method subjects the nutrients to evaporative losses, so not all of this may be available to the crop. The remaining effluent is agitated and injected (14" spacing) into surrounding irrigated fields by Millar's Disposal Service. Each of the two 5,000 gallon tankers injects 6,000 gallons per acre. At the Hanford finishing barn, effluent is collected in a single-celled lagoon, so effluent cannot be applied with irrigation. It is injected the same way as at the Tullis barn.

Effluent from the different barns of the Birsay Pork Farm varies in nutrient content (Tables 1 and 2). Unless management practices change, these nutrient contents will remain similar for the particular barn from year to year. Manure storage, handling and processing influences manure composition as a fertilizer.

Table 1. Irrigated hog effluent nutrient composition (lbs/acre inch of irrigation.)

Location	N	P_20_5	K_20
Tullis Barn	5	2	11

Table 2. Nutrients (lb/ac) injected into the soil in the fall at 6,000 gallons/acre.

Location	N	P_20_5	K_20	SO_4
Tullis Barn	66	30	60	6
Hanford Barn	198	12	144	6

Summary

Irrigators have a particular advantage in using hog manure over dryland producers. Since the main limitation to crop growth (water) has essentially been removed, the use of nutrients is determined mainly by the choice of crop. However, irrigators also have the responsibility of preventing runoff of nutrients and pathogens. The choice of crops in the rotation is very important for efficiently managing effluent as a fertilizer. Productive forage crops generally recover more nutrients from effluent-treated soils than grain crops. Also, productive grain crops remove more manure nutrients that poorly-managed grain crops. ICDC is encouraging the manure users to manage manure as part of their rotation to maximize its value. Soil tests are being used to monitor the changes in soil nutrients and in planning rotations. As the agronomic value of hog effluent is realized and documented, producers and barn operators will also realize the economic value of effluent.

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