Canada-Saskatchewan Irrigation Diversification Centre

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Annual Review

April 1, 2001 to March 31, 2002

- Contents -

This report and other CSIDC publications are available at our internet address:
http://www.agr.ca/pfra/sidcgene.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 summarizes the wide range of activities conducted, funded or facilitated by the Centre in 2001. CSIDC is a federal, provincial, and industry partnership. Industry is represented by the Saskatchewan Irrigation Projects Association (SIPA) and the Irrigation Crop Diversification Corporation (ICDC), the Federal Government by Agriculture and Agri-Food Canada, PFRA, and the Provincial Government by Sask Water. Representatives from each group are members of the CSIDC Executive Management Committee (EMC). I would like to extend special thanks to the members of this committee for their input, direction and support of the Centre.

Executive Management Committee
(EMC)

Don Fox, SIPA
John Linsley, ICDC
Gerry Luciuk, PFRA
Carl Siemens/John Konst, ICDC
Bryan Ireland, Sask Water
Laurie Tollefson, CSIDC

Ensuring producers and industry receive the information developed at the Centre is key to the success of the Centre. The annual field day was once again extremely well attended. In addition, the evening tour, forage tour and potato tour were well received. Numerous tours visited the Centre during the year to view irrigation and diversified crop production. The field day is scheduled for July 11, 2002, so please mark it on your calendar.

The year 2001 is best remembered by the severe drought conditions in many parts of Saskatchewan. Irrigation's value was never more evident. While dryland areas had dramatically reduced production, the irrigated areas displayed excellent yields with extremely high quality product. Requests for information on irrigation technology and diversification opportunities were never more evident. Irrigation also facilitated good results from field agronomic experiments which otherwise would have yielded limited data without water. Many researchers are requesting a site for their work at CSIDC to ensure that their field trials are not affected by weather conditions.

The year 2001 marked the completion and first year of operation of CSIDC's pesticide handling and storage facility. The health and safety of the staff, along with protection of the environment are key priorities at CSIDC. This facility permits pesticides to be stored safely in well ventilated rooms and allows easy access to the chemicals. Personal safety equipment including ventilated lockers, showers, and a cleanup area are available for all staff members using the facility. This facility has the provisions for the safe handling and disposal of left over chemical.

Securing on going funding to conduct the work outlined in the work plan is a priority at CSIDC. Traditionally the Centre has relied on federal and provincial A-base funding, industry support, and agreement dollars to facilitate its program. With the conclusion of the AFIF agreement, additional funding is being sought to facilitate programs. 2001 also was the final year of the AFIF funded irrigated Hub and Spoke Site. This fund allowed innovative approaches to crop diversification to be examined. A number of projects will be detailed in this report. Results from this program have and will be used to assist industry in its development.

International interest in the Centre continues to increase. Numerous groups from around the world visit the Centre each year and are interested in the work being conducted. A world class facility and staff make this type of interaction possible. CSIDC staff are involved in a wide array of projects through membership and participation in National and International Committees. In addition, they provide technical and management expertise to projects in China (Sustainable Agriculture Development Project in Inner Mongolia), the National Water Quality and Availability Management Project (NAWQAM) in Egypt, and the Hebei Dryland Project in China. This interaction keeps staff current and allows networking and new ideas to be continually brought forward to our Centre. In addition, CSIDC staff provided tours and training to delegations from Iran, Romania, China and Egypt.

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
Administration:	M. Martinson
Secretarial:	J. Clark
Clerical:	D. Greig
Market Analyst:	H. Clark
Irrigation Sustainability:	T. Hogg
Horticultural Crops Agronomist:	J. Wahab
Technician:	G. Larson
Technician:	C. Ringdal
ICDC Agrologists:	J. Linsley
	L. Bohrson
	L. Shaw
Field Operations:	B. Vestre
Irrigation:	D. David
Maintenance:	A. MacDonald
Technology Transfer:	J. Harrington
ICDC Co-op Student:	C. Klemmer
YMCA Trainees:	G. Pederson
	D. Prokopiw
	J. Schwanbeck
	H. Anderson
	C. Minchin

Programs

Specialty/Horticultural Crops

A specialty crops development program was initiated at the CSIDC in 1987. This program involves the evaluation of specialty crop production under irrigated conditions with the intent of developing cropping alternatives suitable to irrigated conditions in Saskatchewan. It includes a broad range of varietal evaluation, irrigation and agronomic adaptation studies. A major effort has been made to identify the most promising market opportunities and to act accordingly. Examples of projects include: varietal and agronomic evaluation of dry bean, pea, lentil, faba bean, mint, coriander, fenugreek, medicinal herbs, etc.

In 1992, emphasis was placed on potato and vegetable crop production. This was in response to industry demand. The potato studies involve a wide range of agronomic research to produce high quality ‘seed’, ‘processing’ and ‘table’ potato. The tests include germplasm evaluation, fertility management, irrigation scheduling, plant population studies and harvest management. The vegetable work is designed to raise awareness of the opportunities that exist in the vegetable industry. This is accomplished by developing cost of production information suited for Saskatchewan and by demonstrating improved production techniques to increase yield and improve quality, thereby maximizing economic returns.

Field Crops (Cereals, Oilseeds and Forages)

Field crops (cereals, oilseeds and forages) are a major part of any irrigated rotation. In 1996, more than 90% of the irrigated acreage in Saskatchewan was planted to field crops. While desirable to introduce new and specialty crops, a priority must also be placed on improving the profitability of the more conventional field crops. This includes examining new and/or existing genetic material with improved disease and lodging tolerance suited to irrigated conditions or with novel quality traits which could service niche markets. Suitable varieties must be identified and tested for agronomic performance for irrigated production. Evaluation of agronomic factors which can lead to more efficient water use, increased production or lower input costs must also be determined.

Environmental Sustainability

This program was designed to evaluate the effect of irrigation on the environment. It was initiated in 1991 with funding from the Environmental Sustainability Initiative. It was intensified in 1993 as the irrigation sustainability program using funding from the Canada/Saskatchewan Agriculture Green Plan. More recently the National Soil and Water Conservation Program has provided resources to evaluate the environmental effects under intensively irrigated crop production.

Market Analysis

This program was initiated to identify and evaluate potential markets for irrigated crops and to determine opportunities for value-added processing with the goal of promoting economic security and rural development in the irrigated areas.

Technology Transfer

This activity ensures that information developed at CSIDC is made available to farmers, extension personnel, private industry and the general public. It includes the annual field day, tours, participation in extension meetings, factsheets, extension bulletins, etc.

Field Demonstrations

ICDC agrologists conduct field demonstrations of applied research developed at CSIDC and other institutions. The Crop Manager project examines crop management practices of dry bean and cereals. The Forage Manager project evaluates alfalfa management for southern Saskatchewan irrigators.

Activities

Presentations

CSIDC staff gave presentations at numerous meetings, conferences, and events. Among those were:

- Production of Echinacea and St. John's Wort. Saskatchewan Herb & Spice Association and Saskatchewan Neutraceutical Network Conference, Saskatoon, Saskatchewan

- Spacing and Water Management of Seed Potatoes. Saskatchewan Seed Potato Growers' Association/Canada-Saskatchewan Irrigation Diversification Centre Seed Potato Spring Seminar, Outlook, Saskatchewan

- CSIDC and Irrigation in Canada. Iranian Delgation, CSIDC, Outlook

- CSIDC and Irrigation in Canada. Romanian Delegation, CSIDC, Outlook

- Irrigation Research and Technology Transfer in the Canadian Prairies. Rethinking Irrigation in Light of Competing Pressures meeting, McGill University, Montreal, Quebec

- CSIDC Update - Technical Services Retreat & Fall Workshop, Moose Jaw, Saskatchewan

- Saskatchewan Vegetable Growers' Association Annual Meeting and Workshop, Outlook

- Response of Seed Potatoes to Varying Water Rates. Western Potato Conference, Saskatoon

- Potato Agronomy presentation. Potato Research Coordination Meeting, Carberry, Manitoba

- Herb and Spice Research and Development in Saskatchewan. Western Medicinal and Aromatic Plants Conference, Brandon, Manitoba

- Northern Vigor of Potatoes and Field Scale Production of Milk Thistle. Market Options for New Crops Seminar, Fairview, Alberta

- Irrigation and Water Management (short course) - Baotou College, Inner Mongolia, China

- Salinity Monitoring and Cropping Mission - Egypt

- Irrigation Water Management and Systems - Kentville, Nova Scotia

- Role of Irrigation in Vegetable Production - St. Peter's Abbey, Muenster, Saskatchewan

Publications

[CSIDC] Canada-Saskatchewan Irrigation Diversification Centre. 2000. Business Plan. 43 pp.

CSIDC] Canada-Saskatchewan Irrigation Diversification Centre. 2001. Agri-Food Innovation Fund Specialized Spoke Sites Annual Report. 198 pp.

[CSIDC] Canada-Saskatchewan Irrigation Diversification Centre. 2001. Canada-Saskatchewan Irrigation Diversification Centre Annual Review. Outlook, Saskatchewan: CSIDC. 172 pp.

[CSIDC] Canada-Saskatchewan Irrigation Diversification Centre. 2002. Crop Varieties for Irrigation. Outlook, Saskatchewan: CSIDC. 16 pp.

L. Tollefson. 2001. Irrigation and Technology Transfer in Western Canada. Brace Centre for Water Management. McGill University.

A.J. Cessna, J.A. Elliott, L. Tollefson and W. Nicholaichuk. 2001. Herbicide and nutrient transport from an irrigation district into the South Saskatchewan River. In: Journal Environmental Quality; 30:1796-1807.

D.R. Lynch, J.C. Miller, L.M. Kawchuck, C.A. Schaupmeyer, J. Holley, J. Panford, D.K. Fujimoto, D. Waterer, J. Wahab, B. Rex, and M.S. Goettel. 2000. AC Stampede Russet: A High-yielding Oblong Russet Cultivar for the French Fry and Fresh Market Industries. American Journal of Potato Research. 77:241-244.

D.R. Lynch, S.J. Peloquin, L.M. Kawchuck, C.A. Schaupmeyer, J. Holley, D.K. Fujimoto, D. Driedger, D. Waterer, J. Wahab, and M.S. Goettel. 2001. AC Glacier Chip: A High-yielding Chip Cultivar for Long-term Storage. American Journal of Potato Research. 78:327-332.

D.R. Lynch, G. Secor, L.M. Kawchuck, C.A. Schaupmeyer, J. Holley, D.K. Fujimoto, D. Driedger, J. Wahab, and M.S. Goettel. 2001. AC Peregrine Red: A High-Yielding Red-skinned Fresh Market Cultivar. American Journal of Potato Research. 78:333-337.

D.R. Lynch, L.M. Kawchuck, C.A. Schaupmeyer, J. Holley, D.K. Fujimoto, D. Driedger, T.R. Tarn, D. Waterer, J. Wahab, and M.S. Goettel. 2001. AC Maple Gold: A High-Yielding Yellow-fleshed French Fry Cultivar. American Journal of Potato Research. 78:339-343.

A. Vandenberg, F.A. Kiehn, C. Vera, R. Gaudiel, L. Buchwaldt, S. Dueck, R.A.A. Morrall, J. Wahab, and A.E. Slinkard. 2001. CDC Glamis Lentil. Canadian Journal of Plant Science. 82:103-104.

A. Vandenberg, F.A. Kiehn, C. Vera, R. Gaudiel, L. Buchwaldt, S. Dueck, R.A.A. Morrall, J. Wahab, and A.E. Slinkard. 2001. CDC Grandora Lentil. Canadian Journal of Plant Science. 82:105-106.

A. Vandenberg, F.A. Kiehn, C. Vera, R. Gaudiel, L. Buchwaldt, S. Dueck, R.A.A. Morrall, J. Wahab, and A.E. Slinkard. 2001. CDC Sovereign Lentil. Canadian Journal of Plant Science. 82:107-108.

A. Vandenberg, F.A. Kiehn, C. Vera, R. Gaudiel, L. Buchwaldt, S. Dueck, R.A.A. Morrall, J. Wahab, and A.E. Slinkard. 2001. CDC Vantage Lentil. Canadian Journal of Plant Science. 82:109-110.

A. Vandenberg, F.A. Kiehn, C. Vera, R. Gaudiel, L. Buchwaldt, S. Dueck, J. Wahab, and A.E. Slinkard. 2001. CDC Robin Lentil. Canadian Journal of Plant Science. 82:111-112.

CSIDC Display

CSIDC presented a display at the following events:

- Crop Production Show, Saskatoon
- Shelterbelt Centre Field Day, Indian Head
- CSIDC Annual Field Day, Outlook
- Saskatchewan Irrigation Projects Association Meetings, Swift Current

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 2001 included:

Quebec students tour	May 2
Japanese visitors	May 4
Montreal students tour	May 7
SIAST students tour	May 25
Lutheran Collegiate Bible Institute High School science class	June 13
Egyptian Group tour	June 13
Outlook High School agriculture class tour	June 18
New Zealand Group tour	June 18
Iranian Delegation tour	June 20
Sask Water Board of Directors tour	June 25
Agriculture in the Classroom Group tour	July 4
CSIDC Field Day tours	July 19
Canadian Hay Association Field Day tour	July 20
CSIDC Evening tour	July 25
CSIDC Dry Bean Trial tour	July 27
Potato Field Day tour	August 7
Australian tour	August 8
Saskatchewan Pulse Growers tour	August 8
Romanian Delegation tour	August 8
Crop Development Centre Dry Bean Plot tour	August 14
PBI Herb tour	August 23
Australian tour	August 23
Outlook Elementary School students tour	September 7
Australian Salt Mapping tour	September 14
Harry Hill tour	September 15
Ag & Bioresource Engineering students tour	September 28
Vegetable Producers from Nipawin area tour	November 5
Egyptian Agricultural Counselor tour	November 7
Greenhouse Project tour	December 6

Additional tours and activities were held for private industry, for members of the media, and for numerous other producers, agriculture professionals, industry groups, association representatives, and visitors who stop in at the CSIDC. Attendance in 2001 was at an all time high level.

Committees

L. Tollefson

- Agriculture and Agri-Food Canada National Potato Research Network
- Agri-Food Innovation Fund Horticulture Committee, Federal Co-chair
- Canadian National Committee on Irrigation and Drainage (CANCID), Executive member
- International Commission on Irrigation and Drainage (ICID) Crops and Water Use subcommittee
- National Water Quality and Availability Management Project, Egypt, Headquarters Co-ordinator; Executive Committee member
- PFRA Senior Management Committee
- Partners for the Saskatchewan River Basin Technical Committee
- Prairie Crop Diversification Task Force
- Health of Our Rural Water Steering Committee
- Dept. of Agriculture and Bioresource Engineering, Research Associate
- ICID 18th Congress and 35th International Executive Council, Montreal 2002 Organizing Committee
- Executive Management Committee of CSIDC
- Agriculture and Agri-Food Canada Nutraceutical and Functional Food Task Force
- Agriculture and Agri-Food Canada Development of a Broader Trade Strategy Task Force
- PFRA Capital Planning Committee
- Sustainable Agriculture Development Project, Inner Mongolia
- National Agri-Environmental Health Analysis Reporting Program (NAHARP) Planning Committee
- Drought Communications Implementation Committee
- Program Review Crop Development Centre

T. Hogg

- Prairie Regional Recommendation Committee on Grains
- Saskatchewan Advisory Council of Grain Crops
- Environmental Management Strategy Planning Committee
- PFRA Pesticide Review Committee
- PFRA Universal Classification System Evaluation team
- Canadian Commission on Irrigation and Drainage (CANCID), Executive member
- PFRA Applied R & D Module Development Team

H. Clark

- Agriculture and Agri-Food Canada Ethanol working group
- CSIDC Field Day Committee
- AAFC National Pilot Project for Herb and Spice Delivered Prices
- Western Potato Council Committee

J. Wahab

- Saskatchewan Herb and Spice Association, Herb Production Manual Review
- Saskatchewan Seed Potato Growers Association technical advisor
- Soils and Crops Organizing Committee
- Pesticide Minor Use Registration Committee
- Western Potato Council
- Potato Association of America
- American Horticultural Society
- Saskatchewan Herb and Spice Association
- Saskatchewan Herb and Spice Association - Aster Yellow Research Project
- Steering Committee of the Herb Program, Department of Plant Sciences, University of Saskatchewan

Committees (cont.)

J. Wahab (cont.)
- AAFC Potato Network

B. Vestre
- Environmental Management Strategic Planning Committee
- Joint Occupational Health and Safety Committee
- PFRA Pesticide Review Committee
- PFRA Safety Orientation Committee

M. Martinson
- Saturn Implementation Committee
- PFRA Communicator Newsletter working group

Factsheets

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

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

Factsheets (cont.)

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
Production Practices for *Echinacea angustifolia*
Production Practices for Feverfew

Vegetables:

Pumpkin Production
Vegetables: A Growing Industry
Demonstration of Improved Vegetable Production Techniques in Saskatchewan
Plastic Mulches for Commercial Vegetable Production

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
Northern Vigor™ in Seed Potato

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
Agrochemicals in Soil and Groundwater under Irrigated Potato Production
Hog Effluent Research and Demonstration

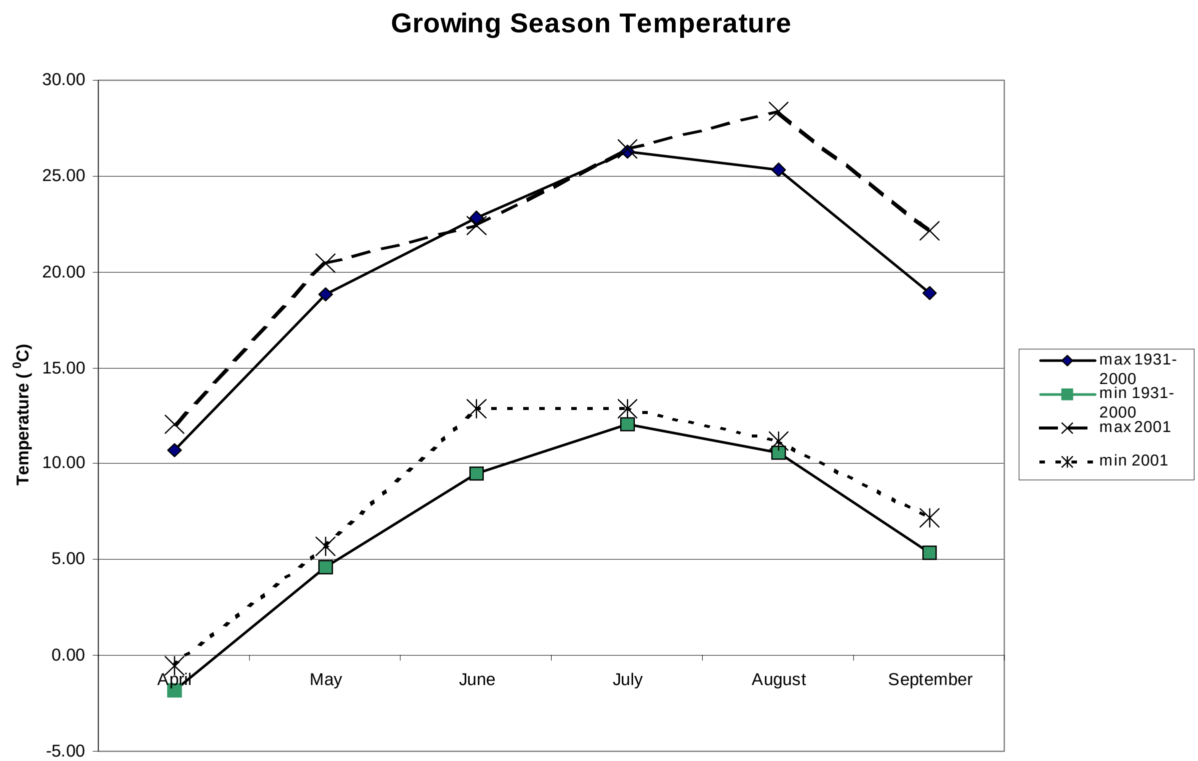
Marketing:

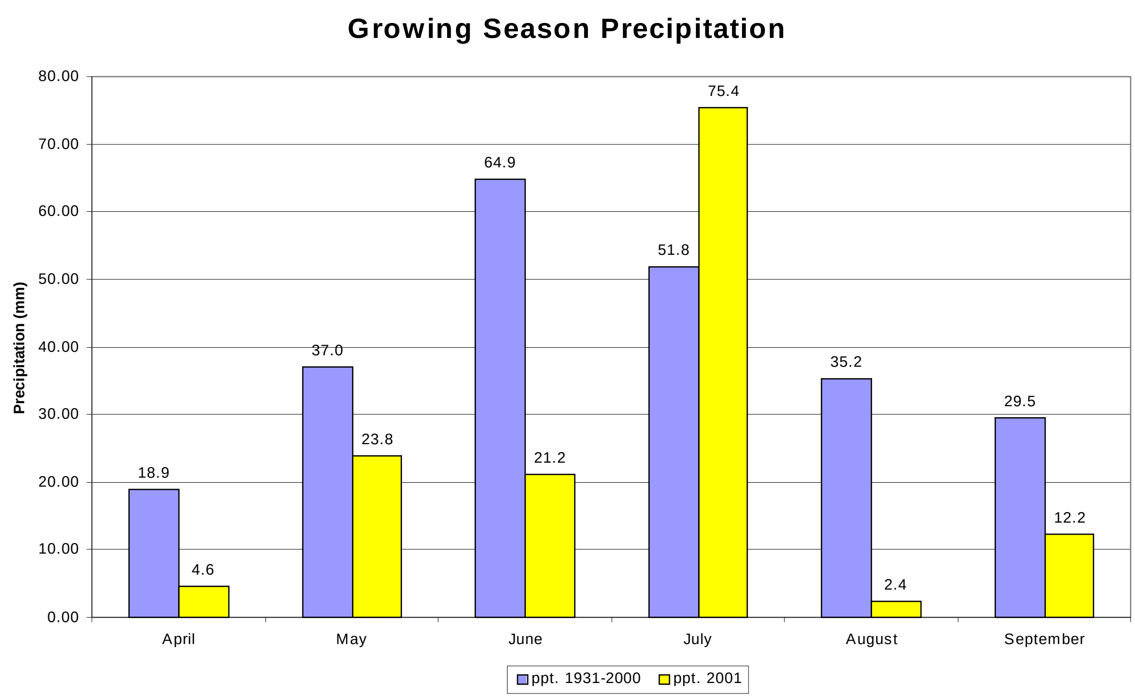
Ginseng Production and Marketing on the Prairies
Ethanol Industry Set for Recovery

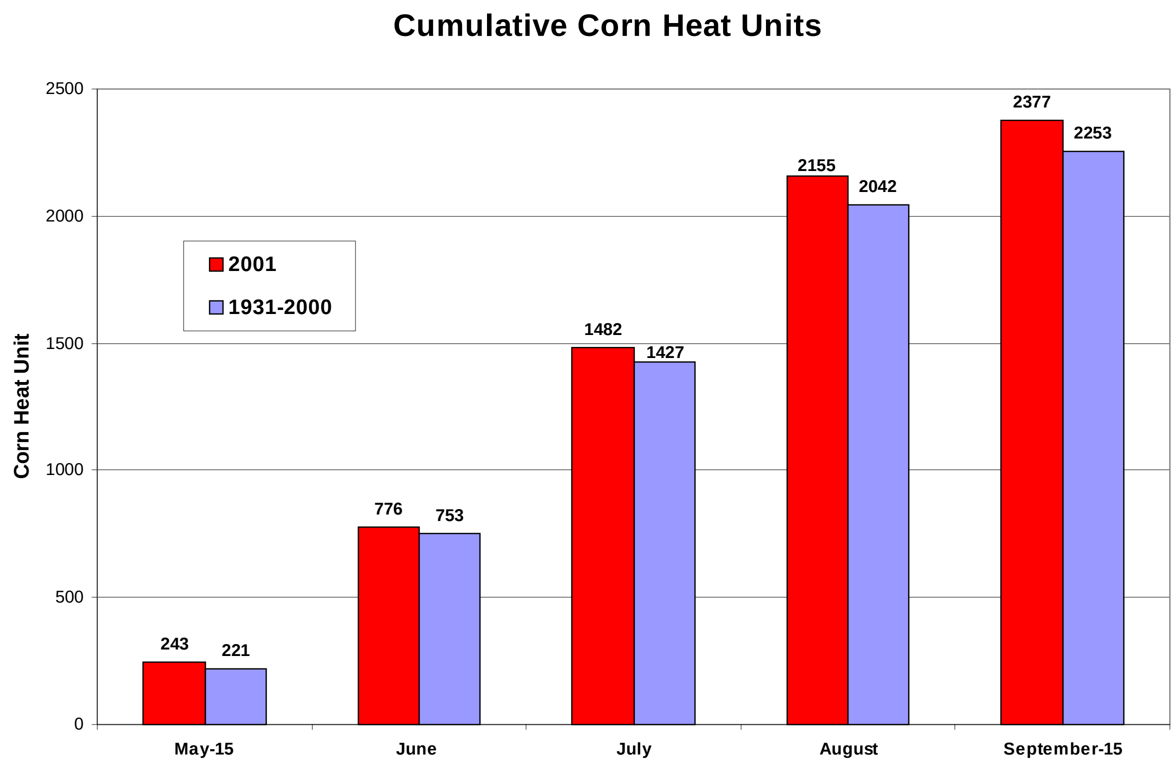
Other:

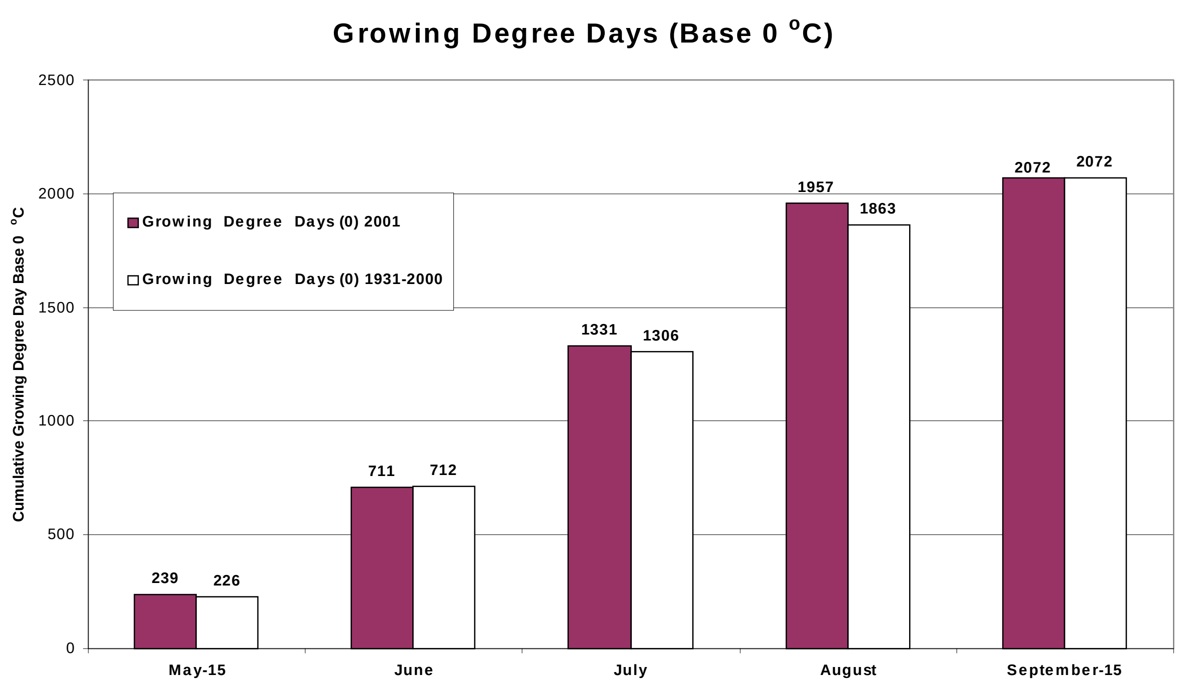
Crop Varieties for Irrigation
Overview of CSIDC
Xeriscape Demonstration Project at CSIDC
Fruit Crops in Saskatchewan

2001 Weather Summary






Cumulative Corn Heat Units
Corn Heat Unit
2500
2000
1500
1000
500
0
2001
1931-2000
243
221
776
753
1482
1427
2155
2042
2377
2253
May-15
June
July
August
September-15


Growing Degree Days (Base 0 °C)
Cumulative Growing Degree Day Base 0 °C
2500
2000
1500
1000
500
0
Growing Degree Days (0) 2001
Growing Degree Days (0) 1931-2000
239
226
711
712
1331
1306
1957
1863
2072
2072
May-15
June
July
August
September-15

2001 Irrigation Data

Field	Crop	Irrigation (mm)					Total irrigation		Fall irrigation
		May	June	July	Aug.	Sept.	mm	inches	mm
CSIDC									
1	Durum Wheat	50	100	100	50	75	375	15	125
3	Strawberries	0	75	50	25	0	150	6	
4	Potatoes	25	0	124	275	50	474	19	
5	Potatoes	25	0	124	275	50	474	19	
6	Durum Wheat	50	50	50	0	50	200	8	50
7	Variety Trials	55	50	100	100	75	380	15	75
7	Crop Sequence	55	50	100	100	75	380	15	75
8	Durum wheat	30	50	75	0	50	205	8	50
8	Herbs and spices	30	50	50	50	25	205	8	
8	Chickpeas	55	25	25	0	0	105	4	
8	Chickpeas-Fungicide	50	50	25	0	0	125	5	
8	Potatoes	30	50	150	175	50	455	18	25
9	Hemp trial	30	50	125	45	25	275	11	25
9	Durum wheat	30	50	125	45	50	300	12	50
10	Grasses	30	75	145	100	75	425	17	
10	Scotch spearmint	30	75	145	50	50	350	14	
11	Potatoes	25	75	200	125	25	450	18	
11	ICDC Canola Trials	25	75	200	50	0	350	14	
11	Dry Beans	25	75	137	75	0	312	12	
11	Crop Sequence	25	75	137	75	0	312	12	
12	Durum wheat	50	100	100	0	100	350	14	50
12	Fall Seeded Canola	50	100	137	50	50	387	15	50
12	Dry Beans	50	100	137	50	50	387	15	50
Off-station Site									
	Northwest	30	75	120	80	0	305	12	
	Northeast	30	75	155	230	15	505	20	15
	Southeast	30	75	155	230	30	520	20	30
	Southwest	30	75	135	60	0	300	12	

Cereals Program

Variety Evaluations

Cereals Program

Variety Evaluations

Western Canada High Yield Wheat Co-operative Test

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

Funded by Agriculture and Agri-Food Canada, PFRA

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 6.0 m (5 ft x 20 ft) plots. Nitrogen was applied at a rate of 112 kg N/ha (100 lb N/ac) as 46-0-0 and phosphorus was applied at a rate of 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0. All fertilizer was side-banded at the time of seeding. The entire plot was harvested for yield estimation. Results of the test are presented in Table 1. Several lines combine high yield with good lodging resistance and short stature.

Western Canada Soft White Spring Wheat Co-operative Test

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

The Soft White Spring Wheat co-operative test was sown mid May in 1.5 m x 6.0 m (5 ft x 20 ft) plots. Nitrogen was applied at a rate of 112 kg N/ha (100 lb N/ac) as 46-0-0 and phosphorus was applied at a rate of 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0. All fertilizer was side-banded at the time of seeding. The entire plot was harvested for yield estimation. Results of the test are presented in Table 2.

Progress: *Ongoing*

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

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

Table 1. Yield and agronomic data for the irrigated High Yield Wheat Co-operative test, Outlook.

Line	Yield kg/ha	Yield bu/ac	Height (cm)	Lodging rating[1]
BW661	6749	100.2	101	1.5
HY413	8144	120.9	87	2.3
HY417	6577	97.7	86	1.8
HY446	7348	109.1	89	1.0
HY459	8103	120.3	87	1.5
HY462	7022	104.3	82	1.0
HY464	7440	110.5	83	1.8
HY467	6198	92.0	81	1.3
HY468	6745	100.2	79	1.3
HY469	7511	111.5	80	1.0
HY470	7362	109.3	82	1.3
HY471	7319	108.7	85	1.3
HY472	8166	121.3	82	2.0
HY473	8518	126.5	84	2.3
HY474	8728	129.6	85	1.8
HY475	7197	106.9	88	1.0
HY476	6760	100.4	87	2.5
HY657	8283	123.0	87	1.0
HY658	6798	101.0	93	2.8
HY659	8181	121.5	89	1.5
HY660	7725	114.7	87	1.0
HY661	7284	108.2	83	1.8
HY968	8080	120.0	85	1.0
HY969	8159	121.2	88	1.0
HY970	8070	119.8	86	1.0
Mean	7539	112.0	86	1.5
CV (%)	6.5		4.7	33.8

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

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

Line	Yield kg/ha	Yield bu/ac	Height (cm)	Lodging rating[1]
AC Phil	9107	135.2	82	1.0
AC Reed	8542	126.8	80	1.0
00-4044	8681	128.9	93	1.0
00-5476	8334	123.8	96	1.0
00-6066	9057	134.5	87	1.0
00-6112	8584	127.5	91	1.0
00-6254	9624	142.9	86	1.0
00-7043	8986	133.4	89	1.0
00-7046	8923	132.5	90	1.0
00-7047	8759	130.1	88	1.0
00-7057	8407	124.8	93	1.0
00-9012	8488	126.0	85	1.0
00B-119	9194	136.5	84	1.0
00B-13	8130	120.7	92	1.0
00B-17	8691	129.1	82	1.0
00B-19	8346	123.9	88	1.0
00B-27	8376	124.4	79	1.0
00B-31	7977	118.5	86	1.0
00B-62	9665	143.5	85	1.0
00D131	8367	124.3	89	1.0
00D133	8532	126.7	89	1.0
00D135	8407	124.8	90	1.0
00D211	8698	129.2	81	1.0
00D221	8022	119.1	82	1.0
00D236	8925	132.5	90	1.0
00D407	7850	116.6	86	1.0
96B-37	9483	140.8	82	1.0
96DH-812	9207	136.7	84	1.0
98B-196	9222	136.9	85	1.0
99PR-328	8471	125.8	86	1.0
Mean	8702	129.2	86	1.0
CV (%)	4.4		3.5	

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

Irrigated Wheat Variety Test

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

Funded by the Irrigation Crop Diversification Corporation (ICDC)

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. Soil type at the various sites are as follows:

- CSIDC: Bradwell very fine sandy loam
- CSIDC off-station site: Asquith sandy loam
- H. Jeske: Tuxford clay loam
- R. Pederson: Elstow loam

Wheat varieties were tested for their agronomic performance under irrigation. The tests were seeded mid May. 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 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0. Yields were estimated by harvesting the entire plot. The results are presented in Table 3. AC Nanda, AC Napolean, AC Vista, AC Chrystal and McKenzie all show potential as high yielding wheat varieties under irrigated conditions. The results from these trials are used to update the irrigation variety trial database at CSIDC and provide recommendations to irrigators on the best wheat variety suited to irrigated conditions.

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

Variety	Jeske site			Pederson site			CSIDC Off-station site			CSIDC site			Mean yield		
	Yield (kg/ha)	Height (cm)	Lodging rating[1]	Yield (kg/ha)	Height (cm)	Lodging rating[1]	Yield (kg/ha)	Height (cm)	Lodging rating[1]	Yield (kg/ha)	Height (cm)	Lodging rating[1]	kg/ha	bu/ac	% of AC Barrie
AC Avonlea	4477	78	1.0	5805	70	1.0	7768	93	1.3	3959	74	1.0	5502	81.7	99
AC Barrie	3824	76	1.0	5916	69	1.0	7305	97	1.8	5217	77	1.0	5566	82.6	100
AC Cadillac	3285	83	1.0	5553	72	1.3	6704	99	3.3	4470	84	1.3	5003	74.3	90
AC Crystal	5183	70	1.0	6612	67	1.8	7639	83	1.8	6329	77	1.0	6441	95.6	116
AC Intrepid	3414	75	1.0	5291	67	1.5	6700	94	2.3	4811	79	1.0	5054	75.1	91
AC Morse	5186	70	1.0	5604	69	1.0	7718	91	1.3	5620	72	1.0	6032	89.6	108
AC Nanda	5645	78	1.0	7271	69	1.0	8300	89	1.3	5503	74	1.0	6680	99.2	120
AC Napolean	4660	72	1.0	5939	71	1.3	9171	99	3.5	6635	85	1.0	6601	98.0	119
AC Vista	5253	70	1.0	5709	69	1.3	8697	88	1.5	5806	75	1.0	6366	94.5	114
CDC Bounty	3637	79	1.0	5630	74	1.5	7617	99	2.5	5420	85	1.0	5576	82.8	100
Katepwa	3366	78	1.0	5497	74	1.5	7098	98	2.8	5236	87	1.3	5299	78.7	95
McKenzie	4254	74	1.0	6178	74	1.5	8273	93	2.3	6558	84	1.0	6316	93.8	113
Prodigy	3926	79	1.0	5799	76	1.0	7173	97	1.5	5535	82	1.0	5608	83.3	101
Mean	4316	75	1.0	5908	71	1.3	7704	94	2.1	5469	80	1.0	5849	86.9	105
CV (%)	11.9	3.6		7.3	1.5	28.7	7.0	3.5	39.5	12.2	7.5	18.1	---	---	---

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

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

Evaluation of Durum Breeding Lines for Irrigation

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

Funded by AAFC Swift Current and the CSIDC

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 near Outlook in 2001. This test consisted of short and semidwarf durum lines with potential adaptation to irrigated and high rainfall environments. The test was also grown under irrigation at Lethbridge, Alberta, and at non-irrigated sites in Saskatchewan and Manitoba. There was a total of 67 experimental lines and five check cultivars, replicated twice to make a total of 144 plots. The best lines selected from this test will enter the Durum 'B' Test, the final test prior to the Durum Cooperative Test.

AC Navigator is currently the only semidwarf durum cultivar under commercial production in Canada. It has shown good yield potential under both irrigation and dryland conditions. It has desirably stronger gluten than other Canadian durum varieties. AC Navigator has been well-received by customers in Europe, North America, and South America due to its premium quality. Significant acreage will again be contracted by the Canadian Wheat Board and Saskatchewan Wheat Pool in 2002.

There are experimental lines with potential for improvement of the yield, straw strength, disease resistance, and protein content of AC Navigator. Plans are to expand our testing of this material under irrigation in 2002 and beyond.

Saskatchewan Advisory Council Irrigated Wheat and Barley Regional Tests

C. Ringdal[2], C. Klemmer[3], T. Hogg[2]

Funded by Agriculture and Agri-Food Canada, PFRA

Progress: *Ongoing*

Objective: *To evaluate wheat and barley varieties under irrigated conditions.*

The Saskatchewan Advisory Council wheat and barley regional tests were sown mid May. 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 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0. Yields were estimated by harvesting the entire plot.

Yield results for the CWRS, CPS, SWS, CWAD and CWES wheat market classes are shown in Table 4. Yield data for the 2-row and 6-row barley tests are shown in Table 5. The SWS wheat market class had the highest yielding wheat varieties, while CWES were the lowest yield wheat varieties. For barley, the highest yielding variety was found in the 2-row class.

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

Table 4. Saskatchewan Advisory Council irrigated wheat regional test, Outlook.

Variety	Yield kg/ha	Yield bu/ac	Height (cm)	Maturity	Lodging rating[1]
Hard Red Spring					
AC Barrie	7079	105.1	98	112	1.3
5500HR	6128	91.0	92	112	2.0
5600HR	5147	76.4	104	112	1.3
Prodigy	7024	104.3	102	112	1.8
CDC Bounty	7123	105.8	99	111	3.0
BW252	7962	118.2	93	112	1.0
BW243	6387	94.8	96	112	1.3
BW256	5194	77.1	99	114	1.5
BW259	6450	95.8	94	111	1.5
BW270	5378	79.9	100	110	2.0
BW758	6515	96.7	92	111	1.3
BW768	6305	93.6	102	112	1.5
PT205	6561	97.4	101	111	2.3
PT416	7024	104.3	97	111	2.5
PT551	6875	102.1	96	111	1.3
PT553	7128	105.9	94	111	2.0
PT554	6820	101.3	96	111	1.5
BW263	5589	83.0	92	111	1.3
BW264	6633	98.5	95	111	2.0
BW275	6129	91.0	94	112	1.8
Durum					
Kyle	7794	115.7	104	113	6.8
AC Avonlea	7656	113.7	96	112	1.5
AC Navigator	8254	122.6	86	113	1.3
DT494	8215	122.0	98	111	3.3
Soft White Spring					
AC Phil	8814	130.9	83	113	1.3
AC Reed	8259	122.6	80	113	1.0
AC Nanda	8589	127.5	88	114	1.0
SWS234	8523	126.6	84	114	1.0
SWS241	9228	137.0	84	114	1.0
Canada Prairie Spring					
AC Vista	8051	119.6	85	114	2.5
AC2000	8147	121.0	89	113	1.3
AC Crystal	7728	114.8	85	112	1.3
5700PR	8675	128.8	81	114	1.3
HY962	7852	116.6	85	113	1.8
HY459	8452	125.5	86	114	1.5
Canada Western Extra Strong					
Glenlea	5668	84.2	105	112	4.0
Amazon	6426	95.4	104	113	5.0
AC Corrine	5383	79.9	107	113	3.5
AC Glenavon	5374	79.8	104	112	2.8
ES21	6473	96.1	102	112	2.0
ES32	6330	94.0	101	111	2.0

[1]0 = erect; 9 = flat

Table 5. Saskatchewan Advisory Council irrigated barley regional test, Outlook.

Variety	Yield kg/ha	Yield bu/ac	Height (cm)	Maturity	Lodging rating[1]
2 Row					
Harrington	5432	100.8	92	112	7.0
AC Bountiful	6049	112.3	97	113	4.3
AC Metcalfe	6954	129.1	89	113	2.0
CDC Copeland	5854	108.7	99	113	5.0
CDC Kendall	5516	102.4	91	114	4.7
CDC Bold	7280	135.1	90	112	5.0
CDC Dolly	6554	121.7	86	112	5.3
CDC Fleet	7112	132.0	92	112	2.0
CDC Dawn	5245	97.4	97	113	5.7
CDC Freedom	5240	97.3	103	113	3.3
CDC Gainer	5237	97.2	97	115	3.0
CDC Select	5657	105.0	97	113	3.7
CDC Stratus	6723	124.8	88	114	2.0
Merit	5291	98.2	100	113	5.3
TR258	7763	144.1	89	112	1.3
CDC Thompson	6684	124.1	70	111	2.3
CDC Helgason	6501	120.7	96	112	3.3
Xena	7682	142.6	94	114	2.7
TR256	6876	127.6	96	113	3.7
CDC McGwire	6175	114.6	94	113	4.3
HB805	6430	119.4	90	113	6.7
Tercel	5951	110.5	98	112	4.3
6 Row					
CDC Sisler	5897	109.5	104	103	5.3
Legacy	6263	116.3	92	103	4.0
CDC Battleford	6079	112.8	95	105	6.7
AC Bacon	4691	87.1	96	103	3.7
AC Hawkeye	4551	84.5	109	105	6.7
AC Harper	6271	116.4	74	104	5.7
AC Ranger	6833	126.8	94	104	5.7
AC Rosser	6969	129.4	94	105	6.3
BT462	5498	102.1	103	105	4.3
CDC Yorkton	6023	111.8	96	103	3.0
Excel	6085	113.0	91	105	4.3
Peregrine	4372	81.2	72	101	2.0
Mahigan	6205	115.2	81	102	3.7
Niska	5590	103.8	80	103	7.3
Trochu	5191	96.4	93	105	7.0
Vivar	6313	117.2	88	104	3.0

[1]0 = erect; 9 = flat

Oilseeds Program

Oilseeds Program

Variety Evaluations

Western Canada Irrigated Canola Co-operative Tests NI1 and NI2

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

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

***Progress**: Ongoing*

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

The canola co-operative tests were conducted on an irrigated site at the CSIDC. The NI1 test was seeded on May 16 while the NI2 test was seeded on May 15. 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 56 kg/ha (50 lb/ac) as 12-51-0. All fertilizer was side-banded at the time of seeding. Results are presented in Tables 1 and 2. In the NI1 trial, NS 4443, NS 4422 and NR 98-6275 show exceptionally high yield and good lodging resistance compared to the check variety AC Excel. In the NI2 trial, PHS00-858, NS 4451, SW-P9883944 and PHS99-833 had high yield and good lodging resistance compared to the check variety AC Excel.

Irrigated Canola Regional Variety Trial

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

Funded by the Irrigation Crop Diversification Corporation (ICDC)

***Progress**: Ongoing*

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

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

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

- CSIDC: Bradwell very fine sandy loam
- CSIDC offsite: Asquith sandy loam
- H. Jeske: Tuxford clay loam
- R. Pederson: Elstow loam

Canola varieties were tested for their agronomic performance under irrigation. The tests were seeded mid May. 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 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0. Yields were estimated by harvesting the entire plot. The results are presented in Table 3. All Canola varieties except Hylite 201, Invigor 2273 and LoLinda produced yield as good as the check variety Quantum.

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

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

Entry	Yield % of AC EXCEL[1]	Maturity	Height (cm)	Lodging 0=erect; 9=flat
AC EXCEL	100	93	95	6.3
DEFENDER	101	93	104	4.8
LEGACY	100	93	92	6.3
Q2	89	94	88	6.8
46A65	75	93	95	6.1
APPOLLO	51	93	76	7.0
LoLinda	70	93	98	5.4
NL97-0219	77	95	97	6.3
NR98-5990	79	92	102	4.4
NR98-6279	109	93	97	5.3
NR98-6275	67	95	97	3.9
NR98-6647	91	93	84	7.0
PR6131	100	93	96	3.8
NS4450	75	93	92	4.0
Z0658	96	95	108	3.8
PHS00-915	105	92	97	5.3
Z0659	85	96	102	2.8
Y9048	82	94	107	4.3
Z0656	93	94	109	4.5
SWD5076NC	89	95	106	3.5
PR6044	69	92	89	6.0
NS4422	111	91	94	4.5
Y9845	73	94	92	5.5
A00-57N	101	93	97	7.0
NS4443	113	92	94	5.5
CV (%)	35.6	1.5	10.7	24.2

[1]AC EXCEL yield = 4196 kg/ha (3739 lb/ac)

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

Entry	Yield % of AC EXCEL[1]	Maturity	Height (cm)	Lodging 0=erect; 9=flat
AC EXCEL	100	92	123	3.5
DEFENDER	92	90	120	3.3
LEGACY	102	90	120	3.8
Q2	86	91	104	4.8
46A65	104	92	113	4.0
PR6121	107	91	109	3.5
PR51-0012	82	88	89	2.5
NS3213	87	93	116	3.8
PR6188	93	88	111	2.0
NS4442	103	92	113	3.3
PR6118	70	90	120	2.4
SWD5113RR	104	92	116	2.3
NS4423	105	89	109	4.0
NS4408	107	91	118	3.0
NS4409	105	91	110	4.3
SWD125NC	98	91	115	3.5
SW-P9883944	112	93	123	2.0
PR51-0002	107	90	114	2.8
SWD5099RR	110	91	120	2.8
S8010	85	93	118	6.5
NS4451	119	93	123	2.8
PR6194	95	93	115	4.3
PHS99-833	111	91	126	2.5
PR6221	89	92	104	3.5
NS3815	95	92	115	3.5
NS4465	100	92	124	2.0
PHS00-858	125	91	121	2.5
A00-36NR	77	88	99	4.0
NS4466	107	93	121	4.5
LoLinda	102	92	123	2.0
CV (%)	13.3	1.7	7.8	38.0

[1]AC EXCEL yield = 3614 kg/ha (3220 lb/ac)

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.

Irrigated Flax and Solin Regional Variety Trial

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

Funded by the Irrigation Crop Diversification Corporation (ICDC)

***Progress**: Ongoing*

***Locations:** Two 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 two locations in the Outlook area. Each site and soil type are as follows:

H. Jeske: Tuxford clay loam
R. Pederson: Elstow loam

Flax and solin varieties were tested for their agronomic performance under irrigation. The tests were seeded mid May. 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 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0. Yields were estimated by harvesting the entire plot. The results are presented in Table 4.

Table 4. Yield and agronomic data for the irrigated flax and solin variety test.

Variety	Jeske site Yield (kg/ha)	Jeske site Height (cm)	Jeske site Lodging rating[1]	Pederson site Yield (kg/ha)	Pederson site Height (cm)	Pederson site Lodging rating[1]	Mean yield kg/ha	Mean yield bu/ac	Mean yield % of AC McDuff
Oilseed flax									
AC Carnduff	3002	48	1.0	3415	53	1.0	3209	51.1	113
AC Emerson	2687	48	1.0	3181	49	1.0	2934	46.7	104
AC Lightning	2700	48	1.0	2932	50	1.0	2816	44.8	99
AC McDuff	2703	51	1.0	2963	55	1.0	2833	45.1	100
AC Watson	2574	44	1.0	3160	48	1.0	2867	45.6	101
CDC Arras	2738	49	1.0	3260	52	1.0	2999	47.7	106
CDC Bethune	3011	53	1.0	3329	59	1.0	3170	50.4	112
CDC Normandy	2750	45	1.0	3003	51	1.0	2877	45.8	102
CDC Valour	2658	51	1.0	2880	53	1.0	2769	44.1	98
Flanders	2617	51	1.0	3196	55	1.0	2907	46.2	103
FP1082	2321	44	1.0	2751	48	1.0	2536	40.4	90
FP1094	2663	49	1.0	3325	53	1.0	2994	47.6	106
FP1096	2907	49	1.0	2958	57	1.0	2933	46.7	104
Taurus	2714	50	1.0	2970	52	1.0	2842	45.2	100
Vimy	2707	47	1.0	3205	50	1.0	2956	47.0	104
Solin									
Linola 1084	2693	52	1.0	3202	55	1.0	2948	46.9	104
Linola 989	2597	54	1.0	2942	56	1.0	2770	44.1	98
Mean	2708	49	1.0	3098	53	1.0	2903	46.2	102
CV (%)	7.3	4.7	---	6.7	5.1	---	---	---	---

[1]1 = upright; 9 = flat

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

Agronomic Evaluations

Impact of Moisture Stress during Grain Filling on Canola Seed Vigor

B. Irvine[1], T. Hogg[2], A. MacDonald[2]

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

***Objective:** To determine the effect of water stress at various stages of crop growth on the seed vigor of canola.*

Low moisture stress generally leads to higher seed weights and higher oil content in canola. If moisture stress during grain filling is a major factor there are areas of the prairies (including irrigation) where moisture stress is lower. It has been shown in previous studies that a wide range of seeding rates and row spacings are possible on irrigation without a major impact on seed yield. One of the goals of seed increase is to ensure the highest possible seed increase ratio. Thus seed rates lower than optimum may produce maximum yields. To maintain equal yields at very low seeding rates, seeds must form on higher order branches. It is not known what impact this has on seed vigor. The goal of this trial is to determine the effect of water stress at various times of the crop production stages on the seed vigor of canola.

Roundup Ready canola was planted at 20 and 40 cm (8 and 16 in) row spacing at seeding rates of 40, 80 and 120 seeds/m^2 (4.3, 8.6 and 12.9 seeds/ft^2). The 40 seed/m^2 (4.3 seeds/ft^2) rate is typical of what would be planted for seed increase and the 120 seed/m^2 (12.9 seeds/ft^2) rate is the commercial seeding rate. All seeding rate and row spacing combinations were given the following irrigation management treatments: Irrigate until end of flowering, irrigate from end of flowering to maturity and irrigation throughout the season.

Yields in 2001 were not affected by any combinations of seeding rate, row spacing or irrigation management. Yields were very high with all irrigation management systems which was unexpected given the hot dry growing conditions in 2001. Hydroponic assessment of seed vigor did not indicate differences in seed vigor.

[1]AAFC, Brandon Research Centre, Brandon, Manitoba
[2]CSIDC, Outlook

Canola Fall Seeding Trial

C. Ringdal[1], K. Zaychuk[2], T. Hogg[1]

Funded by GrowTec Inc. and Agriculture and Agri-Food Canada, PFRA

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

***Objective:** To determine the effect of extender seed coating on fall seeded irrigated canola.*

Fall seeding, or dormant seeding, refers to the planting of spring varieties in the fall, prior to freeze-up. The seeds will remain dormant in the soil over winter and germinate the following spring once conditions become favourable. Plant emergence is typically three to four weeks ahead of normal spring planting allowing the canola plants to flower during the cooler part of the growing season resulting in earlier crop maturity.

The fall seeding window is small, generally a few days before freeze-up. The use of a seed coating can extend the fall seeding window, thus, preventing fall germination and providing better spring establishment.

A canola fall seeding trial was initiated in the fall of 2000 on an irrigated site at the CSIDC. Treatments included two fall seeding dates with and without a seed coating compared to normal spring seeding. Treatment plots measured 3 m x 137 m (10 ft x 420 ft) and were replicated three times. All treatments received 112 kg N/ha (100 lb N/ac) as 46-0-0 and 56 kg P_2O_5/ha (50 lb P_2O_5/ac) as 12-51-0.

Results indicated that even though the fall seeded canola flowered and matured earlier than the spring seeded canola there was no significant difference in yield among the treatments (Table 5).

Table 5. Effect of fall seeding and Extender seed coating on irrigated canola seed yield.

Treatment	Yield	
	kg/ha	lb/ac
October 19, 2000	1998	1780
October 31, 2000	2061	1836
October 19, 2000 + Extender	2055	1829
October 31, 2000 + Extender	1979	1763
May 3, 2001	1971	1756
LSD (0.05)	NS[1]	
CV (%)	6.3	

[1]not significant

[1]*CSIDC, Outlook*
[2]*GrowTec Inc., Nisku, Alberta*

A Field Evaluation of the Effects of Heat and Moisture Stress on Seed Quality and Yield in B. Napus

R. Berard[1], S. Brandt[1], I. McGregor[1]

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

***Objective:** To determine the effect of heat stress on canola seed quality and yield.*

This study was initiated in response to growing industry concerns that canola yields were declining or stagnating in the early to mid-nineties in Saskatchewan. Preliminary analyses of prairie yield data confirmed the presence of a yield stagnating trend or plateau.

Heat stress at critical growth stages such as flowering and pod filling has been shown to affect normal pod and seed growth leading to reduced yields in controlled growth chamber studies. A field technique using remotely sensed canopy temperatures to trigger a micro-sprinkler cooling system was used to determine the effect of heat stress on canola seed quality and yield under irrigated and dryland field conditions.

A study was initiated at the Canada-Saskatchewan Irrigation Diversification Centre to determine the effect of heat stress on canola seed quality and yield. The trial was conducted in both 2000 and 2001.

The abiotic stress field study resulted in surprisingly minor effects of heat stress on yield components given the unusually hot and dry summer of 2001. The general trend was for heat stress during grain filling to have a larger impact on seed size and yield than stress during the flowering stage. Surprisingly, the stressed plants had more seeds per pod than the unstressed plants. In terms of grain quality, there was a tendency for the heat stressed plants to have higher protein and lower oil content although the effect was not significant. The unexpected high yields in the dryland plots may have resulted from lateral movement of water from the nearby irrigated plots, thus resulting in reduced heat stress effects. Nevertheless, while most of the heat stress effects were not statistically significant, they would still represent fairly significant economic losses to growers; e.g. the yield decrease of 13% caused by heat stress treatments would represent some $30/acre in a 40 bu/ac crop (@ $6.00/bu).

[1]AAFC Research Centre, Saskatoon, Saskatchewan

Forage Program

Forage Program

Turf Grass Seed Program

There is a large turf grass seed market both in North America and in Europe. Western Canada can become the low cost supplier of seed if production packages can be developed to produce yields similar to traditional growing areas.

This program seeks to develop information on establishment, weed control and post-harvest management which will allow producers to obtain high seed yields for turf grass species.

Production Package for Bluegrass

B. Coulman[1], S. Sommerfeld[2], T. Nelson[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

<u>Post Harvest Residue Management, N-Fertility and Application of Chemicals for Insect Control</u>

Progress: *Year three of three*

Objective: *To refine a seed production package for bluegrass seed to ascertain the potential effectiveness of weed, insect and residue management.*

A trial was set up in August of 1999 on an established bluegrass stand (seeded 1997) which had previously been used for herbicide trials. This stand was in good condition having yielded close to 700 kg/ha in 1999.

Treatments:

- N fertility (mid-September, 1999, 2000) - 0, 75 and 150 kg/ha
  - 0, 67 and 134 lb/ac
- Residue management (late-August, 1999, 2000) - none; mow close and remove; burn
- Silvertop control (late May, 2000, 2001) - cygon; no cygon

Treatments were applied in a factorial randomized complete block design with four replications.

In 2001, the following data were collected: percent spring vegetative cover, number of days to heading, mean no. of heads/m^2, mean number of silver topped heads/m^2, disease incidence and seed yield.

[1]*Agriculture & Agri-Food Canada Research Centre, Saskatoon*
[2]*CSIDC, Outlook*

The data collected in 2001 are reported in Table 1. Seed yields ranged from 452-810 kg/ha (403-722 lb/ac) depending on treatment. Yields such as this would be considered to be moderate and are about 50% higher than those of 2000. The three residue removal treatments did not differ widely in seed yield, but the burn treatment had the lowest silvertop percentage.

Nitrogen fertilization increased seed yield, and the highest N rate also reduced silvertop incidence. Seed yields were higher for plots treated with cygon, than for those which did not receive cygon. This was likely due to the much reduced incidence of silvertop when cygon was applied. Cygon provides some control of insects associated with silvertop.

Production Package for Annual and Perennial Ryegrass and Tall Fescue

B. Coulman[1], S. Sommerfeld[2], T. Nelson[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

Establishment and Crop Rotation

***Progress**: Year five of five*

***Objective:** To develop a production system for producing seed of perennial ryegrass and tall fescue as biennial crops and annual ryegrass as an annual crop.*

Profitable production of grass seed depends on the establishment of good stands. Most grasses do not produce seed in the year of planting and, thus, stands must be kept for several years to compensate for the loss of income in the establishment year, or a companion crop can be used in the establishment year. Previous research with bluegrass has shown that flax was the most suitable companion crop since it is less competitive. The fine fescues can tolerate Poast Flax Max, therefore flax may be a good choice since these species have weak seedlings. Tall fescue is a much more competitive species and can tolerate Puma, and thus, wheat may be the best companion crop. Perennial ryegrass can be planted after the harvest of an early maturing crop or is broadcast into a standing crop prior to harvest.

New trials were successfully established in 1999 with spring seedings and companion crops established the first week of June, and grasses broadcast into standing crops the middle of August. Tall fescue and perennial ryegrass were seeded without a companion crop and with CPS AC Taber and HRS AC Barrie wheat. They were broadcast in late summer into standing crops of LG3295 canola and AC Pennant yellow mustard. Stands were assessed and seed yields were determined in 2000 and 2001.

Perennial ryegrass failed to establish when broadcast into standing crops and the spring seedings suffered winter kill and were not harvested. Tall fescue established and overwintered in all treatments. In 2000, seed yields of the broadcast and companion crop seedings were much lower than the spring seeded pure stands. In 2001, stands were thinner in the broadcast seedings, but tall fescue seed yields were high (923-1057 kg/ha; 822-942 lb/ac) and not significantly different among the establishment treatments (Table 2).

[1]*Agriculture & Agri-Food Canada Research Centre, Saskatoon*
[2]*CSIDC, Outlook*

Table 1. 1999 Kentucky bluegrass residue management trial - 2001 data.

Residue treatment	Nitrogen fertilizer treatment	Chemical treatment	% Vegetative cover 22-May-01	Mean # of days to 50% heading from April 1	Mean # heads/m^2	Mean # Silvertop/m^2	Disease rating 4-Jul-01	% Silvertop incidence	Seed yield kg/ha	Seed yield lb/ac
None	0N	None	98	61	414	91	0.3	26	464	413
None	0N	Cygon	98	59	590	13	0.0	2	484	431
None	75N	None	95	60	583	189	0.8	33	553	493
None	75N	Cygon	94	60	701	90	1.0	14	740	659
None	150N	None	93	60	845	124	0.8	16	749	667
None	150N	Cygon	97	59	757	40	1.0	6	777	692
Mow	0N	None	98	61	431	165	0.3	37	462	412
Mow	0N	Cygon	95	59	454	16	0.0	4	495	441
Mow	75N	None	98	60	628	162	0.5	28	612	545
Mow	75N	Cygon	97	59	748	151	1.0	22	632	563
Mow	150N	None	98	60	805	166	1.0	24	700	624
Mow	150N	Cygon	85	60	658	55	1.8	10	673	600
Burn	0N	None	75	55	620	47	1.8	9	460	410
Burn	0N	Cygon	88	55	548	14	1.8	3	452	403
Burn	75N	None	87	55	616	69	3.3	10	568	506
Burn	75N	Cygon	78	55	533	73	2.8	14	691	616
Burn	150N	None	88	56	514	177	3.8	33	540	481
Burn	150N	Cygon	91	55	590	38	3.0	6	810	722
Mean	---	---	92	58	613	93	1	16	603	537
CV (%)	---	---	11	4	26	84	69	77	26	
F value	---	---	2	3	3	2	5	3	2	
LSD (0.05)	---	---	15	3	230	111	1	18	221	197

Residue Treatment					Nitrogen Fertilizer				Chemical Treatment			
Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop		Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop	Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
None	628	560	16		0	465	414	13	No Cygon	564	503	24
Mow	596	531	21		75	633	564	20	Cygon	639	569	9
Burn	587	523	12		150	708	631	16	---	---	---	

Table 2. 1999 Tall fescue establishment and crop rotation trial - Year 2 (2001 data).

Treatment	Companion crop	Mean vegetative cover 23 May 01	Seed yield kg/ha	Seed yield lb/ac
Tall Fescue Broadcast	AC Pennant Yellow Mustard	63	1057	942
Tall Fescue Broadcast	LG3295 Canola	69	994	886
Tall Fescue Direct Seeded	AC Barrie HRS Wheat	80	981	874
Tall Fescue Direct Seeded	AC Taber CPS Wheat	90	952	848
Tall Fescue Direct Seeded	No Companion Crop	90	923	822
MEAN		78	981	874
CV (%)		19.8	19.2	
F value		1.7	0.3	
LSD (0.05)		23.8	NS[1]	NS

[1]not significant

Residue management/fertility/insect control in tall fescue

Objective: *To refine a system of residue management, nitrogen fertilization and insect control for tall fescue seed production fields.*

Two trials were set up in August of 1999 on a 1997 established tall fescue stand which had been previously used for herbicide trials. This stand was in good condition having yielded around 900 kg/ha (802 lb/ac) in 1999.

Treatments were applied in a factorial randomized complete block design with four replications.

In 2001, the following data were collected: % spring vegetative cover, number of days to heading, mean no. of heads/m^2, mean no. of silver topped heads/m^2, disease incidence and seed yield.

Trial No. 1 Treatments:

- Residue management (late August, 2000) - none; mow close and remove; burn
- Silvertop control (late May, 2001) - cygon; no cygon

For Trial 1 (Table 3), seed yields ranged from 910-1166 kg/ha (811-1039 lb/ac) for the mowed and no residue removal treatments. Yields were very low for the burned treatment due to low vegetative cover and few heads. The application of cygon had little effect on yield, likely due to the fact that there was little silvertop present. Tall fescue is less susceptible to silvertop than kentucky bluegrass and the fine fescues.

Trial No. 2 Treatments:

- Residue management (late August, 2000) - none; mow close and remove; burn
- N fertility (mid September, 2000) - 0, 75 and 150 kg/ha - 0, 67 and 134 lb/ac

For trial 2 (Table 4), seed yields were lower than trial 1. The burned residue treatment again produced low or nil seed yields due to poor stands and few or no heads. There was little difference between no residue removal and the mowed treatment. Nitrogen fertilization seemed to have a negative effect on seed yield, with the highest yield for the 0 kg/ha rate, and the lowest for the 150 kg/ha rate.

Seeding date trials for Perennial, Italian and Westerwolds ryegrass

Objectives:
- *To determine whether fall dormant seeding will promote seed production in Italian and perennial ryegrass.*
- *To determine whether fall dormant seeding will promote early spring growth and earlier seed production in Westerwolds ryegrass compared to spring seedings.*

Late fall (dormant) seedings have worked well with canola. They also show potential for ryegrass seed crops. Annual (Westerwolds) ryegrass has produced fairly high yields from spring seedings, but yields could perhaps be increased by dormant seeding. Italian and perennial ryegrass do not produce any heads in the year of seeding and must overwinter to become vernalized and produce seed the following year. Italian ryegrass will not survive our winters and perennial ryegrass is only moderately winter hardy. For dormant seedings of these latter two species, seedlings germinating early in the spring may become vernalized and subsequently produce heads and seed. This would eliminate the need to overwinter plants and create an effective annual production system for these grasses.

Table 3. 1997 Tall fescue residue management trial #1 - 2001 data.

Residue treatment	Chemical treatment	% Vegetative cover 22-May-01	Mean # of days to 50% heading from April 1	Mean # heads/m^2	Mean # Silvertop/m^2	Disease rating 4-Jul-01	% Silvertop incidence	Seed yield kg/ha	Seed yield lb/ac
None	None	81	72	161	0.5	2.0	0.3	1166	1039
None	Cygon	79	72	119	0.0	2.3	0.0	1156	1030
Mow	None	89	72	175	2.0	1.0	1.0	910	811
Mow	Cygon	88	72	207	0.0	2.8	0.0	958	854
Burn	None	7	72	6	1.0	0.3	0.0	25	22
Burn	Cygon	13	72	26	0.5	0.3	0.5	62	55
Mean	---	59	72	115	1	1	0	713	635
CV (%)	---	14	0	29	192	37	183	37	
F value	---	53	2	16	1	12	2	11	
LSD (0.05)	---	13	0	50	2	1	1	398	355

Residue Treatment

Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
None	1161	1034	0.1
Mow	634	832	0.8
Burn	43	38	0.3

Chemical Treatment

Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
No Cygon	700	624	0.4
Cygon	726	647	0.2

Table 4. 1997 Tall fescue residue management trial #2 - 2001 data.

Residue treatment	Nitrogen fertilizer treatment	% Vegetative cover 22-May-01	Mean # of days to 50% heading from April 1	Mean # heads/m^2	Mean # Silvertop/m^2	Disease rating 4-Jul-01	% Silvertop incidence	Seed yield kg/ha	Seed yield lb/ac
None	0N	90	73	145	1	3	1	953	849
None	75N	76	73	119	4	4	2	701	625
None	150N	73	73	152	3	3	2	404	360
Mow	0N	84	73	217	5	2	2	726	647
Mow	75N	83	72	169	9	3	4	695	619
Mow	150N	88	73	151	5	3	3	700	624
Burn	0N	18	72	17	0	1	0	43	38
Burn	75N	7	73	0	0	0	0	0	0
Burn	150N	3	73	0	0	0	0	0	0
Mean		58	73	108	3	2	2	469	418
CV (%)		26	1	48	120	58	127	65	
F value		18	1	8	3	5	2	5	
LSD (0.05)		22	1	76	5	2	3	446	397

Residue Treatment

Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
None	686	611	2
Mow	707	630	3
Burn	14	12	0

Chemical Treatment

Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
0N	574	511	1
75N	465	414	2
150N	368	328	2

Seeding dates and seed coating treatments:
- Water-insoluble seed coat - early November, 2000
- Water-soluble seed coat - early November, 2000
- Water-soluble seed coat - May, 2001

Varieties:
- Westerwolds - Barspectra
- Italian - Bardelta, Maris Ledger, Bartali, Bartissimo
- Perennial - Yatsyn

Design - randomized complete block with 4 replications

Data collected in 2001 were: days to heading, mean number of heads/0.25 m^2, and seed yield.

All stands of dormant seedings were poor in the spring due to the extremely dry conditions before irrigation water was available (the second week of May). Stands thickened up as the season progressed through tillering, but none achieved the density of the respective spring seedings. Dormant seedings headed earlier than spring seedings for Yatsyn perennial ryegrass and Bardelta Italian ryegrass, but were not consistently different for westerwolds ryegrass (Table 5). Seed maturity occurred within the same week for all seedings within a ryegrass type.

Yatsyn perennial ryegrass produced low seed yields (150 kg/ha; 134 lb/ac, or less) for the dormant seedings and very little seed in the spring seeding (Table 5). As in previous years, dormant seedings show little promise for economic seed production in perennial ryegrass.

Barspectra westerwolds ryegrass yielded close to, or more than, 1 tonne/ha (0.45 ton/ac) in all seedings. Dormant seedings were higher yielding than spring seedings, with the highest yields for the water-insoluble seed coated treatment. These data support the majority of data from previous years, which indicate a significant yield advantage for dormant seedings of westerwolds ryegrass.

Seed yields of Italian ryegrass varieties were variable. All spring seedings, as expected, produced little or no seed. Bardelta was the only variety to produce moderate (227-401 kg/ha; 202-357 lb/ac) yields in the dormant seedings; however these were lower yields than in previous years. Bardelta is known to have a lower vernalization requirement than the other varieties, thus, it tends to head more in dormant seedings. Based on the 2001 results, Italian ryegrass seed production does not appear to be economic.

Production Package for Slender Creeping Fescue and Chewings Fescue

B. Coulman[1], S. Sommerfeld[2], T. Nelson[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

Residue managment/N fertility/insect control in chewings and slender creeping red fescue

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

***Objective:** To develop a cost effective method of establishing and managing slender creeping fescue and chewings fescue.*

A trial was set up in August of 1999 on 1997 established stands of chewings and slender creeping red fescue which had previously been used for herbicide trials. The chewings fescue stand was in good condition having yielded close to 400 kg/ha (356 lb/ac) in 1999.The slender creeping red fescue stand was not as thick, so no seed was harvested in 1999.

[1]*Agriculture & Agri-Food Canada Research Centre, Saskatoon*
[2]*CSIDC, Outlook*

Table 5. 2000 Ryegrass seed production dormant seeding trial - Growtec seeding coatings - 2001 data.							
Treatment	Ryegrass species	Impermeable seed coat	Date of seeding	Mean # heads/m²	Mean # of days to 50% heading from April	Seed yield	
						kg/ha	lb/ac
Yatsyn	Perennial	Yes	Fall 2000	104	100	105	94
Yatsyn	Perennial	No	Fall 2000	123	97	154	137
Yatsyn	Perennial	No	Spring 2001	16	127	24	21
Maris Ledger	Italian	Yes	Fall 2000	136	102	86	77
Maris Ledger	Italian	No	Fall 2000	24	104	70	62
Maris Ledger	Italian	No	Spring 2001	1	0	0	0
Bartali	Italian	Yes	Fall 2000	36	104	48	43
Bartali	Italian	No	Fall 2000	46	101	79	70
Bartali	Italian	No	Spring 2001	1	0	0	0
Bartissimo	Italian	Yes	Fall 2000	37	96	146	130
Bartissimo	Italian	No	Fall 2000	42	101	123	110
Bartissimo	Italian	No	Spring 2001	0	0	0	0
Bardelta	Italian	Yes	Fall 2000	139	93	401	357
Bardelta	Italian	No	Fall 2000	91	98	227	202
Bardelta	Italian	No	Spring 2001	75	125	48	43
Barspectra	Westerwolds	Yes	Fall 2000	277	78	1136	1012
Barspectra	Westerwolds	No	Fall 2000	372	89	911	812
Barspectra	Westerwolds	No	Spring 2001	205	78	811	723
Mean				96	83	243	217
CV (%)				79.7	5.7	23.3	
F value				6.1	244.5	126.4	
LSD (0.05)				108	7	80	71

Treatments were applied in a factorial randomized complete block design with four replications.

In 2001, the following data were collected: % spring vegetative cover, number of days to heading, mean number of heads/m², mean number of silver topped heads/m², disease incidence and seed yield.

Treatments:

- N fertility (mid-September, 2000) - 0, 75 and 150 kg/ha
- Residue management (late-August, 2000) - none; mow close and remove; burn
- Silvertop control (late May, 2001) - cygon; no cygon

<u>Chewings Fescue</u>

Yields of chewings fescue ranged from 0 to 638 kg/ha (0 to 568 lb/ac) depending on treatment (Table 6). There was little difference between no residue removal and mowing. Burning eliminated seed production because of very poor stands and virtually no head production.

Nitrogen fertilization, as in 2000, had no significant effect on seed yields; the highest application may have even slightly reduced yields, perhaps due to higher silvertop incidence. An application of cygon had a positive effect on seed yield, likely due to lower silvertop incidence.

Table 6. 1997 Chewings fescue residue management trial - 2001 data.										
Residue treatment	Nitrogen fertilizer treatment	Chemical treatment	% Vegetative cover 22-May-01	Mean # of days to 50% heading from April 1	Mean # heads/m²	Mean # Silvertop/m²	Disease rating 4-Jul-01	% Silvertop incidence	Seed yield	
									kg/ha	lb/ac
None	0N	None	92	65	426	75	1.25	17	432	385
None	0N	Cygon	91	65	390	45	2	13	561	500
None	75N	None	91	65	330	74	2.25	24	321	286
None	75N	Cygon	92	65	489	53	1.5	14	425	379
None	150N	None	79	66	210	58	1.5	29	256	228
None	150N	Cygon	82	65	357	83	1.5	23	364	324
Mow	0N	None	90	67	359	62	0.8	26	353	315
Mow	0N	Cygon	94	66	419	27	2.3	6	300	267
Mow	75N	None	89	65	315	99	0.5	36	196	175
Mow	75N	Cygon	91	65	507	70	2	17	638	568
Mow	150N	None	71	67	237	76	0.5	40	135	120
Mow	150N	Cygon	86	65	433	50	2	12	550	490
Burn	0N	None	14	0	0	0	0.0	0	0	0
Burn	0N	Cygon	16	0	22	4	0.3	4	0	0
Burn	75N	None	21	0	0	0	0.0	0	0	0
Burn	75N	Cygon	17	20	36	1	0.0	1	0	0
Burn	150N	None	8	0	0	0	0.0	0	0	0
Burn	150N	Cygon	7	0	0	0	0.0	0	0	0
Mean	---	---	63	45	351	43	1	14	252	225
CV (%)	---	---	13	21	45	67	77	65	66	
F value	---	---	67	36	11	5	5	7	6	
LSD (0.05)	---	---	12	13	161	41	1	13	235	209

Residue Treatment					Nitrogen Fertilizer				Chemical Treatment			
Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop		Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop	Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
None	393	350	20		0	274	244	11	No Cygon	188	168	19
Mow	362	323	23		75	263	234	15	Cygon	315	281	10
Burn	0	0	1		150	217	193	17				

Slender Creeping Fescue

Slender creeping fescue is a high quality turf species used in Europe. Attempts to produce seed in Canada have not been very successful. Yields in this trial ranged from 0-192 kg/ha (0-171 lb/ac), much lower than in 2000 (Table 7). Removing residue by mowing resulted in slightly higher yields, while burning resulted in no seed production as it almost completely eliminated the stands. Cygon application had no effect on seed yield, even though it substantially reduced silvertop incidence. Nitrogen fertilization had no consistent effect on seed yield.

Table 7. 1997 Slender creeping fescue residue management trial - 2001 data.

Residue treatment	Nitrogen fertilizer treatment	Chemical treatment	% Vegetative cover 22-May-01	Mean # of days to 50% heading from April 1	Mean # heads/m²	Mean # Silvertop/m²	Disease rating 4-Jul-01	% Silvertop incidence	Seed yield	
									kg/ha	lb/ac
None	0N	None	88	58	142	14	1.3	9	98	87
None	0N	Cygon	73	72	281	15	1.3	6	138	123
None	75N	None	79	85	150	60	0.8	44	98	87
None	75N	Cygon	35	83	148	8	0.5	5	75	67
None	150N	None	35	61	170	39	1..0	16	44	39
None	150N	Cygon	62	74	189	31	0.7	14	100	89
Mow	0N	None	88	80	238	55	1.0	21	98	87
Mow	0N	Cygon	65	78	198	5	1.2	3	107	95
Mow	75N	None	70	76	185	18	1.0	11	99	88
Mow	75N	Cygon	60	61	168	9	0.5	4	87	78
Mow	150N	None	74	75	229	41	0.8	25	192	171
Mow	150N	Cygon	39	55	129	15	0.3	7	135	120
Burn	0N	None	0	0	0	3	0.0	0	0	0
Burn	0N	Cygon	1	0	0	13	0.0	0	0	0
Burn	75N	None	1	0	0	5	0.0	0	0	0
Burn	75N	Cygon	0	0	0	0	0.0	0	0	0
Burn	150N	None	0	0	0	1	0.0	0	0	0
Burn	150N	Cygon	0	0	0	0	0.0	0	0	0
Mean	---	---	43	48	124	18	1	9	71	63
CV (%)	---	---	39	40	70	130	115	132	98	
F value	---	---	14	12	4	3	2	3	3	
LSD (0.05)	---	---	24	27	123	33	1	17	99	88

Residue Treatment					**Nitrogen Fertilizer**				**Chemical Treatment**			
Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop		Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop	Treatment	Seed yield kg/ha	Seed yield lb/ac	% Silvertop
None	92	82	16		0	74	66	7	No Cygon	70	62	14
Mow	120	107	12		75	60	53	11	Cygon	71	63	4
Burn	0	0	0		150	79	70	10				

Forage Crop Variety Testing at the CSIDC

B. Coulman[1]

The Western Forage Testing System (WFTest) is responsible for testing forage crops across Alberta, Saskatchewan and Manitoba. Private and public plant breeders submit their new varieties to the system and they are tested at a minimum of 16 sites over a period of three years. This provides enough data for consideration of the variety for registration and recommendation in all three provinces. CSIDC is one of the core testing sites of WFTest. Data collected on the tests includes: 1) spring stand to assess winter survival; and 2) dry matter yield (2 cuts). The following trials were evaluated at the CSIDC in 2001:

Table 8. Number of entries in the Western Forage Testing system.

Species	Year established	Number of varieties
Alfalfa	1998 1999 2000	14 24 17
Clovers (red)	1998	3
Clovers (red and alsike)	1999	5
Crested wheatgrass	1999	3
Orchardgrass	1998	5
Timothy	1998 1999 2000	4 3 6
Bromegrass	1999	6
Kentucky bluegrass	1999	2
Westerwolds ryegrass[1]	2001	2
Italian ryegrass[1]	2001	2
Ryegrasses, Festuloliums	2000	8 (dormant seeding)

[1]annual species

In addition, the following new trials of perennial species were seeded in 2001: Alfalfa (11), bromegrass (4), tall fescue (2) and timothy (8).

The numbers of varieties in the trials reflect the amount of breeding activity for the species. Many more new cultivars of alfalfa are being developed than any other forage crop.

[1]*Agriculture & Agri-Food Canada Research Centre, Saskatoon*

Specialty Crops Program

Pulse Crops

Agronomic Investigations

Varietal Investigations

Alternate Crops

Specialty Crops Program

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

Seeding Rate and Row Spacing Effects on Irrigated Dry Bean

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

Progress: *Year five of five*

Objective: *To demonstrate the effect of seeding rate and row spacing on the yield of different dry bean market classes under irrigated conditions.*

Seed yield of dry bean generally increases as plant density increases. High plant density often restricts air movement under the crop canopy that results in high humidity and prolonged periods of dampness which can result in the development of disease. These factors will be affected by both plant architecture, row spacing, and plant population. The currently recommended seeding rate for irrigated production of dry bean is in the range of 25-30 seeds/m² (2.7-3.2 seeds/ft^2) using a row spacing ranging from 60 - 80 cm (24 - 32 in). Lower seeding rates would reduce the seeding costs to producers.

A dry bean seeding rate x row spacing trial was established in the spring of 2001 at the CSIDC. Separate trials were established for each of the selected dry bean cultivars representing pinto, black and small red dry bean market classes. Dry bean market classes used in this study were Pinto: Othello - Type III indeterminate sprawling vine, CDC Camino - Type I upright determinate and CDC Pintium - Type I upright determinate; Black: CDC Expresso - Type I upright determinate; Small Red: NW63 - Type III indeterminate. Treatments consisted of five seeding rates (targeted plant populations of 20, 25,30, 35 and 40 seeds/m^2; 2.1, 2.7, 3.2, 3.8 and 4.3 seeds/ft^2) and three row spacings of 20, 40 and 60 cm (8, 16 and 24 in) for Pintium and 20, 60 and 80 cm (8, 24 and 32 in) for the other cultivars. Extra seeds were added to the various seeding rate treatments to compensate for germination losses. Normal fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. The treatments were arranged in a strip plot design. Seeding rate

[1]*CSIDC, Outlook*

treatments were randomized within row spacing strips. All treatments were replicated four times. Each treatment consisted of two passes with the drill and measured 2.4 m x 8 m (8 ft x 24 ft).

Plant stand increased with increasing seeding rate (Figure 1), and decreased as the row spacing increased from 20 cm (8 in) to 60 and 80 cm (24 and 32 in) (Figure 2) for all market classes of dry bean. This probably occurred due to closer spacing between plants within a row causing increased plant competition.

Dry bean yield was affected by both seeding rate and row spacing for all market classes. There were no seeding rate trends associated with plant growth habit. Highest yield was obtained at a seeding rate of 30-35 seeds/m² (3.2-3.8 seeds ft^2) for Othello, CDC Camino, CDC Pintium and CDC Expresso and 25-30 seeds/m^2 (2.7-3.2 seeds ft^2) for NW63 (Figure 3). This would indicate that the currently recommended seeding rate of 25-30 seeds/m^2 (2.7-3.2 seeds ft^2) may be low for some dry bean cultivars. Yield generally decreased as row spacing increased for all dry bean market classes tested (Figure 4). This can be attributed to inter-row plant competition resulting in reduced plant stands and inefficient utilization of the growing area at the higher row spacings. Leaf Area Index measurements also indicated inefficient utilization of the growing area at the wider row spacings (data not shown).

Seed weight showed a general trend of increasing as the row spacing increased (Figure 5). The reason for this was not obvious but could possibly be attributed to the production of fewer pods with larger seeds at the wide row spacings for some dry bean cultivars. There was no significant effect of seeding rate on dry bean seed weight.

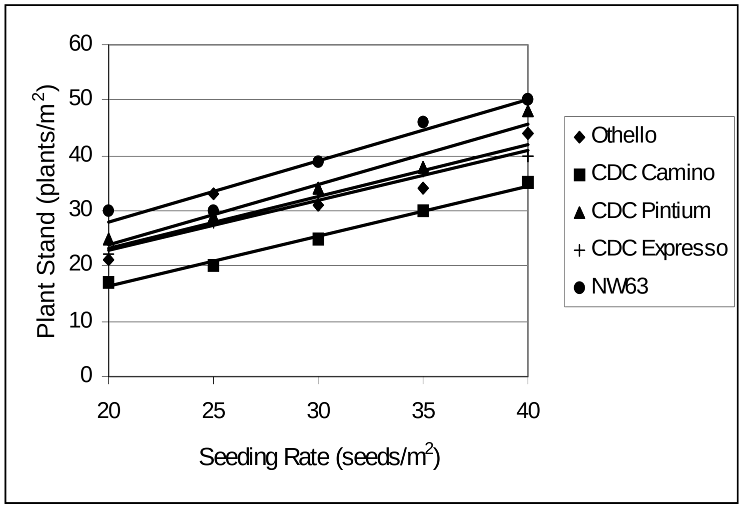

Figure 1. Effect of seeding rate on the plant stand of selected dry bean cultivars.

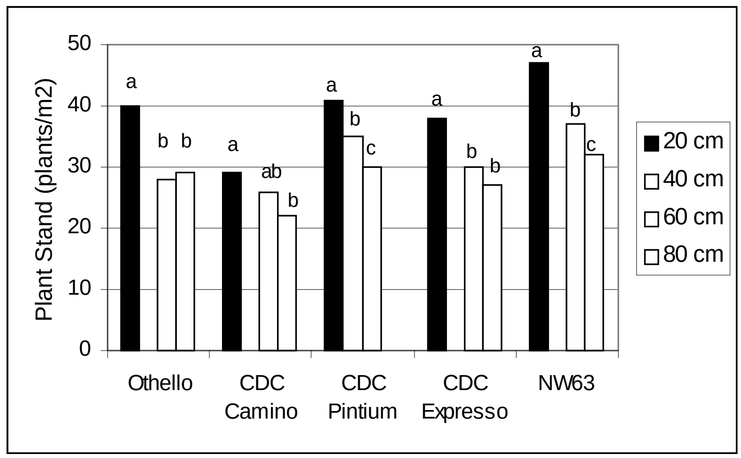

Figure 2. Effect of row spacing on the plant stand of selected dry bean cultivars (Row spacings within a cultivar with the same letter are not significantly different at P=0.05).

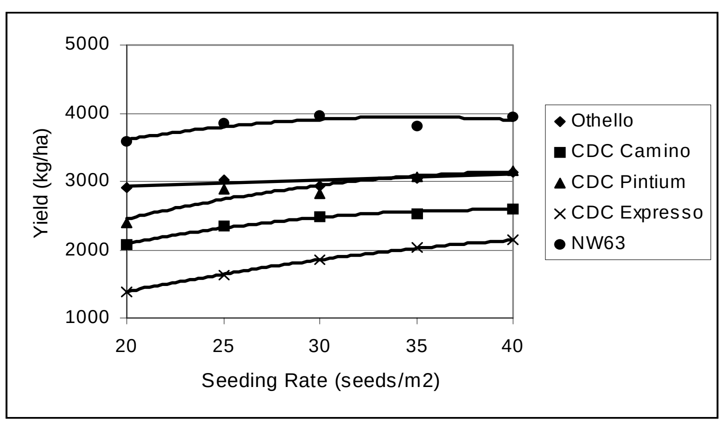

Figure 3. Effect of seeding rate on the yield of selected dry bean cultivars.

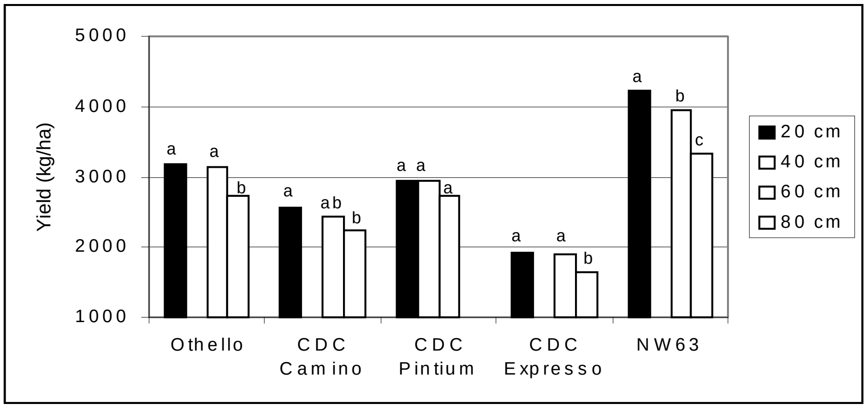

Figure 4. Effect of row spacing on the yield of selected dry bean cultivars (Row spacings within a cultivar with the same letter are not significantly different at P=0.05).

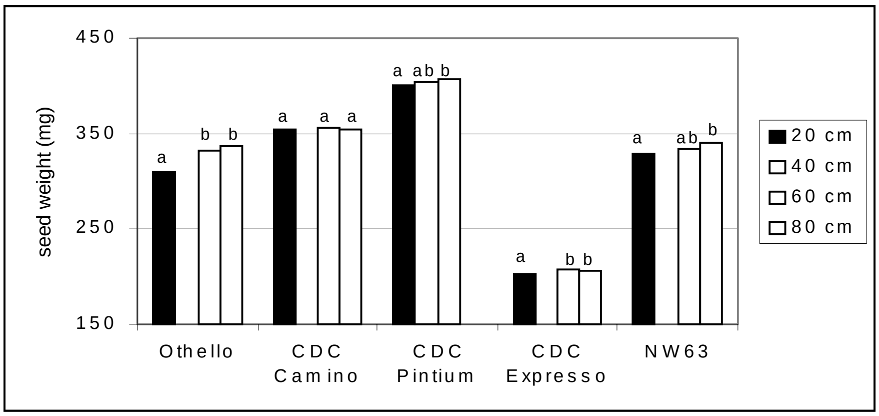

Figure 5. Effect of row spacing on the seed weight of selected dry bean cultivars (Row spacings within a cultivar followed by the same letter are not significanlty different at P=0.05).

Direct Cut Dry Bean Harvest Demonstration

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

***Objective:** To demonstrate the Keho Bean Sweep direct cut harvest system for dry bean.*

Direct cutting of solid seeded dry bean using conventional harvest equipment can result in high harvest losses for some dry bean varieties. These high losses are due to low pod set on the bean plant. The development of direct cut combine headers specifically designed for dry bean harvest conditions should help reduce harvest losses. The Keho Bean Sweep system is one such commercial direct cut harvest system that is under development that offers potential to lower harvest losses with solid seeded dry bean.

[1]*CSIDC, Outlook*

A dry bean direct cut demonstration was established in the spring of 2001 at the CSIDC. Treatments included two pinto bean cultivars with differing growth habit (Othello - Type III indeterminate sprawling vine growth habit; CDC Camino - Type I determinate upright tall growth habit) grown under narrow row (20 cm/8 in) and wide row (60 cm/24 in) conditions. Each treatment was block seeded in an area that measured 8.5 m x 38 m (30 ft x 125 ft). Normal fertilizer, weed control and irrigation practices for irrigated dry bean production were followed.

At harvest one half of each treatment block was direct cut using a small plot combine modified by the addition of Keho Bean Sweep brushes on the cutter bar while the other half of each treatment block was direct cut without the brushes. The seed from each treatment was weighed to determine yield.

Harvest losses were measured by weighing the amount of bean seed left on the ground and the amount left in pods in an area 1.2 m x 1.2 m (4 ft x 4 ft) at five locations for each treatment. A width of 1.2 m (4 ft) was chosen for harvesting since this represents the width of the cutter bar on the small plot combine.

Results indicated that there was no general trend to indicate yield differences between the two cutting treatments. Comparison of harvest losses indicated that highest losses were observed for Othello. Within each cultivar harvest loss was greater for the 20 cm (8 in) row spacing compared to the 60 cm (24 in) row spacing (Figures 6 and 7). As well, shattering losses during the harvest operation were greater than losses due to unharvested pods. Losses due to unharvested pods was generally greater where no brushes were used compared to where brushes were used. Unharvested pod loss was also greater for Othello than for CDC Camino pinto bean. This is probably due to the difference in growth habit for the two cultivars tested. Othello has a sprawling vine indeterminate growth habit that results in a large portion of the pods growing low on the plant while CDC Camino has an upright determinate growth habit with the pods higher up on the plant. As a result more pods are subject to loss during the direct cut harvest operation when Othello is grown.

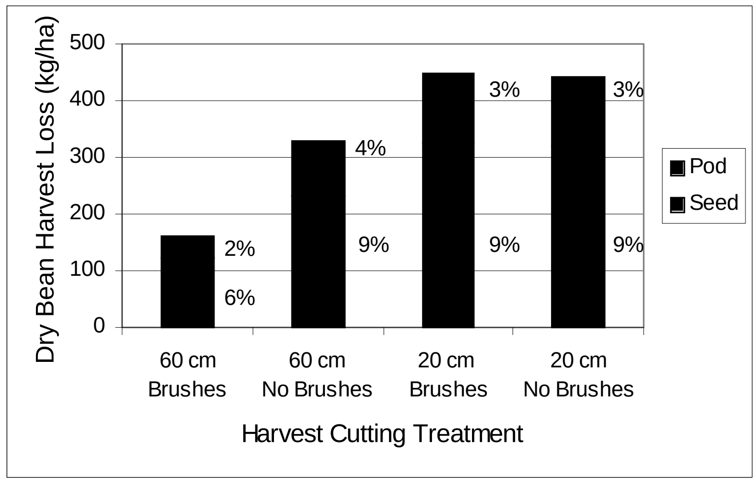

Figure 6. Effect of cutting treatment on irrigated CDC Camino pinto bean harvest losses (Numbers represent % loss).

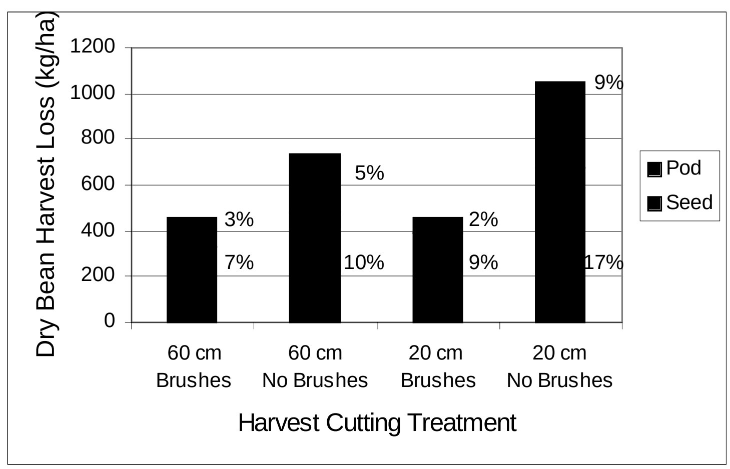

Figure 7. Effect of cutting treatment on irrigated Othello pinto bean harvest losses (Numbers represent % loss).

The results from this work would suggest that the Keho Bean Sweep system does improve direct cut harvest ability of dry bean. However, further testing needs to be done on field scale equipment.

Dry Bean Nitrogen Management

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

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

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

A dry bean nitrogen and granular inoculant trial was established in the spring of 2001 at the CSIDC. Treatments included three dry bean cultivars (CDC Expresso black bean and CDC Camino 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 in 40 cm (16 in) rows at a target plant population of 30 plants/m^2. A factorial arrangement of the dry 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).

There was no effect of the starter nitrogen or inoculant treatments on days to 10% flowering, however, maturity was delayed one to two days by the nitrogen applications (data not presented).

There was a significant seed yield response to the applied starter nitrogen (Table 1 and 2). Seed yield increased with each 25 kg N/ha (22 lb N/ac) increment up to 50 kg N/ha (44 lb N/ac). There was a significant response to inoculant application. When no fertilizer nitrogen was applied, innoculaton produced 20% higher seed yield compared to no inoculation. However, with nitrogen fertilzation, the yield improvement to inoculation was about 1% compared to no inoculation. The addition of nitrogen and inoculant produced healthier and greener plant growth. Results from this trial would indicate that newer dry bean cultivars, such as CDC Expresso, CDC Camino and CDC Pintium, may require the addition of higher quantities of nitrogen fertilizer to produce maximum seed yield than currently recommended by soil test guidelines.

The application of inoculant produced a higher seed weight compared to the control treatment (Table 3). There was no significant effect of the starter nitrogen treatments on seed weight even though seed weight showed a trend of increasing with an increase in applied nitrogen.

[1]*CSIDC, Outlook*

Table 1. Effect of starter nitrogen rate and inoculant treatment on the yield (kg/ha) of irrigated CDC Expresso black bean and CDC Camino and CDC Pintium pinto bean.

N rate		CDC Expresso			CDC Camino			CDC Pintium			Overall mean
(kg/ha)	(lb/ac)	Control	Inoculant	Mean	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	1987	2482	2235	2626	2934	2780	2481	3124	2802	2606
25	22	2775	2468	2621	2866	2902	2884	2978	3302	3140	2882
50	45	2828	2875	2852	3135	2993	3064	3395	3547	3471	3129
75	67	2650	2718	2684	2942	3117	3030	3534	3418	3476	3063
Mean		2560	2636		2892	2987		3097	3348		
Overall mean		2598			2939			3222			
CV (%)		12.6									

ANOVA	LSD (0.05)
Cultivar (C)	183
N Rate (N)	211
Inoculant (I)	125
C x N	NS[1]
C x I	NS
N x I	249
C x N x I	NS

[1]not significant

Table 2. Effect of starter nitrogen rate and inoculant treatment on the yield (lb/ac) of irrigated CDC Expresso black bean and CDC Camino and CDC Pintium pinto bean.

N rate		CDC Expresso			CDC Camino			CDC Pintium			Overall mean
(kg/ha)	lb/ac	Control	Inoculant	Mean	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	1770	2211	1991	2340	2614	2477	2211	2783	2497	2322
25	22	2473	2199	2335	2554	2586	2570	2653	2942	2798	2568
50	45	2520	2562	2541	2793	2667	2730	3025	3160	3093	2788
75	67	2361	2422	2391	2621	2777	2700	3149	3045	3097	2729
Mean		2281	2349		2577	2661		2759	2983		
Overall mean		2315			2619			2871			
CV (%)		12.6									

ANOVA	LSD (0.05)
Cultivar (C)	163
N Rate (N)	188
Inoculant (I)	111
C x N	NS[1]
C x I	NS
N x I	222
C x N x I	NS

[1]not significant

Table 3. Effect of starter nitrogen rate and inoculant treatment on the seed weight (mg) of irrigated CDC Expresso black bean and CDC Camino and CDC Pintium pinto bean.

N rate		CDC Expresso			CDC Camino			CDC Pintium			Overall mean
(kg/ha)	(lb/ac)	Control	Inoculant	Mean	Control	Inoculant	Mean	Control	Inoculant	Mean	
0	0	195	202	198	349	365	357	382	397	389	315
25	22	198	199	199	346	354	350	384	395	389	313
50	45	200	206	203	355	360	357	393	401	397	319
75	67	199	205	202	355	365	360	396	394	395	319
Mean		198	203		351	361		389	397		
Overall mean		200			356			393			
CV (%)		3.0									

ANOVA	LSD (0.05)
Cultivar (C)	5
N Rate (N)	NS[1]
Inoculant (I)	4
C x N	NS
C x I	NS
N x I	NS
C x N x I	NS

[1]not significant

Response of Irrigated Dry Bean to Late Nitrogen Application

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

***Objective:** To determine the effect of late nitrogen application on the yield and seed quality of irrigated dry bean.*

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

A dry bean late nitrogen fertilizer response trial was established in the spring of 2001 at the CSIDC. Treatments included three late nitrogen application times (early flower, mid-late flower and early pod fill) of 50 kg N/ha (45 lb N/ac) applied as granular ammonium nitrate (34-0-0) plus a control. The granular ammonium nitrate was applied just prior to an irrigation to facilitate the movement of the nitrogen into the soil. Four dry bean cultivars representing four market classes (Othello pinto bean, Expresso black bean, NW63 small red bean and AC Alberta Pink pink bean) were row crop seeded at a target plant population of 30 seeds/m^2 (3.2 seed/ft^2) using a 60 cm (24 in) row spacing. Field plots were laid out as a cultivar x nitrogen factorial in a RCBD with four replications. 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).

Late nitrogen application increased yield above that of the control treatment (Table 4). Highest seed yield was obtained for the late nitrogen applied at early flower. Yield decreased as the nitrogen application was delayed beyond the early flower stage. The late nitrogen application at the mid to late flower growth stage produced a significantly lower yield than that applied at the early flower growth stage but still significantly greater than the control treatment. Late nitrogen applied at the early pod fill growth stage was not significantly higher than the control treatment. These results would indicate that late nitrogen application will benefit dry bean seed yield provided it is applied no later than the flowering growth stage and conditions are conducive to response to applied nitrogen. As well, these results indicate that the current soil test guide lines for nitrogen application for irrigated dry bean may need to be increased to obtain maximum yield. There was no significant effect of late nitrogen application on seed weight (Figure 8) indicating that the increase in yield due to the late nitrogen applications was probably due to an increase in the number of seeds produced rather than an increase in seed size.

[1]*CSIDC, Outlook*

Table 4. Effect of late nitrogen application time on the yield of selected dry bean cultivars.

Dry bean cultivar	Yield (kg/ha)					Yield (lb/ac)				
	Control	Early flower	Mid-late flower	Early pod fill	Mean	Control	Early flower	Mid-late flower	Early pod fill	Mean
Othello	3014	3365	3362	3364	3276	2685	2998	2996	2997	2919
Expresso	1917	2220	2040	2106	2071	2534	1978	1818	1876	1845
NW 63	2844	3292	3254	2868	3064	2534	2933	2899	2555	2730
AC Alberta Pink	2906	3435	2961	2937	3059	2589	3061	2638	2617	2726
Mean	2670	3078	2904	2819		2379	2742	2587	2512	
CV (%)	8.5					4.7				
ANOVA	LSD (0.05)					LSD (0.05)				
Cultivar (C)	173					154				
Time (T)	173					154				
C x T	NS[1]					NS				

[1]not significant

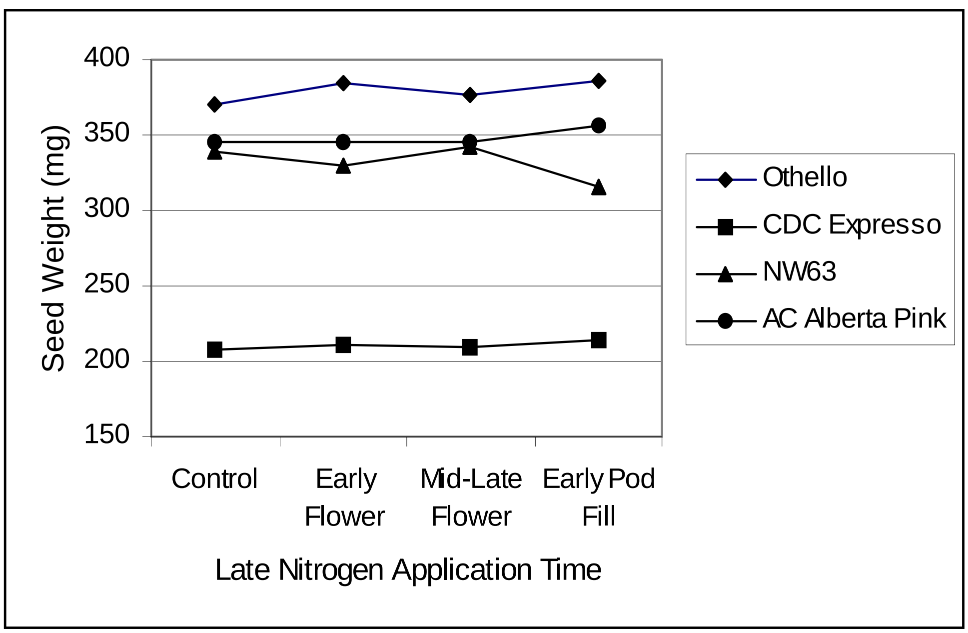

Figure 8. Effect of late nitrogen on the seed weight of irrigated dry bean cultivars.

The Interaction of Seeding Rate and Nitrogen Fertilizer during Seed Production of CDC Pintium Pinto Bean Under Irrigated Conditions

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

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

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

A dry bean seeding rate and nitrogen fertilizer response trial was established in the spring of 2001 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, 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).

Plant stand increased as the seeding rate increased. Plant stand decreased as the nitrogen rate increased (Table 5). The targeted plant population was not achieved at the higher seeding rates possibly due to increased plant competition as seeding rate increased. Higher seeding rates and higher rates of nitrogen application produced greater vegetative growth (data not shown). There

Table 5. Effect of seeding rate and nitrogen application rate on the plant stand and maturity of CDC Pintium pinto bean.

Seeding rate (seeds/m^2)	Plant stand (plants/m^2)				Maturity (days)			
	Nitrogen rate (kg N/ha)				Nitrogen rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	24	24	22	23	93	95	95	94
40	50	36	36	40	92	94	94	93
60	54	48	50	50	91	93	94	93
80	61	51	72	61	90	92	93	92
Mean	48	45	40		92	93	94	
CV (%)	4				0.9			
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	1				1			
Nitrogen rate (N)	1				1			
SR x N	3				NS[1]			

[1]not significant

[1]*CSIDC, Outlook*

were no observed effects of seeding rate or nitrogen rate on days to 10% flower. Higher seeding rates hastened maturity while higher nitrogen rates delayed maturity (Table 5).

Table 6. Effect of seeding rate and nitrogen application rate on the yield of CDC Pintium pinto bean.

Seeding rate (seeds/m²)	Yield (kg/ha)				Yield (lb/ac)			
	Nitrogen rate (kg N/ha)				Nitrogen rate (kg N/ha)			
	0	50	100	Mean	0	50	100	Mean
20	2308	2917	2969	2770	2056	2599	2645	2468
40	2441	3110	3552	3088	2175	2771	3165	2751
60	2745	3390	3731	3338	2446	3391	3324	2974
80	2855	3462	4037	3451	2544	3085	3597	3075
Mean	2608	3220	3572		2324	2869	3183	
CV (%)	8.7							
ANOVA	LSD (0.05)				LSD (0.05)			
Seeding rate (SR)	230				205			
Nitrogen rate (N)	199				177			
SR x N	NS[1]				NS			

[1]not significant

Seed yield increased up to a targeted plant population of 60 seeds/m² (actual plant population of 50 seeds/m²) (Table 6). This plant population is higher than that recommended for Type III growth habit dry bean varieties that are currently grown for commercial production under irrigated conditions. This indicates that dry bean varieties with Type I growth habit, such as CDC Pintium pinto bean, may require a higher seeding rate to achieve maximum yield. Further, seed yield increased with each 50 kg N/ha (45 lb 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 N/ac), produced a 23% higher seed yield 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 10% higher seed yield. 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 dry bean varieties.

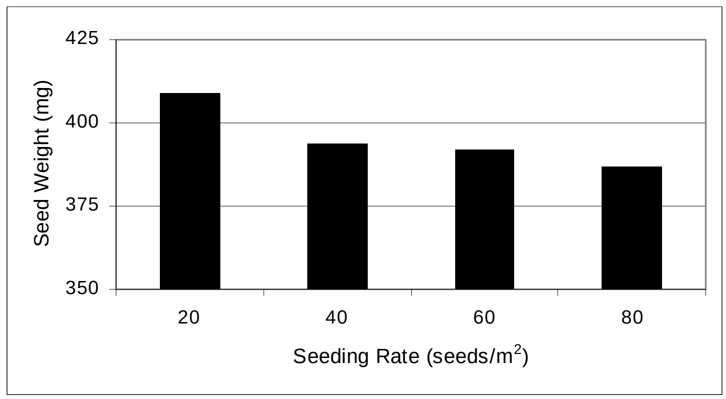

Figure 9. Effect of seeding rate on the seed weight of irrigated CDC Pintium pinto bean.

The size of the CDC Pintium pinto bean seed was affected by both seeding rate and nitrogen application. Higher seeding rates produced smaller seeds (Figure 9) whereas increased nitrogen application produced larger seeds (Figure 10). It is likely that under higher nitrogen levels, higher yields could be due to larger seeds. The smaller seed size with increasing seeding rates coupled with the fact that seed yield increased with increasing seeding rates would indicate there were more smaller seeds at higher seeding rates compared to lower seeding rates. 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.

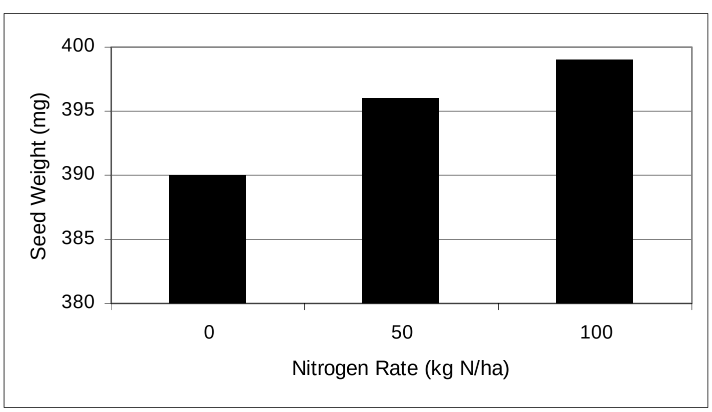

Figure 10. Effect of nitrogen rate on the seed weight of irrigated CDC Pintium pinto bean.

Timing of Fungicide Application for the Control of White Mold during Seed Multiplication of CDC Pintium Pinto Bean Under Irrigated Conditions

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

***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 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 with 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 2001 at the CSIDC. Treatments included four fungicide application times (control, 10% flower, 50% flower and 10% + 100% flower). The fungicide used was Benlate (benomyl), 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 (3.2 seeds/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. Normal 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).

There was little white mold detected in the dry bean trial; probably a result of the hot, dry growing conditions experienced during the later part of the 2001 growing season. Results indicated that there was no effect of the fungicide treatments on seed yield or seed weight (Table 7).

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

Table 7. 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		Yield (kg/ha)	Yield (lb/ac)	Seed weight (mg)
	Incidence (0-5)[1]	Severity (0-5)			
Control	1	1	3377	3009	392
10% flower	1	1	3250	2896	381
50% flower	1	1	3049	2717	380
10%+100% flower	1	1	3285	2927	395
LSD (0.05)	---	---	NS[2]		NS
CV%	---	---	10.2		4.3

[1]0 = no disease; 5 = total infection
[2]not significant

[1]*CSIDC, Outlook*

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

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

***Objective:** To evaluate the effect of chemical control on common 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 high quality pedigreed, disease free seed is the best means of controlling these seed-borne diseases. 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, under furrow irrigation. With sprinkler irrigation conditions, the use of foliar copper bactericide applications in conjunction with seed treatment may help prevent the development and spread of bacterial blight.

A dry bean blight control trial was established in the spring of 2001 at the CSIDC. Treatments included two seed treatments Vitaflo 280 (carbathiin + thiram) and Vitaflo 280 + Bluestone (Copper Sulfate) and eight Kocide treatments (50% metallic copper equivalent) as post-emerge foliar applications (control, pre-flower (PF), early flower (EF), late flower (LF), PF + EF, PF + LF, PF + EF + LF and EF + LF) at a rate of 1.3 kg/ha (1.2 lb/ac) in 90 L/ac (20 gal/ac) water using a small plot push type CO_2 propellant sprayer. CDC Camino pinto bean was row crop seeded at a target plant population of 30 plants/m^2 (3.2 plants/ft^2) using a 60 cm (24 in) row spacing. A factorial arrangement of the seed and Kocide foliar application 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).

A visual rating of bacterial blight during the growing season indicated the presence of blight on the leaves and pods of the irrigated CDC Camino pinto bean. There was no significant effect of the seed treatments or foliar Kocide applications on bacterial blight incidence at the pod fill stage (Table 8). The incidence of bacterial blight as indicated by the leaf area infected at maturity showed a significant effect of both seed treatment and foliar Kocide application. It is not clear why the Vitaflo seed treatment had a lower leaf area infected than the Vitaflo + Bluestone treatment. All Kocide applications had lower leaf area infected compared to the control treatment indicating that the application of Kocide reduced the incidence of bacterial blight on the dry bean. The incidence of bacterial blight as indicated by the pod area infected at maturity showed no significant effect of either seed treatment or foliar Kocide application. However, there was no significant effect of seed treatment and/or Kocide foliar application on the yield or seed weight of the CDC Camino pinto bean (Table 9). The halo blight pathogen, *Pseudomonas syringae* pv. *phaseolicola*, was detected in only one treatment, the Vitaflo 280 plus Kocide at preflower +late flower (1% incidence). There was no incidence of the common blight pathogen, *Xanthomonas campestris* pv. *phaseoli*, observed in any of the treatments**.**

Even though bacterial blight was present on the foliage and pods of the CDC Camino pinto bean, the bacteria did not appear to be transferred 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.

[1]*CSIDC, Outlook*

Table 8. Effect of seed treatment and Kocide foliar application on the bacterial blight incidence of irrigated CDC Camino pinto bean.

Kocide application time[1]	Leaf bacterial blight incidence (pod fill)			Bacterial blight incidence % leaf area (maturity)			Bacterial blight incidence % pod area (maturity)		
	Vitaflo 280	Vitaflo 280 + Bluestone	Mean	Vitaflo 280	Vitaflo 280 + Bluestone	Mean	Vitaflo 280	Vitaflo 280 + Bluestone	Mean
Control	92.5	87.5	90.0	18.8	28.6	23.7	3.1	2.3	2.7
PF	82.5	92.5	87.5	11.6	21.6	16.6	1.3	2.7	2.0
EF	80.	80.0	80.0	13.9	20.0	17.0	2.1	0.8	1.4
LF	90.0	87.5	88.8	14.3	14.3	14.3	1.1	1.4	1.2
PF + EF	92.5	75.0	83.8	10.4	8.5	9.4	1.2	0.6	0.9
PF + LF	82.5	92.5	87.5	11.8	14.8	13.3	2.6	1.9	2.2
PF + EF + LF	82.5	85.0	83.8	10.6	11.8	11.2	1.1	1.5	1.3
EF + LF	80.0	77.5	78.8	8.7	13.5	11.1	0.6	1.7	1.1
Mean	85.3	84.7		12.5	16.6		1.6	1.6	
CV (%)	13.6			51.0			86.0		
ANOVA	LSD (0.05)			LSD (0.05)			LSD (0.05)		
Kocide (K)	NS[2]			3.7			NS		
Treatment (T)	NS			7.5			NS		
K x T	NS			NS			NS		

[1]PF - pre-flower; EF - early flower; LF - late flower
[2]not significant

Table 9. Effect of seed treatment and Kocide foliar application on the yield and seed weight of irrigated CDC Camino pinto bean.

Kocide application time[1]	Yield						Seed weight (mg)		
	Vitaflo 280		Vitaflo 280 + Bluestone		Mean		Vitaflo 280	Vitaflo 280 + Bluestone	Mean
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac			
Control	2988	2662	2722	2425	2855	2544	366	362	364
PF	3270	2914	2868	2555	3069	2734	370	364	367
EF	3101	2763	3129	2788	3115	2775	360	360	360
LF	2960	2637	3058	2725	3009	2681	364	369	366
PF + EF	2956	2634	3009	2681	2983	2658	363	365	364
PF + LF	3156	2812	2962	2639	3059	2726	363	359	361
PF + EF + LF	3720	3315	2944	2623	3332	2969	358	367	363
EF + LF	3106	2767	3132	2783	3119	2779	375	366	370
Mean	3157	2813	2978	2653			365	364	
CV (%)	12.0						3.6		
ANOVA	LSD (0.05)						LSD (0.05)		
Kocide (K)	NS[2]						NS		
Treatment (T)	NS						NS		
K x T	NS						NS		

[1]PF - pre-flower; EF - early flower; LF - late flower
[2]not significant

Field Pea Seeding Rate

T. Hogg[1], A. MacDonald[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

***Objective:** To determine the optimum seeding rate for field pea.*

Field pea plays an important role in crop rotations on the Canadian prairies. Current and future popularity of pea has resulted in heightened interest to determine management practices that ensure maximum yield. Pea is a plastic crop, able to compensate for low plant density with increased branching and pod set. Manipulation of plant populations, through varied seeding rates, is a critical management input that can be used to modify crop productivity.

A trial was established in the spring of 2001 at the CSIDC. Treatments included ten seeding rates (20, 30, 40, 50, 60, 70, 80, 90, 100 and 120 seeds/m^2; 2.1, 3.2, 4.2, 5.3, 6.4, 7.5, 8.5, 9.6, 10.6 seeds/ft^2). The pea cultivar used was Swing yellow pea. The treatments were arranged in a randomized complete block design with four replicates. Normal fertilizer, weed control and irrigation practices for irrigated field pea production were followed. Each treatment measured 1.5 m x 7.3 m (5 ft x 24 ft). Additional seeds were included to compensate for germination losses.

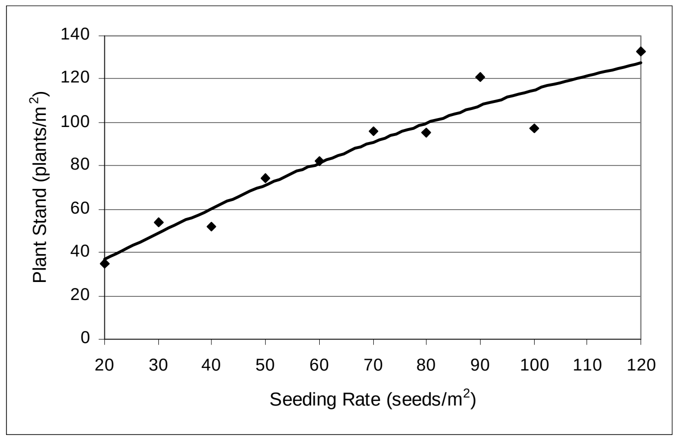

Figure 11. Effect of seeding rate on the plant stand of irrigated Swing pea.

Plant stand increased significantly as the seeding rate was increased and was generally higher than the targeted plant population (Figure 11). The proportion of seedlings emerged relative to the corresponding target seeding rate generally decreased as the target seeding rate was increased. Greater inter-plant competition, as plant density increased, would explain the corresponding increase in seedling mortality and associated stand loss at higher seeding rates.

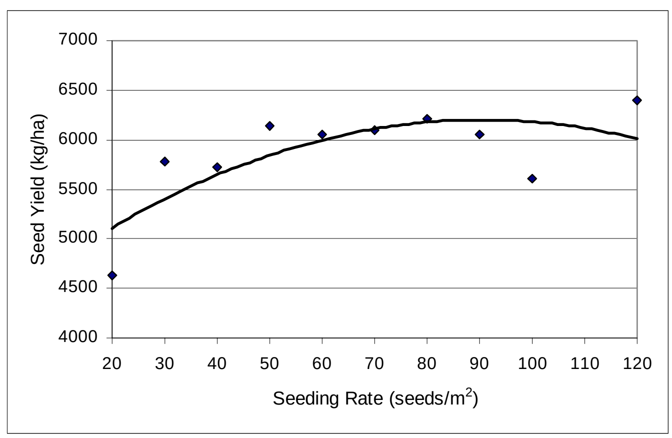

Figure 12. Effect of seeding rate on the yield of irrigated Swing pea.

Yield also increased significantly as seeding rate was increased (Figure 12). Maximum yield was obtained at a target plant population of 80-90 seeds/m^2 and at an actual plant stand of 90-100 seeds/m^2. Seeding rates greater than 60 seeds/m^2 must be maintained where water availability is not limited under irrigated conditions.

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[1]*CSIDC, Outlook*

Seed weight increased slightly with seeding rate (Figure 13). This would indicate that the yield increases observed with an increase in seeding rate were probably due to an increase in the number of seeds produced rather than due to an increase in seed size.

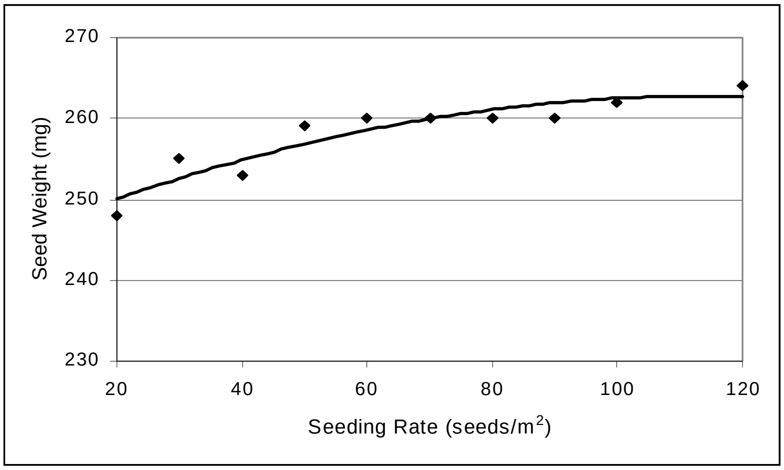

Figure 13. Effect of seeding rate on the seed weight of irrigated Swing pea.

Foliar Disease Management in Chickpea

G. Chongo[1], T. Wolfe[2], T. Hogg[3], A. MacDonald[3]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

Objective:
- To determine the effect of fungicide spray application delivery method on chickpea disease control.
- To determine the effect of fungicide application carrier water volume on chickpea disease control.

One of the major production problems with chickpea is the management of foliar diseases, especially ascochyta blight. 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 2001 at the CSIDC.

<u>Effect of Spray Application Delivery Method</u>

Treatments included four foliar fungicides (Bravo 500 - chlorothalonil, Quadris - azoxystrobin, Headline - pyraclostrobin, Folicur - tebuconazole) and four spray application delivery methods (Control, Standard, Twin, Venturi). The fungicides were applied using a carrier water volume of 200 l/ha (20 gal/ac). The treatments were arranged in a split-plot design with spray application delivery method as subplots within the fungicide main plots. Each treatment was replicated four times. Separate trials were conducted for kabuli and desi type chickpea. Sanford kabuli chickpea and Myles desi chickpea were seeded at a target plant population of 45 plants/m^2. Each treatment measured 2.4 m x 8 m (8 ft x 24 ft).

[1]*CDC, U of S, Saskatoon, Saskatchewan*
[2]*AAFC, Saskatoon*
[3]*CSIDC, Outlook*

Sanford Kabuli Chickpea

Fungicide sprays reduced the incidence of foliar disease compared to the no-fungicide control. There was no significant difference in the disease level for the three different nozzle types tested (Table 10). Disease levels, as described during July 31 ratings, differed significantly among the four fungicides with Headline < Quadris <Bravo 500 < Folicur. Fungicide applied with all three nozzle types had significantly lower disease level than the control treatment that received no fungicide application.

Table 10. Effect of fungicide and spray nozzle type on disease development in Sanford kabuli chickpea.

	Disease rating - Horsfall-Barratt Scale (Grade Formula %)														
	June 20					July 3					July 31				
Nozzle type	Bravo 500	Quadris	Headline	Folicur	Mean	Bravo 500	Quadris	Headline	Folicur	Mean	Bravo 500	Quadris	Headline	Folicur	Mean
Control	2.26	2.34	2.34	2.65	2.40	9.06	6.09	6.87	9.84	7.96	72.19	81.77	81.77	84.12	79.96
Standard	2.42	2.42	2.26	2.50	2.40	6.09	3.43	3.12	4.53	4.29	53.13	34.79	21.98	79.33	47.30
Venturi	2.18	2.65	2.26	2.57	2.42	3.43	3.90	3.59	6.24	4.29	50.2	55.21	22.60	79.18	51.80
Twin	2.65	2.50	2.42	2.54	2.53	7.03	3.43	3.59	5.77	4.96	54.17	57.92	22.71	79.82	53.65
Mean	2.38	2.48	2.32	2.57		6.40	4.21	4.29	6.60		57.42	57.42	37.26	80.61	
CV (%)	12.5					39.0					26.8				
ANOVA	LSD (0.05)					LSD (0.05)					LSD (0.05)				
Fungicide (F)	NS[1]					1.44					16.69				
Nozzle (N)	NS					1.76					13.15				
F x N	NS					NS					NS				

[1]not significant

Sanford chickpea seed yield (Table 11) and seed weight (Table 12) were significantly affected by fungicide application and nozzle type used to apply the fungicide. Headline had the lowest disease level (July 31) and the highest seed yield and seed weight while Folicur and Bravo 500 had the highest disease level and lowest seed yield and seed weight. The Standard flat fan nozzle type produced higher yield and larger seeds than either the Venturi air bubble nozzle or the Twin nozzle. Seed yield and seed weight were significantly higher where fungicide was applied than for the control treatment that received no fungicide application.

Table 11. Effect of fungicide and spray nozzle type on the yield of Sanford kabuli chickpea.

	Yield (kg/ha)					Yield (lb/ac)				
Nozzle type	Bravo 500	Quadris	Headline	Folicur	Mean	Bravo 500	Quadris	Headline	Folicur	Mean
Control	521	900	923	735	770	464	802	822	655	686
Standard	941	1524	2107	1111	1421	838	1358	1877	990	1266
Venturi	856	1194	1947	862	1215	763	1064	1735	768	1083
Twin	587	1270	1608	761	1057	523	1132	1433	678	942
Mean	726	1222	1646	867		647	1089	1467	772	
CV (%)	28.3									
ANOVA	LSD (0.05)					LSD (0.05)				
Fungicide (F)	232					207				
Nozzle (N)	266					237				
F x N	NS[1]					NS				

[1]not significant

Table 12. Effect of fungicide and spray nozzle type on the seed weight of Sanford kabuli chickpea.					
	Seed weight (mg)				
Nozzle type	Bravo 500	Quadris	Headline	Folicur	Mean
Control	245	268	286	254	264
Standard	268	345	375	252	310
Venturi	278	326	350	253	302
Twin	226	291	360	249	282
Mean	254	308	343	252	
CV (%)	7.4				
ANOVA	LSD (0.05)				
Fungicide (F)	29				
Nozzle (N)	18				
F x N	36				

[1]not significant

Myles Desi Chickpea

Disease tended to develop at a slower rate for the Myles desi chickpea than for the Sanford kabuli chickpea. There was no significant difference in the disease level for the three different nozzle types that were used to apply the fungicide (Table 13). Fungicide applied with the Standard and Venturi nozzle types had significantly lower disease level than the control treatment that received no fungicide application.

Table 13. Effect of fungicide and spray nozzle type on disease development in Myles desi chickpea.

	Disease rating - Horsfall-Barratt Scale (Grade Formula %)														
	June 20					July 31					August 16				
Nozzle type	Bravo 500	Quadris	Headline	Folicur	Mean	Bravo 500	Quadris	Headline	Folicur	Mean	Bravo 500	Quadris	Headline	Folicur	Mean
Control	2.11	2.22	1.87	2.34	2.14	12.30	22.98	12.42	18.79	16.62	29.92	34.61	23.67	42.03	32.56
Standard	2.28	2.16	1.99	2.16	2.15	16.13	8.90	5.03	11.83	10.47	33.12	15.54	10.07	27.50	21.56
Venturi	2.22	2.05	1.99	2.22	2.12	15.54	12.30	6.91	22.30	14.26	35.70	14.76	11.95	33.12	23.88
Twin	2.11	2.28	2.16	2.22	2.19	14.14	20.97	10.89	16.56	15.64	30.55	21.40	12.89	39.37	26.05
Mean	2.18	2.18	2.00	2.24		14.53	16.29	8.81	17.37		32.32	21.58	14.64	35.51	
CV (%)	10.5					53.7					43.3				
ANOVA	LSD (0.05)					LSD (0.05)					LSD (0.05)				
Fungicide (F)	NS[1]					4.95					14.09				
Nozzle (N)	NS					NS					8.07				
F x N	NS					NS					NS				

[1]not significant

There was no effect of fungicide application or nozzle type on Myles chickpea seed yield (Table 14) or seed weight (Table 15). Disease levels were lower than observed for the Sanford chickpea and as a result no effects were observed. Myles desi chickpea is less affected by ascochyta blight than Sanford kabuli chickpea.

Table 14. Effect of fungicide and spray nozzle type on the yield of Myles desi chickpea.

Nozzle type	Yield (kg/ha)					Yield (lb/ac)				
	Bravo 500	Quadris	Headline	Folicur	Mean	Bravo 500	Quadris	Headline	Folicur	Mean
Control	3440	3583	4612	4229	3966	3065	3192	4109	3768	3534
Standard	3631	4225	4242	4050	4037	3235	3764	3780	3609	3597
Venturi	3352	4219	4285	4194	4012	2987	3759	3818	3737	3575
Twin	3112	3816	4313	4188	3857	2773	3400	3843	3732	3437
Mean	3384	3961	4363	4165		3015	3529	3887	3711	
CV (%)	10.5									
ANOVA	LSD (0.05)					LSD (0.05)				
Fungicide (F)	NS[1]					NS				
Nozzle (N)	NS					NS				
F x N	NS					NS				

[1]not significant

Table 15. Effect of fungicide and spray nozzle type on the seed weight of Myles desi chickpea.

Nozzle type	Seed weight (mg)				
	Bravo 500	Quadris	Headline	Folicur	Mean
Control	197	197	200	197	198
Standard	196	200	201	195	198
Venturi	198	200	204	197	200
Twin	192	202	200	200	198
Mean	196	200	201	197	
CV (%)	2.8				
ANOVA	LSD (0.05)				
Fungicide (F)	NS[1]				
Nozzle (N)	NS				
F x N	NS				

[1]not significant

Effect of Application Carrier Water Volume

Treatments included four foliar fungicides (Bravo 500 + Quadris, Quadris, Headline, Folicur), three carrier water volumes (Control, 100 l/ha, 200 l/ha, 300 l/ha; 9 gal/ac, 18 gal/ac, 27 gal/ac) and a control. The fungicides were applied using Standard flat fan jet nozzles. The treatments were arranged in a split-plot design with carrier water volume as sub-plots within the fungicide main-plots. Each treatment was replicated four times. CDC Yuma, a fern leaf type kabuli chickpea, was seeded at a target plant population of 45 plants/m^2. Each treatment measured 2.4 m x 8 m (8 ft x 24 ft).

During the advanced crop growth stage (August 16), there was significantly less disease development for the 200 and 300 l/ha (18 and 27 gal/ac) carrier water volume treatments compared to the 100 l/ha (9 gal/ac) carrier water volume treatment (Table 16). Fungicide applied with all three water carrier volumes had significantly lower disease level than the control treatment that received no fungicide application.

Table 16.															
	Disease rating - Horsfall-Barratt Scale (Grade Formula %)														
	June 20					July 31					August 16				
Carrier water volume	Bravo 500 + Quadris	Quadris	Headline	Folicur	Mean	Bravo 500 + Quadris	Quadris	Headline	Folicur	Mean	Bravo 500 + Quadris	Quadris	Headline	Folicur	Mean
Control	2.28	2.28	2.22	2.22	2.25	3.39	4.33	2.93	4.33	3.74	74.53	76.49	88.52	79.46	79.75
100 l/ha	2.22	2.22	2.16	2.05	2.18	2.81	2.81	2.57	2.93	2.78	34.53	35.62	43.91	37.58	37.91
200 l/ha	2.46	2.22	2.46	2.22	2.28	3.28	3.04	3.04	2.69	3.01	11.95	21.33	10.78	45.16	22.30
300 l/ha	2.28	2.22	2.46	2.22	2.34	2.93	2.69	2.46	2.93	2.75	10.07	12.42	9.37	35.78	16.91
Mean	2.31	2.24	2.33	2.18		3.10	3.22	2.75	3.22		32.77	36.46	38.14	49.49	
CV (%)	8.3					19.2					30.2				
ANOVA	LSD (0.05)					LSD (0.05)					LSD (0.05)				
Fungicide (F)	NS[1]					0.30					7.74				
Nozzle (N)	NS					0.42					8.49				
F x V	NS					NS					16.99				

[1]not significant

Table 17. Effect of fungicide and carrier water volume on the yield of CDC Yuma kabuli chickpea.										
	Yield (kg/ha)					Yield (lb/ac)				
Carrier water volume	Bravo 500 + Quadris	Quadris	Headline	Folicur	Mean	Bravo 500 + Quadris	Quadris	Headline	Folicur	Mean
Control	1953	1158	1355	1059	1193	1740	1032	1207	944	1063
100 l/ha	1897	2007	2102	1375	1845	1690	1788	1873	1225	1644
200 l/ha	2434	2189	2611	1607	2210	2169	1950	2326	1432	1969
300 l/ha	2282	2510	2783	1032	2152	2033	2236	2480	920	1917
Mean	1953	1966	2213	1268		1740	1752	1972	1130	
CV (%)	21.0									
ANOVA	LSD (0.05)					LSD (0.05)				
Fungicide (F)	211					188				
Nozzle (N)	278					248				
F x N	556					495				

CDC Yuma chickpea seed yield (Table 17) and seed weight (Table 18) were significantly affected by fungicide application and carrier water volume used to apply the fungicide. Headline had one of the lowest disease levels and the highest seed yield and seed weight while Folicur had the highest disease levels and lowest seed yield and seed weight. The 200 and 300 l/ha (18 and 27 gal/ac) carrier water volumes produced significantly higher yield and seed weight than the 100 l/ha (9 gal/ac) carrier water volume which had a significantly higher yield than the control treatment. Seed yield and seed weight were significantly higher where fungicide was applied than for the control treatment that received no fungicide.

Table 18. Effect of fungicide and carrier water volume on the seed weight of CDC Yuma kabuli chickpea.					
	Seed weight (mg)				
Carrier water volume	Bravo 500 + Quadris	Quadris	Headline	Folicur	Mean
Control	289	287	305	307	297
100 l/ha	335	368	370	344	354
200 l/ha	386	380	402	349	379
300 l/ha	378	396	405	347	381
Mean	347	358	370	337	
CV (%)	6.0				
ANOVA	LSD (0.05)				
Fungicide (F)	17				
Nozzle (N)	15				
F x N	NS[1]				

[1]not significant

Varietal Investigations

Bean and Pea Preliminary Yield Trials

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

Funded by the Saskatchewan Agriculture Development Fund,
Saskatchewan Pulse Growers, Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)
and the Crop Development Centre, University of Saskatchewan

Progress: *Ongoing*

Location: *Outlook*

Objective: *To develop high yielding, early, disease resistant green, yellow 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. Ten two-replicate trials of 36 entries each were grown, in addition to the Field Pea Co-operative Trial B. 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 2002 season.

Additional experiments were conducted as part of a special project investigating the anatomy of pea stems and its relationship to development of lodging and Mycosphaerella.

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 narrow row production systems. Six 36-entry two-replicate advanced trials were grown. Three replicate trials of the 2001 Prairie Dry Bean Narrow Row Co-op Trials (A with 16 entries; B with 25 entries) were also grown. Conditions were excellent for full expression of yield potential. Data from these trials were combined with those from other locations to decide which lines to advance to the 2002 registration 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*

Dry Bean Narrow Row and Wide Row Regional Variety Tests

T. Hogg[1], A. MacDonald[1], A. Vandenberg[2], C. Wildschut[3]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF) and Agriculture and Agri-Food Canada, PFRA

***Progress**: Ongoing*

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

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

Dry Bean Regional variety trials were established in the spring of 2001 at the CSIDC. The 2001 Narrow Row Dry Bean Regional Trial established at 20 cm (8 in) row spacing included only varieties that were specifically bred to suit narrow row production systems. The 2001 Wide Row Dry Bean Regional Trial seeded at 60 cm (24 in) row spacing was identical to the Alberta Regional trial and included varieties bred for wide row production systems under irrigated production.

Dry Bean Narrow Row Regional

Fifteen dry bean varieties consisting of five market classes (pinto, great northern, navy, black, small red) were evaluated. AC Cruiser navy bean and CDC Altiro pinto bean produced the highest yield of all varieties while CDC Expresso black bean produced the lowest yield (Table 19). All market classes had varieties with high yield potential for irrigated production.

Most bean varieties flowered within a range of 50 - 60 days except the new black variety 315-18 which flowered at 62 days. CDC Pintium pinto bean was the earliest variety to flower taking only 50 days from seeding.

CDC Pintium pinto bean matured 7-10 days earlier than most varieties and 14 days earlier than AC Cruiser navy bean. Most varieties required 100-105 days to mature. The highest yielding variety, AC Cruiser navy bean, was the also the latest maturing variety, however, later maturity was not always associated with high yield for the other varieties.

Pod clearance was generally good among the varieties indicating that progress is being made in dry bean breeding programs to develop varieties with upright structure and pods held high on the plant. Two great northern dry bean varieties and one pinto 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

[1]*CSIDC, Outlook*
[2]*Crop Development Centre, U of S, Saskatoon, Saskatchewan*
[3]*Crop Diversification Centre - South, Brooks, Alberta*

for the navy bean variety CDC Whistler. The high yielding navy bean varieties AC Cruiser and CDC Whitecap had high seed weight compared to CDC Whistler. The high yielding great northern variety AC Polaris had a small seed weight compared to the other varieties in this market class. The new black variety AC Black Diamond had a high seed weight compared to CDC Expresso.

Plant height varied among the market classes as well as among varieties within a market class. The shortest varieties were CDC Expresso black bean and Envoy navy bean while the tallest varieties were CDC Pinnacle pinto bean, CDC Whitecap navy bean and AC Redbond small red bean.

Table 19. Irrigated Dry Bean Narrow Row Regional variety trial.

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	372	50	94	45	1	85
CDC Pinnacle	109	360	59	105	67	2	67
CDC Altiro	119	383	55	102	60	2	72
95-83-10	109	401	57	101	61	1	82
Great Northern							
AC Polaris	102	286	56	98	55	2	78
CDC Crocus	102	330	53	98	50	3	60
CDC Nordic	63	304	56	101	50	2	57
Navy							
Envoy	52	161	54	99	41	1	75
CDC Whitecap	98	177	59	103	66	1	85
CDC Whistler	56	139	60	106	45	1	77
AC Cruiser	122	171	59	108	61	1	78
Black							
CDC Expresso	39	174	53	99	40	1	72
AC Black Diamond	100	236	58	99	61	1	78
315-18	69	170	62	105	55	1	83
Small Red							
AC Redbond	101	288	54	99	65	1	80
S.E.	475	26	1.0	1.2	0.7	0.3	3.5
CV (%)	17.8	5.8	2.2	1.4	1.7	29.1	5.6

[1]Yield of CDC Pintium = 3655 kg/ha (3257 lb/ac)
[2]50% of pods are buckskin color
[3]pods >5 cm (2 in) above ground surface

Dry Bean Wide Row Regional

Twenty dry bean varieties consisting of six market classes (pinto, great northern, navy, black, small red, yellow) were evaluated. Yield varied among the market classes and varieties within the market classes (Table 20) . AC Scarlet small red bean produced the highest yield of all varieties while Earliray pinto bean produced the lowest yield.

Most bean varieties flowered within a range of 55 - 60 days except for Earliray pinto bean and Arikara yellow bean which flowered in 50 days.

Earliray pinto bean and Arikara yellow bean matured 7-10 days earlier than most other varieties which required 100-105 days to mature.

Plant height varied among the market classes as well as among varieties within a market class ranging from 45 cm for the yellow variety Arikara to 63 cm for the pinto variety Remmington. Plant height for most other varieties was in the range of 50 to 60 cm.

Table 20. Irrigated Dry Bean Wide Row Regional variety trial.

Variety	Yield % of Othello[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 0 = erect 5 = flat
Pinto						
CDC Camino	109	359	58	103	49	1
CDC Pinnacle	141	394	57	102	60	2
Earliray	71	376	50	93	59	2
Fiesta	132	376	58	103	50	3
Othello (check)	100	353	58	104	50	2
Remington	115	326	59	99	63	1
Winchester	111	351	57	101	54	1
Great Northern						
AC Polaris	145	331	57	99	59	2
CDC Crocus	133	401	52	98	51	3
US 1140 (check)	128	328	57	104	51	3
Navy						
Beryl	118	276	58	102	50	2
Black						
UI 906	104	160	58	105	48	1
AC Black Diamond	107	255	58	103	48	1
Small Red						
AC Scarlet	157	350	57	102	60	2
AC Earlired	139	341	57	97	50	2
NW 63 (check)	123	318	55	101	50	2
AC Redbond	134	326	56	99	57	1
Yellow						
Arikara	87	431	50	93	45	1
S.E.	219	6	0.9	0.8	.08	0.2
CV (%)	11.0	2.4	2.3	1.2	2.1	16.3

[1]Yield of Othello = 2341 kg/ha (2086 lb/ac)
[2]50% of pods are buckskin color

Many varieties showed good upright structure (lodge rating). The great northern varieties lodged to the greatest extent.

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

T. Hogg[1], A. MacDonald[1], H. Mundel[2], J. Braun[2]

Funded by Agriculture and Agri-Food Canada, PFRA

***Progress**: Ongoing*

***Location**: Outlook*

***Objective:** To evaluate new dry bean germplasm for irrigation under wide-row cropping conditions for western Canada.*

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

The study was conducted under irrigation 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. Six test entries were in the first year of co-op testing, seven in the second year and one in the fourth year. 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). The entire plot was harvested to determine yield.

Pintos had several experimental lines similar to Othello in maturity and yield potential (Table 21). In the small reds L98D292 had comparable yield to the checks, with maturity as early as AC Earlired (five days earlier than NW63 over two years), and a larger seed size. In 2001, L98D347 and 737-68 averaged at the top for yield, while maturing as early as AC Redbond. The most interesting great northern line was L98E209. Its yield was slightly lower than US1140 but was one week earlier in maturity. It also had a larger seed weight than US1140 or AC Polaris.

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

Table 21. Irrigated Wide Row Prairie Bean Co-operative trial.

Variety	Yield % of Othello[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 0 = erect 5 = flat
Pinto						
Othello (check)	100	340	58	103	55	2.2
L98B335	100	348	59	103	53	1.7
L98B336	103	344	59	102	49	1.4
L98B351	86	357	60	103	51	1.8
L98B354	99	340	58	103	57	2.0
L99B445	79	334	58	100	57	2.0
Small Red						
NW63 (check)	87	333	56	100	49	1.7
AC Earlired (check)	98	348	57	98	48	0.9
AC Redbond (check)	96	350	56	97	50	1.3
L98D292	90	357	56	97	56	2.0
L98D347	115	349	58	98	54	1.0
737-48	93	313	60	101	49	1.1
737-68	102	341	58	97	48	1.5
Great Northern						
US1140 (check)	94	346	59	106	56	3.8
AC Polaris (check)	112	353	57	100	57	2.3
L96E108	115	340	60	105	60	1.5
L98E207	91	371	56	101	52	1.8
L98E209	90	370	54	95	51	2.0
L99E247	98	323	59	101	59	1.3
Mantiquella						
93-147/148-25	95	402	57	98	53	2.2
S.E.	266	11	1.4	1.4	0.5	0.3
CV (%)	10.5	5.8	3.3	2.5	9.8	23.7

[1]Yield of Othello = 2834 kg/ha (2525 lb/ac)
[2]50% of pods are buckskin color

Desi and Kabuli Chickpea Regional Variety Tests

T. Hogg[1], A. MacDonald[1], T. Warkentin[2]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF) and Agriculture and Agri-Food Canada, PFRA

***Progress**: Ongoing*

***Location**: Outlook*

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

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

Chickpea Regional variety trials were established in the spring of 2001 at the CSIDC. Separate trials were conducted for 'Kabuli' and 'Desi' type chickpeas.

Yield for the kabuli type chickpea varieties ranged from a high of 3995 kg/ha (3560 lb/ac) for 95NN-1 to a low of 2355 kg/ha (2098 lb/ac) for CDC Yuma (Table 22). Several other kabuli type chickpeas yielded in excess of 3000 kg/ha (2673 lb/ac). Yield for the desi type chickpea varieties ranged from a high of 3407 kg/ha (3036 lb/ac) for 92117-14 to a low of 2353 kg/ha (2096 lb/ac) for DH45-1 (Table 23). All other desi type chickpea varieties yielded in excess of 2500 kg/ha (2228 lb/ac).

Days to flower ranged from 48 to 53 days for the kabuli type chickpea varieties and from 48 to 55 days for the desi type chickpea varieties. Days to maturity ranged from 93 to 101 days for the kabuli type chickpea varieties and from 93 to 99 days for the desi type chickpea varieties.

Seed weight was generally greater for the kabuli type chickpea than for the desi chickpea. The kabuli type varieties Amit (B90) and CDC Chico have a small seed size which are even smaller than some of the new desi varieties. CDC Xena had the largest overall seed size for the kabuli type chickpeas followed closely by CDC Diva. The new desi variety CDC Nika had the largest overall seed size for the desi type chickpeas while the smallest seed size was observed for 92085-20, CDC Anna and Myles.

Plant height varied between the chickpea types as well as among varieties within each type. For the kabuli chickpeas 93-120-63 was the tallest variety while CDC Diva was the shortest variety. For the desi chickpeas 92056-21, 92056-22 and 92117-14 were the tallest varieties while CDC Nika, 92085-20 and DH45-1 were the shortest varieties.

Lodge rating indicates that most of the desi type chickpeas stand erect while some of the kabuli type chickpeas lodge to a small extent.

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

Table 22. Kabuli Chickpea Regional variety trial.						
Variety	Yield % of Sanford[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 1 = erect 5 = flat
Sanford	100	443	53	99	48	3
Evans	91	464	52	101	50	2
B90 (Amit)	116	259	51	96	47	3
CDC Yuma	79	415	51	100	49	2
CDC Chico	114	282	48	93	47	2
CDC Xena	97	572	50	101	46	2
CDC Diva	94	531	51	101	43	2
92-060-11	108	405	49	98	49	1
93-120-63	119	404	48	95	52	2
95NN-1	134	359	52	99	48	2
95NN-29	126	375	52	97	47	2
97-Indian2-107	102	423	48	96	50	2
S.E.	203	14	0.8	0.9	2.9	0.5
CV (%)	708	4.1	1.9	1.1	7.3	23.4

[1]Yield of Sanford = 2983 kg/ha (2658 lb/ac)
[2]75% of pods are yellow color

Table 23. Desi Chickpea Regional variety trial.						
Variety	Yield % of Myles[1]	Seed weight (mg)	Days to flower	Days to maturity[2]	Plant height (cm)	Lodging 0 = erect 5 = flat
Myles	100	214	48	94	51	1
CDC Desiray	108	234	48	93	47	1
CDC Anna	91	213	48	99	46	1
CDC Nika	103	353	48	94	41	1
BS1-43	98	314	51	94	44	1
DH45-1	83	246	51	94	40	3
92056-21	116	300	50	96	57	2
92056-22	106	244	54	99	58	2
92073-40	101	317	48	93	49	1
92085-20	90	218	48	93	40	2
92117-14	120	292	55	98	57	2
92117-25	118	288	52	96	54	2
S.E.	283	19	0.7	0.9	0.5	0.3
CV (%)	11.9	8.9	1.7	1.1	1.2	34.5

[1]Yield of Myles = 2838 kg/ha (2528 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], A. MacDonald[3]

Funded by Agriculture and Agri-Food Canada, PFRA, and the Crop Development Centre, University of Saskatchewan

***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. Fifty-three candidate entries were divided into two tests. Relatively later maturing entries were placed in Test A. There were 32 entries in Test A and 21 entries in Test B. There were four check cultivars in each test (three yellow and one green): Carrera, Eclipse, CDC Mozart and Nitouche.

An irrigated field trial was conducted at the CSIDC. Standard fertilizer, weed control and irrigation practices for irrigated pea production were followed. Test A was arranged in a lattice design and Test B was arranged in a randomized complete block design 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, eight yellow lines and six green lines had yield lower than the check variety Carrera (Table 24). Most lines had maturity slightly longer than Carrera. Some lines had better lodging tolerance than the checks. However, some lines with good lodge rating had the lowest yield. Highest seed weight was recorded for the green line Ceb1079. Several varieties had seed weight higher than the checks.

In test B, only three new yellow lines yielded less than check variety Carrera (Table 25). The two yellow lines CDC0101 and CDC0102 had exceptionally high yield. The two green lines yielded higher than the green check variety Nitouche. Most lines matured similar to the checks. Four yellow lines had seed weight higher than the checks with the highest seed weight recorded for the yellow line Ceb4119.

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

Table 24. 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	71	92	233
Eclipse	108	6	92	99	231
CDC Mozart	105	6	76	96	214
MP 1807	123	7	95	97	205
MP 1811	108	5	97	96	240
MP 1812	114	4	90	97	243
Ceb 4103	95	7	69	92	250
Ceb 4104	105	6	70	95	238
CDC0004	109	3	91	95	207
CDC0009	121	6	88	97	223
CDC0010	110	7	88	95	224
CDC0103	105	7	92	97	195
CDC0104	118	5	82	95	222
CDC0105	113	6	80	95	222
CDC0108	111	8	98	95	218
SW965210	100	7	80	95	221
SW985704	97	4	82	94	223
SW985709	110	4	83	91	216
SW985745	90	3	85	91	229
F2-20	111	7	94	94	208
F4-12	101	7	95	97	217
CO9615064	92	5	89	96	208
CO9616005	97	4	80	97	200
Madonna	94	3	81	92	259
Apollo	83	4	89	98	204
Lido	95	2	79	95	261
Green					
Nitouche	88	6	95	96	241
Ceb1078	84	6	77	97	282
Ceb1079	94	7	84	99	292
Ceb1080	121	4	74	98	270
Ceb1081	119	4	86	100	281
CDC0001	81	6	85	96	227
CDC0011	94	5	85	95	242
CDC0106	108	7	94	94	177
CDC0107	90	8	94	97	156
CDC0110	110	7	95	97	146

[1]Carrera yield = 6309 kg/ha (5621 lb/ac)

Table 25. 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	6	72	96	233
Eclipse	119	4	94	94	240
CDC Mozart	105	5	80	95	211
MP 1813	109	5	83	95	229
MP 1814	117	4	78	94	226
DS49404	85	4	91	94	194
Ceb 4117	110	7	77	97	302
Ceb 4118	114	7	72	97	276
Ceb 4119	135	6	89	96	281
Sponsor	112	7	83	97	238
LW9314-2	108	5	71	95	254
CDC0007	125	5	91	95	233
CDC0101	137	8	86	98	228
CDC0102	145	6	80	96	226
CDC0109	118	7	92	97	217
SW975504	92	5	80	95	219
SW975514	120	6	80	96	222
SW985755	106	2	79	92	232
SW985812	96	4	81	94	220
SB2000-1	112	7	81	97	221
SB2000-2	128	4	78	94	233
SB2000-3	112	5	84	95	201
Green					
Nitouche	83	6	81	96	253
NZ4L08	102	8	81	98	206
CO96-901	109	8	85	98	192

[1]Carrera yield = 6012 kg/ha (5357 lb/ac)

Irrigated Field Pea Regional Variety Trial

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

Funded by the Irrigation Crop Diversification Corporation

***Progress**: Ongoing*

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

Pea Regional variety trials were conducted at four locations in the Outlook irrigation area. The soil type at the various sites are as follows:

- CSIDC (SW15-29-08-W3): Bradwell very fine sandy loam
- CSIDC off-station (NW12-29-08-W3): Asquith sandy loam
- H. Jeske: Tuxford clay loam
- R. Pederson: Elstow loam

The trials were seeded from May 9 to May 16. Plots measured 1.5 m x 4 m (5 ft x 13 ft). Phosphorus fertilizer was sideband applied during the seeding operation according to soil test recommendations. Yields were estimated by harvesting the entire plot.

Irrigated pea yield, height and lodge rating varied among the four sites (Table 26). Most of the newer varieties produced higher yield than Radley. The green varieties M98 and SW Parade and the yellow varieties CDC Mozart and Eclipse produced high yields with highest overall yield obtained for the yellow variety CDC Mozart averaged over the four sites. The green variety Majoret and both the Marrowfat (Courier) and Maple (MF10) varieties had yield lower than Radley.

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.

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

Table 26. Yield and agronomic data for the irrigated field pea variety test.

Variety	Jeske site			Pederson site		Off-station site			CSIDC site			Mean yield		
	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 Radley
Green														
Radley	2389	59	8.0	2861	45	5310	66	7.5	1855	46	7.3	3104	46.1	100
MAJORET	2582	69	2.3	2651	63	4527	69	4.5	1838	53	2.3	2900	43.1	93
Nitouche	2526	74	4.3	2700	59	5590	66	4.8	2328	56	3.8	3286	48.8	106
SW Parade	3012	72	4.8	3377	60	6113	71	5.5	2438	51	4.0	3735	55.5	120
M98	3057	57	4.5	2628	48	5931	58	2.8	2535	51	3.0	3538	52.5	114
Yellow														
AC Melfort	2514	51	5.5	3064	40	5885	58	5.5	1988	45	5.3	3363	49.9	108
Alfetta	2846	51	6.5	2880	46	6096	56	4.8	2384	40	6.5	3552	52.7	114
CDC Mozart	3312	61	3.8	3139	51	7251	66	5.0	2834	50	5.0	4134	61.4	133
CDC Handel	3207	64	3.8	3277	56	6441	65	6.3	2701	50	3.3	3907	58.0	126
DS Stalwarth	2936	69	2.5	3381	61	5909	71	2.8	2263	61	2.0	3622	53.8	117
Eclipse	3279	63	3.0	3440	54	6712	73	2.0	2448	51	2.8	3970	59.0	128
SW93550	3110	---	1.8	3189	60	5525	70	2.3	1611	51	2.5	3357	49.9	108
Marrowfat														
Courier	2032	68	7.0	2447	55	4996	69	6.3	2299	54	3.5	2194	32.6	71
Maple														
MF10	2452	58	8.5	2320	45	5015	55	8.0	1727	45	7.5	2879	42.8	93
CV (%)	7.6	8.1	24.6	10.5	10.1	8.6	8.3	23.0	16.4	12.0	25.9	---	---	---

[1] 1 = erect; 9 = flat

Weed Control in Special Crops

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

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

***Progress**: Year five of five*

***Objective:** To develop data in support of minor use registration of herbicides for weed control in selected specialty crops.*

Successful production of special crops depends on good weed control. One important means of weed control is the use of herbicides. However, for many special crops there are few if any herbicides available. CSIDC in Outlook was one of eight sites where minor use registration data for special crops was collected in 2001. Data from all sites will be summarized for submission for minor use registration.

The seeding and herbicide application are presented for each trial. All trials are four replicate randomized complete blocks grown under irrigated conditions. The chickpeas received no irrigation after emergence to control disease and promote seed development. All crops received 50 kg/ha (45 lb/ac) 11-52-0 and all non-legume crops received 100 kg/ha (89 lb/ac) 46-0-0 except chickpeas which received 50 kg/ha (45 lb/ac) 11-52-0 and 20 kg/ha (18 lb/ac) 46-0-0. Phytotoxicity rating data was collected three times for each test using a 0-100 visual rating scale (Table 27). Analysis of variance was performed to determine treatment differences.

Variety: Desi - Myles; Kabuli - Amit (B90)
Seeding date: May 18
Seeding rate: 40 plants/m^2 (4.3 plants/ft^2)
Row spacing: 25 cm (10 m)
Rows per plot: 6
Length of rows: 4 m (13 ft)
Application volume: 100 L/ha (9 gal/ac)
Date of herbicide application:
PPI - May 17
Pre-emergent - May 23

Chickpea Pre-Emerge

Both the Desi and Kabuli chickpea crops had excellent stands in 2001. Visual differences are not reported because there were no differences seen in any of the treatments.

Table 27. Visual rating scale.

Phytotoxicity range	Assessment of injury
0 - 9%	Slight discoloration and/or stunting
10%	Just acceptable
11 - 30%	Not acceptable
> 30%	Severe

[1]CSIDC, Outlook

Desi

There was a significant difference shown in the desi chickpea yield (Table 28). Orthogonal contrast analysis showed that the pre-plant incorporated (PPI) treatments resulted in 10% higher (significant at P<0.01) yield than the pre-emergent (Pre-E) application of sulfentrazone.

Kabuli

The yield difference in the kabuli chickpea was not significant (Table 28) suggesting that they are more tolerant to the sulfentrazone and it can be used for weed control in Kabuli chickpea.

Table 28. Chickpea crop tolerance to pre-emergent herbicide application.

Treatment	Rate kg/ha a.i.	Desi Yield kg/ha	Desi Yield lb/ac	Kabuli Yield kg/ha	Kabuli Yield lb/ac
Untreated	---	5169	4606	3191	2843
Sulfentrazone PPI	0.210	5651	5035	3489	2218
Sulfentrazone PPI	0.420	5421	4830	3739	3331
Sulfentrazone Pre-E	0.210	5131	4572	3155	2811
Sulfentrazone Pre-E	0.420	4907	4372	3348	2983
	LSD (0.05)	444	396	NS[1]	NS
	CV (%)	5.5		11.5	

[1]not significant

Pinto Bean Weed Control

Only the efficacy of the treatments was recorded in this trial. All treatments had fair weed control at seven and 14 days after application (Table 29). At 21 days after application control was poor as the weeds started to recover for all treatments and by 55 days the Basagran treatment no longer controlled the weeds adequately. The lower yields seen with the Basagran treatments may be a result of crop damage from the adjuvant Assist mixed with Basagran due to a high temperature on the day of spraying. On hot days Assist should be used at a lower rate to avoid crop stress.

Variety:	CDC Camino
Seeding date:	May 24
Seeding rate:	35 seeds/m^2 (3.7 seeds/ft^2)
Row spacing:	25 cm (10 in)
Rows per plot:	6
Length of rows:	4 m (13 ft)
Application volume:	100 L/ha (9 gal/ac)
Date of herbicide application:	June 28

Table 29. Pinto Bean crop tolerance and seed yield for post emergent herbicide applications.

Treatment	Rate kg/ha a.i.	Tolerance Rating[1] 7 DAA[2]	14 DAA	21 DAA	55 DAA	Yield kg/ha	Yield lb/ac
Untreated	---	0,a[3]	0,a	0,a	0,a	1709	1523
Fomesafen	0.240	27,b	36,b	22,b	26,bc	1702	1516
Fomesafen	0.480	42,bc	44,b	28,b	24,c	1926	1716
Fomesafen Basagran	0.140 0.840	42,c	40,b	25,b	22,bc	1658	1477
Basagran	0.840	33,bc	37,b	22,b	16,b	1558	1388
LSD (0.05)	---					218	194
CV (%)	---	17.1	13.3	18.7	26.9	8.3	

[1]0% = no damage; >30 = severe damage (ANOVA performed using $\sqrt{(x+0.5)}$ transformation)
[2]days after application
[3] Values followed by the same letters in each column is not significantly (P<0.05) different.

Dry Bean Tolerance

Variety: Pinto - CDC Camino; Great Northern - CDC Crocus; Navy - AC Skipper; Black - CDC Express
Seeding date: May 24
Seeding rate: 20 seeds/m^2 (2.1 seed/ft^2)
Row spacing: 25 cm (10 in)
Rows per plot: 6 rows
Length of rows: 4 m (13 ft)
Application volume: 100 L/ha (9 gal/ac)
Date of herbicide applications: June 28

Pinto beans produced the best stand in 2001. Tolerance was excellent after 7, 14 and 21 days following application. There were no visual differences in crop health so visual ratings are not reported. The high rate of Fomesafen-Basagran mix was the only treatment in the pinto test that had significantly lower yields than any other treatment (Table 30). It can be concluded in this trial that the high rate is too potent. The Basagran treatment was also significantly lower than the untreated check in the navy beans, however due to the lower plant stand positive conclusions could not be drawn. No significant differences were found in the great northern or the black beans.

Table 30. Dry bean seed yield for post emergent herbicide applications.

Treatment	Rate kg/ha a.i.	Pinto		Great Northern		Navy		Black	
		kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
Untreated	---	2405,ab[2]	2143,ab	1417	1263	984,a	877,a	924	823
Fomesafen	240	2768,a	2466,a	1225	1091	799,ab	711,ab	745	664
Fomesafen	480	2494,a	2222,a	1490	1328	895,ab	797,ab	783	698
Fomesafen Basagran	140 840	2600,a	2317,a	1379	1229	1083,a	965,a	664	592
Fomesafen Basagran	280 1680	2035,b	1813,b	1276	1137	849,ab	756,ab	757	674
Basagran	840	2438,ab	2172,ab	1374	1224	625,b	557,b	585	521
LSD (0.05)	---	459	409	NS[1]	NS	375	334	NS	NS
CV (%)	---	12.4		23.7		40.3		8.3	

[1]not significant
[2]Values followed by the same letter in each column is not significantly (P<0.05) different.

Dill

Tolerance to Select was excellent throughout the growing season and yields were similar with the untreated check (Table 31). Tolerance to Linuron did not appear to be good when visual ratings were conducted. The Linuron stunted the dill soon after the application but the crop slowly recovered throughout the growing season. Heights were measured 50 days after application and there were no longer any visual differences. There were no significant differences in the yields indicating that dill is sufficiently tolerant to all treatments.

Seeding) date: May 16
Seeding rate: 8 kg/ha (7 lb/ac)
Row spacing: 25 cm (10 in)
Rows per plot: 6
Length of rows: 4 m (13 ft)
Application volume: 100 L/ha (9 gal/ac)
Date of herbicide application: June 28

Table 31. Dill crop tolerance, plant height and seed yield for post emergent herbicide applications.

Treatment	Rate kg/ha a.i.	Tolerance Rating[1]			Height (cm)	Yield	
		7 DAA[2]	14 DAA	21 DAA		kg/ha	lb/ac
Untreated	---	0,a[4]	0,a	0,a	94	2590	2308
Select Amigo	0.046	1,ab	4,ab	3,a	96	2486	2215
Select Amigo	0.092	3,b	7,b	5,a	103	2620	2334
Linuron	0.800	20,c	23,c	23,b	96	2570	2290
Linuron	1.600	34,d	37,c	30,b	91	2736	2438
LSD (0.05)	---	---	---	---	10	NS[3]	NS
CV (%)	---	23.1	38.2	36.7	6.6	8.9	

[1]0% = no damage; >30 = severe damage (ANOVA performed using $\sqrt{(x+0.5)}$ transformation)
[2]days after application
[3]not significant
[4]Values followed by the same letter in each column is not significantly (P<0.05) different.

Hemp

Seeding date:	June 7
Seeding rate:	25 kg/ha (22 lb/ac)
Row spacing:	25 cm (10 in)
Rows per plot:	6
Length of rows:	4 m (13 ft)
Application volume:	100 L/ha (9 gal/ac)
Date of herbicide application:	June 29/July 5

Two types of hemp were tested in 2001. Finola is a dwarf type hemp that is harvested for seed. Fasamo is a taller variety that is normally grown for fibre. Both tests were treated the same except at harvest. Finola had good tolerance for both Pardner rates at the second spray date but tolerance was poor at the first spray date (Table 32). Pardner stunted and browned off the bottom leaves of Finola. Lontrel slightly stunted the Finola and shrivelled the leaves up throughout the entire growing season, again the first spray date affected the crop more than the second date. The high Lontrel rates seemed to recover throughout the growing season, the yields however did not reflect that as both the high rates of Lontrel were significantly lower than the untreated check.

Fasamo was more tolerant to Pardner than Finola. Pardner stunted the Fasamo at the early growth stage but the crop fully recovered. Fasamo was also very tolerant to the low rate of Lontrel. The high rate of Lontrel curled the leaves and stunted the crop throughout the season but did not significantly decrease yields (Table 33).

Table 32. Finola crop tolerance and seed yield for post emergent herbicide applications.

Treatment[1]	Rate kg/ha a.i.	Tolerance Rating[2]			Seed Yield	
		7 DAA[3]	14 DAA	21 DAA	kg/ha	lb/ac
Untreated	---	0	0	0	2263,ab	2016,ab
Lontrel (1)	150	8	9	6	2178,abc	1941,abc
Lontrel (1)	300	5	11	10	1726,d	1538,d
Pardner (1)	280	22	14	8	2092.bc	1864,bc
Pardner (1)	560	32	22	13	2194,abc	1955,abc
Lontrel (2)	150	10	8	0	2165,abc	1929,abc
Lontrel (2)	300	17	16	2	1961,cd	1747,cd
Pardner (2)	280	6	6	1	2401,a	2139,a
Pardner (2)	560	12	8	0	2157,abc	1922
LSD (0.05)	---	---	---	---	270	241
CV (%)	---	36.9	40.3	71.1	8.7	

[1] (1) - Sprayed June 29; (2) - Sprayed July 5
[2] 0% = no damage, >30% = severe damage (ANOVA performed using $\sqrt{\ }$ (x+0.5) transformation)
[3] days after application

$\sqrt{\ }$

Organic Weed Control Demo

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

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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

***Objective:** To demonstrate the use of a non-selective organic herbicide.*

The introduction of non-selective organic herbicides could improve soil and moisture conservation practises for organic producers. Interceptor has been used successfully as an organic weed control product in New Zealand.

The trial design was a four replicate randomized complete block grown under irrigated conditions. Canola and wheat were seeded as indicators. Rating data was collected three times using a 0-100 scale. Analysis of variance was used to determine differences between the means of the treatments.

The percent damage ratings are for the entire plot rather than a separate rating for wheat and canola (Table 34). Seven days after application the Interceptor caused drying of the leaves in wheat and the canola plants were slightly wilted. By 14 days, the canola looked entirely unaffected by the Interceptor and the new leaves on the wheat looked healthy. After 21 days the only signs of the Interceptor were small brown leaves that could be seen under the new leaves on the wheat plants. It can be concluded that under the growing conditions in 2001, Interceptor was not an effective weed control alternative.

Table 34. Efficacy of Interceptor as an organic non-selective herbicide.

Treatment	Rate	Tolerance Rating[1] 7 DAA[2]	14 DAA	21 DAA
Interceptor	10% Interceptor	90	95	100
Interceptor	20% Interceptor	80	91	97
Interceptor	30% Interceptor	70	79	92
Roundup	0.25 L/acre	75	24	23
Roundup	0.50 L/acre	40	0	0
Roundup	0.75 L/acre	31	0	0
Untreated		100	100	100
LSD (0.05)				
CV (%)		0.9	2.2	7.2

[1]100% = no damage; >70% = severe damage (ANOVA performed using $\sqrt{(x+0.5)}$ transformation)
[2]days after application

[1]*CSIDC, Outlook*

Horticultural Crops Program

Potato Development Program

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

Objective:

- To identify and evaluate improved germplasm for the 'seed', 'processing' and 'table' markets,

- To develop suitable harvest management practices to produce high yields of uniform-size seed and 'consumption' grade potato

- To develop economically viable and environmentally sustainable potato-based crop rotations.

In 2001, projects were conducted in collaboration with the Saskatchewan Seed Potato Growers Association, Agriculture and Agri-Food Canada, Lethbridge Research Centre (Dr. Dermot Lynch), and the University of Saskatchewan (Dr. Doug Waterer). The Canada-Saskatchewan Agri-Food Innovation Fund (AFIF) provided partial funding to conduct these projects.

All test plots were grown under supplemental irrigation using standard management practices. The agronomic practices included Eptam 8E as pre-plant herbicide; 91 cm (36 in) row spacing; 100 kg N/ha (90 lb N/ac), 60 kg P_2O_5/ha (55 lb P_2O_5/ac) and 50 kg K_2O/ha (45 lb K_2O/ac) fertilizers at planting and 100 kg N/ha (90 lb N/ac) at hilling; two applications of Ripcord for Colorado potato beetle control; Dithane DG, Acrobat MZ and Tattoo C; two applications of Bravo 500 for disease control, and two applications of Reglone for top-kill prior to harvest. Trials that included fertility treatments received the required amounts of fertilizer based on treatments. The crop received 161 mm (6.4 in) of rain during the growing season and 450 mm (17.7 in) of supplemental irrigation. The harvested tubers were graded according to tuber diameter. The 'seed' grade included tubers between 30 mm (1.2 in) and 70 mm (2.8 in) for oblong types and 30 mm (1.2 in) and 80 mm (3.2 in) for round tubers. The 'consumption' category included tubers larger than 45 mm (1.8 in) diameter. Tuber specific gravity and culinary characteristics (boiled, baked, chip, and french fry) were determined using recommended AAFC protocols. Fry colour categories are based on USDA standards.

Prairie Regional Trials

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

The Prairie Regional 'Early' and 'Maincrop' Trials were conducted at CSIDC under irrigation. This project was conducted in collaboration with Agriculture and Agri-Food Canada, Lethbridge Research Centre. The 'Early' test included nine advanced clones and three industry standards. The 'Maincrop' trial consisted of 22 advanced clones and 11 industry standards. Yield, tuber characteristics and culinary attributes were evaluated at 80 and 90 days after planting for the 'Early' trial and at 125 days after planting for the 'Maincrop' trial. This information will be used to support registration of new potato cultivars targeted for both domestic and export markets.

Western Seed Potato Consortium

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

Promising french fry, chipping, and fresh market clones offered by the Western Seed Potato Consortium were grown in single-row plots under standard irrigated production. The crop was harvested and displayed to the members of the Saskatchewan Seed Potato Growers Association, Western Seed Potato Consortium members, and other government and industry personnel during the field day conducted on August 7, 2001.

Harvest Management Studies

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

Seed potatoes consist of relatively small tubers, while table and processing potatoes consist of larger tubers. Therefore, seed crops are harvested early, while processing and table crops are harvested relatively late in the season. Potatoes are top killed at appropriate times prior to harvest to ensure proper skin set and to facilitate mechanical harvest. 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.

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

Seed Grade Tuber Yield and Tuber Size Profile for Contrasting Potato Cultivars at Different Harvest Stages Under Irrigation Production

Potato growth, tuber initiation, tuber bulking is a function of many factors including maturity class of cultivars, environmental conditions (e.g. day-length, frost-free period, temperature), and agronomic practices. Production and harvest management practices should be handled appropriately to maximize yields of target tuber size classes. This is particularly important in a relatively cool and short growing conditions such as in Saskatchewan where the season is too short for many cultivars to mature naturally. Consequently, under commercial production, top killing (chemical and/or mechanical) is a common practise adopted to promote skin set and to facilitate machine harvesting. Time of top kill is adjusted in order to maximize the proportion of target tuber grades, i.e. seed, processing, table grades etc. This is dependant on several factors including maturity class of cultivar, production environment, and agronomic practices.

This study is a preliminary investigation to examine the effects of stage of harvest on tuber yield and tuber size distribution for contrasting potato cultivars grown under irrigation. The cultivars included early-maturing Norland, mid-season Russet Norkotah and Shepody, and very late maturing Alpha and Russet Burbank. The crop was grown under standard commercial scale conditions as described earlier. The crop was planted on May 15 and dug approximately after 100, 110, 115, 120, 125, and 130 days from planting. The harvested tubers were graded according to the following size grades based on tuber diameter:

- Round cultivars (Alpha and Norland): 30-50 mm (Small; Seed Grade B), 50-80 mm (Medium; Seed Grade A), 80-90 mm (Large), > 90 mm(Oversize).
- Oblong cultivars (Russet Burbank, Russet Norkotah, Shepody): 30-45 mm (Small; Seed Grade B), 45-70 mm (Medium; Seed Grade A), 70-90 mm (Large), > 90 mm(Oversize).

The seed class comprised of ‘Small’ (Canada Seed Grade B) and ‘Medium’ (Canada Seed Grade A) size categories.Seed grade tuber yield potential (Canada A + Canada B) for the various cultivars at the different harvest dates are presented in Figure 1. It is evident that the tuber bulking characteristics during the growing season, particularly during the latter stages, is different for the various cultivars and this will have a significant impact for determining the suitable top-kill dates to maximize yields of target tuber size categories. For example, the early maturing Norland and the mid-season Russet Norkotah produced higher yields during the early digs (i.e. 100, 110 days) compared to the mid-season Shepody and very late maturing Alpha and for Russet Burbank. Delaying harvesting generally produced higher yields of all cultivars except for Russet Norkotah.

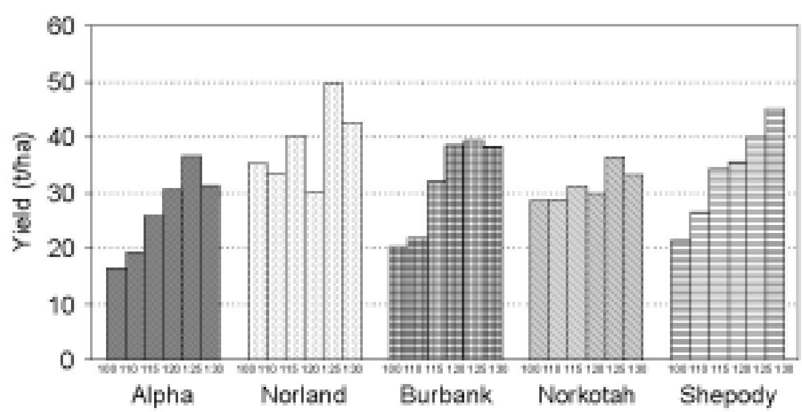

Figure 1. Seed grade tuber yields at different harvest dates for contrasting potato culitvars grown under irrigation.

For Russet Norkotah, there was very little change in tuber yield after 100 days from planting. Tuber yields optimized at 125 days from planting (Mid September) for Alpha, Norland, and Russet Burbank, while tuber yields for Shepody continued to increase until the final harvest date (130 days from planting).

Tuber size profiles for the various cultivars at different harvest dates are illustrated in Figure 2. Following is a brief description of the distribution of tuber size categories for the various cultivars with advancing harvest age:

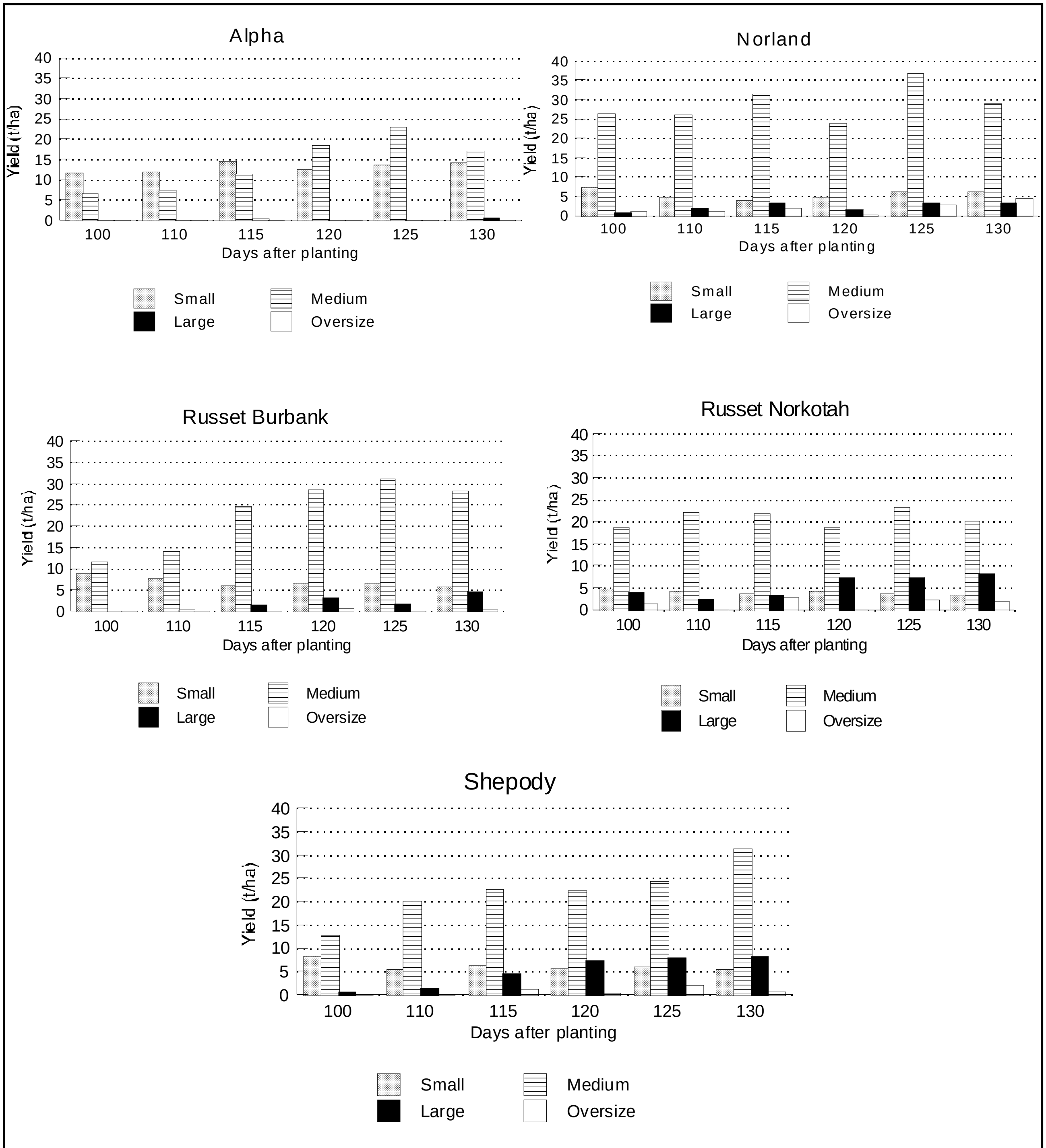

Figure 2. Tuber size categories at different harvest dates for contrasting potato cultivars grown under irrigation.

Alpha: Somewhat similar proportions Grade A and Grade B tubers at all harvest stages. Higher yield of Grade B (small) tubers during early harvest stages and higher yields of Grade A (medium) tubers at later harvest stages. Minimal large tubers and no oversize tubers.

Norland: Higher yields of Grade A (medium) tubers throughout the harvest period. Little change in Grade B (small) yields across the harvest period. Highest yield of Grade A (medium) tubers obtained during the 125 day dig. At the 130 day harvest, Grade A tuber yield decreased while the large and oversize tuber yields increased.

Russet Burbank: Maximum yield obtained at the 125-day harvest period. With successive harvest dates, Grade A (medium) yield increased while Grade B (small) yield decreased. There were a small proportion of large tubers during the later harvest stages.

Russet Norkotah: Seed grade yields comprised mainly of Grade A (medium) tubers that increased progressively up to 125 days from planting. Produced large and oversize tubers even at the 100-day harvest. Proportion of large tubers increased while the proportion of Grade B tubers decreased with advancing harvest age.

Shepody: Tuber yields, primarily Grade A (medium) and large-tuber yields, increased with advancing harvest age. Grade A tubers represented greater proportion of yield during the different harvest periods. Grade B yields remained steady across the harvest periods. Oversize-tubers developed after the 115-day harvest period.

This study examined the yield and tuber size profiles for crops harvested on specific dates without using any top-kill measures to facilitate skin set. On a commercial scale, consideration should be given to compensate for the yield and tuber size changes with respect to the stage of top-kill and the interval between top-kill and digging. Further studies are needed to identify appropriate top-kill methods and harvest stages to maximize yields of specific size grades demanded by the buyer.

Methods and Stage of Top-Kill for Contrasting Cultivars

This study examined two methods of top-kill (flailing + Reglone, and chemical, i.e. two Reglone applications) performed at two crop growth stages (100 and 109 days after planting), three harvest intervals (approximately 10, 15, 20 days) following top-kill for five contrasting potato cultivars (Alpha, Norland, Russet Burbank, Russet Norkotah, Shepody) grown under irrigation. The crop was planted on May 14, 2001 and top killed on August 22 and 31. Harvests were taken on August 31, September 6 and 11 for the first top-kill treatment and on September 11, 16, and 21 for the second top-kill treatment. Tubers were graded according to Canadian seed certification standards as described earlier.

Norland potato produced the highest and Alpha produced the lowest seed grade yields at both 100 and 110 day top-kill periods (Table 1). Delaying top-kill from 100 to 110 days after planting resulted in yield increases for all cultivars. The magnitude of yield differences were 4% for Norkotah, 19% for Norland, 30% for Shepody, 35% for Russet Burbank, and 38% for Alpha. Norland and Alpha recorded the lowest and highest tuber specific gravities during both the 100 and 110 day top-kill periods (Table 1). Top-kill methods, chemical (two applications of Reglone) or flailing (flailing + one application of Reglone) had no effect on seed grade tuber yields irrespective of top-kill dates. Delaying harvest after 100-day top-kill had no effect on tuber yields. However for the 110-day top-kill, delayed harvest produced higher yields than the early harvests.

Cultivars, top-kill methods, and the interval between top-kill and harvest dates significantly influenced the tuber specific gravity when the crop was top-killed at 100 days from planting but had no effect when the crop was top-killed at 110 days after planting (Table 1). For example, during the 100-day top-kill, the chemical top-kill or delayed harvest produced tubers with higher specific gravity compared to the flailing or early harvest (Table 1). During 100-day top-kill, the significant cultivar x top-kill method and cultivar x harvest date interactions indicate that the various cultivars responded differently to top-kill methods and harvest dates.

Figure 3 and Figure 4 illustrate how the tuber specific gravity of various cultivars responded to the two top-kill methods during the two top-kill dates. During the 100-day top-kill, tuber specific gravity for Norland potato was similar for the two top-kill methods (Figure 3). However, all the other cultivars produced higher gravity tubers with chemical top-kill relative to flailing, but the differences were variable for the different cultivars. Top-kill methods had no effect on tuber specific gravity during the 110-day top-kill period (Table 1, Figure 4). It is interesting to note that during the 110-day top-kill, the specific gravity of tubers from the flailed crop was slightly higher than the chemically desiccated crop (Figure 4).

Table 1. Effects of top-kill methods, top-kill dates and the interval between top-kill and harvest on seed grade tuber yield and tuber specific gravity for contrasting potato cultivars grown under irrigation.

Treatment	100 day top-kill			110 day top-kill		
	'Seed' grade yield		Specific gravity	'Seed' grade yield		Specific gravity
	t/ha	Cwt/ac		t/ha	Cwt/ac	
Cultivar						
Alpha	19.1	170	1.0755	26.3	235	1.0854
Norland	32.6	291	1.0590	38.8	346	1.0687
Russet Burbank	26.4	236	1.0696	35.5	317	1.0783
Russet Norkotah	26.9	240	1.0682	27.9	249	1.0749
Shepody	24.3	217	1.0653	31.6	282	1.0757
Top-kill method						
Flail	26.0	232	1.0645	32.7	292	1.0778
Chemical (Reglone)	25.8	230	1.0705	31.4	280	1.0754
Days to harvest after top-kill:						
10	25.2	225	1.0681	30.3	270	1.0765
15	26.1	233	1.0653	32.7	292	1.0767
20	26.3	235	1.0692	33.0	294	1.0766
Analyses of Variance						
Source:						
Cultivar (C)	*2.4		***(0.002)	***(3.0)		***(0.003)
Top-kill method (M)	***NS		**(0.003)	NS		NS
Harvest date (D)	***NS		***(0.002)	*(2.3)		NS
C x M	NS		***(0.003)	NS		NS
C x D	NS		**(0.004)	NS		NS
M x D	NS		NS	NS		NS
C x M x D	NS		NS	NS		NS
CV (%)	15.9		0.4	16.2		0.6

***, **, *, and NS indicate significance at P<0.001, 0.01, 0.05 levels of probability, and not significant respectively.
Values within parentheses are LSD (5%) estimates for corresponding treatments.

Days to harvest after top-kill affected tuber specific gravity when the crop was top-killed at 100 days from planting (Table 1, Figure 5). However, harvest dates had no effect on tuber specific gravity when the crop was top-killed at 110 days from planting (Table 1, Figure 6). It is not clear why the tuber specific gravities for Norland, Russet Burbank, Russet Norkotah, and Shepody were lower when the crop was harvested 15 days after top-kill compared to harvests 10 and 20 days after top-kill for the 100-day top-kill treatment (Figure 5).

Further research is needed to study the effects of top-kill and harvest management techniques on tuber yield, tuber size distribution, and quality characteristics under the short and relatively cool growing conditions in Saskatchewan. Information from these studies will benefit the 'seed', 'table' and 'processing' industries.

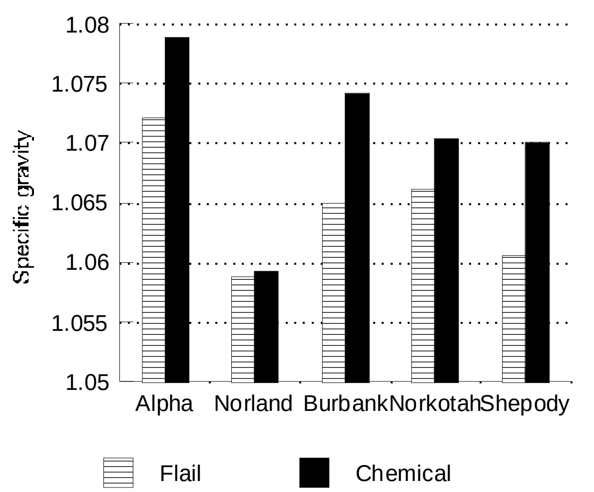

Figure 3. Effect of top-kill method on tuber specific gravity for potato cultivars top-killed at 100 days after planting.

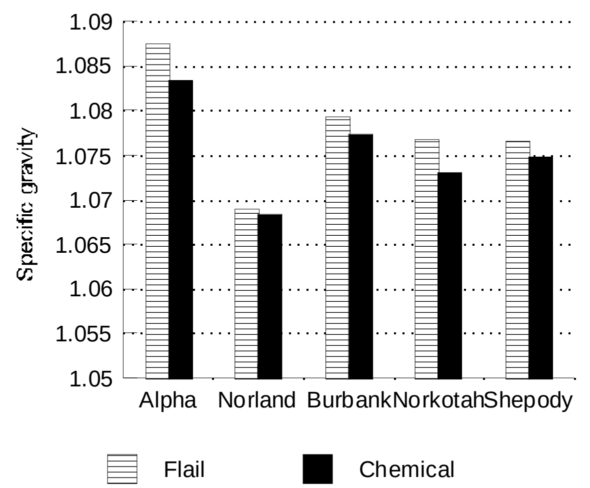

Figure 4. Effect of top-kill method on tuber specific gravity for potato cultivars top-killed at 110 days after planting.

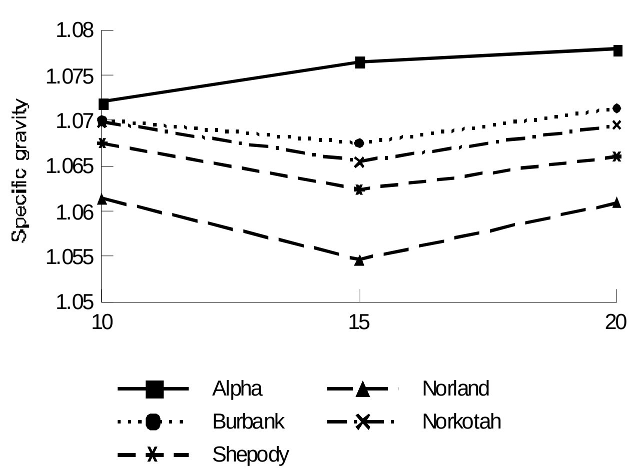

Figure 5. Tuber specific gravity as influenced by the interval between top-kill and harvest for potato cultivars when top-killed at 100 days after planting.

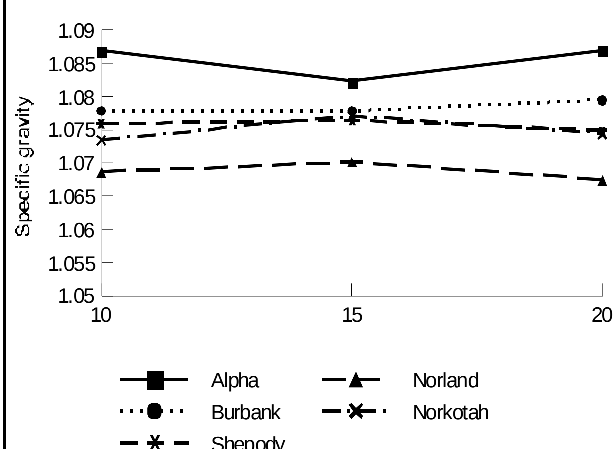

Figure 6. Tuber specific gravity as influenced by the interval between top-kill and harvest for potato cultivars top-killed at 110 days after planting.

Crop Rotation Studies

J. Wahab[1], D. Waterer[2], G. Larson[1]

Proper management of soil, water, nutrients, weeds, insects and diseases is the key to successful crop production including potato. Proper crop rotation can minimize risks associated with soil conditions including soil borne pests and diseases. This project is designed to examine (i) the effects of the previous crop on potato, (ii) the influence of crop inputs and management used for potato on the succeeding crop in the rotation, and (iii) interactive effects of cropping sequence and nitrogen response on potato productivity.

The Effect of Previous Crop on Potato

This study was designed to examine growth and productivity of potato when grown on wheat, dry bean, or canola stubble. Five contrasting potato cultivars (Norland, Russet Burbank, Russet Norkotah, Ranger Russet, Shepody) were evaluated under three nitrogen levels (150, 200, 250 kg N/ha, i.e. 135, 180, 225 lb N/ac) and two phosphorus levels (60, 120 kg P_2O_5/ha, i.e. 54, 108 lb P_2O_5/ac). Spring soil analysis results for the various stubble sites are summarized in Table 2.

Table 2. Spring soil test results at 30 cm (12 in) depth for canola, wheat, and dry bean stubble sites prior to planting potato.

Nutrient	Canola	Wheat	Bean
Texture	loam	loam	loam
pH	8	8.2	8
EC (mS/cm)	0.7	0.9	0.7
Nitrogen: kg/ha (lb/ac)	84 (75)	83 (74)	90 (80)
Phosphorus: kg/ha (lb/ac)	52 (46)	48 (43)	32 (29)
Potassium: kg/ha (lb/ac)	560 (500)	584 (522)	484 (432)
Sulphur (SO_4): kg/ha (lb/ac)	79 (71)	64 (57)	72 (64)

The various cultivars responded similarly with respect to seed grade yield when grown on canola, wheat or dry bean stubbles (Table 3). Shepody and Russet Burbank produced the lowest and highest seed grade yields respectively on the different stubbles. The consumption grade yield responses were similar for the various cultivars when grown on canola and dry bean stubble, but was different for wheat stubble. For example, Shepody produced the highest yields on canola and dry bean stubble while Russet Norkotah produced the highest yield on wheat stubble (Table 4).

Application of 150 kg N/ha (135 lb N/ac) was sufficient for growing seed and table potato on wheat, canola, or dry bean stubble (Tables 3 and 4). Additional levels of nitrogen (200, 250 kg N/ha; 180, 225 lb N/ac) had no beneficial effects for seed or consumption grade tuber yields (Tables 3 and 4). Significant cultivar x nitrogen rate effects were observed for consumption grade tuber yield under the various crop stubbles (Table 4). For example, for Shepody, the application of 250 kg N/ha tended to negatively impact consumption grade yield, while Norland produced similar yields at all three nitrogen levels tested (Figures 7, 8, 9).

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Table 3. Cultivar, nitrogen and phosphorous effects on seed grade yield for potatoes grown on wheat, bean and canola stubble.

Treatment	Seed grade yield					
	Wheat stubble		Dry bean stubble		Canola stubble	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Cultivar:						
Norland	36.4	325	37.1	331	31.9	285
Russet Burbank	41.1	367	41.2	368	39.2	350
Russet Norkotah	32.6	291	31.2	278	30.5	272
Ranger Russet	33.2	296	32.2	287	30.9	276
Shepody	30.6	273	30.5	272	28.5	254
Nitrogen:						
150 kg/ha	35.2	314	35.7	319	31.7	283
200 kg/ha	36.0	321	34.1	304	33.3	297
250 kg/ha	33.1	295	33.5	299	31.6	282
Phosphorous:						
60 kg P_20_5/ha	34.5	308	34.0	303	32.8	293
120 kg P_20_5/ha	35.1	313	34.9	311	31.7	283
Analyses of Variance						
Source:						
Cultivar (C)	***(2.7)		***(2.9)		***(1.9)	
Nitrogen (N)	**(2.1)		NS		NS	
Phosphorous (P)	NS		NS		NS	
C x N	NS		NS		NS	
C x P	NS		NS		NS	
N x P	NS		NS		NS	
C x N x P	NS		NS		NS	
C.V. (%)	13.3		14.5		14.4	

***,**, and NS indicate significance at P <0.001, 0.01 levels of probability and not significant, respectively.
Values within parentheses are LSD (5%) estimates for the corresponding treatments.

Table 4. Cultivar, nitrogen, and phosphorous effects on consumption grade yield for potatoes grown on wheat, bean and canola stubble.						
Treatment	Consumption Grade Yield					
	Wheat stubble		Dry Bean stubble		Canola stubble	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Cultivar:						
Norland	46.1	411	42.8	382	39.0	348
Russet Burbank	43.3	386	41.4	269	37.5	335
Russet Norkotah	47	419	43.1	385	40.9	365
Ranger Russet	39.9	356	36.9	329	34.4	307
Shepody	46	410	44.0	393	42.5	379
Nitrogen:						
150 kg/ha	44.7	399	42.3	377	38.2	341
200 kg/ha	44.8	400	41.8	373	40.1	358
250 kg/ha	43.8	391	40.9	365	38.3	342
Phosphorous:						
60 kg P_20_5/ha	44.4	396	42.1	376	39.4	352
120 kg P_20_5/ha	44.5	397	41.2	368	38.3	342
Analyses of Variance						
Source:						
Cultivar (C)	***(2.9)		***(2.3)		***(2.6)	
Nitrogen (N)	NS		NS		NS	
Phosphorous (P)	NS		NS		NS	
C x N	***(5.0)		***(5.7)		**(6.0)	
C x P	NS		*(4.6)		NS	
N x P	NS		NS		NS	
C x N x P	NS		NS		NS	
C.V. (%)	11.3		13.6		15.6	

***, **, and ns indicate significance at P<0.001, 0.01 levels of probablility and not significant, respectively.
Values within parentheses are LSD (5%) estimates for the corresponding treatments.

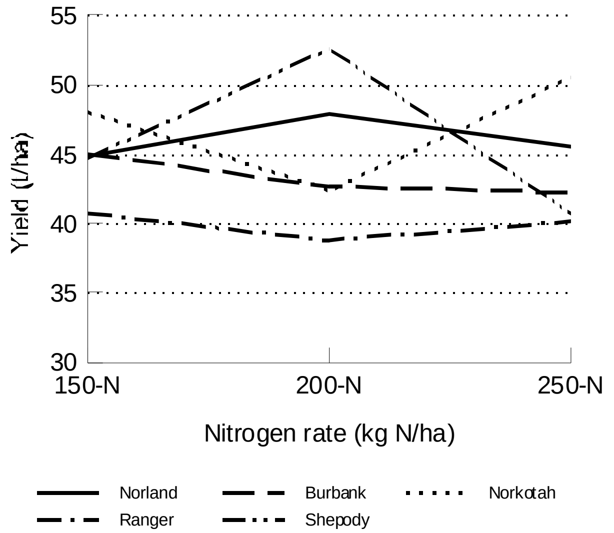

Figure 7. Nitrogen rate effects on consumption grade yields for contrasting potato cultivars grown on wheat stubble.

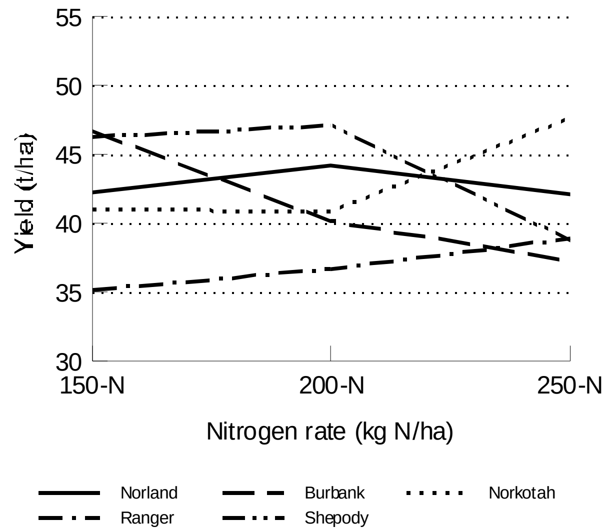

Figure 8. Nitrogen rate effects on consumption grade tuber yields for contrasting potato cultivars grown on dry bean stubble.

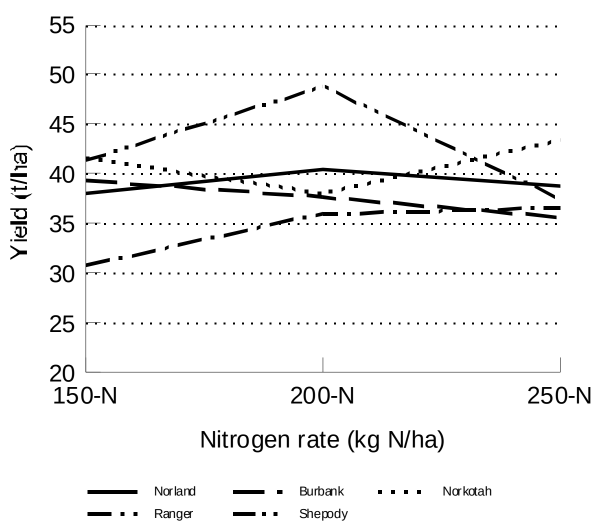

Figure 9. Nitrogen effects on consumption grade tuber yields for contrasting potato cultivars grown on canola stubble.

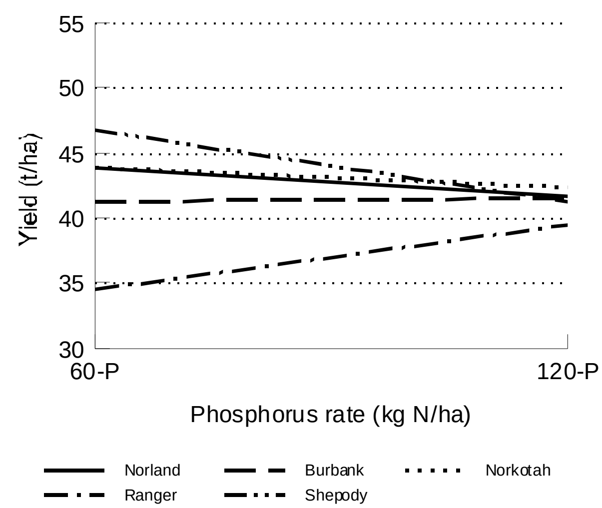

Figure 10. Phosphorus rate effects on consumption grade tuber yields for contrasting potato cultivars grown on dry bean stubble.

Application of 60 kg P_2O_5/ha (54 lb P_2O_5/ac) was generally sufficient for producing seed and consumption grade potato on wheat, canola, and dry bean stubble. Significant cultivar x phosphorus rate interaction was observed for consumption grade tubers on dry bean stubble (Table 4). Consumption grade tuber yields in response to phosphorus application rates for the various cultivars grown on dry bean stubble are presented in Figure 10. Application of 120 kg P_2O_5/ha (54 lb P_2O_5/ac) relative to 60 kg P_2O_5/ha (54 lb P_2O_5/ac) resulted in significantly higher yield for Ranger Russet and significantly lower yield for Shepody. By contrast, Norland, Russet Burbank, and Russet Norkotah produced similar consumption grade yields at the two phosphorus levels (Figure 10).

Productivity of Field Crops when Grown after Potato

Potato is grown using large quantities of nitrogen and phosphorus fertilizers. It is likely that considerable amounts of nitrogen and phosphorus may remain in the soil after harvesting the potato crop. These residual nutrients can be productively utilized to grow crops after the potato.

This study was designed to examine the effects of potato residues on the productivity of field crops grown after potato. Nitrogen and phosphorus interactions were evaluated for durum wheat (AC Morse) pinto bean (CDC Camino), field pea (CDC Mozart), and canola (LG2273) when grown after potato.

High to above average yields were obtained for wheat, canola, dry bean and field pea when grown without any fertilizer nitrogen or phosphorus (Table 5). It is not clear why canola that received 60 kg P_2O_5/ha (54 lb kg P_2O_5/ac) produced significantly lower yield than the no phosphorus check (Table 5).

Table 5. Nitrogen and phosphorus effects on yields for selected field crops when grown after potato.

Treatment	Seed yield							
	Wheat		Canola		Dry Bean		Pea	
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
Nitrogen:								
0 kg/ha	7925	7077	4685	4184	4088	3651	6601	5895
45 kg/ha	7606	6792	4786	7274	4237	3784	6436	5747
90 kg/ha	7452	6655	4535	4050	4041	3609	6600	5894
Phosphorous:								
0 kg P_20_5/ha	7829	7048	4837	4319	4144	3701	6675	5961
60 kg P_20_5/ha	7493	6691	4500	4019	4100	3661	6419	5732
Analyses of Variance								
Source:								
Nitrogen (N)	NS		NS		NS		NS	
Phosphorous (P)	NS		*(308)		NS		NS	
N x P	NS		NS		NS		NS	
CV (%)	7.4		9.6		11.3		8.5	

***, **, and ns indicate significance at P<0.001, 0.01 levels of probablility and not significant, respectively.
Values within parentheses are LSD (5%) estimates for the corresponding treatments.

Spring soil analyses after the potato crop showed large amounts of residual nitrogen and phosphorus in the top 30 cm (12 in) of soil (Table 6). Soil analysis also showed that substantial amounts of nitrogen and phosphorus remained in the top 30 cm (12 in) of soil even after growing the field crops following potato (Table 7).

For example, over 160 kg N/ha (over 144 lb N/ac) was recovered from wheat, dry bean, and canola plots and 86-111 kg N/ha (77-99 lb N/ac) from the pea plots that received 90 kg N/ha (80 kg N/ac) (Table 7). Considerable amounts of nitrogen and phosphorus were also present in the field crop plots that did not receive either nitrogen or phosphorus (Table 7).

It may be possible to grow bean, canola, pea or wheat after a well managed potato crop without any additional nitrogen or phosphorus fertilizer. Further work is necessary to confirm this observation.

Table 7. Residual soil nutrient levels at 30 cm (12 in) depth in the fall taken from the high and low fertility field crops when grown on potato stubble.

Crop	Treatments				Soil nutrient levels					
	Nitrogen		Phosphorus		Nitrogen		Phosphorus		Potassium	
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
Wheat	0	0	0	0	137	123	76	68	496	446
Wheat	0	80	25	22	60	54	72	65	520	468
Wheat	90	80	0	0	>160	>144	64	58	536	482
Wheat	90	0	25	22	>160	>144	72	65	500	450
Pea	0	0	0	0	48	43	72	65	536	482
Pea	0	80	25	22	58	52	64	58	488	439
Pea	90	0	0	0	86	77	56	50	484	436
Pea	90	0	25	22	111	100	72	65	476	428
Dry bean	0	0	0	0	47	42	64	58	476	428
Dry bean	0	0	25	22	38	34	76	68	472	425
Dry bean	90	80	0	0	>160	>144	60	54	436	392
Dry bean	90	80	25	22	>160	>144	76	68	424	382
Canola	0	0	0	0	48	43	52	47	484	436
Canola	0	0	25	22	118	106	52	47	432	389
Canola	90	80	0	0	>160	>144	44	40	416	374
Canola	90	80	25	22	>160	>144	48	43	384	346

Potato-Based Cropping Sequence

J. Wahab[1], D. Waterer[2], G. Larson[1]

Agronomic and economic impacts of potato-based long and short term rotations were evaluated. Thirty-two cropping sequences containing potato (Russet Norkotah), wheat (AC Morse), canola (LG2273), dry bean (CDC Camino), and field pea (CDC Mozart) were compared. Results of the rotation treatment that included potato during 2001 are summarized in Table 8. There were no significant treatment effects with respect to tuber yield, black scurf levels on tuber surface or soil compaction (measured by a penetrometer) for various rotations. It was observed that, although not significant, continuous potato planting produced the lowest yield, highest incidence of black scurf , and lowest soil compaction. Further studies are needed to validate this information.

Table 8. Effects of potato-based crop rotations on potato tuber yield, incidence of black scurf and soil compaction.

Crop in Rotation				2001 Total tuber yield		2001 Black scurf incidence[1]	2001 Soil compaction (PSI)
1998	1999	2000	2001	t/ha	Cwt/ac		
Potato	Potato	Potato	Potato	35.8	319	2.6	313.6
Potato	Wheat	Wheat	Potato	44.0	393	1.8	364.2
Potato	Wheat	Canola	Potato	41.6	371	1.9	362.2
Potato	Wheat	Dry bean	Potato	37.6	336	2.2	331.5
Potato	Wheat	Pea	Potato	43.4	387	2.2	351.8
Potato	Canola	Wheat	Potato	42.3	377	2.2	418.2
Potato	Bean	Wheat	Potato	43.6	389	2.2	385.0
Potato	Pea	Wheat	Potato	41.3	369	1.9	384.9
Potato	Canola	Dry bean	Potato	36.9	329	2.4	361.5
Potato	Canola	Pea	Potato	39.5	352	2.3	378.8
Potato	Bean	Canola	Potato	42.5	379	2.1	344.3
Potato	Pea	Canola	Potato	41.6	371	2.0	383.4
Analyses of Variance							
Source: Rotation treatment				ns		ns	ns
CV (%)				13.7		18	19.5

[1]Percent tuber surface affected by black scurf.
NS indicates non-significant treatment effects.

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Evaluation of Fungicides for the Control of Potato Diseases

J. Thomson[1], D. Waterer[1]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

***Progress**: Final year*

***Location:** CSIDC, Outlook*

***Objective:** To evaluate seed and in-furrow chemical treatments for control of seed-borne potato diseases.*

A number of diseases are borne on potato seed tubers, while others are present in the soil. Seed treatments reduce the impact of seed-borne disease, while in-furrow treatments generally have greater impact on soil-borne organisms. *Rhizoctonia solani* (black scurf) is both seed and soil-borne, silver scurf (*Helminthosporium solani*) is generally considered a seed-borne pathogen. Common scab (*Streptomyces* spp.) and powdery scab (*Spongospora subterranea*) pathogens are both seed and soil-borne. A trial was conducted to evaluate the effectiveness of various fungicidal treatments in controlling both seed and soil-borne pathogens.

Seven treatments were carried out at the field plots of CSIDC at Outlook. The treatments were replicated five times, in a randomized block design. The treatments were:

1. no chemical applied to seed infected with common and powdery scab
2. no chemical applied to clean seed
3. scab infected seed treated with Shirlan (10% a.i. fluazinam, Syngenta), at 500gm/tonne
4. scab infected seed treated with Dithane F45 (mancozeb, Rohm and Haas), at 160gm a.i./100kg seed
5. scab infected seed treated with Genesis XT (mancozeb, thiophanate-methyl, cymoxanil, imidacloprid, Gustafson) at 500gm/100kg seed
6. scab infected seed treated with Genesis XT at 750gm/100kg seed
7. scab infected seed treated with Genesis (imidacloprid applied as liquid) & Evolve (curzate (cymoxanil), mancozeb, thiophanate-methyl) , applied at 750gm/100kg.

The trial was carried out using Alpha and Norland seed produced on University of Saskatchewan plots in the previous season.

The trial was conducted using standard potato-growing procedures. Seed was planted on May 24 into 8 m rows, with 32 seed pieces per row. Stand counts were taken on July 3, and in the first week of August one plant per row was dug up, and powdery scab root gall development was assessed. No galls were found.

Total, marketable, oversize and small tuber yields were determined. Tubers were assessed for the percentage of the tubers infected with common and powdery scab, silver scurf and black scurf, (disease incidence), and the percentage of the tubers with more than 5% of surface area infected were also recorded (disease severity).

There were no powdery scab lesions on any tubers. None of the treatments had any impact on total or marketable yields of either cultivar.

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There were significant differences in the incidence of common scab, silver scurf and black scurf on Alpha tubers (Table 9). Treatment with Shirlan and Dithane reduced levels of scab, compared with the untreated, infested seed. The incidence of silver scurf was highest on the seed not infected with scab. All chemical treatments except Genesis (low rate) reduced silver scurf levels significantly, compared with untreated seed. Shirlan, Dithane and Genesis (higher rate) all reduced the severity of silver scurf. Incidence of Rhizoctonia was lowest on the untreated seed, and none of the treatments were effective in reducing this disease.

Table 9. Incidence and severity of disease on tubers produced from Alpha seed, 2001.

Chemical treatment	Common scab	Silver scurb		Black scurf
	Incidence	Incidence	Severity	Incidence
Diseased seed	5.6a*	20.0ab	2.4ab	5.6abc
Clean seed	2.0ab	28.4a	2.8a	1.6c
Shirlan on seed	1.6b	1.2c	0c	3.6bc
Dithane on seed	1.2b	0.8c	0c	11.6a
Genesis (500 gm)	5.6a	10.4bc	0.8abc	5.6abc
Genesis (750 gm)	2.4ab	4.0c	0.4bc	8.8ab
Genesis + Evolve	4.0ab	7.2c	0.8abc	6.0abc

*means followed by the same letter are not significantly different. P=0.05

Incidence and severity of common scab were lower on the Norland tubers than on Penta tubers, and there were no significant differences in levels of scab (Table 10). Incidence and severity of silver scurf was also lower on the Norland tubers. The chemical treatments did not reduce disease incidence or severity, compared with the level on the tubers produced by untreated, infected tubers. Black scurf levels were higher on the Norland tubers than on Penta tubers and were not significantly altered by seed treatments.

Table 10. Incidence and severity of disease on tubers produced from treated Norland seed, 2001.

Chemical treatment	Common scab	Silver scurb		Black scurf
	Incidence	Incidence	Severity	Incidence
Diseased seed	0.8a	1.2c*	0b	49.6abc
Clean seed	0.4a	11.2a	1.6a	56.8ab
Shirlan on seed	0a	0.4c	0b	30.0c
Dithane on seed	0a	0c	0b	49.6abc
Genesis (500 gm)	1.2a	1.2c	0b	44.8abc
Genesis (750 gm)	0.4a	2.4c	0.4ab	36.4bc
Genesis + Evolve	1.6a	6.4b	0.8ab	62.8a

*means followed by the same letter are not significantly different. P=0.05

None of the treatments tested improved yields, but they were also not phytotoxic. The incidence of scab on the harvested tubers was very low compared with the level of disease on the planted, mother tubers. Transmission of common scab was slight, and was effectively reduced on Alpha by treatment with Dithane and Shirlan. Although Genesis XT and Evolve both contain mancozeb they were not as effective as mancozeb applied alone (Dithane). This may reflect the higher rate of mancozeb (160gm ai per 100kg seed) in the Dithane treatment. All products appeared to reduce the incidence of silver scurf on Alpha tubers, where the incidence of infection was high on the mother tubers (42%). There were very low levels of silver scurf on the Norland tubers planted (7%), and daughter tubers showed similar low levels, regardless of treatments.

CSIDC Vegetable Demonstrations 2001

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Progress: *Ongoing*

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

The opportunities for Saskatchewan irrigation producers to diversify into vegetable production is very large. Saskatchewan currently produces only 7% of its “in-season” vegetables while Alberta and Manitoba produce 33% and 57% respectively. Saskatchewan consumers spend an estimated $25 million annually on fresh vegetables that could be grown in the province.

To help existing and potential producers enter into commercial vegetable production, the CSIDC has been demonstrating modern production techniques and have developed “Saskatchewan- based” costs of production and returns for selected vegetables (see the CSIDC Annual Review 2000-2001 for details). These demonstrations and economic analysis have generated considerable interest in vegetable production.

In 2001, the CSIDC continued this demonstration. Peppers, celery, cantaloupe, and pumpkins were produced utilizing modern production techniques such as plastic mulch, drip irrigation, and mini-tunnels. Specialized equipment including a mulch/drip-tape layer and a water wheel planter were demonstrated. Due to the long and warm summer, yields and quality of the produce were very good. Wholesale buyers and retailers were very impressed with the quality of the produce.

CSIDC is also demonstrating the use of “high tunnels” to produce high-value warm season vegetables. High tunnels are essentially greenhouses with no artificial heat or artificial ventilation. Peppers, tomatoes, and cantaloupe were grown with high yields, superior quality and excellent economic returns (see the CSIDC Annual Review 2000-2001). The demonstration continued in 2001 using cantaloupe as the main crop; watermelon and honeydew melons as observational crops. Yields and quality of the cantaloupe were comparable to previous years. The water melon and honeydew melon also produced excellent yields. Quality was excellent and well received by wholesalers and retailers.

Another sector that has the potential for development is greenhouse vegetable production. CSIDC began a project demonstrating the production of cucumbers, peppers, tomatoes, and lettuce in a greenhouse environment. Yields, fruit quality, costs and returns, and production practices are being collected to assist existing and potential greenhouse producers with their management decisions.

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Native Fruit Evaluation Trials at the CSIDC

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Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

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 Trials

Yield, fruit size, shoot growth and suckering data were collected from trials located at the University of Saskatchewan and at the Canada-Saskatchewan Irrigation Diversification Centre in Outlook (Table 11). Shoot growth and sucker production did not differ substantially between cultivars or sites. Yield from most chokecherry cultivars was lower than previous years. However, the selection Espenant yielded the per-acre equivalent of 10,500 lbs of fruit, based on a plant density of 800 plants/acre.

Table 11. Chokecherry Cultivar Trials 2001 - mean growth, yield and fruit size (+/- standard error).

Site	Cultivar	Shoot growth (cm)	New sucker production	Yield (kg/bush)	# of Fruit per cup
Outlook	Boughen Yellow	16.9 +/- 4.59	2.6 +/- 1.2	4.4 +/- 0.6	349 +/- 28.0
	Garrington	18.8 +/- 3.51	2.2 +/- 0.9	3.6 +/- 0.5	272 +/- 34.0
	Lee Red	17.7 +/- 3.23	2.1 +/- 0.3	4.0 +/- 0.6	230 +/- 12.8
U. of S.	Boughen Yellow	15.1 +/- 2.33	3.6 +/- 1.1	3.3 +/- 0.8	254 +/- 19.4
	Copper Schubert	18.5 +/- 2.65	1.7 +/- 0.5	2.7 +/- 0.7	201 +/- 12.1
	Espenant	17.2 +/- 2.40	1.8 +/- 1.3	6.0 +/- 1.0	226 +/- 5.49
	Garrington	17.2 +/- 3.94	2.3 +/- 0.8	2.3 +/- 0.8	243 +/- 6.81
	Goertz	19.0 +/- 2.75	2.2 +/- 1.6	2.6 +/- 0.4	214 +/- 10.2
	Lee	14.9 +/- 1.94	0.9 +/- 0.7	3.6 +/- 0.6	191 +/- 2.19
	Maxi	17.1 +/- 1.43	2.4 +/- 1.4	0 +/- 0	na
	Mission Red	17.0 +/- 4.42	1.8 +/- 0.4	2.0 +/- 0.4	328 +/- 14.5
	Robert	16.3 +/- 2.82	4.7 +/- 2.3	2.3 +/- 0.8	212 +/- 5.51

Pincherry Trials

Shoot growth, yield and fruit size data were collected from the pincherry cultivar trials located at the University of Saskatchewan and the Canada-Saskatchewan Irrigation Diversification Centre, Outlook. The cultivar Lee #4 yielded the most fruit, averaging 5,400 lbs/acre over both trial sites based on a plant density of 800 plants/acre. Fruit yields at the University of Saskatchewan location were lower than at Outlook but the fruit at the U of S were larger (Table 12). Many pincherry fruit dropped from the plants at the University of Saskatchewan during a windstorm in late-July.

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Table 12. Pincherry Cultivar Trials 2001 - mean growth, yield and fruit size (+/- standard error).				
Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook	Jumping Pound	7.1 +/- 2.7	2.09 +/- 0.79	402 +/- 28.5
	Lee #4	4.8 +/- 0.8	3.51 +/- 0.52	392 +/- 44.2
	Mary Liss	11.1 +/- 2.7	2.26 +/- 0.42	369 +/- 25.8
U. of S.	Jumping Pound	17.9 +/- 1.9	1.23 +/- 0.51	275 +/- 33.8
	Lee #4	17.4 +/- 2.7	2.67 +/- 0.48	243 +/- 1.00
	Mary Liss	17.2 +/- 0.7	0.92 +/- 0.20	230 +/- 9.84

Highbush Cranberry Trials

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 13). Yields of highbush cranberry were down from the previous season at both trial locations. Fruit production at Outlook was very low and the fruit were relatively small. The cultivar Phillips continues to under-perform the other cultivars in these trials. It appears 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 3,250 lbs/ac between them based on a plant density of 800 plants per acre. Shoot growth was similar at both locations and among cultivars.

Table 13. Highbush Cranberry Cultivar Trials 2001 - mean growth, yield and fruit size (+/- standard error).				
Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook	Alaska	41.6 +/- 2.2	0.70 +/- 0.18	306 +/- 12.6
	Phillips	30.7 +/- 1.2	0 +/- 0	na
	Wentworth	31.8 +/- 3.5	0.70 +/- 0.10	401 +/- 22.7
U. of S.	Alaska	37.8 +/- 2.9	1.78 +/- 0.11	245 +/- 10.7
	Andrews	23.7 +/- 2.7	0 +/- 0	na
	Espenant	30.8 +/- 0.4	0.48 +/- 0.19	324 +/- 42
	Garry Pink	33.2 +/- 4.2	1.70 +/- 0.34	275 +/- 15.6
	Manito	43.4 +/- 0.6	2.09 +/- 0.27	231 +/- 16.0
	Phillips	28.7 +/- 4.1	0 +/- 0	na
	Wentworth	31.7 +/- 4.8	1.81 +/- 0.14	274 +/- 6.93

Black Currant Trials

Yield, fruit size and growth data were collected from two sites at the University of Saskatchewan and from the cultivar trial located at the Canada-Saskatchewan Irrigation Diversification Centre (Outlook) (Table 14). Yields were very low in all the trials and only three cultivars (Ben Alder, Ben Nevis & McGinnis Black) produced bush yields greater than 1 kg. Fruit drop caused by high temperatures during fruit development likely contributed to reduced yields. Assuming a 1300 plant per acre planting density, yields were 3,520 lbs/ac for Ben Alder, 3,060 lbs/ac for Ben Nevis and 3,830 lbs/ac for McGinnis Black. The size of fruit produced during the 2001 season also was smaller than that of the 2000 season.

Table 14. Black Currant Cultivar Trials 2001 - mean growth, yield and fruit size (+/- standard error).

Site	Cultivar	Shoot growth (cm)	Yield (kg/bush)	# of Fruit per cup
Outlook[1]	Consort	5.0 +/- 1.7	0.87 +/- 0.07	388 +/- 29.5
	Wellington	7.1 +/- 21	0.51 +/- 0.10	265 +/- 14.1
	Willoughby	8.4 +/- 1.8	0.38 +/- 0.07	301 +/- 12.7
U. of S. Site 1[1]	Black Giant	23.1 +/- 1.3	0 +/- 0	na
	Boskoop Giant	18.7 +/- 2.7	0.05 +/- 0.05	412 +/- 121
	Consort	17.5 +/- 4.4	0.23 +/- 0.19	286 +/- 52
	Coronet	17.5 +/- 0.3	0.13 +/- 0.07	496 +/- 52.2
	Crusader	16.1 +/- 2.0	0.05 +/- 0.04	545 +/- 65.7
	Magnus	14.0 +/- 2.9	0.23 +/- 0.04	339 +/- 37.7
	45068	16.4 +/- 1.4	0.18 +/- 0.02	234 +/- 10.2
	15483	15.6 +/- 1.5	0.17 +/- 0.05	257 +/- 23.9
	39956	21.8 +/- 1.9	0.04 +/- 0.01	448 +/- 48.5
	Topsy	16.1 +/- 1.4	0.41 +/- 0.06	362 +/- 18.9
	Wellington	12.3 +/- 2.8	0.19 +/- 0.09	377 +/- 80.6
	Willoughby	14.4 +/- 1.2	0.21 +/- 0.06	285 +/- 16.5
U of S Site 2[2]	Ben Alder	22.8 +/- 2.4	1.23 +/- 0.13	217 +/- 21.4
	Ben Lomond	39.3 +/- 3.3	0.28 +/- 0.11	271 +/- 24.9
	Ben Nevis	34.4 +/- 3.6	1.07 +/- 0.20	212 +/- 4.9
	Ben Sarek	40.4 +/- 4.5	0.33 +/- 0.18	171 +/- 16.6
	Consort	45.8 +/- 4.7	0.18 +/- 0.05	339 +/- 19.5
	Crusader	46.2 +/- 3.2	0.23 +/- 0.09	379 +/- 9.2
	Magnus	35.7 +/- 3.0	0.75 +/- 0.17	304 +/- 19.9
	McGinnis Black	22.1 +/- 0.9	1.34 +/- 0.21	186 +/- 14.7
	Noir de Bourgogne	33.8 +/- 3.6	0.31 +/- 0.04	299 +/- 16.8
	39956	37.6 +/- 2.2	0.12 +/- 0.04	249 +/- 9.5
	Titania	34.0 +/- 5.0	0.16 +/- 0.03	204 +/- 13.9
	Wellington	42.9 +/- 9.2	0.32 +/- 0.07	213 +/- 27.5

[1]Note that 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]

Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

Progress: *Year five of five*

Location: *CSIDC, Outlook*

Objective:
- To evaluate the adaptability of promising herbs to Saskatchewan growing conditions,
- To develop labour saving management practices for mechanized commercial production,
- To identify appropriate production and harvest methods to increase yield and improve quality, and
- To compare the effects of dryland and irrigated production on yield and quality.

The herb and spice industry is expanding very rapidly in Canada including Saskatchewan. The Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) has expanded the herb research and development program with the objective of developing cost-effective and labour saving production practices for commercial scale production of important herbs. This is the final year of a project that was conducted with funding from the Canada-Saskatchewan Agri-Food Innovation Fund, and with directions from the Saskatchewan Herb and Spice Association. Agronomic studies are being conducted for *Echinacea angustifolia*, feverfew, milk thistle, stinging nettle, and St John's wort. Many other aromatic, culinary, and medicinal herbs are also being evaluated in observational plots.

The goals of the CSIDC's herb research and development project include:
- evaluating the adaptability of promising herbs for Saskatchewan growing conditions,
- developing labour saving management practices for mechanized commercial irrigated and dryland production,
- identifying appropriate production practices, harvest methods to maximize yields of high quality herbs under irrigation and dryland, and
- identify primary processing and storage management practices to maintain superior quality (joint work Department of Agricultural Bio-Resource Engineering, University of Saskatchewan).

The studies were conducted at the field plots of the CSIDC, Outlook. The treatments and production practices employed for *Echinacea,* St. John's Wort, feverfew, milk thistle, and stinging nettle trials are similar to the previous years. Feverfew and St. John's wort transplants were raised in the greenhouse. Field transplanting was done with a Water-wheel Planter. A between-row spacing of 60 cm (24 in) and a within-row spacing of 30 cm (12 in) were utilized for all tests except for the plant population studies. For the plant population studies, plant populations were adjusted by varying the within-row spacing while maintaining the between-row spacing constant at 60 cm (24 in). Milk thistle was direct seeded using a small-plot double-disc press drill. For the irrigation studies, soil moisture status was maintained at approximately 50% Field Capacity through supplemental irrigation using over-head sprinklers.

Plant material from the various field trials have been sent to the Herb Research Program, Department

[1]*CSIDC, Outlook*

of Plant Sciences, University of Saskatchewan for quality analysis.

The 2001 growing season (May to September) was relatively warmer and considerably drier than the long-term average (Figure 11a 11b). The year 2001 growing season received only 135 mm (5.3 in) of rain compared to the long-term average of 219 mm (8.6 in) (Figure 11a). The entire growing season experienced above average minimum temperatures while early spring and the latter part of the growing season experienced substantially higher maximum temperatures (Figure 11b).

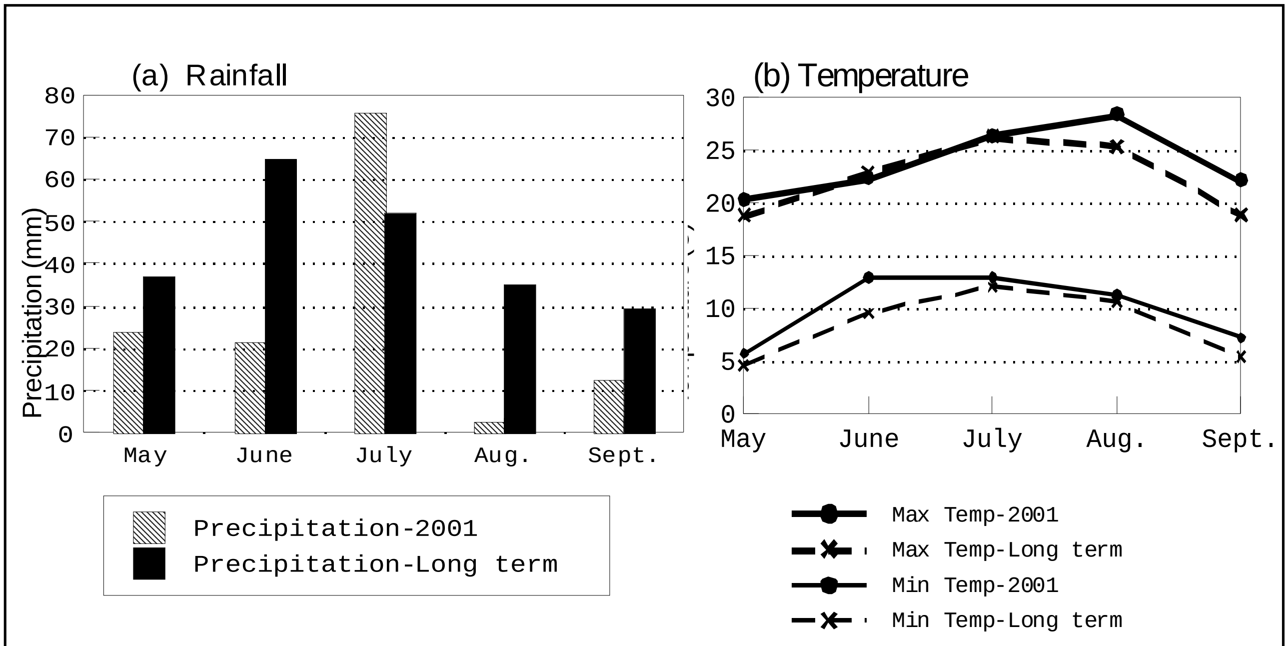

Figure 1. Temperature and rainfall for 2001 growing-season and the long-term average.

Echinacea Angustifolia

Direct Seeded Crop:

Seeding rate and row spacing effects on yield and quality for direct seeded crop grown under dryland and irrigation

Inherent seed dormancy and the requirement of light for germination renders *Echinacea* a difficult crop for direct seeding. Consequently, *Echinacea* is generally produced using transplants. Raising *Echinacea* from transplants requires high capital and labour inputs. This study examines the feasibility of direct seeding *Echinacea angustifolia* with the objective of reducing transplanting costs.

Five seeding rates (60, 90, 120, 150, 180 seeds/m^2; 6, 8, 11, 14, 17 seeds/ft^2) and two row spacings (41, 61 cm; 16, 24 in) were tested under both dryland and irrigated conditions. The test was seeded on July 2, 1997 and harvested on October 9, 2001.

The coefficients of variation for the dry root weights in this test, particularly under dryland, were relatively high. This is likely due to variability in root development of individual plants (Table 15).

Echinacea angustifolia grown under irrigation produced on average over double the root yield of the dryland crop (Table 15).

Seeding rate or row spacing had no significant effect on root yields under dryland or irrigation (Table 15). Dry root yields ranged between 326 kg/ha (291 lb/ac) and 624 kg/ha (557 lb/ac) under dryland and between 814 kg/ha (727 lb/ac) and 1024 kg/ha (914 lb/ac) under irrigation. Narrow (41 cm; 16 in) and wide (61 cm; 24 in) plant spacings produced similar root yields both under dryland and irrigation.

Fertilizer response studies for direct seeded Echinacea angustifolia

Presently, *Echinacea angustifolia* is grown under small scale organic and non-organic conditions. Effective fertilizer management is essential to increase yields and improve quality. Information on fertility management for direct-seeded *Echinacea angustifolia* is not available for Saskatchewan or the prairies. This study examines the effects of nitrogen and phosphorus application on root yield under irrigated production.

Two nitrogen rates (50, 100 kg N/ha; 45, 90 lb N/ac), two methods of nitrogen application (Spring only, ½ at spring + ½ at fall), and two phosphorus rates (50, 100 kg P_2O_5/ha; 45, 90 lb P_2O_5/ac) were evaluated under irrigation. The crop was seeded on July 2, 1997 using an average seeding rate of 120 seeds/m^2 (11 seeds/ft^2) and a row spacing of 61 cm (24 in). The roots were harvested on October 9, 2001.

The rate and time of nitrogen application or the rate of phosphorus application had no effect on dry root yields (Table 16).

Table15. Seeding rate and row spacing effects on dry root yield for direct seeded *Echinacea angustifolia* grown under dryland and irrigation: fourth-year crop.

Seeding rate (seeds/m^2)	Dry root yield			
	Dryland		Irrigation	
	kg/ha	lb/ac	kg/ha	lb/ac
60	327	292	940	839
90	326	291	814	727
120	624	557	1010	902
150	401	358	966	863
180	511	456	1024	915
Row spacing (cm)				
41	396	354	939	839
61	426	380	963	860
Analyses of Variance				
Source				
Seeding rate (R)	NS		NS	
Row spacing (S)	NS		NS	
R x S	NS		NS	
CV (%)	73.8		36.2	

NS indicates non-significant treatment effects.

The 50 kg (45 lb) rates of N and P_2O_5 produced slightly (non-significant) higher root yields relative to 100 kg (90 lb) rates of N and P_2O_5. Split application of nitrogen produced slightly(non-significant) higher yield than the single application of nitrogen.

Transplanted Crop:

Comparison of planting material types for transplanted Echinacea angustifolia

Raising *Echinacea* transplants for spring planting requires heated greenhouse facilities at substantial additional cost. Alternatively, transplants can be raised during the fall and overwintered in a straw-covered pit, and planted in the following spring. The second method does not require any specialized growth structures, thereby reducing cost. This study was designed to compare the root yield potential of different methods of producing and over-wintering *Echinacea angustifolia* transplants.

Transplant production:

Production season	Over-wintering	Container type
1. 1997 fall	Heated greenhouse	50-cell plug tray
2. 1997 fall	Straw covered pit	50-cell plug tray
3. 1998 spring	---	50-cell plug tray
4. 1998 spring	---	Bare root

The various transplant types were evaluated under irrigation utilizing 15, 30 cm (6, 12 in) within-row spacing and 61 cm (24 in) between row spacing. The test was established on June 11, 1998 and harvested on October 9, 2001.

Echinacea angustifolia established using transplants raised in plug trays produced higher root yields than the crop established using bare-root transplants (Table 17). The yield advantage by using transplant plugs ranged from 40% to over two-fold dry root yields relative to bare-root transplants.

Table 17. Effect of planting material and plant spacing on dry root yield for transplanted *Echinacea angustifolia* grown under dryland and harvested three years after planting.

Treatment type	Dry root yield					
	15 cm (6 in) spacing		30 cm (12 in) spacing		Mean	
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
Transplant type						
Raised during fall 1997 and grown in greenhouse during winter	718	641	526	470	622	556
Raised during fall 1997 and over-wintered in a straw covered pit	772	689	600	536	686	613
Transplants raised in 1998 and grown in plug trays	1031	921	881	787	956	854
Bare-root transplants raised in 1998	557	497	329	294	443	396
Mean	769	687	584	522		
Analysis of Variance						
Source						
Planting material (P)	***(308)					
Spacing (S)	***					
P x S	NS					
CV (%)	45.8					

*** and NS indicate significance at P<0.01 level of probability and not significant respectively.
Values within parenthesis are LSD estimate at 5% level of significance.

Plants spaced at 15 cm (6 in) within-row produced on the average 769 kg/ha (687 lb/ac) dry root relative to a yield of 584 kg/ha (521 lb/ac) for the wider 30 cm (12 in) within-row spacing (Table 7).

Interactive effects of nitrogen, phosphorus and harvest age on root yield for transplanted Echinacea angustifolia

Echinacea angustifolia roots are generally harvested three to four years after planting. Recent studies show that younger roots have higher concentration of marker compounds than older roots. However, the root yield can be lower when harvested at an early stage. This study examines the influence of fertilizers on root yield and active ingredient levels for *Echinacea angustifolia* when harvested at different crop ages.

Two nitrogen rates (50, 100 kg N/ha; 45, 90 lb/ac), two application methods (Spring only, ½ at spring + ½ at fall), and two phosphorus rates (50, 100 kg P_2O_5/ha; 45, 90 lb P_2O_5/ac) were examined for transplanted *Echinacea angustifolia*. Plants were spaced 61 cm (24 in) between rows and 31 cm (12 in) within-row. The crop was established in July of 1997 and 1998 and harvested in October 2001.

Table 18. Nitrogen and phosphorus effects on dry root yield for transplanted *Echinacea angustifolia* grown under irrigation and harvested three and four years after planting.

Treatment		Dry root yield			
		Year three		Year four	
		kg/ha	lb/ac	kg/ha	lb/ac
Nitrogen rate	50 kg N/ha (45 lb N/ac)	3191	2850	2582	2306
	100 kg N/ha (90 lb N/ac)	3134	2799	3133	2798
Time of application	Spring	3061	2733	2340	2090
	Spring & fall	3264	2915	3374	3013
Phosphorus rate	50 kg P_2O_5/ha (45 lb P_2O_5/ac)	2888	2579	2681	2394
	100 kg P_2O_5/ha (90 lb P_2O_5/ac)	3438	3070	3033	2708
Analyses of Variance					
Source					
Nitrogen rate (N)					
Nitrogen application (A)		NS		NS	
Phosphorus rate (P)		NS		NS	
N x A		NS		NS	
N x P		NS		NS	
A x P		NS		NS	
N x A x P		NS		NS	
CV (%)		57.3		37.4	

NS indicates non-significant treatment effects.

Summary of dry root yields in relation to nitrogen (rate and timing) and phosphorus (rate) is presented in Table 18. The root yields for fourth-year crop was slightly lower (10%) than the third-year crop. The reason for this yield depression is not clear at the present time. High variability in this trial resulted in lack of treatment effects. The trends observed in this study were (i) higher rates of nitrogen produced higher root yields for the fourth-year crop, by contrast root yields were similar for both nitrogen rates for the third-year crop, (ii) split application of nitrogen produced higher root yields than single application (spring only) for the two age classes, and (iii) higher levels of phosphorus produced slightly higher yield.

Spacing and fertilizer effects for transplanted Echinacea angustifolia

Under commercial scale production, appropriate agronomic practices should be adopted to maximize yields. This includes suitable plant populations and proper fertility management practices. It is likely that the response to fertility levels and plant populations can vary between dryland and irrigated production. This study examines the interactive effects of nitrogen, phosphorus and plant population for transplanted *Echinacea angustifolia* grown under dryland and irrigated conditions.

Two within-row plant spacings (15, 30 cm; 6, 12 in), three nitrogen levels (0, 75, 150 kg N/ha; 0, 68, 136 lb N/ac), and two phosphorus levels (0, 60 kg P_2O_5/ha; 0, 54 lb P_2O_5/ac) were evaluated for dryland and irrigated crops. The test was established on June 10 & 11, 1997 and harvested on October 9, 2001.

Root yields were relatively low under both dryland and irrigation (Table 19).

Under irrigated production, the 15 cm (6 in) within-row spacing produced 57% higher dry root yields than the 30 cm (12 in) within-row spacing, whereas the two plant spacing produced similar yields under dryland (Table 19).

Higher nitrogen rates tended to depress root yields. This effect reached significant proportions under dryland but not under irrigation (Table 19).

Application of phosphorus fertilizer (60 kg P_2O_5/ha; 54 lb P_2O_5/ac) did not produce any yield differences compared to the no fertilizer treatment under the two growing conditions (Table 19).

Table 19. Plant spacing, nitrogen and phosphorus effects on dry root yield for transplanted *Echinacea angustifolia* grown under dryland and irrigation: fourth-year crop.

Treatment		Dry root yield			
		Dryland		Irrigation	
		kg/ha	lb/ac	kg/ha	lb/ac
Spacing	15 cm (6 in)	451	403	659	588
	30 cm (12 in)	404	361	421	376
Nitrogen rate	0 kg N/ha (0 lb N/ha)	581	519	650	580
	75 kg N/ha (67 lb N/ha)	418	373	575	513
	150 kg N/ha (53 lb N/ha)	283	253	394	352
Phosphorus rate	0 kg P_2O_5/ha (0 lb P_2O_5/ac)	431	385	516	461
	60 kg P_2O_5/ha (53 lb P_2O_5/ac)	424	379	563	503
Analyses of Variance					
Source					
Spacing (S)		NS		**(184)	
Nitrogen (N)		**(171)		NS	
Phosphorus (P)		NS		NS	
S x N		NS		NS	
S x P		**(197)		NS	
N x P		NS		NS	
S x N x P		NS		NS	
CV (%)		55.7		57.3	

** and NS indicate significance at P<0.01 level of probability and not significant respectively.
Values within parenthesis are LSD estimates at 5.0% level of significance.

Feverfew

Spacing and fertilizer effects for transplanted feverfew

Under commercial scale production, suitable agronomic practices should be adopted to maximize yields. This includes suitable plant populations and proper fertility management practices. It is likely that the response to fertility levels and plant populations can vary between dryland and irrigated production. This study examines the interactive effects of nitrogen, phosphorus and plant population for transplanted feverfew.

Two within-row plant spacings (15, 30 cm; 6, 12 in) three nitrogen levels (0, 50, 150 kg N/ha; 0, 45, 135 lb N/ac) and two phosphorus levels (0, 60 kg P_2O_5/ha; 0, 54 lb P_2O_5/ac) were evaluated under irrigation. The test was planted on July 5 and the harvest was taken at 10% flower stage (August 24). Plants were harvested approximately 10 cm (4 in) above ground.

Closer within-row spacing (15 cm) produced 38% higher fresh herbage yield and 28% higher dry herbage yields relative to the 30 cm spacing (Table 20).

Significant nitrogen effects were observed on fresh and dry herbage yields. It is not clear why the yields are lower for the intermediate nitrogen level (50 kg N/ha) compared to the no nitrogen control or the higher 100 kg N/ha application (Table 20).

Phosphorus application had no effect on fresh and dry herbage yields of feverfew grown under irrigation (Table 20).

Table 20. Plant spacing and fertility effects on fresh and dry herbage yield for feverfew grown under irrigation.

Treatment		Irrigated yield			
		Fresh		Dry	
		t/ha	tons/ac	t/ha	tons/ac
Spacing	15 cm (6 in)	13.8	6.16	3.2	1.43
	30 cm (12 in)	10.0	4.46	2.5	1.12
Nitrogen rate	0 kg N/ha (0 lb N/ac)	13.0	5.80	3.1	1.38
	50 kg N/ha (45 lb N/ha)	10.2	4.55	2.5	1.12
	100 kg N/ha (89 lb N/ha)	12.5	5.58	3.0	2.49
Phosphorus rate	0 kg P_2O_5/ha (0 lb P_2O_5/ac)	12.0	5.35	2.8	1.25
	60 kg P_2O_5/ha (53 lb P_2O_5/ac)	11.8	5.26	2.9	1.29
Analyses of Variance					
Source					
Spacing (S)		***(1.8)		***(0.4)	
Nitrogen (N)		*(2.2)		*(0.5)	
Phosphorus (P)		NS		NS	
S x N		NS		NS	
S x P		NS		NS	
N x P		NS		NS	
S x N x P		NS		NS	
CV (%)		21.6		20.4	

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

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

Different herb buyers tend to prefer feverfew harvested at different growth stages such as prior to flowering, during early flowering, or at full bloom. This study examines the interactive effects plant spacings and harvest stages on herbage yield and quality characteristics for transplanted feverfew grown under dryland and irrigated conditions.

Treatments in this study included two within-row plant spacings (15, 30 cm; 6, 12 in) and three harvest stages (Pre-flower, 10% flower, 100% flower). This study was conducted both under irrigated and dryland conditions. Test plots were planted on July 5, 2001 and harvests were taken on August 17, 24, and 31 that corresponded to the pre-determined harvest stages.

Irrigated feverfew on average produced 86% higher fresh herb yield and 64% higher dry herb yield than the dryland crop (Table 21).

Table 21. Plant spacing and harvest stage effects on dry herbage yield for feverfew grown under dryland and irrigation.

Treatment		Dryland yield				Irrigated yield			
		Fresh		Dry		Fresh		Dry	
		t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac
Spacing	15 cm (6 in)	5.6	2.5	1.5	0.7	10.7	4.8	2.7	1.2
	30 cm (12 in)	4.4	2.0	1.2	0.5	7.9	3.5	1.9	0.8
Harvest stage	Pre-flower	4.2	1.9	1.3	0.6	7.0	3.1	2.6	1.2
	10% flower	5.2	2.3	1.1	0.5	8.3	3.7	1.7	0.8
	100% flower	5.6	2.5	1.5	0.7	12.6	5.6	2.8	1.3
Analyses of Variance									
Source									
Spacing (S)		**(0.8)		**(0.2)		*(2.3)		NS	
Nitrogen (N)		*(0.8)		NS		**(2.8)		NS	
Phosphorus (P)		NS		NS		NS		NS	
CV (%)		15.5		16.9		24.7		49.0	

**, *, and NS indicate significance at P<0.01, 0.5 levels of probability and not significant respectively.
Values within parenthesis are LSD estimates at 5.0% level of significance.

Closer plant spacing produced significantly higher herb yields than wider plant spacing under both dryland and irrigation (Table 21). Under irrigation 15 cm (6 in) plant spacing produced approximately 25% higher fresh and dry yields compared to the 30 cm (12 in) plant spacing. Under dryland closer spacing produced 35% higher fresh yield and 42% higher dry herb yield relative to wider spacing.

Harvesting feverfew at the pre-flowering stage produced the lowest yield. Harvesting at more advanced stages (10% and 100% flowering) generally produced higher fresh and dry herb yields under both dryland and irrigated conditions (Table 21).

Milk Thistle

Seeding rate and row spacing effects on plant stand, seed yield and quality

Milk thistle is a late maturing species with indeterminate growth and flowering habit. Under relatively short Saskatchewan growing conditions, the later formed flowers may not mature. Cool environmental conditions and excess moisture can further delay flowering and maturity. This study examines the effects of seeding rate and row spacing on yield and quality of milk thistle grown under dryland.

This study examined three seeding rates (50, 100, 200 seeds/m^2; 5, 9, 19 seeds/ft^2) and three row spacings (20, 40, 60 cm; 8, 16, 24 in). The crop was seeded on May 8, 2001, desiccated with Reglone and harvested on September 5, 2001.

Milk thistle produced on average 275 kg/ha (245 lb/ac) good quality seed when the crop was harvested once-over using a conventional combine. Seeding rate or row spacing had no significant effect on seed yield (Table 22).

Table 22. Seeding rate and row spacing effects on seed yield for milk thistle grown under dryland.

Treatment		Seed yield	
		kg/ha	lb/ac
Seeding rate	50 seeds/m^2 (5 seeds/ft^2)	274	245
	100 seeds/m^2 (9 seeds/ft^2)	277	247
	200 seeds/m^2 (19 seeds/ft^2)	273	244
Row spacing	20 cm (8 in)	233	208
	40 cm (16 in)	308	275
	60 cm (24 in)	283	253
Analyses of Variance			
Source			
Seeding rate (S)		NS	
Row spacing (R)		NS	
S x R		NS	
CV (%)		41.8	

NS indicates non-significant treatment effects.

Fertilizer response study

This study examines the effects of seeding rate in combination with nitrogen and phosphorus application on yield and quality of milk thistle grown under dryland.

This study examined three seeding rates (50, 100, 200 seeds/m^2; 5, 9, 19 seeds/ft^2), three nitrogen levels (0, 50, 100 kg N/ha; 0, 45, 90 lb N/ac) and three phosphorus levels(0, 60, 120 kg P_2O_5/ha; 0, 54, 108 kg P_2O_5/ac). The crop was seeded on May 8, 2001 and harvested on September 5, 2001 after desiccation with Reglone.

Milk thistle yielded on average 266 kg/ha (237 lb/ac) good quality seed. Seeding rate, nitrogen, or phosphorus had no effect on seed yield (Table 23).

A significant seeding rate x nitrogen interaction was observed in this test. It was evident that at 200 seeds/m^2 seeding rate, increase in nitrogen tended to depress seed yield (Figure 12). By contrast, at 100 seeds/m^2 (9 seeds/ft^2) seeding rate, increase in nitrogen application tended to increase seed yields.

Table 23. Seeding rate and fertility effects on seed yield for milk thistle grown under dryland.

Treatment		Seed yield kg/ha	Seed yield lb/ac
Seeding rate	50 seeds/m^2 (5 seeds/ft^2)	264	236
	100 seeds/m^2 (9 seeds/ft^2)	241	215
	200 seeds/m^2 (19 seeds/ft^2)	292	261
Nitrogen rate	0 kg N/ha (0 lb N/ha)	299	267
	50 kg N/ha (45 lb N/ha)	250	223
	100 kg N/ha (90 lb N/ha)	248	222
Phosphorus rate	0 kg P_2O_5/ha (0 lb P_2O_5/ac)	266	238
	60 kg P_2O_5/ha (53 lb P_2O_5/ac)	268	239
	120 kg P_2O_5/ha (107 lb P_2O_5/ac)	262	234
Analyses of Variance			
Source			
Seeding rate (S)		NS	
Nitrogen (N)		NS	
Phosphorus (P)		NS	
S x N		**(109)	
S x P		NS	
N x P		NS	
S x N x P		NS	
CV (%)		63.4	

** and NS indicate significance at P<0.01 level of probability and not significant respectively.
Value within parenthesis is LSD estimate at 5.0% level of significance.

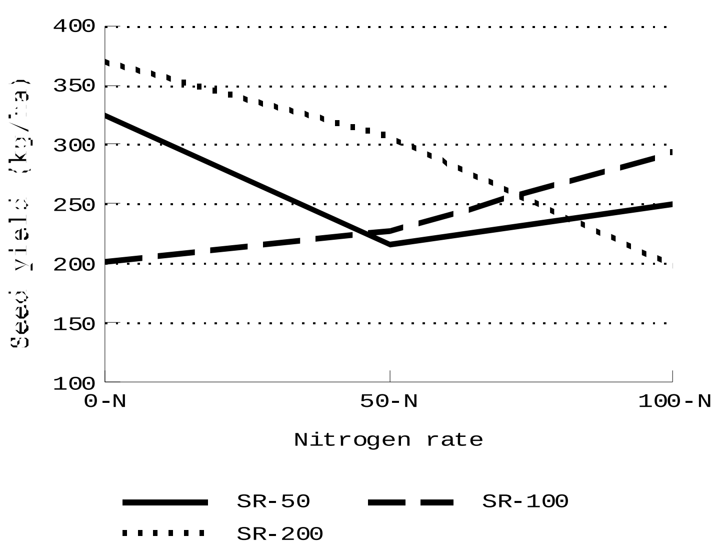

Figure 2. Milk thistle seed yields in response to nitrogen and seeding rate effects.

Stinging Nettle

Planting material comparison under dryland and irrigation

Stinging nettle is a hardy perennial with extremely small seeds. Commercially, stinging nettle can be grown using transplants. This study was established in 1997and was intended to examine the effects of plant material on herbage yield.

Transplant production:

Production season	Over-wintering	Container type
1. 1997 fall	Heated greenhouse	50-cell plug tray
2. 1997 fall	Straw covered pit	50-cell plug tray
3. 1998 spring	---	50-cell plug tray

The various transplant types were evaluated under irrigation and dryland conditions and harvested on August 16, 2001.

Stinging nettle grown under irrigation produced over three times higher fresh and dry herbage yields than the dryland crop (Table 24).

Under dryland, the 1997-greenhouse transplants produced the lowest herbage yield while transplants overwintered in the pit produced the highest yield (Table 24). By contrast, under irrigation, the 1998-transplants produced the highest yields. Further work is required to determine this differential response.

Table 24. Effect of planting material on fresh and dry shoot yield for stinging nettle grown under dryland and irrigation.

	Herbage yield							
	Dryland				Irrigation			
	Fresh weight		Dry weight		Fresh weight		Dry weight	
Treatment	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac
Transplant type								
1997-greenhouse[1]	9.0	4.0	2.9	1.3	38.9	17.4	11.7	5.2
1997-pit[2]	13.0	5.8	4.8	2.2	20.0	8.9	6.2	2.8
1998 transplants[3]	12.3	5.5	4.4	2.0	50.9	22.7	17.5	7.8
Analyses of Variance								
Source Planting material (P)	**(2.4)		**8(0.7)		***(5.6)		***(1.9)	
CV (%)	16.6		16.2		14.3		14.7	

[1]Transplants raised during fall 1997/grown in greenhouse during winter.
[2]Transplants raised during fall 1997/over-wintered in a straw covered pit.
[3]Transplants raised in 1998: plug trays.
*** and ** indicates significance at P<0.001 and 0.01 levels of probability respectively.
Values within parenthesis are LSD estimates at 5.0% level of significance.

Fertility studies for transplanted stinging nettle grown under dryland and irrigation

Both stinging nettle root and shoot are used by the industry. It is likely that fertilizer application and production conditions (dryland or irrigation) can influence crop growth and root:shoot ratio. This study examines the effects of nitrogen and phosphorus application on root and shoot yield.

Two nitrogen rates (50, 100 kg N/ha; 45, 90 lb N/ac), two methods of nitrogen application (Spring only, ½ at spring and ½ at fall), and two phosphorus rates (50, 100 kg P_20_5/ha; 45, 90 lb P_2O_5/ac) were evaluated under irrigation and dryland. The herbage yield was taken on August 16, 2001.

Stinging nettle grown under irrigation on average produced double the fresh and dry shoot yield relative to dryland (Table 25). Irrigated stinging nettle produced 28.4% higher dry root yield than dryland production (Table 25).

Nitrogen rate, nitrogen timing, or phosphorus rate had no effect on fresh and dry shoot yields and dry root yields under both dryland and irrigation (Table 25).

Plant material is being analysed for active ingredient profile in relation to fertilizer effects for both irrigated and dryland production.

Table 25. Nitrogen (rate and timing) and phosphorus (rate) effect on fresh and dry shoot yield and dry root yield for transplanted stinging nettle grown under dryland and irrigation: fourth-year crop.

		Herbage yield											
		Dryland						Irrigation					
		Fresh shoot		Dry shoot		Dry root		Fresh shoot		Dry shoot		Dry root	
Treatment		t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac
Nitrogen rate	50 kg N/ha (45 lb N/ac)	16.7	7.5	5.2	2.3	23.3	10.4	29.8	13.3	10.0	4.6	28.3	12.6
	100 kg N/ha (90 lb N/ac)	15.3	6.8	4.8	2.2	21.6	9.6	32.1	14.3	10.8	4.8	28.4	12.7
Nitrogen application	Spring	16.7	7.5	5.1	2.3	23.1	10.3	30.6	13.7	10.3	4.6	28.6	12.8
	Spring & fall	14.7	6.6	4.7	2.1	21.3	9.5	31.4	14.0	10.5	4.7	28.1	12.5
Phosphorus rate	50 kg P_2O_5/ha (45 lb P_2O_5/ac)	16.8	7.5	5.4	2.4	24.2	10.8	30.3	13.5	10.2	4.6	27.9	12.4
	100 kg P_2O_5/ha (90 lb P_2O_5/ac)	15.3	6.8	4.6	2.1	20.7	9.3	31.7	14.1	10.5	4.7	28.8	12.9
Analyses of Variance													
Source													
Nitrogen rate (R)		NS		NS		NS		NS		NS		NS	
Nitrogen application (A)		NS		NS		NS		NS		NS		NS	
Phosphorus rate (P)		NS		NS		NS		NS		NS		NS	
R x A		NS		NS		NS		NS		NS		NS	
R x P		NS		NS		NS		NS		NS		NS	
A x P		NS		NS		NS		NS		NS		NS	
R x A x P		NS		NS		NS		NS		NS		NS	
CV (%)		31.0		32.2		58.4		21.4		24.0		29.6	

NS indicates non-significant treatment effects.

Plant spacing and cutting height effects for transplanted stinging nettle grown under dry-land and irrigation

Stinging nettle leaf is one of the plant parts used for herbal remedies. Plant spacing and cutting height can affect herbage yield and quality. Moisture status during the growing season can also influence productivity and level of marker compounds. This study examines the effects of plant population and cutting height on third-year stinging nettle crop grown under dryland and irrigation.

Stinging nettle grown under irrigation produced over four times more fresh and dry shoot yields, and 26% higher dry root yield than dryland production (Table 26).

Plant spacing or cutting heights had no effect on fresh and dry herb yields, or dry root yields under both irrigated and dryland production (Table 26).

Table 26. Plant spacing and cutting height effects on fresh and dry shoot yield and dry root yield for transplanted stinging nettle grown under dryland and irrigation: fourth-year crop.

		Yield (shoot and root)											
		Dryland						Irrigation					
		Fresh shoot		Dry shoot		Dry root		Fresh shoot		Dry shoot		Dry root	
Treatment		t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac
Plant spacing	15 cm (6 in)	11.7	5.2	4.0	1.8	15.3	6.8	46.8	20.9	16.1	7.2	17.2	7.7
	30 cm (12 in)	10.6	4.7	3.8	1.7	15.6	8.5	50.1	22.3	16.9	7.5	21.8	9.7
Cutting height	Ground level	10.9	4.9	3.9	1.7	11.6	5.2	50.7	22.6	17.2	7.7	23.3	10.4
	10 cm (4 in)	11.3	5.0	3.9	1.7	20.9	9.3	46.1	20.6	15.6	7.0	16.8	7.5
	15 cm (6 in)	11.3	5.0	3.9	1.7	14.1	6.3	48.5	21.6	16.6	7.4	23.3	10.4
Analyses of Variance													
Source													
Spacing (S)		NS		NS		NS		NS		NS		NS	
Cutting height (H)		NS		NS		NS		NS		NS		NS	
S X H		NS		NS		NS		NS		MS		NS	
CV (%)		38.3		33.1		57.9		24.2		26.4		35.7	

NS indicates non-significant treatment effects.

St. John's Wort

St. John's Wort is a perennial. Flowering tops are harvested for commercial use as the flowers and leaves are found to contain higher levels of hypericin. The 2000/2001 winter caused considerable winter-kill to St. John's Wort. Winter kill was severe on dryland plots and plots where two harvests were taken. The incidence of winter-kill was so severe for the dryland crop (>90%), these plots had to be abandoned. The irrigated plots suffered less winter-kill. However the plants were weaker and the stand was uneven. There was less winter-kill for both dryland and irrigated St. Johns' Wort that were established during the summer of 2000 and harvested only once during that season.

Only one cut was taken in all the tests as regrowth was very poor to take a second cut in the fall of 2001.

Effects of plant population and harvest methods on yield and quality characteristics for different cultivars: Year-1 and Year-2 harvest.

St. John's Wort is a perennial. Flowering tops are harvested for commercial use as the flowers and leaves are found to contain higher levels of hypericin. Plant growth characteristics and harvest height can affect yield and quality. Plant growth and flowering habit can be a function of several factors including genotype, population density, and growing conditions. This study examines the effects of plant spacing and harvest height on yield and quality attributes of St. John's Wort cultivars grown under irrigation and dryland. Comparisons will be made on yield and quality aspects for crops harvested at different years from planting.

Two production systems were examined in this study, i.e.

1. Where one cut was taken in the previous year (2000)
2. Where two cuts were taken in the previous year (2000)

Year-1 Harvest:
In this study, only one harvest was taken during the 2000 establishment year.

In this study, where only one harvest was taken during the 2000 growing season, the incidence of winter-kill was less in both the dryland and irrigated crops. The incidence of winter-kill varied among the different cultivars. As summarized in (Table 27), Standard suffered the highest incidence of winter-kill both under dryland (72%) and under irrigation (64%). The winter-kill percent ranged between 35% and 58% for the other cultivars under the two growing conditions.

Dry herbage yields in relation to plant spacing and cutting height under dryland and irrigated production are summarized in Table 28.

Table 27. Incidence of winter-kill during 2000/2001 season for St. John's Wort cultivars grown under dryland and irrigation[1].

Crop	Winter-kill (% of original plant stand)	
	Dryland	Irrigated
Anthos	58	56.3
Topaz	46.5	53.6
Elixir	34.8	57.2
Standard	72.1	64.2

[1]The crop was established in the summer of 2000 and one harvest was taken during that year.

Different cultivars responded differently when grown under irrigation or dryland. Anthos, Topaz, and Standard produced almost double the yield under irrigation than dryland, whereas Elixir produced similar yields under dryland and irrigation. On average, Elixir was the highest yielder under dryland and Topaz was the highest yielder under irrigation.

Closer within-row spacing (15 cm; 6 in) produced higher dry herbage yields under both irrigated and dryland production. However, the differences did not reach statistically significant proportions for dryland Topaz and irrigated Anthos (Table 28). Different cultivars responded differently to plant spacing effects under the two growing conditions. Standard at 15 cm (6 in) spacing produced two-fold higher yield under irrigation and threefold higher yield under dryland compared to 30 cm (12 in) spacing. Elixir at closer spacing produced approximately 45% higher yield than the wider spacing both under irrigation and dryland.

Table 28. Plant spacing and cutting height effects on dry herbage yield for St. John's Wort cultivars harvested during the following year when grown under dryland and irrigation: first cut.

Treatment		Dry herbage yield (t/ha)															
		Dryland								Irrigated							
		Anthos		Topaz		Elixir		Standard		Anthos		Topaz		Elixir		Standard	
		t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac	t/ha	tons/ac
Plant spacing	15 cm (8 in)	1.42	.64	1.44	.64	2.05	.92	1.13	.50	2.57	1.15	3.26	1.45	1.99	.89	2.67	1.20
	30 cm (12 in)	0.73	.33	1.3	.58	1.42	.63	0.46	.21	1.75	.78	2.3	1.03	1.35	.60	1.21	.54
Cutting height	Top-1/3	1.22	.55	1.89	.84	1.18	.53	0.94	.42	2.08	.93	2.5	1.12	1.34	.60	1.43	.64
	Top-1/2	1.32	.59	1.63	.73	1.71	.76	0.68	.30	2.62	1.17	3.21	1.43	1.85	.83	2.3	1.03
	Top-2/3	0.67	.30	1.68	.75	1.21	.54	0.76	.34	1.77	.79	2.62	1.17	1.82	.82	1.94	.87
Analyses of Variance																	
Source																	
Spacing (S)		***(0.28)		NS		**(0.45)		**(0.37)		NS		*(0.99)		**(0.49)		**(0.94)	
Cutting height (C)		**(0.34)		NS		NS		NS		NS		NS		NS		NS	
S X C		NS		NS		NS		NS		NS		NS		*(0.85)		NS	
CV (%)		30.2		40.8		30.1		53.1		64.6		40.9		34		55.9	

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

The various cutting heights produced similar herbage yields under dryland and irrigated production (Table 28). The significant cutting height effects for dryland Anthos is likely due to experimental error as the lowest cutting height appeared to produce the lowest yield in relation to the higher cutting heights. Logically, the lower cutting height should have yielded higher than the higher cutting heights.

Year-2 Harvest:

The dryland part of this test was completely winter- killed, whereas the incidence of winter-kill under irrigated production was somewhat lower (Table 29).

Winter-kill was more severe for Anthos and Standard than Topaz or Elixir (Table 29).

Cutting height had no effect on winter kill for the different cultivars (Table 29).

Closer planted {15 cm (6 in) within-row spacing} crop suffered more winter-kill than the wider planted {30 cm (12in) within-row spacing} crop (Table 29).

Table 29. Winter-kill incidence as influenced by plant spacing and cutting height for St. John's Wort cultivars grown under irrigation.

Treatment		Winter kill (% of original plant stand)			
		Anthos	Topaz	Elixir	Standard
Plant spacing	15 cm (6 in)	90.5	69.8	75	94.1
	30 cm (12 in)	77.8	43.8	56.9	89.2
Cutting height	Top-1/3	89.1	55	61.5	94.8
	Top-1/2	80.7	49.5	66.4	87.8
	Top-2/3	82.6	65.9	70.1	92.5
Analyses of Variance					
Source					
Spacing		**	***	***	NS
Cutting		NS	NS	NS	NS
Spacing x Cutting		NS	NS	NS	***
CV (%)		15.2	14.3	19.9	9.3

The average for winter-kill presented are estimates of original data.
Summary of ANOVA based on arcsine transformation of the data.
***, ** and NS indicate significance at P<0.001, 0.01 levels of probability and not significant respectively.

The significant spacing x cutting interaction for Standard (Table 29) also indicated that closer planting suffered more winter-kill than wider planting (Figure 13).

Figure 13. Interactive effect of plant spacing and cutting height on winter-kill for 'Standard' St. John's Wort.

The coefficients of variation for dry herb yields were relatively high for the different cultivars (Table 30). This is most likely due to the uneven plant stand due to winter-kill. Dry herbage yields for the various cultivars were considerably low. The high incidence of winter-kill for Anthos and Standard is reflected by extremely low herb yields for these cultivars (Table 30).

Table 30. Plant spacing and cutting height effects on dry herbage yields during the second year of production for St. John's Wort cultivars grown under irrigation.

Treatment		Dry herbage yield							
		Anthos		Topaz		Elixir		Standard	
		t/ha	ton/ac	t/ha	ton/ac	t/ha	ton/ac	t/ha	ton/ac
Plant spacing	15 cm (6 in)	0.26	.12	1.65	.74	0.77	.34	0.15	.07
	30 cm (12 in)	0.32	.14	1.49	.66	0.73	.33	0.31	.14
Cutting height	Top-1/3	0.18	.08	1.51	.67	0.75	.34	0.09	.01
	Top-1/2	0.36	.16	1.64	.73	0.81	.36	0.18	.08
	Top-2/3	0.34	.15	1.56	.70	0.69	.31	0.13	.06
Analyses of Variance									
Source									
Spacing		NS		NS		NS		NS	
Cutting		NS		NS		NS		NS	
Spacing x Cutting		NS		NS		NS		**(0.15)	
CV (%)		84		57.9		58.9		73.3	

** and NS indicate significance at P<0.01 level of probability and not significant respectively. Value within parenthesis is LSD estimate at 5.0% level of significance.

Spacing or cutting height had no effect on dry herb yields for Anthos, Elixir, and Topaz (Table 30). For Standard, the significant spacing x cutting height interaction shows herb yields were higher under wider spacing that experienced less winter-kill relatively to narrow spacing that suffered more winter-kill (Figure 14).

Figure 14. Plant spacing and cutting height effects on dry herb yield for 'Standard' St. John's Wort grown under irrigation.

Fertility management and cutting height effects on yield and quality: Second-year crop

St. John's Wort is a perennial. Flowering tops are harvested for commercial use as the flowers and leaves are found to contain higher levels of hypericin. Plant growth characteristics and harvest height can affect yield and quality. Plant growth and flowering habit can be a function of many factors including genotype, fertility management, and growing conditions. This study examines the effects of nitrogen and phosphorus application and harvest height on yield and quality attributes for St. John's Wort cultivars grown under irrigation and dryland.

Dryland Crop:
The dryland test for 2001 was abandoned due to severe winter-kill.

Irrigated Crop:
The incidence of winter-kill in this study varied between 37% for Elixir and 55% for Standard (Table 31). Nitrogen, phosphorus and cutting treatments during the previous crop year had no effect on winter-kill for the various cultivars (Table 31).

During the 2001 growing season, only one cut was possible for all cultivars. On average Topaz and Standard produced one tonne dry herbs per hectare (0.5 ton/ac), while Anthos and Elixir produced 1.8 and 2.2 t/ha (0.8 - 1.1 ton/ac) dry herbs, respectively (Table 32).

Table 31. Winter-kill incidence for St. John's Wort cultivars as influenced by nitrogen, phosphorus and cutting height treatments during the preceding crop production season under irrigation.

Treatment		Winter kill (% of original plant stand)			
		Anthos	Topaz	Elixir	Standard
Nitrogen rate	Check	30.2	42.5	32.8	49.5
	100 kg N/ha (89 lb N/ac)	51.8	64.1	40.9	59.6
Phosphorus rate	Check	44.8	53.7	37.2	49.2
	100 kg P_2O_5/ha (89 lb P_2O_5/ac)	37.2	52.9	36.5	59.9
Cutting height	Top-1/3	41.9	52.9	35.4	51.8
	Top-2/3	40.1	53.7	38.3	57.3
Analyses of Variance					
Source					
Nitrogen (N)		NS	NS	NS	NS
Phosphorus (P)		NS	NS	NS	NS
Cutting (C)		NS	NS	NS	NS
N X P		NS	NS	NS	NS
N X C		NS	NS	NS	NS
P X C		NS	NS	NS	NS
N X P X C		NS	NS	NS	NS
CV (%)		53.7	41.3	56.4	31.6

The average for winter-kill presented are estimates of original data.
Summary of ANOVA based on arcsine transformation of the data.
NS indicates non-significant treatment effects.

Nitrogen application tended to depress dry herb yields for all cultivars (Table 32). The lack of significance for nitrogen effect is likely due to the high variability in these trials (Table 32).

Phosphorus application had no effect on herb yields for all cultivars (Table 32).

Although non-significant, the crop cut at 1/3 from top consistently out-yielded the crop harvested 2/3 from the top (Table 32). This can be attributed to the reduced growth of plants that were severely cut (i.e. 2/3 from top) during the previous growing season. By contrast, the crop that was less severely damaged (i.e. 1/3 from top) during the previous year produced higher herb yields during the current year.

Table 32. Nitrogen, phosphorus and cutting height effects on dry herbage yield during the second year of production for St. John's Wort cultivars grown under irrigation.

Treatment		Dry herbage yield							
		Anthos		Topaz		Elixir		Standard	
		t/ha	ton/ac	t/ha	ton/ac	t/ha	ton/ac	t/ha	ton/ac
Nitrogen rate	Check	2.36	1.1	1.26	0.6	2.63	1.2	1.17	0.5
	100 kg N/ha (89 lb N/ac)	1.27	0.6	0.78	0.4	1.77	0.8	0.81	0.4
Phosphorus rate	Check	1.64	0.7	1.11	0.5	2.35	1.1	1.02	0.5
	100 kg P_2O_5/ha (89 lb P_2O_5/ac)	1.99	0.9	0.93	0.4	2.05	0.9	0.96	0.4
Cutting height	Top-1/3	2.2	1.0	1.11	0.5	2.38	1.1	1.27	0.6
	Top-2/3	1.43	0.6	0.92	0.4	2.02	0.9	0.71	0.3
Analyses of Variance									
Source									
Nitrogen (N)		*(0.60)		NS		NS		NS	
Phosphorus (P)		NS		NS		NS		NS	
Cutting (C)		NS		NS		NS		*(0.35)	
N X P		NS		NS		NS		NS	
N X C		NS		NS		NS		NS	
P X C		NS		NS		NS		NS	
N X P X C		NS		NS		NS		NS	
CV (%)		63.8		70.3		62.1		67.9	

* and NS indicate significance at P<0.05 level of probability non-significant respectively.
Values within parenthesis are LSD estimates at 5.0% level of probability.

Collaborative Studies:

1. Provided St. John's Wort to the Department of Agricultural and Bio-Resource Engineering University of Saskatchewan for post-harvest studies.

2. Provided *Echinacea angustifolia*, milk thistle, stinging nettle, St. John's Wort and feverfew to the Department of Plant Sciences, University of Saskatchewan for quality determination.

Observational Plots:

Produced a wide range of medicinal, aromatic and culinary herbs for demonstration purposes.

Northern Vigour® of Strawberry Crowns - Improving Crown Yield for Local and Foreign Markets

K. Krieger[1], K. Tanino[1]

Funded by the Agriculture Development Fund

Increasing the yield of strawberry crowns appears to be the critical limitation to commercial crown production in Saskatchewan. This project examines methods to cost-effectively increase strawberry crown yields of 'Camarosa' for the California market 'Sweet Charlie' for the Florida market and 'Totem' and 'Kent' for the domestic market. Results suggest that using a fertility regime of 200 lbs/ac of nitrogen, adding floating row covers of Remay to strawberry fields and propagating strawberry crowns in tissue culture are all positive methods to increase the number of daughter plants. Hormonal dips of benzyl amino purine (BAP) and the use of Treflan seem to be detrimental to daughter formation, while fumigation has no effect on the number of daughters produced.

The production advantages of vegetatively propagated crops such as potatoes grown in northern regions compared to southern sources has long been recognized by potato growers in Europe and North America. Saskatchewan's unique climate of long days, cool nights during the growing season along with a disease-free environment provides an opportunity to produce superior plant material. This phenomenon has already been established in Saskatchewan-grown seed potatoes and is termed "Northern Vigour®". It has resulted in significant export of seed potatoes and domestic production of this crop.

Over the past four years, our results on strawberry, garlic and medicinal plants show tremendous potential to develop Saskatchewan as a supplier of high quality, superior planting material. Saskatchewan grown crowns have produced higher early fruit yields (40-60% over California-grown crowns). The market potential is promising where California annually plants 750 million crowns ($35 US million). Californian commercial growers are keenly interested in testing and accessing new markets since there is an increased push for earlier yields.

Markets also exist for domestic crown sales to provide a superior plant for local producers. However, to create a viable industry, crown yield must be increased. The minimum crown yield required to make a profit is eight daughter crowns per mother, and returns significantly increase with each additional daughter/mother produced.

To increase daughter crown yield, the following treatments were tested:
(1) crown yields under the Remay field cover; (2) crown yields after a hormonal application under tissue culture and crown dip treatments; (3) one year versus a two-year production cycle; (4) the effect of fertility on runner and crown production; (5) herbicide trial; and (6) fumigation trial. Within the field cover study, 'Camarosa' crowns grown under Remay produced a significantly greater number of marketable crowns. In addition, when looking at the data, all cultivars performed better under the Remay.

No significant differences were detected between tissue cultured plants treated with various concentrations of BAP. However, when looking at the daughters per mother produced, tissue cultured

[1]*Department of Plant Sciences, U of S, Saskatoon*

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material with no hormones had on average 28 daughters. This is considerably higher than crowns not produced in tissue culture. Crowns treated with a BAP dip for 10 seconds proved to have a negative affect on daughter formation and on overall plant health.

For the fertility trial, 250 lbs/ac of nitrogen produced significantly fewer daughter crowns, while other treatments of 100, 150 and 200 lbs/ac expressed no significant differences. The CV% were quite high in this study and if the variation had been lower, differences may have been noted that 200 lbs/ac did produce higher numbers which would then agree with the previous season's data (2000). From the one-year versus two-year study general observations were only collected due to winter-kill in year one which affected the continuation of the research. Generally, daughters from year one allowed to over-winter for a second season produced more daughters than newly planted mother crowns in the spring. The herbicide had a negative effect on the crowns this season as the control plants produced significantly more daughter crowns.

Differences between the 2000 and 2001 data are believed to be due to field variations. The test plots in 2000 were located at Pike Lake, Saskatchewan which had a loam sand soil with a pH of 7.6. The test plots in 2001 were located in Outlook, Saskatchewan where the soil is a loam with a pH of 8.0-8.2. The pH presented problems with iron deficiency causing the plants to be further stressed in conjunction to the treatments being tested.

As well a portion of the Outlook site had been used previously for horticulture research which provided low weed populations, however a portion of the plot had been seeded to wheat in prior years creating a gradient in the plot of higher weed populations. This gradient was not apparent prior to planting and therefore had an effect on certain replicates of certain experiments. The fumigation study had no significant differences between the control and treatment of Basmid.

Soils and Water Management Program

Soil and Water Management Program

Soil Conservation Demonstration on Potato Stubble

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

***Progress**: Ongoing*

***Objective:** To demonstrate soil conservation measures on potato stubble.*

Wind erosion on light sandy soils can be a significant problem on potato land. Potato production requires deep and several tillage operations before and after the growing season. Once the crop is harvested, little or no residue cover remains on the soil surface to protect the soil from wind erosion. Erosion can occur immediately after harvesting and continue through the winter months until a new crop is established. To combat this erosion, the Canada-Saskatchewan Irrigation Diversification Centre conducted a demonstration utilizing spring wheat straw and fall-seeding of winter wheat. The demonstration was conducted over the past two growing seasons.

The primary goal of the demonstration was to protect the soil from wind erosion following a crop of potatoes with a secondary goal of preparing the land for research and demonstration plots in the following year. Immediately after the potatoes were harvested, the soil was tilled with a heavy duty offset disc. This tillage operation levelled the soil surface and buried the potato vines. A field cultivator was unsuccessful as the potato vines simply gathered on the cultivator shanks and plugged, leaving a very rough surface. The next step involved spreading straw bales on the soil surface. A Highline bale processor was used to evenly chop and spread the straw on the soil. The number of bales per acre varied depending on the susceptibility of the soil to erosion (i.e. more bales were spread on knolls). After the straw was applied, the field was harrow packed twice to incorporate straw, level, and pack the soil surface.

Two applications of irrigation, 15 mm (.06 in) each were applied subsequently. Winter wheat was sown with a IH 6200 press drill at a rate of 135 kg/ha (120 lbs/ac). The discs and press wheels "hair pinned" the straw into the soil surface providing wind protection. The winter wheat had two to three leaves before freeze up.

The success of this procedure was distinctly evident in the spring of 2001. The winter wheat survived the winter well and started growing early in the spring. This growth along with the added straw from the previous fall provided excellent protection from the strong winds. Wind erosion on adjacent potato stubble was noticeable, while the straw/winter wheat treated field had little or no erosion. An added benefit is that the winter wheat yielded over 4704 kg/ha (70 bu/ac) on residual nutrients from the potato field.

Wind erosion is a problem for many land owners in the irrigated areas around Lake Diefenbaker. Light sandy soil is the desirable soil for high value potato production. This demonstration has shown that wind erosion can be minimized with proper post harvest management of these soils.

[1]*CSIDC, Outlook*

The best way to protect erosion-prone soils requries using a complete management system including shelterbelts, annual barriers, proper residue management and crop rotations. Cover crops are only one of the important components of this system.

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

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Funded by the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

***Progress**: Year four of four*

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 were grown in a three-year rotation followed by canola and a cereal. Nitrate (NO_3) leaching was monitored throughout the rotation by measuring concentrations in soil and groundwater under different fertilizer regimes for potatoes and, as well, groundwater was analysed for the applied pesticides. In 2001, a potato crop was grown on the South field while wheat was grown on the North field. The rates of fertilizer application for the potato crop are given below but the wheat was fertilized at an average rate for the field to meet crop requirements.

There were no significant differences in yield of either potatoes or wheat between treatments.

The water level in the piezometers under the potato field rose in 2001 (Figure 1) while the level under wheat dropped. The rise in the water table was accompanied by an increase in NO_3 in shallow groundwater beneath all of the fertilizer treatments (Figure 2). The most pronounced increase in groundwater NO_3 was beneath the treatment that received 300 kg N ha^{-1} prior to seeding.

Nitrogen -Fertilizer treatments in the potato year of the rotation:

300	300 kg N/ha (270 lb N/ac) incorporated prior to seeding
200	200 kg N/ha (180 lb N/ac) incorporated prior to seeding
Split	100 kg N/ha (90 lb N/ac) incorporated prior to seeding and 100 kg N/ha (90 lb N/ac) applied at hilling
Fert	100 kg N/ha incorporated prior to seeding and the balance applied through fertigation according to petiole analysis

Nitrate in the soil profile to 1.8 m also increased from spring to fall when potatoes were grown in 2001. Once again the greatest increase in NO_3 was beneath the **300** treatment where there was approximately 120 kg N ha^{-1} more NO_3 measured in the soil profile after harvest than was present prior to fertilizer application in the spring. The greatest gains occurred in the 0 to 0.3 m depth and the 1.2 to 1.5 m depth. Beneath the wheat crop on the North field, soil NO_3 decreased on all treatments.

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

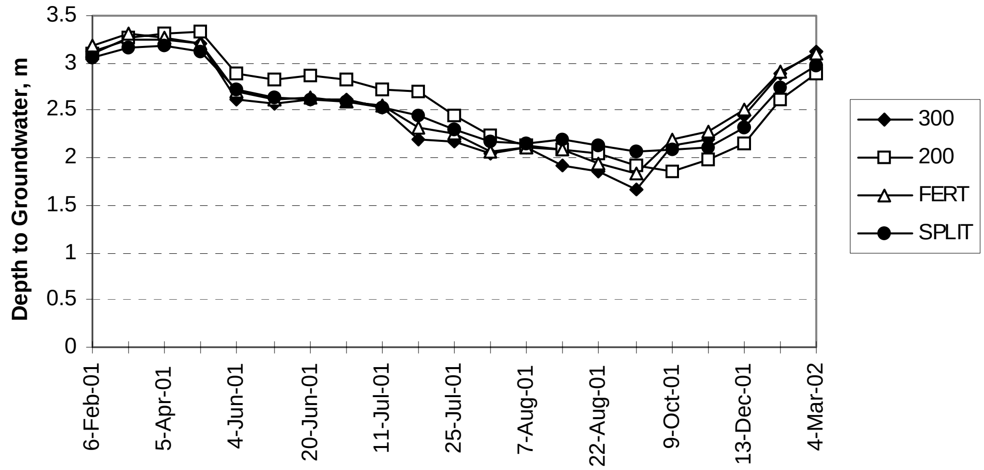

Figure 1. Depth to groundwater beneath the potato crop in the South field in 2002.

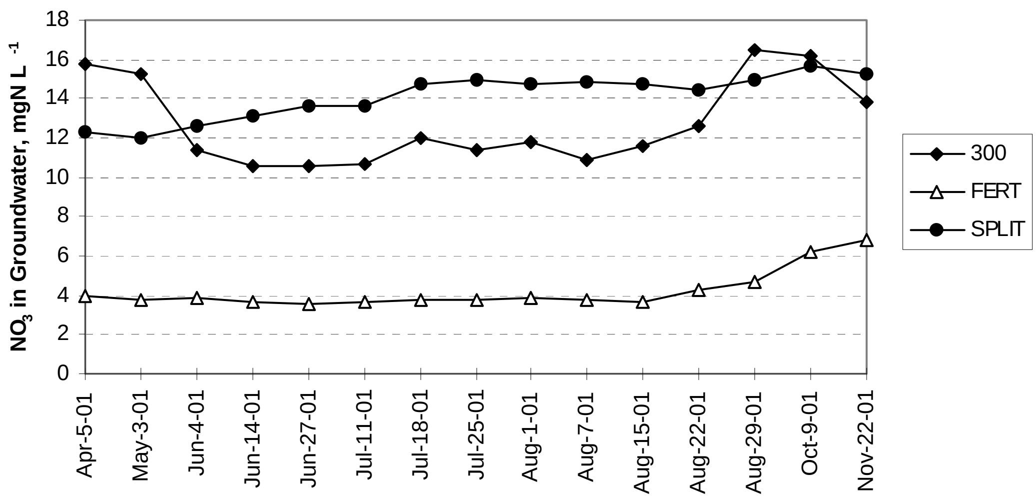

Figure 2. Nitrate concentration in shallow groundwater beneath potatoes in the South field in 2001. (Data for the 2002 treatment is not shown as the piezometer was contaminated during the seeding operation).

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 processing opportunities.

The objectives of the economic analysis program are met, in part, by gathering and analysing price, cost, and return data for irrigated 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 are summarized in the following article: (1) evaluation of crop alternatives for irrigation; (2) benefit cost analysis of irrigated crops in the Outlook area; (3) the value of irrigation compared to dryland farming; (4) the market prospects for irrigation crops in the coming year; (5) potato costs and returns; (6) an evaluation of irrigated vegetable crop alternatives for Saskatchewan; (7) herb and spice marketing and potential for value added industry; (8) the potential for additional ethanol processing in Saskatchewan; and (9) the potential effects of climate change on irrigation farming.

(1) Evaluation of Crop Alternatives for Irrigation

A comparison of the expected irrigated crop returns in the Outlook area using long term price averages (the higher of five or eleven year average prices), and the cost data provided by the Irrigation Crop Diversification Corporation (ICDC) is presented in Table 1. This is one manner of determining the comparative advantage among alternative crops in a given area. It indicates that the better returning crops over the past five to eleven years have been seed and table potatoes, dry beans, timothy grass, alfalfa, pasture, field peas, and potentially corn and barley silage.

Sunflower is actually produced more for the birdseed market, but Outlook is in a risky location for sunflower production as it is also a migratory route for birds. Chickpeas have been produced under irrigation, but there are still considerable challenges with disease. Durum wheat has been the best of the wheat options. Canola and mustard appear to have close to equal returns in theory, while canola has been much more commonly grown in practise. Lentil has not done well under irrigation compared to other crops.

While corn is being tried by many irrigation farmers in southern and central Saskatchewan, the budget indicated for this table is based on a frost free period of 140 days. Corn is more likely to be harvested for silage. Until a larger cattle feeding industry develops, the market for silage is very limited unless growers have their own herds.

[1]CSIDC, Outlook

Table 1. Expected irrigated crop returns - Saskatchewan average prices [3], February 18, 2002.

Crop	Expected yield		Expected price	Expected returns	Investment	Total costs	Land and management	Return on investment [1]	Returns per acre to land, management, and investment
	kg/ha	t/acre	$/t	$/acre	$/acre	$/acre	$/acre	(%)	$/acre
Alfalfa	9612	3.890	85	331	1221	283	41	11	89
Timothy grass	10410	4.213	116	489	1159	381	36	16	144
Barley	5379	2.177	111	242	1095	305	53	1	-10
Barley silage	27181	11.000	28	308	1178	283	44	9	69
Corn silage	29652	12.000	33	395	1244	333	44	12	106
Corn[2]	5708	2.310	142	328	1100	342	56	6	42
Tame pasture			$150/head	449	1395	365	44	13	128
Oats (milling)	4727	1.913	118	226	1095	261	53	4	18
Triticale	5347	2.164	112	242	1095	314	53	0	-19
CPS wheat	5043	2.041	133	270	1095	315	53	3	8
SWS wheat	5043	2.041	133	272	1095	314	53	3	11
CWRS wheat	3699	1.497	155	232	1095	315	53	-1	-30
Durum wheat (2CW)	4371	1.769	192	340	1095	323	53	9	70
Green peas	4035	1.633	200	327	1124	297	53	10	83
Yellow peas	4035	1.633	180	294	1124	297	53	7	50
Fababean	3027	1.225	213	261	1100	298	53	4	16
Flaxseed	2511	1.016	271	275	1095	311	53	4	17
Brown mustard	2241	0.907	341	309	1098	311	53	7	51
Yellow mustard	1680	0.680	454	309	1095	307	53	7	55
Canary seed	1905	0.771	355	274	1095	296	53	5	31
Canola	2523	1.021	319	326	1098	323	53	7	56
Confection sunflower	2242	0.907	456	414	1256	361	53	11	106
Eston lentil	2019	0.817	325	266	1124	311	53	3	8
Kabuli chickpea	1569	0.635	639	406	1124	311	53	15	148
Pinto beans	2069	0.837	542	454	1184	399	53	12	108
Pink beans	1902	0.770	574	442	1184	398	53	11	97
Small red beans	1878	0.760	601	457	1184	398	53	12	112
Great Northern beans	2090	0.846	594	503	1184	399	53	16	157
Black beans	1950	0.789	608	480	1184	394	53	14	139
Seed potato	32123	13.000	274	3562	5718	2278	270	29	1554
Table potatoes (red)	31628	12.800	218	2790	5718	2108	270	19	952

[1]Does not include interest on fixed investment. This should be compared with the discount rate of 8%.

[2]Alberta corn yield is used to approximate Saskatchewan's current corn yield under irrigation.

[3]Using the higher of 5 or 11 year average prices.
Source of cost data: ICDC, Irrigation Economics and Agronomics for Saskatchewan (2002).

(2) Benefit Cost Analysis of Irrigated Crops in the Outlook Area

The benefit cost analysis is another method for determining comparative advantage among irrigation crops. This is a method suggested by the U.S. Department of Agriculture in its extension material for irrigation[1]. It involves the calculation of present and future value.

[1]USDA Natural Resources Conservation Service: Irrigation Page: National Engineering Handbook, Chapter 11, 2001.

The first step is to calculate the ownership costs of a centre pivot irrigation system which covers 130 acres. Assuming an interest rate of 8%, a life span of 20 years, the cost for a new system of $65,000, declining depreciation at 10% per year, no additional taxes, and a water charge of $12 per year, the annual ownership charge of the irrigation system is $62 per acre.

Step two calculates the operating costs for a specific irrigation crop compared to the crop that might normally be grown were the farmer to continue with dryland farming. Step three calculates the expected benefits or revenues to be received comparing the expected irrigated production with the expected dryland production for that location (in this case, Outlook). The costs for specific irrigated crops are estimated in the publication Irrigation Economics and Agronomics - Saskatchewan 2000. Long term average prices for the area have been estimated.

Table 2 shows a calculation of this benefit/cost comparison for soft wheat, durum, canola, alfalfa, pinto beans, and seed potatoes. Calculations are limited to those crops for which there are both irrigation and dryland budgets to compare. Nonetheless the benefit/cost analysis shows that an investment in irrigation is worthwhile if the grower is planning a rotation which includes canola, alfalfa, dry beans, or seed potatoes, but would be questionable if the grower were only planning to produce wheat or durum.

(3) The Value of Irrigation Compared to Dryland Farming

Table 3 gives a weighted average of net returns for irrigated crops in Saskatchewan using the returns of Table 1, but adjusting them by the actual area that is estimated to be irrigated for the respective crops. This information was developed for research purposes, but comparing with the average expected returns for dryland crops in the Outlook area of $23.50 per acre, the weighted average returns for the irrigated crops show an advantage of about $78 per acre. This would probably be the minimum expected rental charge for irrigated land, although there is not enough public information on the rental values of irrigated land to make a comparison[2]. This information could be used and is used to some degree in determining water levies which vary from about $12 an acre in the Outlook area to $25 an acre in newer areas.

Comparing the weighted average returns for irrigated crops in the Outlook area with comparable returns for Southern Alberta helps to explain both the higher water charges in Alberta, the higher land rates, and illustrates the higher values that accrue to irrigated land as processing industries develop for the production of higher value crops.

Table 3. Weighted average of net returns for irrigated crops in Saskatchewan.

Crop	Harvested area acres	Net returns to land, management & investment ($/acre)	Total net returns by crop $
Alalfa	125063	89	11,130,607
Timothy grass	11388	144	1,639,872
Barley	22929	0	0
Barley silage	12026	69	829,794
Pasture	23359	128	2,989,952
Triticale	1801	0	0
CPS wheat	5755	8	46,040
SWS wheat	3868	11	42,548
CWRS wheat	38043	0	0
Durum wheat	26694	70	1,868,580
Peas	4016	83	333,328
Flaxseed	3101	17	52,717
Mustard	1234	53	65,402
Canola	26875	56	1,505,000
Lentil	2389	8	19,112
Chickpeas	968	74	71,632
Dry beans	8000	123	980,800
Seed potatoes	4400	1554	6,837,600
Table potatoes	3600	952	3,427,200
Vegetables	470	1763	828,610
Fruit/berries	683	795	542,985
Weighted average net return	326662	101.67	33,211,779

[2]Other than for potatoes, relatively little irrigated land is rented.

(4) Market Prospects for Irrigated Crops in 2002

While average prices for irrigated and dryland crops have been used in the budgets and analysis discussed thus far, current expected prices are also determined for the coming year. These are summarized in Table 4.

As of March 5, 2002, above average prices and returns are expected for alfalfa, timothy, corn silage, oats, soft white spring wheat, flaxseed, mustard, canary seed, seed and table potatoes, while dry beans are expected to have good returns with prices close to long term average levels.

Prices are expected to be close to average levels for durum and field peas, while canola, lentil, and chickpea prices are somewhat depressed. Barley and hard red spring wheat are expected to have above average prices, but the prospects for these crops as grains under irrigation appears uncompetitive with other options. Cereals grown as silage, however, can compete in the feed market.

Dill seed has had a strong market in the past year due to poor crops in India in 2000 and 2001, and has been tried by some growers and marketing companies. There is too little history on dill seed to establish long term prices.

Processing potatoes may also be grown in Saskatchewan under irrigation for supplying processors in Manitoba and Alberta, but thus far the table and seed potato markets have been more attractive. Some Saskatchewan potatoes were sold for processing this year when supplies ran short in areas affected by drought and low yields.

(5) Potato Costs and Returns

At the request of the Western Potato Council a comparison was made between irrigated and dryland potato production costs for the three prairie provinces[3]. The irrigated potato budgets are summarized in Table 5.

An interesting part of this budget comparison is that while Saskatchewan has the smallest potato industry, there still appear to be reasonable returns for both seed and table potatoes, despite somewhat higher seed costs due to the production of higher generation of seed potatoes.

There appears to be higher long term prices for table potatoes in Saskatchewan. In normal years the large potato processing industries in Manitoba and Alberta can depress table potato prices in these provinces more than in Saskatchewan.

However 2001 was an exception with very high prices for white potatoes in Alberta due to shortages throughout North America. Potato acreage was lower in the U.S. in 2001, and the dry weather reduced yields in both countries. While potato production is expected to expand in 2002 due to the strong prices, growers should be cautious about overexpansion in this highly cyclical market.

[3]The objective was to develop potato budgets to help growers determine their own costs of production.

Table 5. Costs and returns for irrigated potatoes - Western Canada, 2001.

	Manitoba irrigated processing potatoes	Saskatchewan irrigated seed potatoes	Alberta irrigated processing potatoes (Russet)	Saskatchewan irrigated table potatoes
Soil Zone	Black	Dark Brown	Brown	Dark Brown
Yield (tonnes/acre)	12.00	12.70	14.61	14
Loss during storage	10%	10%	7%	15%
Marketable yield (t/acre)	10.8	11.4	13.6	11.9
Market price ($/tonne)[1]	168	286	148	192
Market price (¢/lb)	7.60	12.98	6.72	8.73
A. Gross returns ($/acre)	1,809	3,269	2,012	2,290
B. Cash and operational costs[2]				
Seed	174	686	172	192
Fertilizer	83	72	117	63
Chemicals	244	225	230	225
Crop insurance	45	38	9	84
Fuel, oil, lube & trucking	180	50	64	50
Machinery repairs	100	43	131	100
Building repairs	11	50	25	35
Irrigation - fuel & electricity	24	29	56	29
Custom work	94	24	100	33
Labour	81	135	145	90
Utilities & miscellaneous	54	222	130	148
Storage costs	38	83	65	170
Operating interest	51	88	14	84
Total direct expenses	1179	1745	1258	1303
C. Fixed costs				
Land rent (C1)	70	200	275	200
Taxes, insurance, water rates	42	58	86	58
Building & equipment depreciation	232	236	189	236
Investment interest (C4)	102	108	56	108
Total fixed costs	445	601	605	602
D. Owner labour & management	88	290	145	218
E. Total production costs	1712	2636	2008	2123
Cost per pound (¢/lb)	7.19	10.46	6.71	8.09
Return above cash costs	630	1524	754	987
Return above total costs	97	633	4	167
Return to investment (A-E+C4)	199	741	60	275
Return to land, management, and investment (A-E+C4+C1+D)	357	1231	480	693

[1]The Manitoba processing potato price is an average for 1999 (Manitoba Agriculture). The Alberta processing potato price is the average potato price for Prince Edward Island in 1999, the lowest Canadian potato price for the last year. The Saskatchewan seed potato price is an expected price FOB Broderick for 2001/2001. The Saskatchewan table potato price is the average Ontario price for 2000/2001 (Statistics Canada, Nov. 2001, Canadian Potato Production).
[2]For Alberta an average cost of 1995 to 2000 is used, except when the 2000 cost is highest.
Sources: Manitoba Agriculture and Food (contact Ian McCartney) and Internet site.
Saskatchewan Agriculture and Food (Andrew Sullivan and Mike Pylypchuk) and Internet site.
Alberta Agriculture, courtesy of Nabi Chaudhary, Economics Unit, September 2001.

(6) Irrigated Vegetable Crops for Saskatchewan

The irrigated vegetable budgets developed for the AFIF project and reported on in the annual CSIDC report for 2000/2001 were updated with further wholesale price information for 2001, and are presented in Table 6. A significant difference between these budgets and those of the more traditional crops for irrigation is that they use a target price[4] which approximates between higher prices that are often received for vegetables in the farmers' markets, and the commercial wholesale prices which can often be depressed either by local competition or by the greater experience which wholesalers often have in negotiating purchase prices with producers.

For instance in the long term budget for table potatoes for Saskatchewan given in Table 5, a market price of 8 to 9¢ a pound is to be expected, and this is higher than the price often received by table potato growers in Alberta (with the exception of this year). The target price determined for table potatoes in Table 6 is 11¢ a pound, which has been consistent with prices for red table potatoes in 2001/2002. While the returns for other vegetables in this table will generally be higher than growers usually obtain in selling to the commercial wholesale market, they should be less than they receive in selling to the farmers' market. The difference between vegetables and other crops usually grown under irrigation in Saskatchewan is that the other crops are usually exported. Since the farmers' market plays a significant role for farmers producing vegetable crops in Saskatchewan, the use of target prices has been developed as a consistent approach to approximating the returns from these two distinct markets.

While the returns for vegetables represented by the average of these budgets is higher than last year, the actual returns for vegetables in Saskatchewan has been estimated by Statistics Canada in their net farm cash receipts to be lower than 2000. This is because of low prices for sweet corn and cabbage which Saskatchewan grows more of than any other vegetables other than potatoes. The area planted to vegetables in Saskatchewan appears to have risen from 2000, but this will be clarified when the Census of Agriculture data is released in May of this year (2002).

The reasons for which vegetables are expected to expand as an irrigated crop option in Saskatchewan are: (1) the strong U.S. dollar which tends to raise imported vegetable prices in comparison to other crops for which Canada is exporting to nations with weaker currencies; (2) the lower Canadian dollar which helps us compete with the U.S., but not necessarily other nations whom we might import vegetables from; (3) the greater availability of water for irrigation in Canada compared to the U.S.; (4) a greater availability of additional water for irrigation in Saskatchewan as compared to Alberta which has used up a large portion of their available sources for irrigation; and (5) the emphasis of farm support programs in the U.S. on commodities which the U.S. normally exports, thus causing vegetable planted area in the U.S. to decline.

Some of the better vegetable crops for Saskatchewan at the moment appear to be pumpkins, brussel sprouts, celery, zucchini, parsnips, cabbage, squash, green peppers and cantaloupe. Most vegetables have the potential for favorable returns, but will require good management practises, irrigation, storage, and reasonable market access. There is the potential to raise market returns for most vegetable growers by a co-ordinated marketing effort.

[4]The geometric mean between the wholesale vegetable selling price and the estimated cost of production is used as a 'target' to strive for in selling commercial vegetables.

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(7) Herb and Spice Marketing and the Potential for Value Added Industry

Most herbs and spices grown in Saskatchewan are processed and exported, in contrast to vegetables which have mostly a local market in Saskatchewan. This market is more challenging than traditional crops. Spice crops may be exported similar to mustard with appropriate cleaning and storage, but herb crops are perishable and must either be processed or dried for shipment.

There are generally three types of markets for herbs and spices. A grower can contract with a company that is buying and distributing the herbs he wants to grow. The buyer and the grower reach agreement on either a quantity or the buyer agrees to take all that the grower will produce of the herb. Prices are usually set later, and both parties may risk loss depending upon how well the grower can produce the given herb in comparison to other growers and growing areas. The grower sends in a sample which may or may not be accepted by the purchaser depending on the quality of the herb. If the company finds the sample acceptable they can then determine a price. CSIDC has collected herb and spice prices in the past, but worked with AAFC this year on a pilot project to collect a smaller sample of herb and spice prices for a six month period[5].

Some companies prefer to establish long term relationships with growers, and want to deal with them exclusively. Other companies recommend that growers contact several buyers to spread out their risk, and to leave the buyers free to purchase the best quality of herbs they can access. In this situation the grower may choose to sell some or all of their herb production on a spot basis. The availability of herbs on a spot basis may be advertised on the Internet or with dealers and marketing agents who specialize in this line of business.

Some growers have found it difficult to obtain prices for their herbs to compensate them for their time and trouble in producing them. If the contracting and spot market prices appear too low to a grower, then they may always choose to produce a value added product themselves. In Outlook, there have been one or two companies producing essential oils from spearmint. Prices have been more depressed in the past year than when this industry started. There are also growers producing essential oils from coriander, caraway, and dill which are now more widely grown in Saskatchewan. Since the market for essential oils is relatively small, too many growers trying to market the same product could create instability for this industry.

A company in Moose Jaw is now processing and packaging medicinal herbs as powders and pills for growers on the prairies, while other companies have undertaken similar endeavours for tinctures, dried and fresh herbs in other areas. A more co-ordinated marketing approach has developed with groups in different areas and with the assistance of the meetings held by the Saskatchewan Herb and Spice Association and the federal and provincial governments.

While CSIDC continues to be involved in the agronomic evaluation of herbs suitable to irrigation, marketing assistance has been limited to price collection and the referral of growers to appropriate industry sources. Some work has been done in evaluating costs and returns for the herbs and spices tested at CSIDC, but this remains incomplete. Some budgets were developed for spearmint, echinacea, garlic, and dill. The evaluation of ginseng on the Canadian prairies was impeded by a sharp drop in prices as this industry expanded in Ontario and British Columbia, areas more favorable to the production of this herb. The markets for other herbs which CSIDC has done work on including St. John’s Wort, chamomile, stinging nettle, and milk thistle remain more uncertain.

Some draft information has been compiled on the processing opportunities for these herbs and spices.

(8) The Potential for Additional Ethanol Processing in Saskatchewan[6]

Provincial and federal policies have aided in the establishment of one ethanol plant in Saskatchewan which produces approximately 13 million litres of ethanol for blended fuels per year with the co-products of wet distillers’ grains being used as feedstock for a local feedlot.

With high gasoline prices experienced in 2000 and the summer of 2001, the Saskatchewan government has shown interest in the expansion of the ethanol industry in the province. This has been delayed by the drought which has temporarily raised feed grain prices in Saskatchewan. Ethanol production in the U.S. has been expanding rapidly promoted by federal excise tax exemptions, lower corn prices, a greater perceived need for reducing energy imports in the U.S., and a move to establish cleaner air

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[5]The intention was to carry on with the collection of herb and spice prices if these could be obtained on a regular basis.
[6]For previous information compiled on ethanol see *Ethanol: Fact or Fiction?* posted at the CSIDC/PFRA/AAFC website: http://www.agr.gc.ca/pfra/sidcpub/sidcft3.htm.

policies in various states. This includes California which will rely on ethanol from other areas for its requirements as it switches to blended fuels containing oxygenates[7].

The Saskatchewan government would like to have an ethanol industry with a capacity of 400 million litres per year, which would expand the current capacity by 30 times. They feel that just under half of this could be used in-province, and the remainder could be exported to meet requirements in the U.S. and other parts of Canada. At CSIDC, information has been gathered on ethanol to assist those areas wishing to pursue this as a value added opportunity. The water requirements of ethanol production both for distillation and for livestock use could help to promote this industry in irrigated areas.

The movement of ethanol tends to follow the grain flow, as ethanol is mostly produced from the distillation of grain at the moment. For this reason, since Saskatchewan is normally an exporter of grain, the province appears to be a natural choice for the location of ethanol production. Corn appears to be the feedstock of choice for ethanol production, although prairie spring wheat is currently used mostly for ethanol production in Saskatchewan.

(9) The Potential Effects of Climate Change on Irrigation Farming

The number of frost free growing days in Outlook as estimated in five year periods over the past twenty years is summarized in Table 7. The PFRA Agro-Climate Unit has noted that the climate for the prairies appears to be getting warmer and drier. While 134 growing days may be insufficient to make corn worthwhile as a grain crop, it is certainly encouraging farmers to try it as a silage crop.

Table 7. Frost free days in the Outlook area.

Period	Frost free days (average)
1997 to 2001	134
1992 to 1996	127
1987 to 1991	127
1982 to 1986	116

Budgets provided by ICDC would tend to confirm the increasing viability of corn silage, but the market for silage will depend upon expansion in the livestock industry. Preliminary budgets developed for the incorporation of clover silage into an irrigated “double” cropping pattern to take advantage of the longer season could help to make this an interesting opportunity. Further information will be required to test some of these “double” cropping rotations to make use of irrigation and the climate changes.

(10) Summary

Following a drought is a natural time for interest to expand in irrigation farming. This is borne out by the various irrigation budgets available for this year. The potential crops for irrigation farmers are expanding due to the developments of new markets, expansion in value added industries, and the extension in the crop season. Irrigation is viewed to be an important factor in promoting sustainable agriculture in the drier, southern areas of the Canadian prairies.

[7]Oxygenates are fuels such as ethanol which contain oxygen for cleaner burning.

Field Demonstration Program

Field Demonstration Program

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 conducts field demonstrations in the Lake Diefenbaker area in order to field test ideas that come from research at CSIDC and other institutions. These field demonstrations are monitored weekly and data is collected. This data is entered into a database and is used to develop agronomic recommendations. This information will be used to direct and influence irrigated crop production in the province. Demonstration co-operators pay $2.00 per acre to have their field monitored. ICDC informs the co-operator of any problems developing in the crop. ICDC reimburses the co-operator for any extra cost involved in hosting the demonstration plot.

Forage Manager Demonstration

Les Bohrson[1]

Phosphorus Reponse on Flood Irrigation

Most prairie soils are naturally low in plant available phosphorus. Iin Saskatchewan, the first research reporting the benefit of seed placed phosphorus appeared in 1927. Commercial phosphate fertilizer use became common in the 1950's. In Southwest Saskatchewan most of the large flood irrigated forage projects were in full production by this time. Now some fifty years later the fertilizer management of choice on forage has largely been to add a nitrogen source with little or no phosphate maintenance. Numerous soil tests and forage feed analyses have reported deficient and extremely deficient phosphorus nutrition at these projects.

There are limitations to the ease of phosphorous placement and to the responsiveness of perennial forage crops. Applying a large batch of fertilizer at stand establishment is very expensive and cannot sustain benefits for the desired life of the stand. Annual surface broadcast on clay soils has left the slow moving phosphorus, high and dry, above most of the root system. Two new placement methods offer promise. One is to deep band a highly concentrated batch application at a depth greater than three inches at alfalfa establishment. A second chance after establishment is to inject a multi-year rate of liquid or dry phosphorus into a three inch deep coulter disc opening. This report deals with seven years of Don Arendt's Eastend Irrigation Project experience with the residual benefit of deep banding at establishment.

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The main objective of these phosphorus treatments is to improve the yield and profitability of irrigated cereals and alfalfa by improving the effectiveness of applied fertilizer. We also attempt to observe quality changes in the annual and perennial forages. Normally the concentration of phosphorus increases in the plant after proper placement. In turn phosphorus helps the plant absorb other nutrients. Specifically, phosphorus is essential to energy transfer in the plant, converting the sun's energy in starches, sugars and other compounds. What you want your bag of phosphorus fertilizer to do is:

(1) to promote early root activity,
(2) to stimulate an aggressive root system that will efficiently seek nutrient laden available moisture, and
(3) to help every alfalfa plant cope with environmental stress and winter injury to compete with weeds.

Table 1. Don Arendt's phosphorus response summary.

Year	Crop Planted	Application Rates of Phosphorus: 0 lbs/ac	150 lbs/ac	350 lbs/ac	700 lbs/ac
		Yield in Tons/Acre			
1995	CPS wheat	2.3	3.1	3.9	4.1
1996	Triticale and oats	2.2	**	2.8	4.0
1997	CPS wheat	3.1	**	3.7	4.1
Total three year yield		7.6	**	10.4	12.2
1998	Alfalfa seedlings	**	**	**	**
1999	One cut alfalfa	1.7	3.4	3.2	3.3
2000	First cut alfalfa	1.7	4.5	4.4	4.4
2000	Second cut alfalfa	0.0	1.8	1.9	1.9
2001	One cut alfalfa	1.7	1.6	2.2	2.3
Total three year yield		5.1	11.3	11.7	11.9
Total yield from 1995-2001		12.7	**	22.1	24.1
Average yield/year		2.1	3.6	3.7	4.0

**Note: No data available for these treatments.

The bottom line at Don Arendt's irrigated alfalfa demonstration is that when the field was cut on July 9, 2001, the deep banded batch application produced well over 11 tons per acre while the unfertilized alfalfa produced a typical 5.0 tons per acre in the three years of forage harvesting (Table 1). However, there is more to this story. Don Arendt spent $48.00 per acre on three hundred pounds on 11-51-0 and banded it on April 17, 1998. Previous to this the field was broken out of alfalfa in 1994 and three application rates to meet the needs of a 1995 crop of CPS wheat, a 1996 crop of triticale and oats, and a 1997 crop of CPS wheat were deep banded. The original 1995 batch applications averaged 3.6 tons of green-feed per acre per year while the zero phosphorus averaged 2.5 tons. All other inputs on the cereals were equal including the nitrogen fertilizer. Another premium to Don Arendt's fertilizer treatments is that the nutritive value increase averaged, over all six years, a $4.00 per ton advantage. Table 2 shows "Beef per acre" and Table 3 shows "Milk per acre" predictions for the feeder and dairy utilization of these forages.

Table 2. Beef per acre (lbs/ac).

Treatment	Cereals: 1995	1996	1997	Alfalfa: 1999	1st cut 2000	2nd cut 2000	2001	Six-year total
0 lbs/ac	235	118	369	259	225	No cut	241	1447
150 lbs/ac	308	*	*	481	538	365	244	1936
350 lbs/ac	378	256	481	448	485	376	327	2751
700 lbs/ac	406	238	456	558	461	382	347	2848

*Note: No yield data was available for the 150 lbs/ac strip in the 1996 and 1997 crop years.

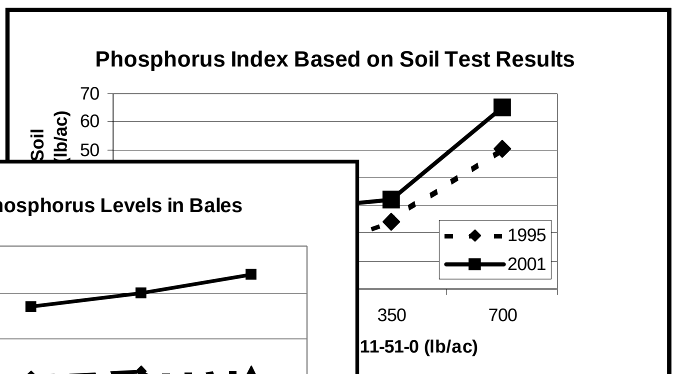
Table 3. Milk per acre (lbs/ac)* from alfalfa.

Treatment	1999	1st cut 2000	2nd cut 2000	2001	Three-year total
0 lbs/ac	4264	4026	No cut	4396	12686
150 lbs/ac	8280	10188	5243	3965	27676
350 lbs/ac	7480	9570	5355	5484	27889
700 lbs/ac	8265	9534	5384	5737	28920

*Note: Based on a 1350 lb cow, producing 90 lbs of milk/day, mid lactation, 3.8% milk fat, 10% feeding losses.

The massive 1994 dandelion population virtually disappeared due to competition in the deep banded phosphorus treatment, but they remain alive and well in the zero phosphorus. The 2001 bromegrass volume in all treatments exceeded 50% of the stand. The soil moisture depletion extends past four feet deep with phosphorus and about three feet deep with zero phosphorus. In fact most years the zero phosphorus field was the only area that showed any fall green-up in the cereal stubble. The zero phosphorus still had as thick a plant population with 72 stems per square foot as the fertilized treatments, but it lacked vigor all spring and was now four inches behind in height and growth stage. This lack of vigor was even more dramatic when considering that the fertilized treatments had provided a full second cutting in August 2000. Phosphorus dividends are paid back as a long term investment in the health of your soils and crops.

Repeated soil and plant tissue sampling at Don Arendt's irrigation have displayed enriched phosphorus levels relative to phosphorus rates of application as shown in Figures 1 and 2. The zero phosphorus application treatments continue to report a marked deficiency. Annual applications can work, but in the long run are time consuming and more expensive. There is good reason to budget larger phosphorus applications every four years. We applied this strategy at Blair Backman's Cypress Lake irrigation demonstration. Drought, salinity, and poor clay structure weaken many of our alfalfa stands on the old flood irrigated projects, but the reason some irrigated fields are not producing the way they could is lack of phosphorus. Don Arendt applied good management, PFRA delivered the same volume of water to similar soils, and sunshine provided equal energy. All things being equal at Eastend, ten tons of extra forage was produced. Deep banding is a cost effective placement method to remove a serious phosphorus deficiency on flood irrigation projects in Southwest Saskatchewan.



on soil P levels.

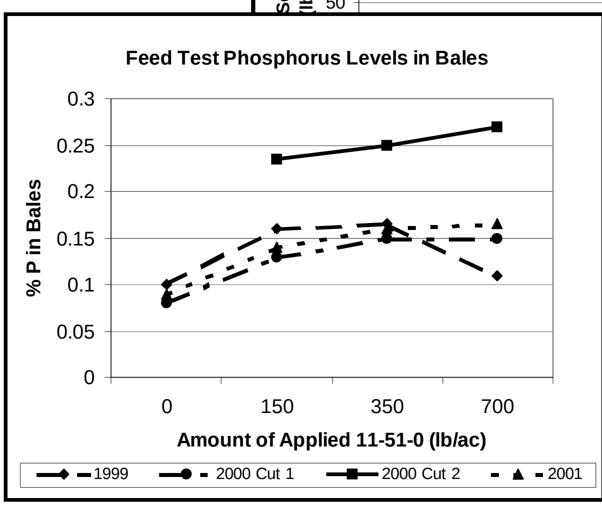


Figure 2. Feed test P levels in hay bales.

Cypress Lake Irrigation Demonstration

Blair Backman's 34 acre water use efficiency demonstration project at Cypress Lake produced nearly two hundred tons of baled alfalfa in the 2000 year and one hundred and thirty tons in 2001. The thirty-four acres under the irrigation system averaged 3.9 tons per acre (2.1 tons on July 5, 2001 plus 1.8 tons on August 17, 2001). The majority of the irrigated field received twelve inches of irrigation water. Only three acres were irrigated to a near optimum for alfalfa of eighteen inches of irrigation water and produced 5.0 tons per acre (2.5 tons on first and 2.5 tons on second cut). The additional 1.0 tons per acre was achieved not only with adequate irrigation, but as a result of better stand vigor from fall irrigation in 2000, and aggressive deep band placement of phosphorus at establishment. High winds, before first cut, affected irrigation making the accurate measurement alfalfa yield advantage to aggressive phosphorus unmeasurable in 2001. The quality achieved at both cuts was very good with relative feed value exceeding 130 and crude protein above 17 %.

In 2000, the third alfalfa irrigation rate of six inches per year came back with the help of timely rainfall to produce 2.8 tons per acre on July 5th. However, second cut reached only fourteen inches in height and was left to protect the plant population. In 2001, the six inch treatment with little spring rainfall started slow. The first cut was on 0.8 tons per acre, but July showers helped the second cut to 1.1 tons per acre. The rain fed alfalfa field border yielded all of twenty tons in early 2000. Since July 2000 and through 2001, there has been virtually no alfalfa regrowth on this 24 acres of dryland. Both of these examples mirror the results for traditional forage production achieved on Consul area farms and ranches in 2000 and 2001. Note that the Backman irrigation system is piped directly from Cypress Lake with no water transmission losses.

Two ICDC field days were hosted at Blair Backman's. Irrigators in the Consul region supported both evening tours very well. On June 18th forage management and variety selection was featured. The evening field day served as a meeting place and discussion with 15 Montana irrigators from the Milk River Basin. On August 8th Alberta Ag's Beef Specialist, Delyn Jensen presented beef cow/calf nutrient cycling, forage utilization and production analysis. The Saskatchewan Forage Council assisted at both gathering a plot harvesting demonstration and discussion of legume and grass vigor and quality. A full report of this year's results will be discussed at Consul this winter.

Randy Pastl and his Saskatchewan Forage Council technicians provided great assistance in the 1999 establishment and our 2000 and 2001, first and second cut yield and quality assessment of four legume and thirteen grass varieties. The 2001 alfalfa produced well at 5.4 tons per acre and exceeding the 18 inch irrigation alfalfa field because of their earlier second cut date in 2000. The cicer milkvetch had excellent quality and improved in 2001 to produce yields half of alfalfa. The sainfoin was selectively grazed down by wildlife and is poor. The intermediate, tall and crested wheatgrass, dahurian wildrye grass, tall fescue, smooth and meadow bromegrass are out yielding the alfalfa. The highest quality grasses have responded to early cutting and two 75 pound per acre applications of nitrogen. Russian and altai wildrye grass, meadow bromegrass, tall fescue and western wheatgrass are considered grazing species and delivered the best quality of the grasses. The early first cutting strategy of these grass plots and aggressive fertilization produced over two and a half tons of grass hay at second cut. The third harvest year information will be collected.

Blair Backman's ICDC demonstration on the south shore of Cypress Lake is monitored for water quality as well as quantity. The reservoir level dropped from 972.1 m in November 2000 to 971.1 m in November 2001. The total salt concentration increased nearly thirty percent through the irrigation season due chiefly to evaporation. The E.C. at 1.1, TDS at 672 and SAR at 2.9 of Cypress Lake are well within the irrigation suitability guideline for Blair Backman's soils and crops. The surface soil salinity after two years of irrigation was sampled October 18, 2001. The zero to 12 inch depth soil samples in all four areas of the field averaged 0.9 mS/cm or less, which is well within the non-saline category.

With a good spring runoff, we are looking forward to Monday, June 24, 2002 as our next forage field day. SeCan will be back at Backman's in 2002 with an annual cereal grain and green feed crop selection demonstration.

Corn Energy

Corn is the number one feed grain and silage crop in the world. The combination of superior energy value and high 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 fifty percent.

ICDC was involved in two corn field days this summer. On September 10th Rick Swenson, Ryan Gibson and Dan Prefontaine hosted a corn silaging and pit storage demonstration at the Baildon I.D. south of Moose Jaw. Ryan Gibson runs a large feedlot operation, and grows and contracts corn silage as an alternative to barley silage. Rick Swenson is gaining experience with corn for silage and grazing, and hopes to shift into grain corn production. On October 17th, Grant and Keith Carlson of KEG Farms hosted a grain corn harvesting and drying demonstration at the S.S.R.I.D. north of Broderick. Dan Prefontaine offers a complete custom silage service to Manitoba and Saskatchewan corn growers. KEG Farms experience with row crops and two previous years of grain corn production paid off in 2001. Carlsons produced a 130 acre pivot of Pioneer Hybrid 39N03 that topped the 100 bushel/acre at 56 pounds/bushel. Carlsons have sold the corn stover (leaves, stalks, husks and lost cobs) for beef cow fall grazing. Corn industry representatives and media people assisted in making both field days highly successful.

In 2001, ICDC again worked with Watts, Estuary, and Rick Swenson on Roundup Ready Corn Technology. Regionally irrigated corn sights included Peter J. Fehr of Fair Haven Farm near Osler, Bob and Marlys Sawatzky of Riverhurst, Ryan Gibson of Moose Jaw, and KEG Farms of Broderick (Tables 4, 5, 6 & 7).

Modern hybrid corn plants are very specialized. On every acre (43,560 square feet) about 30,000 corn seedlings battle to create enough leaf area to capture the optimum number of sunlight hours. Any delay in the effective leaf area affects the leaf sheath, stalk, husk, ear shank, silk, cob and finally the grain. The battles lost during the early development of the first six leaves can never be overcome. The initiation of a tiny cob structure inside the small corn plant has already been pre-programmed. Our fields varied widely in precision planting, weed competition and cool/windy conditions. One or more of these features, factored with grower experience, account for the wide range of crop conditions reported in the following tables. Overall the 2001 corn crop had better tissue nitrogen, weed control, taller plants and was closer to silk by August 1st than in 2000. During the fourth week of July, Table 4 describes 38 different corn field observations. Tassel stage was achieved in 60% of our corn fields and in most varieties requiring less than 2250 corn heat units (CHU) to mature. The corn field height ranged from five to nearly ten feet. The desirable concentration of 3.25% nitrogen in the leaf tissue was demonstrated in only three fields. Thirty three fields had marginal status and two fields were below 2.75% nitrogen in the leaf tissue and were rated as deficient. The micro-nutrient tissue concentration in the corn leaf was higher where soil organic matter is higher.

Cob samples collected and analyzed on September 6th (simulating an early killing frost) indicated that only half of the cobs could be dried to mature grain. The 2000 oven dry bushel weight average of 48 pounds was exceeded in 2001 with an average of 54 pounds. Ten cobs per field (380 cobs) were selected and evaluated to describe average grain weight, kernels and cob length. The average grain yield estimate for 2001 was 82 bushels per acre. A fair assessment of risk suggests that one quarter of the corn fields would have suffered a serious silage loss and two thirds of all corn fields would have had poor grain results with a September 6th frost at almost normal CHU. Outlook irrigators already had received their 2253 CHU average by then and were six percent above normal with 2377 CHU by September 15, 2001. According to data from Medicine Hat, the CHU's received in 2001 totaled 2630 by September 15th. This helps explain the success Kim, Brent and Jerry Watts and the Estuary Colony had with 2600 CHU corn varieties this fall.

Table 6, which lists corn silage results by energy describes the grain fraction. Great corn cobs propel corn silage well past the optimum cereal silage in total digestible nutrients. Both in 2000 and again in 2001, Watts led in corn silage quality and Estuary led in corn silage yield (Tables 5 and 7). The grain harvest at KEG Farms proceeded smoothly through the third week of October (Table 6). Grain drying was achieved with natural air for the first time. This energy cost saving and a strong feed grain market were a real bonus in grain corn profitability. Grain sample results shows that we have room for optimism in both quantity and quality in future Saskatchewan corn (data not shown).

The Roundup Ready Corn comparison allowed three growers to use cheap and available herbicides that were already required for several other applications on their farms. None of the existing corn herbicides are licenced here for many grassy and broadleaf weeds. Roundup can be applied twice on the corn, if required, without affecting crop rotation choices next year. This encourages spraying early and seeding into a weed-free field. In 2000, Watts got the most successful result because their cattle had seeded volunteer ryegrass while fall grazing. The flush of ryegrass turned the two pivots as green as grass just when the corn emerged. The converse is control of Roundup resistant weeds. Also in 2000, KEG Farms had the negative situation of spraying corn with 2-4-D to handle the volunteer Canola that was Roundup resistant. Heavily manured corn fields have frustrated soil applied corn herbicides, but work for Roundup. The current DeKalb brand Roundup Ready Corn varieties are only suitable for silage production with Saskatchewan's CHU and have compared well with other hybrid corn.

Table 4. Irrigated corn leaf tissue analysis, July 31, 2001.

							Macro Nutrient					Micro Nutrients				
Producer	Variety	Stage	CHU	Height	Pop.	Texture	N	Rank	P	Rank	Comp. rank	CU	Rank	Zn	Rank	Comp. rank
Estuary HC	PH 39A26	Silk	2450	88	36000	LL 30	3.14	14	0.30	29	27	12.9	5	66.5	1	1
Estuary HC	PH 39A26	Silk	2450	87	33000	LL 29	3.16	13	0.34	25	21	12.6	8	54.4	4	4
Rick Swenson	PH 39W54	Silk	2200	117	33500	SL 15	2.91	26	0.45	11	19	8.0	24	40.8	16	20
Rick Swenson	PH 39W54	Silk	2200	101	33000	SL 16	2.97	24	0.44	12	18	6.0	31	28.9	31	36
Rick Swenson	PH 39W54	Silk	2200	100	26500	SL 19	3.18	11	0.57	3	3	6.9	26	37.7	21	23
Rick Swenson	PH 39W54	Silk	2200	99	29000	SL 14	3.05	22	0.39	15	19	10.8	14	39.2	17	12
Keg Farms	PH 39N03	Silk	2100	92	26800	FL 17	3.21	9	0.60	1	1	7.9	25	48.3	7	14
Keg Farms	PH 39N03	Silk	2100	92	28000	FL 18	3.21	9	0.49	9	7	6.9	26	33.5	25	30
Keg Farms	PH 39N03	Silk	2100	92	25000	VL 21	3.28	2	0.37	20	8	10.0	17	46.9	8	8
Keg Farms	PH 39N03	Silk	2100	88	26200	VL 22	3.12	16	0.39	15	13	9.8	19	57.9	3	7
Kim Watts*	DK RR 27-11	Tassel	2250	94	27500	VL 26	3.12	16	0.33	26	25	10.9	12	25	35	23
Rick Swenson	DK RR27-11	Tassel	2250	93	28000	LS 6	3.09	20	0.32	27	30	8.9	21	31.6	27	25
Peter Fehr	PH 39M27	Tassel	2250	93	31000	SL 9	3.23	5	0.54	5	1	6.0	31	38.8	19	28
Kim Watts*	DK RR 27-11	Tassel	2250	88	28000	VL 25	3.11	18	0.36	22	23	13.8	3	37.5	22	8
Kim Watts*	DK RR 27-11	Tassel	2250	76	5500	VL 27	3.22	6	0.37	20	10	10.9	12	36.7	23	17
Rick Swenson	PH 39W54	Tassel	2200	111	24000	LS 7	2.88	29	0.39	15	28	6.0	31	23.9	36	38
Rick Swenson	PH 39W54	Tassel	2200	111	28000	LS 8	2.90	27	0.38	19	29	10.0	17	41.9	14	12
Rick Swenson	PH 39W54	Tassel	2200	106	31500	LS 5	2.83	32	0.36	22	31	6.8	30	39	18	25
Bob Sawatzky	Canamaize	Tassel	1950	69	92000	LL 38	3.22	6	0.35	24	12	10.7	16	25.3	34	28
Bob Sawatzky	Canamaize	Tassel	1950	66	79000	LL 37	3.33	1	0.43	14	5	6.9	26	23.8	37	37
Bob Sawatzky	Canamaize	Tassel	1950	63	66000	LL 35	3.10	19	0.39	15	16	8.9	21	26.7	32	32
Bob Sawatzky	Canamaize	Tassel	1950	63	70000	LL 36	3.24	4	0.44	12	6	8.9	21	21.7	38	34
Estuary HC	Pioneer ?	Pre-tassel	2650	90	31000	VL 23	2.66	38	0.25	38	38	13.6	4	42.7	12	6
Estuary HC	Pioneer ?	Pre-tassel	2650	87	31500	VL 24	2.82	34	0.27	33	35	13.9	1	44.8	9	2
Estuary HC	DK RR 335	Pre-tassel	2600	97	32000	FL 20	3.14	14	0.31	28	25	13.9	1	43.5	10	3
Estuary HC	DK RR 335	Pre-tassel	2600	93	30500	FL 19	3.22	6	0.28	32	21	12.8	6	50.2	6	4
Kim Watts	DK RR 335	Pre-tassel	2600	90	29000	LL 32	2.85	30	0.27	33	32	11.0	11	25.9	33	21
Kim Watts	DK RR 335	Pre-tassel	2600	86	28000	LL 31	2.75	36	0.26	35	36	11.9	9	29.8	29	18
Kim Watts	DK RR 335	Pre-tassel	2600	82	26500	LL 34	2.70	37	0.26	35	37	9.8	19	29.5	30	27
Kim Watts	DK RR 335	Pre-tassel	2600	77	23500	LL 33	2.84	31	0.26	35	34	11.9	9	34.8	24	15
Kim Watts*	DK RR 27-11	Pre-tassel	2250	81	14000	VL 28	3.27	3	0.30	29	15	12.8	6	30.5	28	16
Peter Fehr	PH 39W54	Pre-tassel	2200	101	32000	SL 10	2.97	24	0.54	5	11	5.9	35	43.2	11	22
Peter Fehr	PH 39W54	Pre-tassel	2200	101	28500	SL 12	2.89	28	0.52	7	17	3.9	38	40.9	15	32
Peter Fehr	PH 39W54	Pre-tassel	2200	100	27000	SL 11	2.83	32	0.49	9	24	6.0	31	37.8	20	30
Ryan Gibson	PH 39W54	Pre-tassel	2200	91	30600	DS 1	2.81	35	0.30	29	33	10.8	14	42.2	13	10
Ryan Gibson	PH 39W54	Pre-tassel	2200	87	25800	DS 2	3.17	12	0.58	2	3	6.9	26	60.3	2	11
Ryan Gibson	PH 39W54	Pre-tassel	2200	80	28800	DS 4	3.09	20	0.56	4	9	5.9	35	54.4	4	19
Ryan Gibson	PH 39W54	Pre-tassel	2200	70	26400	DS 3	2.98	23	0.51	8	13	5.9	35	33.3	26	35

*Note: July 13 hail breakage of stalks 12%, 16%, 82% and 41% respectively.

Pocket gophers ... controlling this pest

At the December 2000 Annual General Meeting, the ICDC Board of Directors invited Irrigation Districts to outline their pocket gopher control objectives. In February 2001, ICDC sent a letter requesting funding proposals for pocket gopher control to all Saskatchewan irrigation districts. Grainland I.D. offered their ditch-rider, Clint Bjolverud, as a part-time pocket gopher technician. Grainland I.D. Board also enlisted fifteen irrigators to smooth all of the old dirt mounds on their participating alfalfa fields. For the purposes of evaluating the Grainland I.D. 2001 experience, the five alfalfa fields with greater than 66 fresh mounds spring baited are rated in Table 8 as the "high population", 58 to 66 fresh mounds spring baited as the "mid population", and from 8 to 47 fresh mounds spring baited as the "low population" infestation. Five fields that did not receive a spring baiting were added for summer and/or fall baiting. The last five fields averaged 10.4 hours of additional work and 62 baitings each, and represented critical source areas on the borders of the original fifteen fields.

Table 8. 2001 Grainland I.D. pocket gopher management demonstration plot baiting summary.

Plot Number	Owner	Total mounds baited	Total hours baiting	
High Population				
14	Marks	147	13.5	8 mounds/hr
20	Monroe	210	22.0	
24	Crowley	155	21.8	
25	Arnold	136	17.0	
26	King	266	24.5	
Average		**183**	**19.8**	
Mid Population				
12	Cooper	107	16.5	7 mounds/hr
15	White	87	13.0	
16	Kurtz	128	17.0	
22	Tucker	127	17.0	
30	Chapman	113	15.5	
Average		**112**	**15.8**	
Low Population				
4	May	94	14.5	6 mounds/hr
5	Paysen	79	14.5	
13	Esmond	114	20.0	
17	May	54	11.9	
19	Oram	97	16.1	
Average		**88**	**15.4**	
No Spring Baiting				
2	McIntyre	60	11.0	6 mounds/hr
21	Oram	39	7.0	
23	Robertson	108	14.5	
27	Oram	51	11.5	
28	Oram	53	8.0	
Average		**62**	**10.4**	

The 2001 baiting periods offered slightly different objectives. Spring baiting, which followed the smoothing of previous pocket gopher mounds and other surface roughness, attacked the breeding age adult population. The bait served as a high energy source for hungry rodents. Immediate success was noted on the fifteen fields at the first alfalfa cut. Very few fresh mounds were encountered even in the high population areas. The cutting height of haying equipment was operated at lower settings than previous years. Field smoothness at July 1st was still rated as good after two months.

The summer baiting, that followed the first hay cut, second hay cut and during the irrigation season, attacked the new crop of adolescent pocket gophers. As many as six pocket gophers are weaned per burrow, and are turned out in July, hungry and inexperienced. In July, the adults are thought to be more bait shy than the adolescents. The five high population fields only required about one extra hour of baiting over the other fields during the summer. This confirms the high success achieved in spring baiting. The 2001 summer baiting period was judged least effective because the responsibility of operating the irrigation project took priority over baiting. Also the pocket gophers were already moving into irrigated alfalfa plots from dryland areas due to drought conditions. Bait was less attractive due to the abundance of fresh alfalfa roots, and the oat bait was soon wet from irrigation. Fresh digging was observed on all the hay fields at second cut.

The October and November fall baiting periods enabled longer term bait stations to be established. The burrows are freeze dried, and the bait will be viable until soaking spring moisture arrives. The adult pocket gophers do not hibernate and will potentially even move some of the bait into their wintering quarters. The opportunity for multiple kills per site baited justified an increase in the volume of bait placed in each burrow. The original fifteen fields, whether rated as high, mid or low population in the spring, all averaged over 20 fresh mounds baited during fall baiting. Much of this falls baiting was on the field borders due to immigration. Fall baiting was the most costly and averaged about five hours per field. The hay fields were not leveled this fall and will require floating early next spring.

The Grainland I.D. pocket gopher management demonstration saw 2225 burrows baited, over 800 acres in about eight weeks of work (Table 9). The five hundred bait stations established this fall offer some certainty that the spring 2002 activity in all twenty irrigated fields will be less than in the low population fields of 2001. As effective as the 2001 baiting has been, the population on at least 2000 acres of neighboring these twenty field represents a source area. 2002 is the second step in reducing the in field population and pushing the source areas farther back from the new alfalfa fields.

Table 9. 2001 Grainland I.D. pocket gopher management demonstrations, summary of bait delivered and labour required.

	Mounds Baited/Field				Labour (Hours/Field)			
	Spring	Summer	Fall	Total	Spring	Summer	Fall	Total
High Population								
Average Baited	117	43	23	183	7.9	6.6	5.3	19.8 hours
Baitings/hr	15	6	4	9				
Mid Population								
Average Baited	62	28	22	112	6.2	4.6	5.0	15.8 hours
Baitings/hr	10	6	4	7				
Low Population								
Average Baited	33	35	20	88	4.6	6.1	4.7	15.4 hours
Baitings/hr	7	6	4	6				
No Spring Baiting								
Average Baited	---	40	30	62	---	4.2	6.2	10.4 hours
Baitings/hr	---	8	5	6				
Cost**	$859.00	$650.00	$700.00	$2,150.00	$933.00	$1,075.00	$1,060.00	$3,068.00
Bait/hole		$0.97	Labour/hole		$1.38	Total/hole		$2.35
Bait/field		$107.50	Labour/field		$153.40	Total/field		$260.90
Bait/hour		$7.00	Labour/hour		$10.00	Total/hour		$17.00

**In field cost only (not included - training, April leveling, farmer activities, administration, inventory and profit).

The ICDC's series of Pocket Gopher Control field demonstrations rolled through six central and southern irrigation districts in 1999 attracting 155 participants. In October, 2000, five similar demonstration field days attracted 120 participants, and were delivered from South Saskatchewan River dairy belt to Northminster ID. In 2001, field demonstrations attracted over 200 clients at Grainland ID, Central Butte; PFRA Shelterbelt Centre, Indian Head; Craven on the Qu'Appelle River; S.S.R.I.D. at Broderick; West Central Region, Tessier; Hillcrest ID & SSEWS, Dundurn; and at the Western Beef Development Centre, Lanigan. Technical pocket gopher assistance was also provided at DU's Allan Hills Workshop and at SAF's Edam Seminar.

Elton Weich of Hoskins, Nebraska, and Brodie Blair of Headingly, Manitoba, led a practical training demonstration of complimentary control methods. Elton is a retired alfalfa farmer and offers a professional gopher control service. He has traveled widely in the USA, demonstrating how to effectively control this pest. He currently looks after 4,000 acres of alfalfa, and charges about $7.00 US/acre. This excellent program featured both a slide presentation and a hands-on gopher logic session out in an irrigated alfalfa field. Elton Weich presented a three piece set of his pocket gopher control tools at each demonstration. Local resource people added valuable experience and insight regarding current issues in pest management.

Effective control of pocket gophers in your irrigated alfalfa can be achieved:

1. **Smooth the field first.** Mounds of earth on your field and the resulting surface roughness are always the first problem to address. Old compact mounds must be loosened. Effective smoothing should be performed with either harrows, a float, a land leveler or an old rod weeder, combined with a light rolling. “Zero roughness tolerance.”

2. **The pocket gopher control program starts three days after the alfalfa field has been smoothed.** Once smoothed, new mounds pinpoint the location of each individual pest. Attack every sign of fresh digging with bait or traps. You may have far less gophers than you had expected. Fresh digging is very obvious in the early fall with the first light snow cover on your hay field.

3. **Go after the source of infestation.** Early defense of your borders is essential! When you kill only the infield pests, a secondary immigration will soon arrive to take their burrows. The “old mama” pocket gopher digs under cover from predators, heavy traffic and winter cold in ditches, fence lines, road allowances, under bale stacks and waste areas. With an annual birth rate increase of four to six, young pocket gophers will establish a home away from home out in your irrigated alfalfa field in late July, or after second cut. The tunnels dug by the youngsters are smaller in diameter.

4. **Traps, hand or machine baiting.** If you want to study your pest, trap the pocket gopher. Use a trap like The Black Hole trap, costing about $12.00. Effective hand bait placement is cheaper (about $0.75/hole), faster, can produce multiple kills over many days, and allows you to cover many acres per day. When baiting severely infested areas in advance of trapping or hand baiting a burrow building ripper may be useful. Fumigation of the pocket gopher is best left to trained professionals.

5. **Rodenticides.** A rodenticide is any chemical licensed to control rodents. Acute poisons such as zinc phosphide and strychnine are more applicable to pocket gopher control than the anticoagulants which require multiple feedings. Elton Weich “has tried them all”, and now buys **Burrow Oat Bat** (United Agri Products 1-800-561-5444). This bait is oats, rolled to allow absorption of the poison, laced with zinc phosphide. On contact with dilute stomach acids, phosphine gas is released causing asphyxia. Fresh, palatable bait is essential regardless of the poison. Cameron Wilk, Saskatchewan Pesticide Specialist, 306-787-2195; and John Bourne, Vertebrate Pest Specialist at Vermilion, Alberta, 780-853-0531, are most familiar with the latest rodenticides registrations.

6. **Hand baiting method.** Careful probing at a 45 degree angle to locate and trowel out the entry tunnel will expose the main burrow system less than a foot below the surface. Pocket gopher tunnels are not directly below their mounds. Check your field in the early morning before the gopher has fully plugged the fresh rising tunnel. Funnel half a cup of bait right down into the main burrow and always plug the tunnel and level the mound. Always level the mound you bait. A tunnel left open after baiting will encourage the gopher to throw the bait and even more dirt onto

the surface mound while rapidly re-plugging the entry tunnel. The pocket gopher does not hibernate and complete burrow systems go down below the frost under your alfalfa.

7. **Calling all entrepreneurs!** Your best option can be the establishment, training and part-time support of a custom gopher control business for your district. This two-year battle plan is realistic:
   1. In late August immediately following second cut when all bales are removed, and after three inches of irrigation if possible, carefully level the field. You have to deal with the source areas by mowing, cultivation or, maybe by annual burning of the dry cover.
   2. Inspect the field at least twice in October and hand bait every "fresh dug" tunnel.
   3. Do two spring hand baitings, and start trapping where bait is not being taken.
   4. Bait after first & second cuts.
   5. Flag the problem areas that you notice while taking first and second cuttings and always bait the bordering source areas.

For an information package on Elton Weich's method of pocket gopher control, as well as plans and video of the truck mounted leveler are available from ICDC, (306) 778-5043.

Crop Manager Demonstration

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

Bean Seed Project 2001

Irrigation can offer the Saskatchewan Pulse Growers a reliable "seed factory" upon which their predicted expansion in bean acres could be reliably based. In 2001, three irrigators grew foundation CDC Pintium seed in 2001. CDC Pintium is an early maturing, upright pinto bean designed for dryland production, solid seeding, and straight combining in Saskatchewan. The variety also produces well under irrigation in Saskatchewan.

This year, ICDC worked to facilitate irrigators' move into bean seed production. Several issues quickly emerged:

1. **Seed Treatment**: Streptomycin is not registered in Canada, but imports of Streptomycin-treated seed are permitted. Alternative seed treatments, such as bluestone, seem to be as effective as streptomycin in controlled seedling blight (Howard & Leduc, 1999). Both seed treatments, as bactericides, are very harmful to the rhizobia inoculant. Does application of these seed treatments reduce nitrogen fixation and nodulation?

2. **Seed Testing and Field Inspection**: Bean seed producers need field inspection and seed testing for anthracnose and especially bacterial blight. Who will conduct the inspections and which seed test should be the new standard? What will be the consequences for fields that contain a certain level of disease?

3. **Foliar Treatments**: Will bactericides such as Kocide be necessary for seed producers? If so, when and how often should they be applied.

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

4. **Seed Standards**: ICDC and seed producers are working to develop bean seed standards that are reasonable, and yet competitive with seed from Idaho, Manitoba, and North Dakota. Seed producers want to establish a standard that will offer northern vigor, isolation, low disease levels, and experienced production.

ICDC has been working with the Saskatchewan Pulse Growers Association (SPGA), Canadian Food Inspection Agency (CFIA), Discovery Labs, the Crop Development Centre (CDC), and the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) in Outlook since January of 2001 to resolve these problems.

Beans were grown by three different seed producers in 2001; Ewen's, Carlson's and Siemens'. All three used CDC Pintium bean seed from the same source and had a dome rating of 3 for bacterial blight.

Carlsons

Soil: Loam, pH 7.1, non-saline.

Field preparation: Corn stubble was mowed, disked, and burned in spring of 2001. Edge (20 lb/ac) was worked. Water (0.8") was applied before seeding and 70 to 80 lb/ac of N was applied. There was no P application.

Seeding: Seeded CDC Pintium on May 22 (rate of 90,000 plants/acre) using a row crop planter with a 22" spacing. The seed was treated with Vitaflo 280 + Diazanon. Tagteam was applied on south half of the field with MBR self-stick peat-based inoculant.

Weed Control: Basagran and Assure. Row cultivation was done on July 12.

Fungicide: Ronilan 0.6 kg/ac + Kocide 1 kg/ac were sprayed twice within 14 days.

Harvest: The crop was undercut twice on August 24 and combined on August 30 with a JD 9610 running at 220 rpm. The swaths were windrowed before combining. The swath was 44 feet wide. **Yield was 2800 lb/ac**. Total water was 12" or 305mm including the 0.8 inches pre-plant. **The dome seed test had a rating of 2 with 4.0 lesions**.

Notes: Generally, the plant population produced a healthy stand under row-crop production with timely fungicide and bactericide application. In mid-July, chlorotic areas on leaves were noticed at flowering and in bean formation. Seed had 93% germination.

Ewens

Soil: Sandy loam, pH 6.9, non-saline.

Field Preparation: Field was tandem disked in the fall. Edge (18 lb/ac) was worked in.

Seeding: CDC Pintium was seeded on May 23. The field was initially seeded with a row-crop seeder (1/3 only). An air seeder was used to overseed the entire field. Plant count was 116,000/acre on overseeded area and 95,000/acre on other 2/3 of the field. Seed was treated with Vitaflow 280 + Bluestone (2.6 ml/kg seed). Liquid inoculant was also used.

Fertilizer: Fertilizer was applied with air seeder (actual N 46 lb/ac, P 40 lb/ac, K 40 lb/ac, S 10 lb/ac, Zn 3 lb/ac). Additional N (10 lb/ac) was applied through the pivot in the first week of August. The plants seemed to respond to the foliar application.

Crop Protection: Basagran + Assure for weed control applied June 25th. Benlate was applied July 17 to control fungal diseases.

Harvest: The field was swathed (24') on August 26 and combined September 14 with a Case IH 2388. **Yield was 2400 lb/ac**. Total water was 9" or 224 mm. **The dome test had a rating of 3 with 8 lesions**.

Notes: Chlorotic leaves appeared during flowering and pin bean formation (week of 20 July). On July 30, it appeared that the chlorotic or yellow plants had less nodulation than the green plants. There seemed to be an immediate response to foliar application of N (10 lb/ac) and blight symptoms seemed to be reduced once the plants were less stressed? Blight seemed to thrive on nutrient and water stressed plants.

Achieved good yield on this field, despite problems with fertility and seeding. Solid seeding worked well, but the seeding rate could possibly be lighter. The liquid inoculant applied with the seed treatment seemed to be ineffective, based on poor nodulation. Kocide probably helped to control bacterial blight, so spraying once or twice before disease spreads would be a good idea. Disease symptoms seemed to subside when irrigation resumed after a dry spell and plants regained their health. A swath width of 30' may improve harvested yield.

Siemens'

Soil: variable (Clay to Sandy Loam), pH 8.0, non-saline.

Field Preparation: Fall soil test indicated the presence of 37 lb/ac N, 25 lb/ac P, 742 lb/ac K, and >86 lb/ac S. Edge (18 lb/ac) worked in. Fertilizer was added at a rate of 40 lb/ac N, 35 lb/ac P and 5 lb/ac Zn.

Seeding: CDC Pintium seed was treated with copper sulfate (bluestone) at 2.6 ml/kg seed and a polymer coating (2g/kg seed) was applied. Peat-based inoculant was sprinkled on seed in seed box. Beans were seeded with an Edwards No-Till drill 812 (12" spacing). Seeding resulted in a plant stand of 70,000 plants/acre.

Weed Control: Basagran was applied on July 3 and Assure was spot applied on July 7.

Fungicide: No fungicide or bactericide applied.

Harvest: The crop was desiccated with Reglone (0.8 L/ac) with tripled surfactant on September 7. The crop was straight combined with a Massey 760 equipped with a flex header September 10th. The cylinder was set at 220. **Yield was 1500 lb/ac**. Total water applied was 6.8" or 171 mm. **The dome seed test had a rating of 3 with 5.6 lesions**.

Notes: This was a first-time bean grower who did an excellent job. Some chlorotic leaves were found late in season, and only in low areas. There was heavy flowering, excellent podding, and no disease found, likely due to geographical isolation. Compaction from the heavy drill may have prevented some beans from emerging. With a low plant population, early weed control can increase bean yield. A higher plant population would likely also have increased yield. Bactericide and fungicide may increase yield and improve quantity. The crop was too dry at combining, resulting in a lot of splits and cracks. Weeds were also a problem at combining.

Field Demo Goals for 2002

With the valuable experience that these growers have gained in 2001 (Table 10), 2002 should be an excellent year. Every aspect of production seems to affect bean yield, from field selection and preparation to harvest. Beans are not a very forgiving crop. Most importantly, try for a good plant stand, be ahead of weeds and diseases, water when flowering begins, and have a good harvest plan.

ICDC's goal is to encourage irrigators to explore the potential of new bean seed varieties: Why shouldn't seed growers multiply, market, and reap the rewards for the quality seed the customer is looking for? Why not use Saskatchewan-grown bean seed? Saskatchewan has a bean breeding program producing varieties that suit our climate. Outlook's CSIDC has a variety testing program for irrigated crops, including beans. Since irrigators are the obvious choice for multiplication of bean seed, they also have the opportunity to guide bean seed standards for Saskatchewan.

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Swine Manure Nutrient Management 2001

Manure is an Asset, Not a Liability

D. Oram[1], C. Klemmer[2], L. Schoenau[1], G. Weiterman[3], L. Shaw[2]

ICDC is working with Birsay Pork Farms and Sask Water's Agro-Environmental Unit to make the best use of swine effluent on irrigated crops. Information on soil applied effluent is available, but there is very little information on sprinkler applied effluent. In the Birsay area, one farmer is set up to utilize the effluent directly through two pivots, while other producers are interested in the use of fall injected effluent. ICDC was asked to quantify the amount of nutrients available from the different types of swine barns and to assess the application methods; soil injection and overhead application. ICDC and the Agro-Environmental unit of Sask Water also conducted soil analysis at the end of the season for areas treated and untreated with manure to determine changes in the soil. Another goal of the demonstration was to identify crops and crop rotations that would effectively capture and use the nutrients provided.

Manure Application

Manure management plans were delivered to the farm managers of each of the four project fields. Field information included pre-application soil tests, effluent analysis, rate of injection, crop nutrient recommendations, and the fall 2001 soil test results and interpretation from the treated and untreated areas.

In fall of 2000, liquid swine effluent was injected into four fields chosen for this project from two of the barns of the Birsay Pork Farms (Table 11). Two fields received effluent from a farrowing barn. The other two fields received effluent from a weanling to finisher barn (Table 12). In fall of 1999, effluent was broadcast applied, no analysis was done and the producers did not see any results in their crop yield in fall of 2000. Fall of 2000 was the first time that hog effluent was injected into the fields, but not the first application of manure.

Six thousand gallons/acre of hog effluent was injected into the demonstration fields around the pig barns. The fields around the Tullis barn received a total of only 66 lb of actual N per acre. The Handford fields received 198 lb of actual N per acre. Even after effluent injection, supplemental N needed to be applied to the fields around the Tullis barn.

Liquid effluent from the second cell of the Tullis unit farrowing barn was pumped to the pivots in Field 1 and 2 through the irrigation system. At the lagoon a 7 hp pump transferred the effluent to a diverter at a pressure of 76 psi. Fifty catch cups placed in a row under the pivot collected the diluted effluent so that the quantity of nutrients received by the canola crop could be measured. Samples from four different locations were taken for nutrient analysis; one from under the pivot point, two samples from catch cups and one from the undiluted lagoon. The samples were analyzed by Enviro-Test Lab in Saskatoon. Eight inches of effluent irrigation were applied to fields one and two, which contained a total of 40 lb/ac N, 16 lb/ac P and 88 lb/ac K. A summary of available nutrients and crop yield is presented in Table 12.

[1]Bloomfield Consulting, Central Butte, Saskatchewan
[2]ICDC, Outlook
[3]Sask Water

Crop Response

Crops were noticeably lush throughout the season. Tissue tests from the cereal crops were taken at the flag leaf stage. No additional nutrients were required. Cereal leaf disease incidence was very low. The durum was aerial sprayed with tilt fungicide at the flag leaf stage. Very windy, hot conditions dried out the canopy between applications of water, reducing the humidity up to the flowering stage. Irrigation during flowering and a period of warm temperatures likely helped the development and spread of fusarium head blight in the durum crop. Fusarium developed in both varieties of durum, but was less severe in the wheat. Overall yield was acceptable.

The canola crops both had a slow start this year. Yields were lower than expected, possibly due to flowering during very hot weather. Sclerotinia did not develop, even though the fields were not sprayed with fungicide. The four fields received eight to twelve inches of irrigation water throughout the season. Soil samples from treated, untreated and dryland benchmark areas were taken in the fall of 2001 at three depths. Nutrient removal and movement through the profile were monitored. Because of the heat and drought, the dryland corner did not produce much of a crop this year. Most of the nutrients remained in the first foot of the soil profile. The irrigated crop with overhead effluent application had similar amounts of residual soil N to the injected fields, even through there was more nutrient applied to the injected fields.

Producers would like to know what their effluent application rotation will be for irrigated crops. This year, the durum, wheat and canola crops seemed to be luxury consumers of nutrients. There was no yield response to the effluent applications. ICDC will continue to monitor these fields in 2002 to look at crop rotation, mineralization of organic nutrients, and severity of fusarium head blight.

Timothy Project

D. Oram[1], C. Klemmer[2], L. Schoenau[1], L. Shaw[2]

Irrigators are interested in growing timothy hay for processing and domestic sales. There is a growing market for compressed bales for export. These are locally processed in the Broderick area at Elcan Forage. Good quality timothy sells for over $200 per tonne. In the Outlook area, timothy acreage has increased from 1000 acres in 1998 to 4500 acres in 2001 due to the presence of Elcan Forage as a processor. Irrigators see the opportunity, but need to fine-tune management for this shallow-rooted forage crop.

Co-operators: Greg Sommerfeld, BJ Boot, Eliason Farms

Although yields of timothy were down slightly this year, the quality was excellent with less brown leaf than in the past. Since 2001 was an exceptionally hot and dry year in the Outlook area, it was a challenge to keep the timothy roots moist. Total available moisture, including precipitation and irrigation,

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

was 8 and 12 inches at two newly-established fields and both yielded one cut. There was a total of 14 inches of available moisture for an established field, which yielded two cuts. A late first cut will reduce the amount of regrowth produced for the second cut. With new varieties maturing three to five days earlier, two cuts will be more common. ICDC completed weekly field scouting, which included irrigation scheduling, rain gauge data collection, soil moisture tensiometer readings, soil and tissue testing, and ongoing agronomic support.

The success or failure of this crop depends on good establishment and timely application of irrigation. Seeding rates of 2 to 4.5 lb/ac have been used successfully. Firm and shallow seed placement will improve the plant stands. Fertilization will improve yields. Site selection is also important, as the crop will not tolerate flooding. The field should be free of Agropyron species, which harbor the Hessian fly larvae, non-saline and free of harmful herbicide residues. The purpose of this project was for ICDC to assist producers to identify the key agronomic needs to produce maximum yield while maintaining quality.

Field 1
Crop: Sixty acres of Climax timothy was established in 1998 on canola stubble. Crop stand was uniform in 2001.
Soil: Loam, pH 7.3, slightly saline.
Fertilizer: 60 lb/ac N, 50 lb/ac P, 100 lb/ac K (actual) spring broadcast
70 lb/ac N (actual) fertigated in season
40 lb/ac P (actual) applied after first cut
Soil test results on July 12 indicated 43 lb/ac N, 64 lb/ac P, >1200 lb/ac K in the soil. By October 23, soil test indicated 21 lb/ac N, 34 lb/ac P, 566 lb/ac K. Tissue test results indicated that N was sufficient, P marginal, and K slightly deficient.
Weed Control: Buctril M was applied to control broadleaf weeds. Persistent wild oat and some foxtail barley was observed creeping in on the field edge.
Insects: Mature heads were bleached, possibly due to damage by the Capsus bug. Grasshoppers became a problem toward the end of the season.
Disease: There were no noticeable problems with disease.
Water to first cut was 149 mm and water after first cut was 201 mm, for a total of 350 mm or 13.8 inches. The first cut yielded **2.76 tonne/acre** cut, baled and hauled prior to July 10. The second cut yielded **1.5 tonne/ac** cut, baled and hauled during the week of September 15.

Field 2
Crop: 135 acres of Colt timothy was seeded in fall of 2000 at 4.5 lb/ac. Establishment was poor, so the field was reseeded with 2 lb/ac on May 14, 2001. As of fall, 2001, the field had a well established stand.
Soil: Loam, pH 7.9, non-saline.
Fertilizer: 75 lb/ac N, 50 lb/ac P, 100 lb/ac K (actual) spring broadcast
70 lb/ac N (actual) fertigated in season
Soil test results on July 12 indicated 55 lb/ac N, 36 lb/ac P, 79 lb/ac K in the soil. By October 23, soil test indicated 31 lb/ac N, 28 lb/ac P, >192 lb/ac K.
Weed Control: Buctril M was applied. Green foxtail, wild oats, foxtail barley, volunteer canola, flixweed, stinkweed, goatsbeard and buckwheat were present.
Insects: There were no noticeable problems with insects.
Disease: There were no diseases observed in the field.
Water to first cut was 170 mm (6.7 inches). The first cut yielded approximately **2.5 tonne/acre** cut, baled and hauled during the week of August 6. There was no second cut. The field was mowed at freeze-up to reduce brown-leaf in 2002.

Field 3
Crop: 135 acres of Aurora timothy was seeded on pea stubble in fall of 2000. This was the first year of production and the seeding rate of 3.4 lb/ac resulted in good establishment.
Soil: Clay Loam, pH 7.7 to 8.2, non-saline.
Fertilizer: 60 lb/ac N, 50 lb/ac P, 20 lb/ac K
50 lb/ac N applied
Weed Control: Buctril M, Banvel and 2,4D Amine.
Weeds: flixweed, buckwheat, narrow-leaved hawk's beard, wild oat.
Water to first cut was approximately 12 inches. The first cut yielded approximately **3 tonne/ac** cut, baled and hauled August 4-11. There was no second cut.
Notes: There was some wind and hail damage in late July and early August. The field was mowed at freeze-up to reduce brown-leaf in 2002.

Fields 4 and 5
Crop: North field seeded to Climax timothy in 1998 at 4.5 lb/ac. This is the fourth year of production. South field seeded to Aurora timothy in Fall 2001 at 4.5 lb/ac.
Soil: Clay Loam, pH 7.1 to 8.2, non-saline in upper profile, severely saline at depth.
Fertilizer: 70 lb/ac N, 30 lb/ac P, 15 lb/ac K (actual) granular applied with floater from Agricore United
20 lb/ac N (actual) fertigated in season
50 lb/ac N (actual) split applied and watered-in five days apart
40 lb/ac P (actual) applied after first cut
Weed Control: MCPA-K applied. Some foxtail barley in established stand.
Insects: Grasshoppers.
Disease: Purple eyespot throughout established field.
Water to first cut was approximately 7 inches. The first cut yielded approximately **2.5 tonne/acre** cut, baled and hauled first week of August. Regrowth was mowed and baled in September.
Notes: Hail delayed crop maturity.

Demonstration Management Plan for 2002

ICDC and the cooperators have identified agronomic practices that will likely improve yield and quality in the timothy hay demonstrations.

- Fertilization – a soil test (0-12") after first cut will help to determine the level of fertilization needed for the second cut.
- Nitrogen and potassium fertilizer will be split applied, with an application for each cut, either broadcast or fertigated. Palatability or sweetness of the hay is related to the amount of applied K.
- Potassium (K) split applied to maintain quality and yield in the second cut.
- Adequate phosphorous fertilizer applied in the spring and additional P may be required after first cut.
- Careful weed monitoring and more than one spray application may be necessary to manage weeds, especially in newly-established and poorly established fields.
- Date of cutting will be correlated with protein levels in timothy hay to determine the best cutting time. Also, leaf to stem ratio of the three timothy varieties will be compared at maturity.
- Irrigation scheduling will be used to make the best use of moisture. Because timothy is shallow-rooted, moisture must be applied often on coarse-textured soils.

ICDC will continue weekly field scouting in 2002 on the five fields selected for this timothy demonstration project. Please feel free to contact ICDC agrologists with your ideas and comments on growing the best timothy hay crops in 2002.