Saskatchewan Irrigation Diversification Centre

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Annual Review

April 1, 1998 to March 31, 1999

- Contents -

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

Introduction

Manager's Report

On behalf of the Saskatchewan Irrigation Diversification Centre (SIDC), it is my pleasure to present the annual progress report. The report summarizes the wide range of activities conducted, funded or facilitated by the Centre in 1998. I would like to extend special thanks to the members of our newly formed Executive Management Committee (EMC): Carl Siemens, Don Fox, Gerry Luciuk, Dale Sigurdson and John Linsley. Their input and support have been critical to the operation and success of the Centre. Harvey Fjeld, a long-serving member of our management committee, has recently retired. His input and enthusiasm was highly regarded. We thank him for his past service, and wish him well in the future.

1998 was a year of transition for the Centre. Recognizing the value of partnership and industry participation, a memorandum of understanding (MOU) was signed. This MOU formally added industry representation through the Saskatchewan Irrigation Projects Association (SIPA) and the Irrigation Crop Diversification Corporation (ICDC) to the previous partnership between Agriculture and Agri-Food Canada (PFRA) and Sask Water. Clearly this will add a positive dimension to the operation of the Centre. The signing took place at the annual SIDC field day on July 8, 1998. SIDC had the privilege of having Hon. Lyle Vanclief, Minister of Agriculture and Agri-Food Canada, Hon. Maynard Sonntag, Minister Responsible for Sask Water, along with industry representatives Ron Tittle (SIPA) and Carl Siemens (ICDC) present to sign the agreement.

In view of the newly signed Canada-Saskatchewan-Industry partnership, a strategic planning workshop was held in Outlook on November 17 & 18, 1998. Participants in the workshop included a broad range of producers, industry, university and government stakeholders. Producer delegates from twelve irrigation districts representing 75% of the district irrigated acres were in attendance. The workshop was designed to achieve a consensus on a vision for the role of SIDC, the obstacles which may prevent achieving the vision and the strategic directions the Centre must take.

<u>Stategic Planning Workshop Recommendations</u>:

1. *Publish an SIDC Business Plan by September 1, 1999.*
2. *Secure appropriate irrigation R & D funding through*
   i) *A-base funding (federal and provincial)*
   ii) *Federal/provincial/industry agreements, and*
   iii) *Research/industry contracts*
3. *Commission the documentation of irrigation personnel, and R & D information applicable to Saskatchewan conditions in an electronic database by December 31, 1999.*
4. *Encourage collaborative R & D partnerships on a prairie-wide and on an international basis.*
5. *Commission the creation and distribution of an updatable irrigation manual for the Canadian Prairies by March 31, 2001.*
6. *Define requirements for and identify mentor irrigators to be involved in a farmer-to-farmer information exchange process by May 31, 1999.*
7. *Establish four irrigation demonstration spoke sites located province-wide by December 31, 2000.*

Staff at SIDC continue to focus on rural growth and resource care issues, particularly as they apply to irrigation. There is a need to diversify and adopt irrigated cropping practices in Saskatchewan to encourage sustainable production of higher value crops with value added potential. SIDC's primary impact has been through crop diversification and intensification efforts. Interest in irrigated crop diversification and higher valued alternatives is clearly evident through ever increasing and large attendance at the annual field day and commodity tours. Depressed commodity prices have accentuated this need for new alternatives. Potato and vegetable production, medicinal herbs and spices, dry bean, and turf grass seed production have all seen huge increases in the requests for information.

Adequate funding is critical to the operation of SIDC. Funding has been provided through federal and provincial A-base dollars along with agreement dollars. The Canada/Saskatchewan Agreement on Water Based Economic Development (PAWBED) provided an excellent source of funding for irrigated research and demonstration. Benefit cost analysis of the R & D portion of this program managed by SIDC displayed returns ranging from 3:1 for cereals to 12:1 for potatoes. The federal portion of this agreement is now completed and the provincial portion will end December 31, 1999.

More recently, an industry driven program, the Canada/Saskatchewan Agri-Food Innovation Fund (AFIF), has provided support for the agriculture and irrigation sectors in Saskatchewan. This program has requested and allowed SIDC to act as a spoke site for irrigated research and demonstration for specialized crops. SIDC has also received R & D funding to support the potato and vegetable industries. In addition, AFIF infrastructure funding has provided SIDC the opportunity to construct a potato/vegetable storage and handling facility along with retrofitting the greenhouse. These industry driven initiatives will provide SIDC the ability to support the development of higher valued cropping opportunities.

Interest in irrigated crop diversification and higher valued alternatives is clearly evident through ever increasing and large attendance at the annual field day and commodity tours.

Partnerships on a prairie-wide and international basis are important to the development of sustainable irrigation practices. An MOU called the Prairie Irrigated Crop Diversification Group is in place between SIDC, the Manitoba Crop Diversification Centre (MCDC), and the Alberta Crop Diversification Centre (ACDC). This MOU assists the Agri-food industry across the prairies in addressing issues, needs and opportunities in irrigated crop diversification and value adding. It has encouraged working together and the development of joint projects.

SIDC expertise has also been recognized and utilized in the international sphere. This includes technical and administrative involvement in the CIDA sponsored Canada/Egypt National Water Quality and Availability Management program. SIDC staff have also participated and will continue to participate in the training of agronomists from the Hebei project in China.

Finally, SIDC staff are involved in national and international committees. These include the National Potato Research Network, the Canadian Committee on Irrigation and Drainage, and the International Commission of Irrigation and Drainage. This activity continues to bring new ideas and approaches to work at the Centre.

I trust you will find this report a useful summary of SIDC activities.

History

The Saskatchewan Irrigation Diversification Centre (SIDC) originated as the Prairie Farm Rehabilitation Administration (PFRA) Farm at Outlook, Saskatchewan. The PFRA Pre-development Farm was established in 1949, prior to the construction of the Gardiner Dam. The farm was designed to demonstrate irrigation to assist farmers in their transition to irrigated agriculture. Upon completion of the Gardiner Dam and the formation of Lake Diefenbaker, the farm became known as the Demonstration Farm and served a useful role in demonstrating irrigation technology.

At that time irrigated research and demonstration programs conducted by Agriculture Canada, PFRA, the University of Saskatchewan, and Saskatchewan Agriculture were limited. Each program addressed specific organizational or scientific objectives independent of the work of others. The need existed for a co-ordinated, co-operative program.

In 1986, the Saskatchewan Irrigation Development Centre (SIDC) was established as a jointly funded federal/provincial agency as a result of a Memorandum of Understanding between Agriculture and Agri-Food Canada (PFRA) and Saskatchewan Agriculture. Its purpose was to conduct, fund, and facilitate irrigated research and demonstration in response to producer and industry needs. The redesign and rehabilitation of the Centre's irrigation infrastructure created the capacity to perform complex irrigated agronomic and environmental studies. The goal of the Centre was to promote economic security and sustainable rural development primarily through diversified cropping and more intensive management of irrigated cropland.

A new Memorandum of Understanding (MOU) was signed in July of 1998. This MOU includes Canada (PFRA), Saskatchewan (Sask Water) and Industry [Saskatchewan Irrigation Projects Association (SIPA) and the Irrigation Crop Diversification Corporation (ICDC)] at the management table of the newly named Saskatchewan Irrigation Diversification Centre.

Since the formation of SIDC, Canada and Saskatchewan have delivered irrigated research and demonstration information to their clients. This has been done using departmental budgets along with funding from federal/provincial initiatives including the Saskatchewan Irrigation-Based Economic Development (SIBED) program, the Partnership Agreement on Water-Based Economic Development (PAWBED), and the Agri-Food Innovation Fund (AFIF).

In recognition of the importance of partnerships, and particularly the role of industry as part of the partnership, a new Memorandum of Understanding (MOU) was signed in 1998. This MOU now includes Canada (PFRA), Saskatchewan (Sask Water) and Industry [Saskatchewan Irrigation Projects Association (SIPA) and the Irrigation Crop Diversification Corporation (ICDC)] at the management table of the newly named Saskatchewan Irrigation Diversification Centre (SIDC). This agreement places SIDC in a strong position to meet the future needs of its clients.

In addition, an MOU with the Manitoba Crop Diversification Centre, the Alberta Crop Diversification Centre, and the SIDC has been signed. This formal arrangement will guide co-operative activity in irrigated crop diversification for the Canadian prairies.

Objectives

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

2. Conduct, fund and facilitate 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 research agencies.

4. Demonstrate sustainable irrigated crop production methodology at SIDC.

5. Promote and extend sustainable irrigated crop production methods to ensure clients are well served.

6. Evaluate the environmental sustainability of irrigation and evaluate 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. This will increase levels of co-operation in marketing, research and demonstration that support diversification and value adding, along with transfer of such technology to strengthen the industry.

Staff

Manager	L. Tollefson	ICDC Agrologists	J. Linsley
Administration	M. Martinson		L. Bohrson
Secretarial	J. Clark		I. Bristow
Market Analyst	H. Clark		K. Olfert
Field Crops Agronomist	L. Townley-Smith	Field Operations	B. Vestre
- Technician	G. Larson	Irrigation	D. David
Irrigation Sustainability	T. Hogg	Maintenance	A. MacDonald
- Technician	M. Pederson	Irrigated Forage Project	L. Sexton
Specialty Crops Agronomist	J. Wahab	Student Interns	G. Kort
- Technician	C. Burns		N. Warwaruk
Technology Transfer	J. Harrington		G. Saraurer

Programs

Specialty/Horticultural Crops

A specialty crops development program was initiated at SIDC 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 involves a broad range of varietal evaluation, along with 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 optimizing economic returns.

Field Crops (Cereals, Oilseeds and Forage)

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 (varietal trials) under irrigated conditions with improved disease and lodging tolerance or novel quality traits which could service a niche market. Suitable varieties must be identified and tested for agronomic performance under irrigated conditions. Evaluation of agronomic factors which can lead to more efficient water use, optimize production and lower input costs must also be determined.

Environmental Sustainability

This program attempts 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 SIDC is made available to farmers, extension personnel, private industry and the general public. It includes the annual field day, tours, participation in extension meetings and report writing.

Field Demonstrations

ICDC agrologists conduct field demonstrations of applied research developed at SIDC 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

SIDC staff made presentations at the following meetings and conferences:

- Soils and Crops Workshop, Saskatoon, Sask.
- National Potato Research Conference, Lethbridge, Alberta
- ICDC Crop Manager Meeting, Outlook, Sask.
- Pre-Inception meeting on NAQWAM Project, Hull, Quebec
- Water Quality Workshops, Regina (2), and Saskatoon, Sask.
- Irrigation in International Development, University of Regina, Regina, Sask.
- Special Crops meeting, Edmonton, Alberta
- PFRA Service meeting, Russell, Manitoba
- Sask. Seed Potato Grower's Annual meeting, Saskatoon, Sask.
- Sask. Herb and Spice Association public meeting, Saskatoon, Sask.
- Sask. Herb and Spice Association public meeting, Moose Jaw, Sask.
- ICDC/SIDC Program Update meeting, Outlook, Sask.
- Diversification - The Vegetable Option, Outlook, Sask.
- Prairie Potato Council Annual Meeting, Saskatoon, Sask.
- Alberta Agriculture "Opportunities and Profits II into the 21st Century," Edmonton, Alberta

Tours

Tours of the Centre and of the field programs are conducted regularly at SIDC. Noteworthy groups touring the facilities in the past year included:

Dutch research group	Jun 15
SIDC Field Day and signing of new Memorandum of Understanding	Jul 8
Hon. L. Vanclief, Memorandum signing and personal tour	Jul 8
Saskatchewan Pulse Growers	Jul 14
British producer group	Jul 14
Japanese trade delegation	Jul 14
University of Regina international development group	Jul 15
SIDC Evening Tour	Jul 15
National Farmer's Union	Jul 16
Brazilian trade delegation	Jul 20
Philippine potato growers	Jul 21
Saskatchewan Vegetable Growers' Association Tour	Jul 30
Chilean irrigation specialists	Aug 4
Canola Council of Canada	Aug 5
SIDC Potato Day (W. Canada Seed Potato Consortium)	Aug 11
Chinese delegation (CIDA project)	Aug 11
Manitoba Agriculture tour group	Aug 12
Western Diversification personnel	Aug 17
Australian producer group	Aug 28
Saskatchewan Treasury Board	Sep 21
Egyptian water resource group	Sep 26
PFRA Service tour	Oct 30
ICDC delegates to the SIDC Strategic Planning Workshop	Nov 18
Russian Potato Agronomists	Mar 24

Additional tours and activities were held for students of the Dinsmore and the Outlook Elementary schools, for private industry managers with projects on station, for members of the media, and for numerous other individuals who stopped to visit the Centre.

SIDC Display

SIDC presented a display at trade shows at the following events:

- Crop Production Show, Saskatoon
- Trade Fair, Beechy
- Saskatchewan Irrigation Projects Association annual meeting, Moose Jaw
- SIDC Strategic Planning Workshop, Outlook
- SIDC Annual Field Day, Outlook
- Diversification - The Vegetable Option meeting, Outlook

Publications

H. Clark. A Comparison of the Costs and Returns for Irrigated and Dryland Crop Production in Saskatchewan. Soils and Crops Workshop, February 25, 1999, Saskatoon, Sask.

J. Elliot, A. Cessna, K. Best, W. Nicholaichuk, and L. Tollefson. Leaching and Preferential Flow of Clopyralid under Irrigation: Field Observations and Simulation Modelling. Journal of Environmental Quality, 1998, Vol. 27: pp 124-131.

T. Hogg, J. Linsley, M. Martinson, and J. Harrington. Challenge and Opportunity: A New Era in Irrigation Research and Demonstration in Saskatchewan. SIDC Strategic Planning Workshop, November 18 & 19, 1998, Outlook, Sask.

A. Johnston, W. Schatz, G. Lafond, T. Hogg, D. Larsen, E. Johnson, and B. Nybo. Pulse Crop Adaptation in Saskatchewan. Pulse Crops Research Workshop, November 27 & 28, 1998, Saskatoon, Sask.

A. Johnston, G, Lafond, S. Brandt, B. Nybo, W. Schatz, D. Larsen, and T. Hogg. Fertilizer Response and Placement with Field Pea. Pulse Crops Research Workshop, November 27 & 28, 1998, Saskatoon, Sask.

G. Larson, L. Townley-Smith, J. Wahab, T. Hogg, I. Bristow, and J. Harrington. Crop Varieties for Irrigation. February, 1999.

Saskatchewan Irrigation Development Centre Annual Review. March, 1998.

K. Stonehouse, J. Gillies, and L. Tollefson. Evaluation of LESA technology in the Saskatchewan Environment. Canadian Water Resources Journal, Vol. 23, No. 4, pp 339-350.

L. Tollefson, R. Wettlaufer, and A. Kassem. National Water Quality and Availability Management in Egypt. Proceedings of the Canadian Water Resources Association technical sessions, June, 1998, Victoria, B.C.

L. Tollefson. Agri-Food Innovation Fund Specialized Crops Spoke Site Annual Report, March, 1999.

J. Wahab. New Initiatives in Potato Agronomy. Agriculture and Agri-Food Canada Potato Network meeting, February 2, 1999, Lethbridge, Alberta.

J. Wahab. New Crops Field Research at the Saskatchewan Irrigation Diversification Centre. Opportunities and Profits II into the 21st Century, November 1 - 4, 1998, Edmonton, Alberta.

J. Wahab. What's New in Herb Agronomy? Soils and Crops Workshop, February 25, 1999, Saskatoon, Sask.

J. Wahab. SIDC Herb Research Program. Sask. Herb and Spice Association Industry Conference, November 7, 1998, Regina, Sask.

J. Wahab. Developments in Seed Potato Agronomy. Prairie Potato Council Annual Conference, December 9 & 10, 1998, Saskatoon, Sask.

Committees

L. Tollefson

- Prairie Potato Council, Chair of the Storage and Marketing Committee
- Agriculture and Agri-Food Canada National Potato Research Network
- Agri-Food Innovation Fund, Horticulture committee
- Canadian Commission on Irrigation and Drainage, Secretary/Treasurer
- Dept. of Agriculture and Bioresource Engineering, Research Associate
- Effluent Irrigation Project Liaison Committee
- International Commission on Irrigation and Drainage Crops and Water Use sub-committee
- Egypt National Water Quality and Availability Management Project (NAWQAM) Project Executive Committee and Canadian Co-ordinator
- USCID conference "Irrigation and Drainage in the new Millenium", Organizing committee
- Partners for the Sask. River Basin Technical Committee
- PAWBED Irrigation Improvement sub-committee
- PFRA Operations committee
- Prairie Crop Diversification Task Force
- Prairie Agricultural Landscapes Technical committee
- Canadian Water Resources Assoc. Technical committee for the year 2000 conference
- Health of our Rural Water steering committee
- 18th Congress & 35th International Executive Council for Montreal 2000, ICID Organizing committee
- Herbfest 2000 organizing committee

T. Hogg

- Environmental Management Strategy Planning committee
- PFRA Universal Classification System Evaluation team
- PFRA North Sask. Region EDP Committee
- PFRA Pesticide Review committee
- Prairie Irrigated Crop Diversification Working Group
- Prairie Regional Recommendation Committee on Grains
- SIDC Strategic Planning steering committee

L. Townley-Smith

- Prairie Agricultural Landscapes Technical committee

H. Clark

- PFRA Human Resources Strategy Group
- PFRA Service Workshop planning committee
- Developing Seed Potato Production Costs working group
- National Cost of Production and Marketing for herbs and spices working group
- Agriculture and Agri-Food Canada Ethanol Working Group
- Saskatoon Branch of the Sask. Institute of Agrologists, Executive member

J. Wahab

- Agriculture and Agri-Food Canada National Potato Research Network
- Prairie Potato Council
- Prairie Regional Recommendation Committee on Grains
- Saskatchewan Seed Potato Growers' Association
- Western Expert Committee on Grains - production section
- Saskatchewan Herb and Spice Association
- Potato Association of America
- Herbfest 2000 organizing committee

B. Vestre

- Environmental Management Strategy Planning committee
- Joint Occupation Safety and Health committee
- PFRA Pesticide Review committee
- Herbfest 2000 organizing committee

M. Martinson

- Environmental Management Strategy Planning committee
- PFRA Communicator Newsletter working group
- SIDC Strategic Planning steering committee

Factsheets

The following factsheets are available from the SIDC. Please contact the Centre for copies.

***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 SIDC
- Alfalfa Establishment under Irrigated Conditions

Herbs and Spices:
- Herbs, Spices and Essential Oils Research & Demonstration
- Annual Caraway Trials at SIDC
- Coriander Trials at SIDC
- Dill Seed Trials at SIDC
- Irrigated Scotch Spearmint Production in Saskatchewan

Marketing:
- Vegetable Price Comparison
- Ginseng Production and Marketing on the Prairies
- Ethanol Industry Set for Recovery

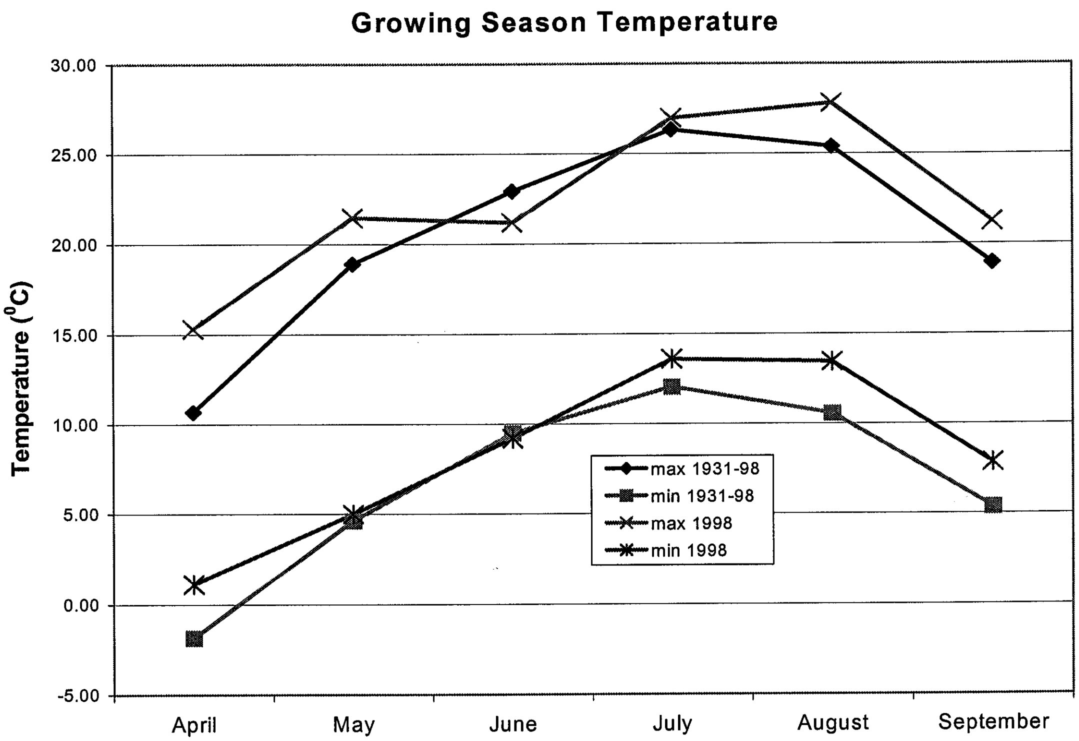
Oilseeds:
- Date of Seeding, Seed Rate, and Row Spacing of Irrigated Flax
- Seeding Rate and Row Spacing for Irrigated Canola
- Crop Management for Sclerotinia Control in Canola
- Innovations in Canola Production

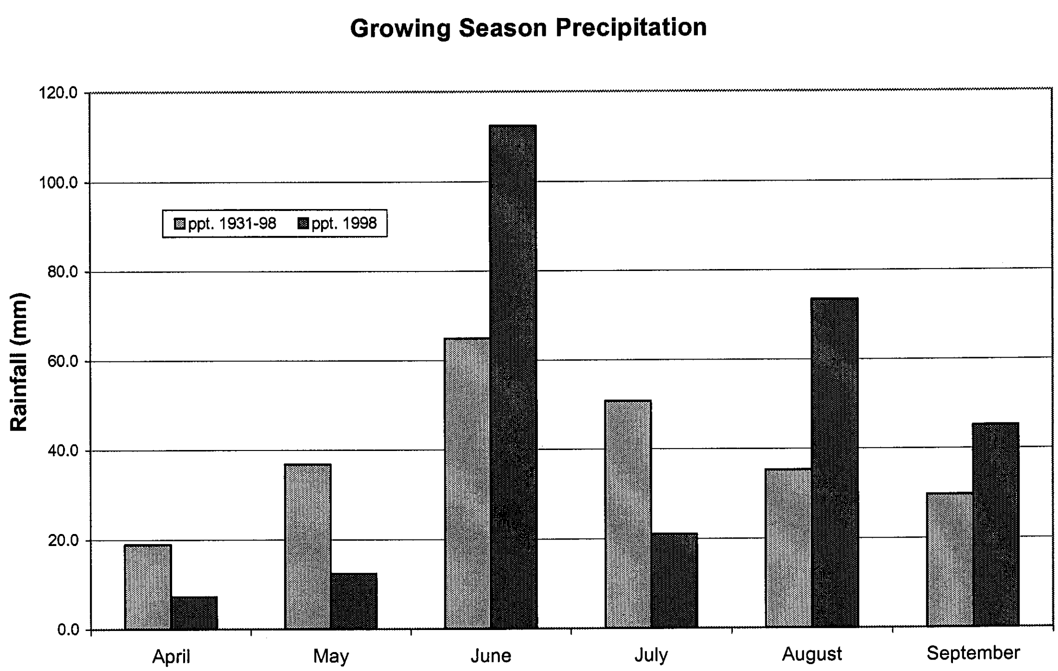
Pulse Crops:
- Dry Bean Production under Irrigation in Saskatchewan
- Irrigated Dry Bean Production Package
- Intercropping Pea with Oilseeds under Irrigation
- Management of Field Pea under Irrigation
- Faba Bean Trials at SIDC
- Management of Irrigated Lentil
- Irrigated Chickpea Trials at SIDC

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 Canola
- Canola Fertilization Trials at SIDC
- Hog Effluent Research and Demonstration

Other:
- Crop Varieties for Irrigation
- Overview of SIDC
- Geographic Information System at SIDC
- Northern Vigor™ in Seed Potato
- Xeriscape Demonstration Project at SIDC
- Fruit Crops in Saskatchewan
- Plastic Mulches for Commercial Vegetable Production

1998 Weather Summary

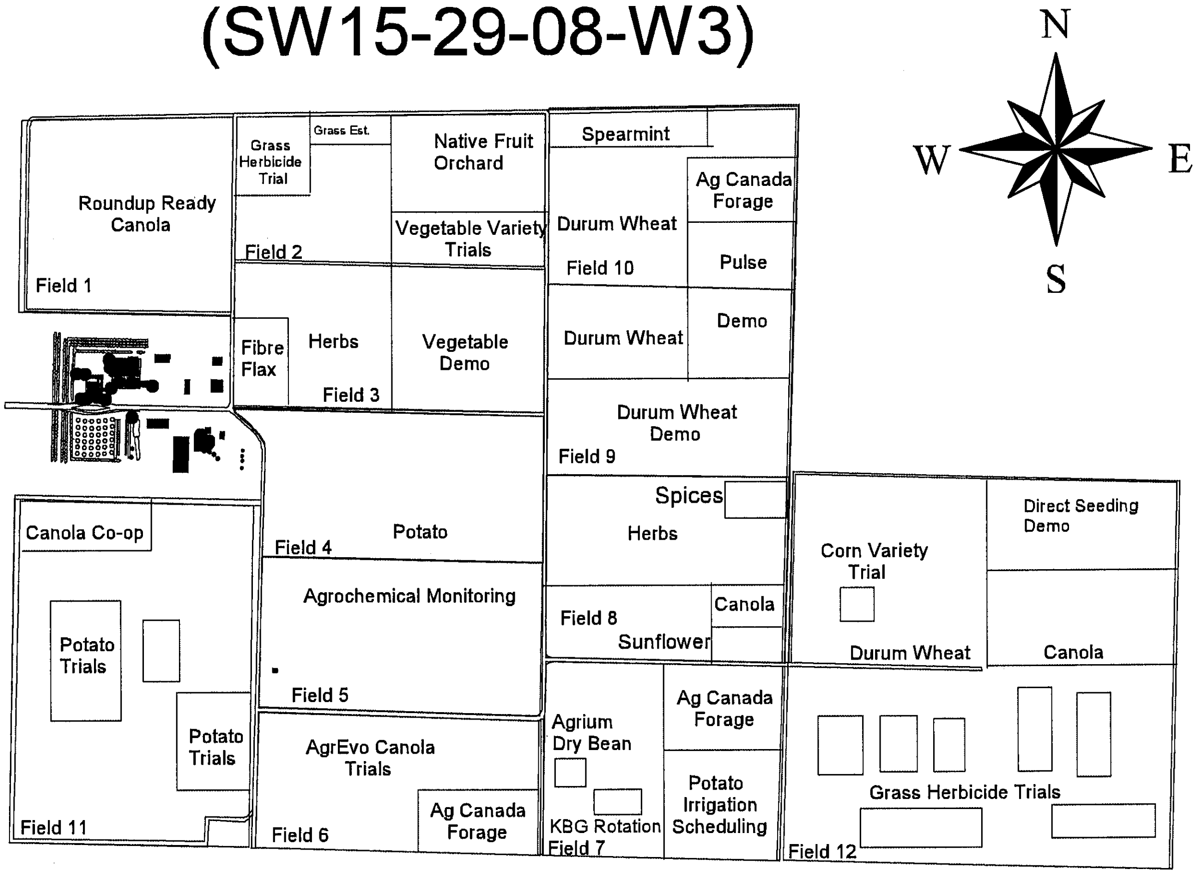




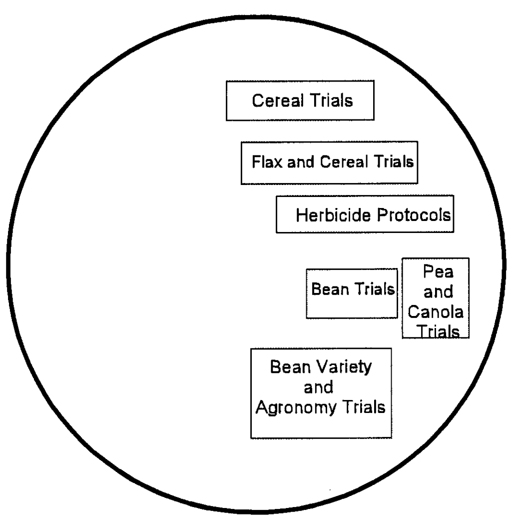
Irrigation Data

Field	Crop	Millimeters Applied					Total Irrigation	
		May	June	July	Aug	Sept	mm	inches
SIDC								
1	Canola	55		125	25		205	8.1
4	Potato	25		90	50		165	6.5
5	Potato	25		90	50		165	6.5
7	Dry Bean	40	75	125			240	9.4
7	Forages	40	75	125	25		265	10.4
7	Potato	25	75	125	75	25	325	12.8
8	Rotation study	40	75	100	25		240	9.4
8	Durum demo	40	50	100			190	7.5
9	Faba bean	40	75	100	25		240	9.4
9	Chickpea	25	25	50			100	3.9
9	Dry Bean	40	75	100	25		240	9.4
9	Lentil	40	75	50			165	6.5
9	Durum	40	50	100			190	7.5
10	Mint	40	75	100			215	8.5
10	Durum	15	75	100			190	7.5
11	Canola		75	115	75		265	10.4
11	Potato		75	115		25	215	8.5
12	Direct Seed demo	25	25	75			125	4.9
12	Durum	25	25	75			125	4.9
12	Forages	25	50	100	25		200	7.9
Off-station site								
	NE quadrant	55	60	135	30		280	11.0
	NW quadrant	30	60	135			225	8.9
	SE quadrant	80	60	135	30		305	12.0
	SW quadrant	30	60	135		50	275	10.8
Rainfall		12	112	21	73	45	264	10.4

SIDC MAIN SITE
(SW15-29-08-W3)



SIDC OFF-STATION SITE
(NW12-29-08-W3)



Cereals Program

Cereals Program

Variety Evaluations

Western Canada High Yield Wheat Co-operative Test

L. Townley-Smith[1], G. Larson[1]

> ***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 May 14 in 1.5 m x 4.0 m (5 ft x 13 ft) plots. Fertilizer applications of 100 kg/ha N (90 lb/ac) as 46-0-0, and 50 kg/ha P (45 lb/ac) as 11-52-0 were side-banded at seeding. The plots were desiccated on August 28 and were harvested September 15. The entire plot was harvested for yield measurements. Results of the test are shown in Table 1.

Several lines combine high yield with good lodging resistance and relatively short stature.

Western Canada Soft White Spring Wheat Co-operative Test

L. Townley-Smith[1], G. Larson[1]

The Soft White Spring wheat co-operative test was sown May 14 in 1.5 m x 4.0 m (5 ft x 13 ft) plots. Fertilizer rates of 100 kg/ha N (90 lb/ac) as 46-0-0, and 50 kg/ha P (45 lb/ac) as 11-52-0 were side-banded at seeding. The plots were desiccated on August 28 and were harvested September 15. The entire plot was harvested for yield measurements. Results for the test are shown in Table 2.

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

Several lines outyielded the check varieties. The highest yield, by a wide margin, was obtained for line 97DH-617.

[1]SIDC, Outlook

Table 1. Yield and agronomic data for the 1998 irrigated high yield wheat co-operative test, Outlook.

Line	Days to maturity	Height cm	Lodging (1-9)[1]	Yield kg/ha	Yield bu/ac
HY453	94	77	1.0	4933	72.9
HY433	96	76	2.0	4888	72.3
HY446	95	74	1.0	4752	70.3
HY448	98	78	2.3	4607	68.1
HY962	97	82	1.0	4532	67.0
HY442	98	85	1.0	4417	65.3
HY449	100	78	1.5	4409	65.2
HY638	94	89	1.3	4390	64.9
HY451	95	81	1.8	4356	64.4
HY450	95	77	1.3	4187	61.9
HY643	97	81	1.8	4182	61.8
HY413	97	83	2.0	4156	61.4
HY454	92	82	1.8	4128	61.0
HY642	96	80	1.3	4118	60.9
HY963	97	82	1.0	4116	60.9
HY645	94	78	1.0	4033	59.6
HY452	95	77	1.3	3989	59.0
HY644	99	80	1.3	3965	58.6
HY417	94	74	1.8	3869	57.2
HY634	96	80	1.8	3796	56.1
HY646	93	74	1.3	3729	55.1
HY639	95	78	1.8	3676	54.3
BW661	94	95	1.0	3670	54.3
HY441	97	77	1.3	3580	52.9
HY447	94	91	1.3	3515	52.0
HY961	95	78	1.0	3503	51.8
HY637	97	86	2.3	3495	51.7
HY395	94	72	1.5	3405	50.3
BW002	92	94	1.3	3364	49.7
HY641	97	82	1.0	3287	48.6

[1] 1 = good, 9 = poor

Table 2. Yield and agronomic data for the 1998 irrigated soft white spring wheat co-operative test, Outlook.

Line	Days to maturity	Height cm	Lodging (1-9)[1]	Yield kg/ha	Yield bu/ac
95PR-2027	99	85	1.5	4218	62.4
96B-157	97	81	1.5	4828	71.5
96B-37	97	76	1.8	5867	86.8
96DH-812	98	80	1.0	5588	82.7
96PR-329	98	75	1.3	6045	89.5
97B-45	101	78	1.3	6117	90.5
97B-5	98	87	1.8	5933	87.8
97B-56	100	79	1.3	4970	73.6
97B-6	98	78	1.5	5600	82.9
97B-65	100	80	1.0	5547	82.1
97DH-006	98	87	2.3	5860	86.7
97DH-429	99	82	1.8	5062	74.9
97DH-430	99	80	1.0	5257	77.8
97DH-611	97	75	1.8	5540	82.0
97DH-614	98	81	1.3	6168	91.3
97DH-617	99	81	1.5	6790	100.5
97PR-124	99	79	2.0	5875	87.0
97PR-203	99	79	1.0	5012	74.2
97PR-205	98	79	1.0	5268	78.0
97PR-206	98	81	1.3	5893	87.2
97PR-207	98	78	1.3	5025	74.4
97PR-210	97	76	1.3	4800	71.0
97PR-314	100	85	1.8	5630	83.3
97PR-315	97	78	1.8	4622	68.4
97PR-316	98	82	1.5	4900	72.5
97PR-319	96	76	1.0	4668	69.1
97PR-322	97	80	2.0	4875	72.2
AC Nanda	101	83	1.3	4788	70.9
AC Phil	96	79	1.8	5512	81.6
AC Reed	96	79	1.5	4602	68.1

[1] 1 = good, 9 = poor

Irrigated Wheat Variety Test

L. Townley-Smith[1], G. Larson[1], I. Bristow[2]

Funded by the Irrigation Crop Diversification Corporation (ICDC)

Progress: *Ongoing*

Locations: *Birsay, Hanley, Outlook*

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

The tests were grown under a normal input treatment and a high input treatment. There were three replicates of each.

Plots of 1.5 m x 4.0 m (5 ft x 13 ft) were sown May 12 to May 14. All plots received 100 kg/ha N (90 lb/ac) as 46-0-0 and 50 kg/ha P (45 lb/ac) as 11-52-0.

The high input plots received an additional 50 kg/ha N (45 lb/ac) as 46-0-0 broadcast applied on July 17. These same plots were sprayed with Bravo 500 foliar fungicide on July 21.

All plots were desiccated on August 28. Harvest was taken on September 3 (Hanley) and on September 9 (Birsay and Outlook). Yields were estimated by harvesting the entire plot.

Agronomic characteristics and yields for the normal and high input trials respectively are presented in Tables 3a and 3b.

There was a noticeable increase in lodging and a delay in maturity on the high input treatments at the Birsay and Outlook sites.

Table 3a. Yield and agronomic data for the irrigated wheat variety test: **Normal input**

	Days* to mature	Height* cm	Lodging* (1-9)[1]	Yield			
				Birsay	Hanley	SIDC	Average
Katepwa - kg/ha				3623	4392	4563	
Katepwa - bu/ac				53.5	64.9	67.5	
				% of Katepwa			
AC Avonlea	97	101	2.0	134	84	117	112
AC Barrie	95	97	1.0	116	125	115	119
AC Crystal	97	88	1.0	149	150	125	141
AC Karma	97	89	1.4	146	133	117	132
AC Pathfinder	97	102	3.6	123	102	113	113
AC Navigator	97	90	1.8	134	109	101	115
AC Reed	96	82	1.1	137	127	117	127
AC Vista	97	91	1.7	149	147	135	144
HY433	96	84	1.0	145	137	128	137
HY441	100	92	1.3	149	134	136	140
Katepwa	94	97	2.1	100	100	100	100
Roblin	92	92	1.4	107	104	77	96

* average of three sites   [1] 1 = good, 9 = poor

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

Table 3b. Yield and agronomic data for the irrigated wheat variety test: **High input**							
	Days* to mature	Height* cm	Lodging* (1-9)[1]	Yield			
				Birsay	Hanley	SIDC	Average
Katepwa - kg/ha				4481	4175	3992	
Katepwa - bu/ac				66.3	61.7	59.0	
				% of Katepwa			
AC Avonlea	97	100	2.7	112	80	127	106
AC Barrie	95	99	1.2	97	122	114	111
AC Crystal	99	84	1.1	144	147	137	143
AC Karma	98	89	1.7	121	143	132	132
AC Pathfinder	97	99	3.7	111	116	114	114
AC Navigator	98	87	1.8	124	117	112	118
AC Reed	95	81	1.0	136	125	119	127
AC Vista	96	91	2.3	131	147	136	138
HY433	96	86	1.6	132	138	133	134
HY441	99	88	1.6	129	135	128	131
Katepwa	95	97	2.2	100	100	100	100
Roblin	94	100	1.6	93	100	90	94

* average of three sites [1] 1 = good, 9 = poor

Saskatchewan Advisory Council
Irrigated Wheat and Barley Regional Tests

L. Townley-Smith[1], G. Larson[1]

Progress: *Ongoing*

Objective: *To evaluate crop varieties in various regions of the province.*

The Saskatchewan Advisory Council wheat regional tests were sown on the SIDC off-station site on May 14. Plot size was 1.5 m x 4.0 m (5 ft x 13 ft). 100 kg/ha N (90 lb/ac) as 46-0-0 and 50 kg/ha P (45 lb/ac) as 11-52-0 were side-banded at seeding. The plots were desiccated on August 28 and were combined on September 15.

Results for the CPS, SWS, Durum, and Extra Strong market classes are shown in Table 4. Yield and agronomic data for the Hard Red Sring wheat test is shown in Table 5. This data is part of the information base from which the provincial variety guide is published.

The barley regional test was grown under the same conditions as the wheat tests. Dates of seeding, desiccation and harvest were the same. Results of the barley regional test are shown in Table 6.

[1]SIDC, Outlook

Table 4. Saskatchewan Advisory Council wheat regional test.					
Variety	Days to maturity	Height cm	Lodging (1-9)[1]	Yield	
				kg/ha	bu/ac
AC Crystal	99	73	1.8	4755	70.3
HY433	97	76	1.8	4712	69.7
AC Vista	98	87	1.5	4656	68.8
AC Phil	96	80	2.3	4448	65.8
HY441	100	76	1.5	4399	65.0
Fielder	99	82	1.3	4328	64.0
AC Nanda	100	78	1.3	4223	62.4
AC Reed	98	75	1.8	4136	61.1
ES4	98	100	2.3	4073	60.2
AC Karma	97	79	1.8	4028	59.6
Kyle	101	97	3.3	3938	58.2
AC Pathfinder	100	89	1.5	3702	54.7
Glenlea	97	96	1.8	3635	53.7
AC Melita	99	91	1.3	3590	53.1
Katepwa	93	97	1.8	3480	51.4
AC Morse	97	81	1.3	3439	50.8
AC Avonlea	97	85	1.3	3286	48.6
ES7	99	98	1.5	3275	48.4
AC Navigator	100	71	1.3	3225	47.7
LASER	96	93	1.8	3182	47.0
DT675	100	74	1.5	3154	46.6

[1] 1=good, 9=poor

Table 5. Saskatchewan Advisory Council Hard Red Spring wheat regional test.					
Variety	Days to maturity	Height cm	Lodging (1-9)[1]	Yield	
				kg/ha	bu/ac
PT405	93	98	1.0	4160	61.5
BW720	96	98	2.0	4131	61.1
BW220	97	93	1.0	4075	60.3
AC Intrepid	96	95	1.8	3911	57.8
PT545	96	95	2.0	3860	57.1
AC Barrie	96	101	1.0	3758	55.6
McKenzie	94	91	2.5	3684	54.5
AC Cora	93	97	1.3	3661	54.1
AC Elsa	94	91	1.8	3608	53.3
AC Cadillac	96	102	1.8	3537	52.3
Katepwa	93	100	2.3	3357	49.6
BW226	96	91	1.3	3346	49.5
AC Majestic	95	89	1.3	3226	47.7
AC Splendor	94	95	1.8	3226	47.7
BW238	96	93	1.3	3118	46.1
BW691	95	81	1.8	3094	45.7
BW228	94	90	1.0	2988	44.2
BW703	97	78	1.0	2789	41.2

[1] 1 = good, 9 = poor

Table 6. Saskatchewan Advisory Council barley regional test						
	2 or 6	Days to	Height	Lodging	Yield	
Variety	row	maturity	cm	(1-9)[1]	kg/ha	bu/ac
Feed						
CDC Dolly	2	89	86	4.3	5692	105.3
CDC Fleet	2	90	100	3.7	4967	91.9
AC Harper	6	94	85	2.3	3647	67.5
AC Lacombe	6	92	97	3.7	4175	77.2
AC Rosser	6	94	93	3.7	5880	108.8
BT 435	6	92	94	4.7	3702	68.5
CDC Earl	6	91	85	2.3	4973	92.0
Kasota	6	88	81	4.3	4435	82.0
SD 511	6	88	87	2.0	4267	78.9
Stetson	6	90	77	1.3	4998	92.5
Hulless						
CDC Dawn	2	91	91	3.7	4432	82.0
CDC Gainer	2	94	101	3.3	5420	100.3
HB 329	2	92	97	3.0	4477	82.8
HB 605	2	93	98	2.7	3812	70.5
AC Hawkeye	6	96	108	3.3	3762	69.6
CDC Silky	6	94	92	2.0	4013	74.2
Falcon	6	91	77	1.3	2217	41.0
HB 105	6	92	96	2.3	3877	71.7
HB 608	6	93	82	1.7	4228	78.2
Malting						
AC Metcalfe	2	93	100	2.0	5380	99.5
AC Oxbow	2	92	92	4.0	4922	91.1
CDC Lager	2	93	98	4.3	5740	106.2
CDC Stratus	2	92	94	2.0	5840	108.0
Harrington	2	92	89	4.0	4345	80.4
Manley	2	94	93	3.3	5497	101.7
Merit	2	94	94	3.0	5913	109.4
Stein	2	91	90	5.0	4030	74.6
TR 139	2	92	96	3.0	5785	107.0
TR 145	2	91	92	3.3	4820	89.2
TR 243	2	92	90	2.3	5618	103.9
CDC Sisler	6	94	101	3.3	4282	79.2
Excel	6	96	95	2.3	5243	97.0
Foster	6	94	93	4.0	5290	97.9
Robust	6	95	101	4.0	5448	100.8
Stander	6	96	90	1.7	6938	128.4

[1] 1 = good, 9 = poor

Evaluation of Durum Breeding Lines for Irrigation

J. Clarke[1], L. Townley-Smith[2], G. Larson[2]

Funded by the Irrigation Crop Diversification Corporation (ICDC)

Progress: *Ongoing*

Location: *Swift Current, Outlook*

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

Field experiments were planted under irrigation near Outlook and Swift Current in 1998. These tests consisted of short and semi-dwarf durum F_6 and F_8 breeding lines. The results are used to select potential new varieties that perform well under irrigation. The best F_6 lines were sent to New Zealand for seed multiplication during the winter, and will be tested further in 1999. The F_8 lines that have good quality will be entered into pre-co-operative 'A' level tests in 1999.

Yields of durum varieties for the 1994 to 1997 period are summarized in Table 7. The new variety AC Avonlea, registered in 1996 from our program, performed very well under irrigation. AC Avonlea has higher protein than other varieties. Certified seed will be available for 2000. AC Avonlea, AC Melita, AC Navigator (tested as DT673) and Sceptre all have shorter straw than Kyle and Plenty.

AC Navigator is a semi-dwarf line tested through this project at Outlook since 1991. It was tested in the Durum Co-operative Test from 1996 to 1998. Interim registration was granted in 1998 to permit market evaluation by the Canadian Wheat Board and Saskatchewan Wheat Pool.

AC Navigator has shown good yield potential under both irrigation and dryland conditions. It has desirably stronger gluten than other Canadian durum varieties. AC Navigator has the potential to supply customers in North America and Europe with premium quality durum. At present only 'desert durum' from California and Arizona, and more recently Australian durum going into Europe, is supplying these markets.

Table 7. Grain yield and grain protein of durum wheat varieties grown under irrigation near Birsay in 1994 and 1995 and near Outlook in 1996 and 1997.

Variety	Yield			Protein %
	kg/ha	bu/ac	% of Kyle	
Kyle	4307	64	100	14.7
Plenty	4175	62	97	14.7
Sceptre	4403	66	101	13.9
AC Melita	3720	55	84	14.5
AC Avonlea	4733	70	127	15.4
AC Navigator	4552	68	124	14.3

Sceptre was not in the 1997 test.

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

Oilseeds Program

Oilseeds Program

Variety Evaluations

Western Canada Irrigated Canola Co-operative Tests A, B, and C

L. Townley-Smith[1], G. Larson[1]

Funded by the Canola Council of Canada

Progress: *Ongoing*

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

The canola co-operative tests were sown at SIDC on May 13 in 1.5m x 6.0m (5 ft x 20 ft) plots. Nitrogen was applied at 100 kg/ha (90 lb/ac) as 46-0-0, and phosphorus was applied at 50 kg/ha (45 lb/ac) as 11-52-0. All fertilizer was side-banded at the time of seeding.

All plots were sprayed with an insecticide for flea beetle control on June 15, and again on June 29. Test C was swathed on August 17. Tests A and B were swathed on August 31. Yield was determined by harvesting the entire plot.

Results are shown in Tables 1, 2 and 3. As in past years, several lines had superior yield and lodging resistance compared to the check varieties.

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

Line	Days to Flower	Height cm	Days to Mature	Lodging (1-9)[1]	Yield	
					kg/ha	bu/ac
AC EXCEL	55	137	94	3.8	3146	55.8
DEFENDER	54	123	93	2.0	2430	43.1
LEGACY	52	125	92	1.8	2971	52.7
SW 02621	55	135	93	3.0	3180	56.4
SW 02622	54	128	96	3.8	3273	58.1
SW 02623	53	125	94	3.3	2738	48.6
SW A2662	54	129	94	1.8	3621	64.2
SW A2665	54	134	96	2.5	2726	48.4

[1] 1 = good, 9 = poor

[1] *SIDC, Outlook*

Table 2. Yield and agronomic data for the irrigated canola co-operative test A.						
	Days to	Height	Days to	Lodging	Yield	
Line	Flower	(cm)	Mature	(1-9)[1]	kg/ha	bu/ac
LEGACY	40	90	86	2.8	4296	76.2
SW 02627	35	92	85	1.0	4147	73.6
SW A2642	40	100	88	1.3	4094	72.6
NS 2805	38	97	87	2.3	3952	70.1
CNS601*	43	95	86	2.3	3918	69.5
PR4596	40	89	85	3.0	3818	67.7
5.189	40	102	87	1.8	3779	67.0
ZNA005	42	92	84	2.0	3674	65.2
ZCT7020	42	92	87	2.0	3673	65.2
NS2385	38	100	86	4.8	3623	64.3
PR5227-1	40	94	88	1.8	3572	63.4
SW A2659	35	82	88	2.3	3546	62.9
ZNP009	40	95	86	3.3	3510	62.3
PR4595	40	91	84	2.0	3507	62.2
CNS603*	40	98	87	2.3	3403	60.4
SR 96278	39	100	87	2.5	3369	59.8
ZNP008	41	94	84	2.5	3355	59.5
A97-16N	39	98	89	2.0	3284	58.3
NS2810	40	88	85	3.0	3275	58.1
SW A2657	40	92	88	4.0	3241	57.5
NS 2804	41	95	86	1.5	3139	55.7
NS2479	40	90	86	2.5	2959	52.5
PR3665	41	99	88	2.0	2915	51.7
A97-14N	39	100	87	3.5	2859	50.7
APOLLO	40	87	89	4.5	2854	50.6
SR 96280	41	85	86	1.5	2835	50.3
AC EXCEL	38	94	88	5.3	2746	48.7
PHS97-579	38	96	88	2.3	2726	48.4
CNS604*	41	97	84	2.8	2475	43.9
DEFENDER	41	96	89	2.5	1891	33.5

[1]1 = good, 9 = poor
* = low linolenic acid content

Table 3. Yield and agronomic data for the irrigated canola co-operative test B						
Line	Days to Flower	Height cm	Days to Mature	Lodging (1-9)[1]	Yield kg/ha	Yield bu/ac
4.23	40	115	86	2.3	4086	72.5
AC EXCEL	39	97	87	4.5	3477	61.7
AC EXCEL2	39	89	86	5.5	3463	61.4
BY0784	39	115	88	2.8	3899	69.2
CN510	40	102	89	3.0	3912	69.4
CNR501	39	94	86	3.3	3497	62.0
DEFENDER	39	110	86	3.3	3369	59.8
DEFENDER1	39	104	86	3.3	3230	57.3
HCN41	40	99	88	3.0	3809	67.6
LEGACY	37	107	86	3.8	3703	65.7
LEGACY1	37	97	84	4.5	3609	64.0
NS 2501	39	103	88	2.3	3758	66.7
NS 2515	39	97	87	3.8	3750	66.5
NS1539	38	98	84	3.8	3479	61.7
NS2732	38	103	89	3.0	3877	68.8
PR4406	36	90	84	4.5	3082	54.7
PR5269	37	91	86	2.5	3694	65.5
PR5271	37	102	87	3.5	3812	67.6
PR5292	37	98	85	3.5	3686	65.4
PR5295	37	96	85	2.5	3338	59.2
PR5296	38	94	88	4.5	3726	66.1
SW A2658	38	104	84	4.0	3676	65.2
ZCT7076	37	104	87	1.8	3598	63.8
ZCT7120	39	109	87	1.8	3449	61.2
ZSN701	37	106	88	3.0	3107	55.1

[1]1 = good, 9 = poor

Western Canada Irrigated Flax and Solin Co-operative Tests

L. Townley-Smith[1], G. Larson[1]

Progress: *Ongoing*

Objective: *To evaluate potential new flax and solin varieties under irrigated conditions in western Canada.*

The flax and solin co-operative tests were sown May 15 in 1.5 m x 4.0 m (5 ft x 13 ft) plots on a sandy loam soil. Nitrogen was applied at 100 kg/ha (90 lb/ac) as 46-0-0, and phosphorus was applied at 50 kg/ha (45 lb/ac) as 11-52-0. All fertilizer was side-banded at the time of seeding.

Total rainfall plus irrigation on the plots was 485 mm (19 in). The plots were sprayed for grassy and broadleaf weeds on June 23. Yield was determined by harvesting the entire plot. Exceptional yields were achieved for the 1998 flax and solin tests at SIDC.

Results are shown in Tables 4 and 5. The solin line SP 1084 combined high yield with good lodging resistance and early maturity in the 1998 test. Several flax lines performed better than the checks.

Irrigated Canola Variety Test

L. Townley-Smith[1], G. Larson[1], I. Bristow[2]

Funded by the Irrigation Crop Diversification Corporation (ICDC)

Progress: *Ongoing*

Locations: *Birsay, Outlook*

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

The irrigated canola variety tests were conducted using two management systems; a normal level of crop inputs, and a high input treatment. All plots received 100 kg/ha N (90 lb/ac) and 50 kg/ha P_2O_5 (45 lb/ac) side-banded at the time of seeding. The high input plots received an additional 50 kg/ha N (45 lb/ac) broadcast at the time of flowering. Benlate fungicide was applied to the high input plots on July 21.

The Birsay test was sown on May 12. An insecticide was applied on May 29 to control flea beetles. The canola was swathed on August 18 and was harvested September 4.

The Outlook test was sown May 11. It was swathed August 17 and was harvested September 9. Yield was determined by harvesting the entire 1.5 m x 4.0 m (5 ft x 13 ft) plot in both tests.

Results are shown in Tables 6a and 6b. The highest yielding variety tested in 1998 was InVigor 2153. It performed well under both the normal and high input treatments.

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[1] *SIDC Outlook*

[2] *ICDC, Outlook*

Table 4. Yield and agronomic data for the irrigated solin co-operative test.					
Line	Height cm	Days to Mature	Lodging (1-9)[1]	Yield	
				kg/ha	bu/ac
Linola™947	71	107	1.5	4439	70.4
Linola™989	70	104	1.3	4273	67.8
SP 1084	71	104	1.8	4573	72.6
SP 1089	67	109	1.5	4265	67.7
SP 2012	66	107	1.0	4373	69.4
SP 2018	72	107	2.0	4015	63.7
SP 2019	60	107	1.3	4253	67.5
SP 2020	70	109	2.8	3816	60.6
SP 2021	63	101	1.8	4024	63.9
SP 2022	68	110	1.3	4018	63.8
SP 2023	70	110	3.5	3757	59.6

[1]1 = good, 9 = poor

Table 5. Yield and agronomic data for the irrigated flax co-operative test.					
Line	Height cm	Days to Mature	Lodging (1-9)[1]	Yield	
				kg/ha	bu/ac
AC Linora	69	105	3.0	3792	60.2
AC McDuff	68	107	1.5	3763	59.7
CDC Normandy	70	107	2.3	3975	63.1
FP 1048	67	103	1.5	4033	64.0
FP 1050	67	104	4.8	3337	53.0
FP 1051	73	103	1.8	4095	65.0
FP 1069	65	107	1.5	4133	65.6
FP 1070	65	102	1.0	4210	66.8
FP 1071	65	105	2.3	4222	67.0
FP 1072	65	102	4.3	3492	55.4
FP 1077	65	103	1.5	3742	59.4
FP 1082	68	107	1.8	3888	61.7
FP 1092	66	106	1.5	4485	71.2
FP 1093	66	109	1.0	4345	69.0
FP 1094	62	101	1.0	4350	69.0
FP 1096	67	107	1.5	4007	63..6
FP 2000	64	107	1.5	4288	68.1
FP 2004	71	108	3.8	3127	49.6
FP 2006	63	103	3.3	3262	51.8
FP 2008	67	107	1.8	3950	62.7
Flanders	63	106	1.8	3928	62.3
NorLin	70	107	2.3	3822	60.7

[1]1 = good, 9 = poor

Table 6a. Yield and agronomic data for the irrigated canola variety test: **Normal input.**						
	Days* to maturity	Height* cm	Lodging* (1-9)[1]	Yield		
				Birsay	SIDC	Average
Quantum - kg/ha				4161	3680	
Quantum - bu/ac				73.8	65.3	
				% of Quantum		
45A02	95	117	2.9	87	103	95
45A50	94	115	3.3	69	103	86
45A51	96	109	2.2	91	114	103
45A71	95	117	2.9	80	117	99
46A65	97	103	2.7	84	108	96
46A74	98	111	1.3	91	114	103
Cyclone	94	113	2.3	88	129	109
Ebony	97	139	1.9	93	135	114
Exceed	96	97	2.7	93	98	96
Global	99	122	1.4	87	121	104
IMPULSE	97	107	2.7	88	123	106
Innovator	93	115	3.1	70	105	88
InVigor 2153	93	128	2.1	96	151	124
LG3295	95	109	3.1	91	106	99
LG3310	96	121	2.0	100	117	109
LG3388	97	124	2.5	90	126	108
OAC DYNAMITE	96	114	2.2	103	126	115
Q2	98	117	2.0	98	114	106
Quantum	97	125	1.5	100	100	100
Quest	96	104	3.0	80	81	81
SW ARROW	96	123	2.9	80	125	103
Synbrid 220	98	115	1.0	90	109	100
5.189	97	120	2.7	98	106	102

[1]1 = good, 9 = poor * average of two sites

Table 6b. Yield and agronomic data for the irrigated canola variety test: **High input.**						
	Days* to maturity	Height* cm	Lodging* (1-9)[1]	Yield		
				Birsay	SIDC	Average
Quantum - kg/ha				3723	4412	
Quantum - bu/ac				66.1	78.3	
				% of Quantum		
45A02	94	125	3.4	93	101	97
45A50	94	125	2.5	81	94	88
45A51	96	123	2.8	83	93	88
45A71	97	119	2.7	93	97	95
46A65	98	122	1.7	99	102	100
46A74	97	124	1.8	85	99	92
Cyclone	95	119	2.3	95	97	96
Ebony	99	126	2.1	103	97	100
Exceed	95	121	3.5	85	111	98
Global	99	128	1.7	96	92	94
IMPULSE	98	132	2.8	83	98	90
Innovator	94	116	3.0	75	84	80
InVigor 2153	95	124	2.7	104	114	109
LG3295	96	126	2.4	107	101	104
LG3310	96	121	2.0	108	99	104
LG3388	96	128	2.0	97	107	102
OAC DYNAMITE	97	111	2.6	98	93	95
Q2	98	123	1.9	85	82	83
Quantum	97	126	1.3	100	100	100
Quest	97	118	2.6	86	68	77
SW ARROW	96	116	2.5	78	91	85
Synbrid 220	97	125	1.2	96	91	93
5.189	96	134	2.1	94	124	109

[1]1 = good, 9 = poor * average of two sites

Irrigated Flax and Solin Variety Test

L. Townley-Smith[1], G. Larson[1], I. Bristow[2]

Funded by the Irrigation Crop Diversification Corporation (ICDC)

Progress: *Ongoing*

Locations: *Birsay, Hanley, Outlook*

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

The test was grown under both a normal and a high input management systems. The plots were sown between May 11 and May 15. The tests were dessicated August 25 to 28, and were harvested in the first week of September.

The normal input tests received 100 kg/ha N (90 lb/ac) and 50 kg/ha P_2O_5 (45 lb/ac) side-banded at the time of seeding. An additional 50 kg/ha N (45 lb/ac) was broadcast on the high input plots. No foliar fungicides or insecticides were applied. Yields were estimated by harvesting entire 1.5 m x 4.0 m (5 ft x 13 ft) plots.

Results are shown in Tables 7a and 7b. Ac McDuff, AC Watson, and CDC Bethune performed well in these trials.

Table 7a. Yield and agronomic data for the irrigated flax variety test: **Normal input.**

	Days* to maturity	Height* cm	Lodging* (1-9)[1]	Yield			
				Birsay	Hanley	SIDC	Average
NorLin - kg/ha				1701	1698	3644	
NorLin - bu/ac				26.9	26.9	57.7	
				% of NorLin			
AC Emerson	104	63	1.4	136	76	106	106
AC McDuff	107	64	1.1	126	144	104	125
AC Watson	105	59	1.0	119	133	110	120
CDC Normandy	108	64	1.6	117	90	92	100
CDC Triffid	104	64	1.8	122	97	97	106
CDC Valour	104	63	2.7	118	85	78	94
Flanders	106	65	2.0	123	128	91	114
CDC Bethune	105	63	1.3	132	138	115	128
CDC Arras	103	61	2.2	126	101	104	110
Linola™ 989	106	66	1.6	114	96	99	103
NorLin	105	65	1.8	100	100	100	100
Somme	105	63	1.7	125	101	97	108
Vimy	104	60	2.4	93	121	103	106

[1]1 = good, 9 = poor * average of three sites

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

Table 7b. Yield and agronomic data for the irrigated flax variety test: **High input**.							
	Days* to maturity	Height* cm	Lodging* (1-9)[1]	Yield			
				Birsay	Hanley	SIDC	Average
NorLin - kg/ha				2183	1613	2429	
NorLin - bu/ac				34.5	25.5	38.5	
				% of NorLin			
AC Emerson	105	60	2.1	67	80	95	81
AC McDuff	107	61	1.6	101	110	113	108
AC Watson	104	60	1.3	98	87	142	109
CDC Normandy	106	64	2.2	97	89	105	97
CDC Triffid	104	64	2.9	93	119	93	101
CDC Valour	104	62	2.9	89	86	101	92
Flanders	108	61	1.8	96	112	111	107
CDC Bethune	105	61	1.9	107	106	104	106
CDC Arras	105	63	2.9	111	97	88	99
Linola™ 989	106	63	1.6	106	85	114	102
NorLin	106	64	2.2	100	100	100	100
Somme	106	63	2.0	92	127	110	110
Vimy	106	59	3.0	106	108	105	106

[1]1 = good, 9 = poor * average of three sites

Sunflower Regional Trial

L. Townley-Smith[1], G. Larson[1]

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

Progress: *Year Two of Five*

Location: *Outlook*

Objective: *This trial is part of a multi-site regional effort to determine the yield of conventional height oilseed sunflowers.*

This was the only irrigated site and did not include dwarf early maturing sunflowers. One confectionary cultivar was included. Confectionary sunflower seed is a specialty crop with significant potential but with a limited market.

Yields were exceptionally good in 1998. Combining was delayed until late November, which in many years would cause harvest problems.

Producers require information on the relative performance of sunflower varieties to aid them in planting decisions. Sunflower trials had not been conducted under irrigation since 1991. New genetic material has been developed during this time. This trial provides a basis for recommendations to producers.

[1]*SIDC, Outlook*

conducted under irrigation since 1991. New genetic material has been developed during this time. This trial provides a basis for recommendations to producers.

Sunflowers were planted May 19 in 2-row plots 60 cm (24 in) apart and 6 m (20 ft) long. Plant numbers were adjusted to a constant number by hand thinning. All heads were bagged after flowering to prevent bird damage. Yields were determined by harvesting the entire plot on November 24.

Yields were high, with considerable variation between cultivars (Table 8). At current prices for confectionary sunflowers very high net returns may be possible.

Field scale production of confectionary sunflower may be possible after potatoes or alfalfa since these fields should have lower levels of *Sclerotinia* infection. Application of a fungicide for control of *Sclerotinia* head blight may be an advantage in terms of yield and quality.

Table 8. Sunflower Co-operative Test, Outlook 1998.

Cultivar	Days to Maturity	Height cm	Yield	
			kg/ha	lb/ac
6230	124	173	3071	2733
IS 5077	125	149	3321	2956
IS 5757	125	165	3353	2984
IS 6111	121	144	3183	2833
SF 128	124	171	3189	2838
SF187	125	173	2604	2318
SF 270	127	156	3150	2804
SF 3210	125	169	3153	2806
SF 3272	125	158	3136	2791
X49097	130	163	4000	3560
XF 361	128	186	2986	2657
XF 3720	125	175	2797	2489

Bertha Armyworm Surveillance Program

G. Larson[1]

The program for monitoring bertha armyworm throughout the prairie provinces was implemented again in 1998. The Saskatchewan program was co-ordinated by the Sustainable Production Branch of Saskatchewan Agriculture and Food. Pheromone traps were installed across the prairies to determine the density and distribution of moths. SIDC installed and monitored traps located north of Outlook, Saskatchewan.

Geographic distribution and density of moth catches were combined with weather data to form the basis of a regional forecast. Increased awareness among producers of the potential for bertha armyworm damage in their area was achieved.

[1] *SIDC, Outlook*

Forage Program

Forage Program

There is a large turf grass seed market both in North America and in Europe. If production packages can be developed that result in similar yields to traditional growing areas, Western Canada can become the low cost supplier of seed due to low land costs. 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.

Weed Control in Grass Seed Production

L. Townley-Smith[1], G. Larson[1]

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

Progress: *Year two of five*

Objective: *This project is part of the overall effort to develop information on the tolerance of grass species to the herbicides necessary for successful turf grass seed production.*

There are few registered herbicides for grasses such as fine fescue, tall fescue, bluegrass, and perennial and annual ryegrass. A prairie-wide effort to evaluate herbicides for minor use registration is necessary to support a Western Canadian grass seed industry.

Fine Fescues

The fine fescues were planted at Outlook on June 6, 1997, at 4 kg/ha (3.5 lb/ac) on 20 cm (8 in) row spacings. The broadleaf and grass weed control protocols were arranged in a four replicate randomized complete block design. Willma chewings fescue and Basic Barcrown slender creeping fescue were sown at a depth of 0.5 cm (0.25 in). Both the broadleaf and the grass weed control products were applied in 100 L/ha (9 gal/ac) of solution on July 2, 1997. The crop was in the four-leaf stage. Crop tolerance ratings were made on July 9, July 17 and August 6.

[1] *SIDC, Outlook*

Weed-free plots were maintained by regular hand weeding. All other plots except the weedy check were mowed for weed control. Weed control ratings were done using a visual damage rating using the Expert Committee on Weeds protocol (0 = no damage). The July 9 ratings for both species and July 17 ratings for slender creeping fescue are not shown since no effects were observed.

Both fine fescue species showed good tolerance to the broadleaf herbicides (Table 1). Damage to slender creeping fescue on August 6 on the weedy check was due to significant weed competition. Both fine fescues showed good tolerance to the entire range of grassy weed herbicides (Table 2).

The stands were patchy in the spring of 1998. A combination of salinity and winter-kill were the likely causes. Only the Chewings fescue graminicide test had sufficient stand to harvest. It was combined on July 23, 1998. The treatments showed no significant differences.

Table 1. Tolerance of fine fescue seedlings to broadleaf weed control products.

Treatment	Rate kg/ha ai	Visible Crop Damage		
		Slender Creeping Fescue August 6	Chewings fescue July 17	Chewings fescue August 6
Check, weedy		31	0	0
Check,weed free		11	0	0
Dicamba Mecoprop MCPA amine	0.093 0.093 0.408	6	0	0
Dicamba Mecoprop MCPA amine	0.185 0.185 0.816	7	0	0
Thifensulfuron Tribenuron methyl Agral 90	0.010 0.005 0.200	4	0	0
Thifensulfuron Tribenuron methyl Agral 90	0.020 0.010 0.200	4	0	0
Fluroxypyr Clopyralid MCPA ester	0.144 0.100 0.560	6	0	0
Fluroxypyr Clopyralid MCPA ester	0.288 0.200 1.120	5	0	0
Bromoxynil MCPA ester	0.280 0.280	6	0	0
Bromoxynil MCPA ester	0.560 0.560	6	0	0
Dicamba	0.288	6	0	0
Dicamba	0.560	5	3	4
Fenoxaprop-p-ethyl Bromoxynil MCPA ester	0.092 0.280 0.280	4	2	1
Fenoxaprop-p-ethyl Bromoxynil MCPA ester	0.184 0.560 0.560	5	2	1
LSD		3	2	11

0 = no damage 100 = complete topkill

Table 2. Tolerance of fine fescue seedlings to grass weed control products.							
		Visible Crop Damage					
	Rate kg/ha ai	Slender creeping fescue		Chewings fescue		Yield	
Treatment		July 10	August 6	July 10	August 6	kg/ha	lb/ac
Check, weedy		0	5	0	9	569	505
Check, weed free		0	55	0	5	547	485
Quizalofop ethyl	0.15	2	5	0	4	512	455
Quizalofop ethyl	0.29	2	4	0	5	554	490
Sethoxydim Merge	0.50 0.40	2	4	0	4	437	390
Sethoxydim Merge	1.00 0.40	2	4	0	4	552	490
Fluazifop butyl Turbocharge	0.17 0.50	3	12	0	4	587	520
Fluazifop butyl Turbocharge	0.35 0.50	4	3	0	5	473	420
Quinclorac Merge	0.13 1.00	4	8	0	4	506	450
Quinclorac Merge	0.25 1.00	3	4	0	5	552	490
Clodinafop-propargyl Score	0.07 1.00	6	4	0	4	628	555
Clodinafop-propargyl Score	0.14 1.00	2	4	0	4	491	436
LSD		6	12	0	3	NS[1]	NS

[1]not significant at P<0.05
0 = no damage 100 = complete topkill

Kentucky Bluegrass

Boreal Kentucky bluegrass was planted at Outlook on June 6, 1997 at 4 kg/ha (3.5 lb/ac) on a 20 cm (8 in) row spacing. This trial was a four-replicate RCBD. Both the broadleaf and the grass weed control products were applied in 100 L/ha (9 gal/ac) of solution on July 2, 1997. The crop was in the four-leaf stage. Weed control ratings were done using a visual damage rating as per the Expert Committee on Weeds protocol (0 = no damage). Ratings of crop damage were made July 9, July 17 and August 6 (Table 3). Weed control was by hand weeding followed by two mowings at a height of 5 cm (2 in). Plots were harvested on July 23, 1998.

A second experiment using a similar set of treatments was conducted in 1998 on a Boreal Kentucky bluegrass established adjacent to the 1997 experiment (Table 4). Herbicides were applied June 17,1998 at the pre-boot stage. It was harvested on July 23,1998.

Tall Fescue

Courtney tall fescue was planted at 8 kg/ha (7 lb/ac) in rows 20 cm (8 in) apart on May 14, 1997, into a seedbed prepared by pre-plant application of Roundup. Both broadleaf and grassy weed herbicide trials were four replicate RCBD. Herbicides were applied June 17 when the plants were in the 4-5 leaf stage. There was a significant population of chickweed in the grass weed control trial. This was treated with Refine Extra three weeks after the grassy weed control products were applied. The delayed application resulted in significant weed competition. Hand weeding was done on the weed free check, but some crop damage occurred. The check was abandoned. The trials
were clipped four times to a height of 15 cm (6 in) during the growing season to control tall weeds. Weed control ratings were done using a visual damage rating as per the Expert Committee on Weeds, where 0 indicates no damage.

Table 3 . Tolerance of Kentucky bluegrass seedlings to various herbicides.

Treatment	Rate kg/ha ai	Visible Crop Damage 28 days after treatment	Yield	
			kg/ha	lb/ac
Check, weedy		0	1000	890
Check, weed free		0	1151	1020
Dicamba	0.2880	0	1164	1030
Dicamba	0.5760	0	1099	975
Bromoxynil MCPA ester	0.2800 0.2800	0	1017	905
Thifensulfuron Tribenuron methyl Agral 90	0.5600 0.5600 0.0100	0	1169	1040
Thifensulfuron Tribenuron methyl Agral 90	0.0100 0.0050 0.2000	0	1254	1115
Dicamba Mecroprop MCPA amine	0.0930 0.0930 0.4125	0	1060	940
Dicamba Mecroprop MCPA amine	0.1875 0.1875 0.8250	0	1173	1040
Bentazon	1.2000	0	1009	895
Bentazon	2.4000	0	1112	985
Dichlorprop 2,4-D ester	0.5250 0.5250	0	1137	1010
Dichlorprop 2,4-D ester	1.0500 1.0500	0	1041	925
Fluroxypyr Clopyralid MCPA ester	0.1440 0.1000 0.5600	0	1224	1090
Fluroxypyr Clopyralid MCPA ester	0.2880 0.2000 1.1200	0	1055	935
LSD			NS[1]	NS

[1]not significant at P<0.05
0 = no damage 100 = complete topkill

Table 4 . Tolerance of established Kentucky bluegrass to various herbicides.					
Treatment	Rate kg/ha ai	Visible Crop Damage		Yield	
		14 days after treatment	28 days after treatment	kg/ha	lb/ac
Check, weedy		0	0	649	578
Check, weed free		0	0	794	707
Dicamba	0.2880	2	2	701	624
Dicamba	0.5760	3	3	746	664
Bromoxynil MCPA ester	0.2800 0.2800	4	3	712	634
Thifensulfuron Tribenuron methyl Agral 90	0.5600 0.5600 0.0100	4	3	656	584
Thifensulfuron Tribenuron methyl Agral 90	0.0100 0.0050 0.2000	3	3	756	673
Dicamba Mecroprop MCPA amine	0.0930 0.0930 0.4125	0	2	638	569
Dicamba Mecroprop MCPA amine	0.1875 0.1875 0.8250	0	2	674	600
Bentazon	1.2000	16	12	667	594
Bentazon	2.4000	25	16	712	634
Dichlorprop 2,4-D ester	0.5250 0.5250		4	563	501
Dichlorprop 2,4-D ester	1.0500 1.0500	0	3	793	706
Fluroxypyr Clopyralid MCPA ester	0.1440 0.1000 0.5600	0	2	747	665
Fluroxypyr Clopyralid MCPA ester	0.2880 0.2000 1.1200	0	3	784	698
Triallate	1.4000		21	518	461
Trifluralin	0.5600			248	221
Triallate	2.8000		41	292	260
Trifluralin	1.1200				
LSD		4.0	3	248	221

0 = no damage 100 = complete topkill

The experiments were repeated in 1998. Courtney tall fescue was planted at 8 kg/ha (7 lb/ac) in rows 20 cm (8 in) apart on June 1, 1998, into a seedbed prepared by pre-plant application of Roundup. Both broadleaf trials were four replicate RCBD. Herbicides were applied June 17, 1998 when the plants were in the 4-5 leaf stage.

Crop tolerance to broadleaf herbicides was excellent (Table 5). In general, yield was reduced with phenoxy herbicides. Crop tolerance to the grassy weed control products applied was good (Table 6). Crop damage on July 14 was quite variable and was mainly due to weed competition. Competition from chickweed (not normally a field weed) was significant in the grassy weed trial. In 1998, seed yield tended to be higher in herbicide treated plots than in checks.

Tall fescue showed good to excellent tolerance to all treatments in the 1998 experiments (Table 6).

Table 5 . Tolerance of tall fescue seedlings to various herbicides.

Treatment	Rate kg/ha ai	Visible Crop Damage		Yield	
		14 days after treatment	28 days after treatment	kg/ha	lb/ac
Check, weedy		1	5	280	249
Check, weed free		2	4	390	347
Thifensulfuron Tribenuron methyl Agral 90	0.010 0.005 0.200	5	4	288	256
Thifensulfuron Tribenuron methyl Agral 90	0.020 0.010 0.200	6	4	247	220
Thifensulfuron Tribenuron methyl 2,4-D ester	0.010 0.005 0.413	5	4	278	247
Dicamba 2,4-D amine	0.145 0.413	4	6	264	235
2,4-D amine	0.546	4	4	195	174
MCPA amine	0.546	3	6	252	224
Bromoxynil MCPA ester	0.280 0.280	2	4	323	288
Fluroxypyr 2,4-D ester	0.108 0.546	4	4	330	294
Fluroxypyr 2,4-D ester	0.216 1.092	5	5	237	211
Quinclorac	0.100	4	4	306	272
Quinclorac	0.200	5	4	278	247
Quinclorac 2,4-D ester	0.100 0.500	3	4	258	230
Dicamba Mecoprop MCPA amine	0.063 0.063 0.275	4	7	248	221
Dicamba Mecoprop MCPA amine	0.125 0.125 0.550	5	6	204	182
LSD		1	5	280	249

0 = no damage 100 = complete topkill

Table 6. Tall fescue tolerance to grassy weed control products.					
Treatment	Rate kg/ha ai	Visual Injury		Yield	
		14 days after treatment	28 days after treatment	kg/ha	lb/ac
Fenoxaprop-p-ethyl	0.092	5	16	462	411
Tralkoxydim	0.198	6	8	446	397
Tralkoxydim	0.396	8	11	573	510
Fenoxaprop-p-ethyl Bromoxynil MCPA ester	0.092 0.280 0.280	5	7	347	309
Check, weeded		6	8	408	363
Check, weedy		3	12	330	294
LSD		3	46	208	185

0 = no damage   100 = complete topkill

Perennial Ryegrass

This species will normally be grown under irrigation by broadcasting seed into a standing crop in early August, or by planting in late August after the harvest of a crop such as barley. This crop would normally be sprayed in the spring. Triallate and trifluralin (10:4) was applied on November 6, 1997 at 11 kg/ha (10 lb/ac) of product to a stand of Blazer II perennial ryegrass established August 22, 1997. At the time of application, the perennial ryegrass plants had 4-6 leaves. The other treatments were applied on June 16, 1998. Visual ratings of crop damage were made at 14 and 28 days after treatment application using a visual damage rating as per the Expert Committee on Weeds, where 0 = no damage. Seed yields were determined on September 11, 1998.

There was severe damage to the perennial ryegrass from the application of triallate and trifluralin as indicated by the high visual injury ratings (Table 7). There was also visual damage from the application of fenoxaprop-p-ethyl and fenoxaprop-p-ethyl/bromoxynil/MCPA ester tank mix (light browning colour). The grass outgrew the damage as the season progressed. The test looked completely uniform at harvest in September. Lowest yield was obtained for the triallate and treflan treatment, but the yield differences were not significant among the treatments.

Table 7. Tolerance of perennial ryegrass to broadleaf and grass weed products.					
Treatment	Rate kg/ha ai	Visual Injury		Seed yield	
		14 days after treatment	28 days after treatment	kg/ha	lb/ac
Fenoxaprop-p-ethyl	0.092	13	10	601	535
Fenoxaprop-p-ethyl	0.184	13	13	619	551
Bromoxynil MCPA ester	0.280 0.280	11	8	708	630
Bromoxynil MCPA ester	0.560 0.560	10	10	623	555
Fenoxaprop-p-ethyl Bromoxinil MCPA ester	0.092 0.280 0.280	13	13	609	542
Fenoxaprop-p-ethyl Bromoxynil MCPA ester	0.184 0.560 0.560	20	16	624	555
Imazamethabenz	0.400	5	5	713	635
Imazamethabenz	0.800	6	7	582	518
Imazamethabenz 2,4-D ester	0.400 0.850	6	6	638	568
Imazamethabenz 2,4-D ester	0.800 1.700	9	10	579	515
2,4-D ester	0.850	10	8	759	676
2,4-D ester	1.700	10	9	634	564
Fenoxaprop-p-ethyl 2,4-D ester	0.092 0.850	13	10	710	632
Fenoxaprop-p-ethyl 2,4-D ester	0.184 1.700	12	10	579	515
Dicamba	0.288	13	9	747	665
Dicamba	0.576	10	9	613	546
Fluroxypur 2,4-D ester	0.105 0.560	8	8	668	595
Fluroxypur 2,4-D ester	0.210 1.120	9	7	764	680
Triallate Trifluralin	1.400 0.560	40	46	486	434
Weed free check	--	0	0	698	621
LSD		6	6	NS[1]	NS

[1]Not significant at $P<0.05$

0 = no damage   100 = complete topkill

Annual Ryegrass

Aubade annual ryegrass was seeded June 1, 1998 at a rate of 16 kg/ha (14 lb/ac) using a 25 cm (10 in) row spacing. Fertilizer was applied at a rate of 75 kg N/ha (70 lb/ac) and 40 kg P_2O_5/ha (35 lb/ac) as a side-band application. Herbicide treatments were applied at the four-leaf growth stage on June 16, 1998. Crop tolerance ratings were taken 14 and 28 days after treatment. Seed yields were determined on September 11, 1998.

Fenoxaprop-p-ethyl and the fenoxaprop-p-ethyl/bromoxynil/MCPA ester tank mixes showed visual damage at 14 and 28 days after treatment application (Table 8). There were no significant yield reductions due to any of the herbicide applications. The stand was excellent, producing good yields.

Table 8. Tolerance of annual ryegrass to broadleaf and grass weed control herbicides.

Treatment	Rate kg/ha ai	Visual Injury		Seed Yield	
		14 days after treatment	28 days after treatment	kg/ha	lb/ac
Weed free check	--	0	0	876	780
Fenoxaprop-p-ethyl	0.092	18	21	829	738
Fenoxaprop-p-ethyl	0.184	23	16	873	777
Bromoxynil MCPA ester	0.280 0.280	2	4	827	736
Bromoxynil MCPA ester	0.560 0.560	2	3	806	717
Fenoxaprop-p-ethyl Bromoxynil MCPA ester	0.092 0.280 0.280	15	8	794	707
Fenoxaprop-p-ethyl Bromoxynil MCPA ester	0.184 0.560 0.560	14	13	798	710
Imazamethabenz	0.400	5	6	931	829
Imazamethabenz	0.800	8	6	841	749
Imazamethabenz 2,4-D ester	0.400 0.850	5	4	829	738
Imazamethabenz 2,4-D ester	0.800 1.700	5	4	901	802
2,4-D ester	0.850	2	2	841	749
2,4-D ester	1.700	2	2	818	728
Fenoxaprop-p-ethyl 2,4-D ester	0.092 0.850	8	6	806	717
Fenoxaprop-p-ethyl 2,4-D ester	0.184 1.700	10	6	858	764
Quinclorac + merge	0.050 + 1%	5	5	853	759
Quinclorac + merge	0.100 + 2%	7	4	884	787
Fluroxypur 2,4-D ester	0.105 0.560	3	3	861	766
Fluroxypur 2,4-D ester	0.210 1.120	4	3	779	693
LSD	--	5	4	NS[1]	NS

[1]Not significant at P<0.05

0 = no damage 100 = complete topkill

Establishment of Grasses with Companion Crops

L. Townley-Smith[1], G. Larson[1]

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

Progress: *Year two of five*

Objective: *To evaluate the effect companion crops have on the establishment of fescue and ryegrass.*

Profitable production of grass seed depends on the establishment of good stands. Most grasses do not produce seed in the year of planting. 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 more competitive and can tolerate Puma, therefore, wheat may be the best companion crop. Perennial ryegrass is planted after the harvest of an early maturing crop or is broadcast into a standing crop prior to harvest.

Establishment trials were three replicate RCBD with eight 6 m (20 ft) rows on a 20 cm (8 in) row spacing. With the exception of the perennial ryegrass trials, both grass and companion crop were planted May 16. The grass was planted parallel to the crop row. As in previous work, flax at 40 cm (16 in) row spacings did not have greatly reduced yields (Table 9). Canola yields were low due to poor stands, a result of low seed vigor (observed in other trials sown with the same seed source).

Slender Creeping Fescue and Chewings Fescue

Approximately half of the plots did not establish a stand sufficient to harvest. The flax with the wider row spacing tended to have more fescue establishment than the narrow row spacing. More fescue established in May than in August seedings. There were stand failures for May plantings, and for plantings with no companion crop.

Table 9. Flax yields under seeded with slender creeping and chewing fescues.

Companion crop	Seed/m²	Seed yield			Seed yield		
		kg/ha	lb/ac	SE[1]	kg/ha	lb/ac	SE
McDuff flax 20 cm with grass	500	826	735	47	1625	1446	69
McDuff flax 40 cm with grass	500	1240	1104	136	1933	1720	504
McDuff flax without grass	500	1061	944	38	1445	1286	185
Quest without grass	100	758	675	38	577	514	258

[1]standard error of the mean

[1]*SIDC, Outlook*

Perennial Ryegrass Establishment

Good stands of perennial ryegrass were obtained with both broadcast and drilled establishment methods. The warm open fall of 1997 allowed the crop to develop 5-7 leaves before winter. Yields of barley were moderate while the yields of mustard and canola were low (Table 10a).

Seeding method and companion crop did not significantly affect yield (Table 10b). Some plots had stands that were too thin to harvest.

Table 10a. Yield of companion crop prior to planting of perennial ryegrass, 1997.

Companion crop	Seeding rate seeds/m^2	Seed yield		
		kg/ha	lb/ac	SE[1]
Foster barley	250	5789	5152	362
Quest canola	100	1144	1018	137
Oriental mustard	100	907	807	126

[1]standard error of the mean

Table 10b. Seed yield of perennial ryegrass, 1998.

Companion crop	Direct seeded		Broadcast	
	kg/ha	lb/ac	kg/ha	lb/ac
Foster barley	842	749	853	759
Quest canola	483	430	596	530
Oriental mustard	424	377	771	686

Tall Fescue Establishment

The tall fescue was broadcast seeded under mustard and canola. Broadcast plots did not produce a stand.

Seed yield of tall fescue direct seeded into spring wheat was 500 kg/ha (445 lb/ac). Tall fescue undersown with a CPS wheat companion crop yielded 470 kg/ha (420 lb/ac). Tall fescue seeded alone in the spring yielded 550 kg/ha (490 lb/ac). Yields were comparable for all three treatments.

Table 11. Seed yield in 1998 of tall fescue undersown with under various companion crops in 1997.

Companion crop	Seeding rate seeds/m^2	Seed yield	
		kg/ha	lb/ac
None	---	550	490
AC Barrie HRS wheat	250	500	445
Oriental mustard	100	---	---
AC Taber CPS wheat	100	470	420
Quest canola	100	---	---

Effect of Grasses in Rotation on the Yield of Subsequent Crops

L. Townley-Smith[1], G. Larson[1]

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

Progress: *Year two of five*

Objective: *To determine the effect of bluegrass on subsequent crops in the rotation.*

Perennial grass crops add significant amounts of root material to the soil. This can stabilize soil structure and reduce erosion. Including perennials in the rotation may reduce weed populations and may lower disease pressures. The trials are designed to quantify these potential benefits that may accrue by adding a grass seed crop to the crop rotation.

Effect of Bluegrass on Yields of Subsequent Crops

Bluegrass was harvested as a seed crop on August 18. Tillage and Roundup treatments were implemented following harvest. Separate trials were laid out for bean and for potato in a four-replicate split plot design with main plots being the year of breaking and subplots being tillage treatments. Grass seed will be harvested each season and the following treatments applied:

1) Roundup @ 1.5 L/ac; cultivate in August and the following spring.
2) Spray with Roundup in August; cultivate prior to seeding.
3) Rototill in August; spray with Roundup @ 0.5 L/ac in spring.
4) Rototill in August; rototill in spring.

Tillage treatments are 2 m X 6 m (6 ft X 20 ft).

The trials are designed so that the rotation will be run for three seasons. Plot layout for the trial (each replication) is as follows:

1997	1998	1999	2000	2001
tillage	potato	bean		
tillage	bean	potato		
	tillage	potato	bean	
	tillage	bean	potato	
		tillage	potato	bean
		tillage	bean	potato

The 1998 bean crop was severely damaged by an overdose of Edge while the potato crop was severely damaged by potato beetles. No yields are available. Planting potato was difficult on grass sod remained difficult after several cultivations.

[1]*SIDC, Outlook*

Weed Control in Fescue and Perennial Ryegrass Seedling Stands

L. Townley-Smith[1], G. Larson[1]

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

Progress: *Year two of five*

Objective: *To evaluate weed control practices for seedling stands of fescue and ryegrass.*

The fine fescues tolerate all type I herbicides and all broadleaf products tested. Effort should be concentrated on developing tank mixes that can be used with a flax companion crop. These include Poast FlaxMax, and Select or Venture tank mixes with MCPA and Lontrel. Further weed control work should be done with fewer products, with and without a flax companion crop.

Perennial ryegrass will be grown like winter wheat. Products that should be evaluated are Assert tank mixes, surface applied Fortress, and other broadleaf herbicides.

Tall fescue seedlings appear to tolerate both Achieve and Puma. Given the vigorous development of this crop, wheat will likely be the companion crop of choice. If this is true, volunteer wheat would have to be controlled in the seed production year. This would likely limit grass weed control options to surface applied products such as Fortress. Flax can not be recommended as a companion crop at this time since it would not be possible to control wild oats in the flax crop with currently registered herbicides.

Establishment Trials

Late seeding of the fine fescues appears to be unsuccessful. Some effort is required to determine if companion cropping with flax is viable.

Rudy-Rosedale Irrigated Hay Project

L. Sexton[1], A. MacDonald[1]

The Rudy-Rosedale irrigated alfalfa project was established to demonstrate large-scale irrigated alfalfa production, and to provide a secure source of hay for the PFRA community pasture system. The project consists of a one section centre pivot on Sec-1-31-7-W3 pumping from drain 1C of the South Saskatchewan River Irrigation District #1.

Hay production and protein content for the 1998 season are shown in Table 12. The south half was in alfalfa production. The NW quadrant was sown to Brier barley for greenfeed and was undersown to alfalfa. The NE quadrant produced greenfeed barley only.

Weather problems plagued the first alfalfa cut on the SW quadrant. It was cut mid-June, but was

[1] *SIDC, Outlook*

not baled until mid-July due to numerous rain delays. A second cut was made four days after baling in order to harvest the regrowth between the windrows. This allowed sufficient regrowth for a productive third cut of high quality hay.

Alfalfa production was average overall, despite the weather problems. Greenfeed yield was above average in 1998. Total production was lower than in 1997, but was greater than the long-term average for the project.

The continuing problem with pocket gophers increased in 1998 after two years of relatively little trouble. Most difficulty was encountered on the second cut of alfalfa.

Allocation of feed from the Rudy-Rosedale project to the various pastures is listed in Table 13. An additional 175 straw bales were shipped from SIDC to the Montrose pasture.

Table 12. Rudy-Rosedale hay and greenfeed yield, production and protein content.

Quarter	Yield						Total production tonnes	Protein content, %		
	1st cut		2nd cut		3rd cut					
	t/ha	t/ac	t/ha	t/ac	t/ha	t/ac		1st cut	2nd cut	3rd cut
SW Alfalfa	2.1	0.9	2.1	0.9	3.3	1.5	413	15.2	20.2	20.5
SE Alfalfa	3.0	1.3	4.5	2.0			408	20.0	18.1	
NW Greenfeed	4.2	1.9					230	12.1		
NE Greenfeed	5.4	2.4					296	10.9		
Grass corners	1.7	0.8					27			
							1374			

Table 13. Rudy-Rosedale hay and greenfeed allocations.

Pasture	Alfalfa[1]		Greenfeed		Total	
	# bales	tonnes	# bales	tonnes	# bales	tonnes
Rudy-Rosedale/Spring Creek	1019	454	343	183	1362	637
Paynton	270	120	180	98	450	218
Royal	30	13	30	17	60	30
Antelope Park	180	80			180	80
Monet			180	98	180	98
Oakdale	150	67	180	98	430	165
Newcombe			60	32	60	32
unallocated	255	114			255	114
Totals	1904	848	983	526	2887	1374

[1]Includes grass hay from dryland corners

A Crop Diversification Opportunity: Potential of Ryegrass (*Lolium* spp.) as a Seed Crop under Irrigation in Saskatchewan

B. Coulman[1], H. Leoppky[1], D. Murrell[2], G. Kruger[3]

Funded by
Canada/Saskatchewan Partnership Agreement of Water-Based Economic Development (PAWBED)

***Progress:** Final year of three*

***Location:** SIDC*

***Objectives:** To evaluate the potential of Italian, Westerwolds, and perennial ryegrass for seed production under irrigated conditions and to evaluate agronomic practices which will assist development of a ryegrass seed industry.*

An Italian ryegrass (biennial type) cultivar trial seeded in spring 1997 was completely winterkilled. No seed was harvested in 1998.

Seed was harvested in 1998 from a perennial ryegrass cultivar trial seeded in the spring of 1996 (Table 13). This test had suffered considerable winterkill, consequently yields were about one-third of 1997 yields for this trial. None of the cultivars had a better stand than the Canadian cultivar Norlea. Yields were again highly variable, pointing out the importance of choosing the correct cultivar. A similar test seeded in 1997 was completely winterkilled, and no seed was harvested in 1998.

A larger number of Westerwold ryegrass (annual type) cultivars were tested in 1998 than in previous years. Two cultivars, Magnum and Andrea, numerically outyielded Aubade (the standard cultivar). The yield differences were not statistically significant (Table 14). Uneven ripening of heads was again a problem. The crop was straight combined and dried at an earlier stage of maturity this year to avoid excessive shattering.

Table 14. Seed yield of Westerwold Ryegrass varieties, 1998 planting.

Variety	# heads/m^2	Seed Yield		Yield as % of Aubade
		kg/ha	lb/ac	
Magnum	955	1345	1200	114
Andrea	883	1249	1114	106
Aubade	808	1179	1051	100
Agraco	811	1063	948	90
SW WWR9016	677	1059	945	90
Barcimatra	555	986	880	84
Barturbo	845	930	829	79
Barwoltra	712	900	803	76
Barspectra	648	740	660	63
Baroldi	640	687	613	58
Max	675	253	225	21
Mean:	746	945	843	
CV %	50.84	15.7	15.7	
F-Value	0.52	21.03**	21.03**	
LSD (0.05)	NS[1]	190	169	

[1] not significant at P<0.05

[1] *Agriculture & Agri-Food Canada Research Centre, Saskatoon*
[2] *Formerly Saskatchewan Forage Council, currently Newfield Seeds, Nipawin*
[3] *Formerly Saskatchewan Forage Council, currently Cargill Grain, Rosetown*

Table 15. Seed yield of perennial ryegrass cultivars.						
Variety	% Stand 19-May	Head Count 02-July m^2	Silvertop count 14-July % heads	Seed yield 05-Aug kg/ha	Seed yield 05-Aug lb/ac	Yield % as Norlea
Gettysburg	17	520	1.0	234	209	148
Barrage	28	541	0.8	228	204	144
SWE225	22	515	0.4	210	187	133
Bardessa	19	579	0.2	171	153	108
Norlea	42	293	0.2	158	141	100
Barball	25	568	0	152	136	96
Stallion Select	30	483	0.6	152	136	96
Catalina	11	509	0	151	135	96
Leon	20	280	0	140	125	89
Brightstar	8	539	0.2	124	111	78
Barcredo	11	384	0.4	117	105	74
Terry	7	243	0.4	101	90	64
Figaro	20	435	0.2	99	89	63
Sabor	22	437	0.4	95	85	60
Affinity	16	413	0.4	92	82	58
Barmaco	6	203	0	63	56	40
Barlano	6	269	0	62	56	39
Barylou	12	344	0.6	61	55	39
Barlinda	5	320	0	59	53	37
Sommora	8	75	0	52	47	33
Spelga	4	104	0.2	43	38	27
SWER8744	6	189	0	40	36	25
Baristra	6	280	0.2	34	30	21
Rosalin	3	117	0	33	30	21
Barlatra	3	184	0	30	27	19
Yatsyn1	5	251	0	29	26	19
Ronja	8	296	0	16	15	10
Barlet	4	211	0	6	5	4
Barezane	4	93	0	0	0	0
Moy	6	216	0	0	0	0
SWUER8782	3	107	0	0	0	0
Barclay	4	120	0	0	0	0
Mean	12	314	0	86	77	
CV%	52	63	249	90	81	
F-value	11.47**	3.32**	1.53	3.96**	3.96**	
LSD (0.05)	3	97	0	38	34	

A trial was seeded in 1997 to compare the seed yields of Italian and perennial ryegrasses and tall fescue for spring and fall (August 15) seedings, and under companion crops in spring seedings (Table 16). For Italian ryegrass, the only seeding which produced any yield (close to 220 kg/ha) was the August 15 seeding; all other seedings were completely winterkilled. There were no significant differences among the treatments for perennial ryegrass, in contrast to the 1997 harvested trial for which the fall seeding was clearly superior. Fall seedings of tall fescue were inferior to the spring seeded treatments. Among the spring treatments, the pure stands were generally higher yielding than the companion crop treatments.

Table 16. Seed yields as affected by companion crop and time of seeding.

A. Italian ryegrass establishment trial (Maris Ledger).

Cover crop	Rate	Seed yield kg/ha		Seed yield lb/ac	
		Cover crop 1997	Grass seed 1998	Cover crop 1997	Grass seed 1998
None - Fall		n/a	220	n/a	196
None - Spring		n/a	0	n/a	0
Wheat	100 kg/ha	3510	0	3131	0
Wheat	50 kg/ha	3310	0	2953	0
Flax	40 kg/ha	1240	0	1106	0
Flax	20 kg/ha	990	0	883	0
Mean		2260	400	2016	33
CV%		23	53	23	53
F-value		103.3**	103.3**	33.8**	103.3**
LSD (0.05)		0.03	30	624	30

B. Perennial ryegrass establishment trial (Norlea).

Cover crop	Rate	Seed yield kg/ha		Seed yield lb/ac	
		Cover crop 1997	Grass seed 1998	Cover crop 1997	Grass seed 1998
None - Fall		n/a	600	n/a	535
None - Sring		n/a	650	n/a	580
Wheat	100 kg/ha	3510	570	3131	508
Wheat	50 kg/ha	3200	590	2854	526
Flax	40 kg/ha	890	530	794	473
Flax	20 kg/ha	690	590	616	526
Mean		2100	590	1873	526
CV%		35	30	35	30
F-value		21.1**	0.23	21.1**	0.23
LSD (0.05)		1000	NS[1]	892	NS

C. Tall fescue establishment trial (Courtney).

Cover crop	Rate	Seed yield kg/ha		Seed yield lb/ac	
		Cover crop 1997	Grass seed 1998	Cover crop 1997	Grass seed 1998
None - Fall		n/a	170	n/a	152
None - Spring		n/a	810	n/a	723
Wheat	100 kg/ha	3570	700	3184	624
Wheat	50 kg/ha	3440	560	3068	500
Flax	40 kg/ha	1580	670	1409	598
Flax	20 kg/ha	1380	600	1231	535
Mean		2500	590	2230	526
CV%		33	32	33	32
F-value		10.0**	7.02**	10.0**	7.02**
LSD (0.05)		1100	250	981	223

[1] not significant at P<0.05
n/a = not applicable

A new trial was established in 1997 to examine dormant fall seeding of the ryegrasses. Coated seed of Advance Westerwold, of Bufor and Sikem Italian, and of Napoleon perennial ryegrasses were seeded in late October, 1997. In addition, Advance Westerwold was seeded in May of 1998 for comparison with the dormant seedings. Half of the dormant seeded plots were cut for forage in June of 1998. All were harvested for seed on August 12. Advance Westerwold ryegrass seeded in the spring produced low yields compared to the cultivars reported in Table 12. The yield was almost doubled for the dormant seeding. Taking a forage cut in June lowered the seed yield of the dormant seeding by about one-third. Yields of forage residue (material left after combining) were around 4500 kg/ha (4000 lb/ac). Our previous work has shown the crude protein content of this material to be close to 10%, thus providing forage of moderate quality.

The dormant seedings of Italian ryegrass also produced seed in 1998 (Table 17). Bufor [750 kg/ha (670 lb/ac)] was higher yielding than Sikem [540 kg/ha (480 lb/ac)]. Spring cutting reduced the seed yield of this type of ryegrass. Forage residue production of the Italian types (>5500 kg/ha) was higher than for Advance Westerwold ryegrass. These results are interesting, considering the difficulty in overwintering Italian ryegrass to produce a seed crop. It appears that established plants of this type of ryegrass do not need to be exposed to winter temperatures for vernalization. Seedlings developing in the early spring are capable of being vernalized and of producing seed in the same year.

Unlike Italian ryegrass, Napoleon perennial ryegrass produced few heads in 1998 and did not have any harvestable seed. It appears that this species of ryegrass has a strong vernalization requirement. Established plants must be exposed to winter temperatures to induce plants to head.

Table 17. Forage and seed yields for the ryegrass dormant seeding trial, Outlook.

Entry	Time of seeding	Spring cut	Head count #/m^2	Spring Cut DM yield		Forage residue		Seed yield	
				kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
Advance Westerwold	late-Oct-97	Yes	400	2379	2122	4443	3963	1232	1099
	late-Oct-97	No	369	0	0	4680	4175	879	784
	May-98	No	412	0	0	2938	2621	625	557
Bufor Italian	late-Oct-97	No	191	0	0	6244	5570	752	671
	late-Oct-97	Yes	155	895	798	5815	5187	685	611
Sikem Italian	late-Oct-97	No	148	0	0	6223	5551	546	484
	late-Oct-97	Yes	145	763	681	5401	4818	379	338
Napoleon Perennial	late-Oct-97	Yes	17	60	64			0	0
	late-Oct-97	No	11	0	0			0	0
Mean			209	477	425			566	505
CV%			38	50	50			25	25
F-Value			14.58**	44.67**	44.67**			31.07**	31.07**
LSD (0.05)			77	231	206			137	122

Specialty Crops Program

Pulse Crops

Alternate Crops

Specialty Crops Program

Pulse Crops

The pulse crop program at the SIDC 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.

Locations: *SIDC: SW 15-29-08-W3* *Off-station site: NW 12-29-08-W3*

Agronomic Investigations

Fertilizer Response and Placement with Irrigated Pea and Dry Bean

T. Hogg[1], M. Pederson[1]

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

Progress: *Final year*

Objective: *To determine the effect of rate and placement of starter fertilizer on the establishment and yield of irrigated pea and dry bean.*

Pulse crops require adequate soil fertility to maintain optimum yield. Application of fertilizer at or near seeding is required under cold soil temperatures or where soil available nutrient levels are low. This ensures an adequate nutrient supply early in the growing season. High concentrations of fertilizer placed with the seed can cause seedling damage and can reduce the plant stand. Fertilizer placed in close proximity to the seed can reduce the effectiveness of the *Rhizobium* inoculant resulting in reduced nitrogen fixation. Information on rate and placement of starter fertilizer is required by pulse crop growers to ensure optimum production.

A starter fertilizer response trial was established in the spring of 1998 at the SIDC. A separate trial was established for each crop. A 13-20-10-10 starter fertilizer blend was both side-banded and seed placed at rates of 0, 50, 100 and 150 kg/ha (0, 45, 90 and 135 lb/ac) during the seeding operation. Carneval pea was seeded at a target plant population of 80 seeds/m^2 (170 lb/ac) using a 20 cm (8 in) row spacing. Othello pinto bean was row crop seeded at a target plant population of 30 seeds/m^2 (105 lb/ac) using a 60 cm (24 in) row spacing. A factorial arrangement of the fertilizer rate and placement treatments plus a control in a randomized complete block design with four replicates was used. Each treatment measured 2.4 m x 6 m (8 ft x 20 ft).

[1]*SIDC, Outlook*

Soil analysis of samples collected in the spring prior to plot establishment are presented in Table 1. Current soil test recommendations indicate a requirement for 20-25 lbs P_2O_5/ac for both irrigated pea and dry bean.

Table 1. Spring soil analysis for the pea and dry bean starter fertilizer response trial.

Crop	Depth in inches	pH	1:2 E.C. dS/m	NO_3-N	P	K	SO_4-S
				lb/ac			
Pea	0-12	7.9	0.7	50	60	644	51
	12-24	8.1	0.7	40			63
Dry Bean	0-12	7.9	0.6	62	84	756	40
	12-24	8.2	0.6	48			58

Pea

The effect of starter fertilizer rate and placement on irrigated pea is indicated in Table 2. Overall plant stand was less than that recommended for irrigated pea production. Analysis of variance indicated there was a significant treatment effect on plant stand, dry matter yield and seed yield. The two highest rates of seed placed fertilizer reduced plant stand, dry matter and seed yield. There were no significant increases in yield above that of the control for any of the starter fertilizer treatments.

There was no significant effect of fertilizer rate or placement on plant height, seed weight or nodulation.

Table 2. Response of Carneval field pea to starter fertilizer under irrigation.

Fertilizer Treatment			Yield		Seed Weight mg	Flat Pod DM Yield		Plant Stand #/m^2	Plant Height cm	Lodge Rating[1]	Nodule Rating[2]
Place	Rate										
	kg/ha	lb/ac	kg/ha	bu/ac		kg/ha	lb/ac				
Check	0	0	5874	87.2	208	3049	2717	50	89	5	7.0
Seed	50	45	5491	81.5	214	3082	2746	33	93	5	6.3
	100	90	4859	72.2	210	1955	1742	23	90	4	7.0
	150	135	3270	48.6	204	1652	1472	12	82	3	6.5
Side	50	45	5774	85.7	207	2892	2577	41	93	6	7.0
	100	90	6000	89.1	208	2853	2542	44	96	6	5.8
	150	135	5961	88.5	202	3008	2680	46	100	6	5.5
LSD(0.05)			564	8.4	NS[3]	931	830	10	10	1	NS

[1] 1 = erect; 9 = flat
[2] 0 = no N-fixation potential; 8 = fully effective nodulation
[3] not significant

Dry Bean

The effect of starter fertilizer rate and placement on irrigated dry bean is indicated in Table 3. Analysis of variance indicated there was a significant treatment effect on plant stand and flat pod dry matter yield. Plant stand was significantly reduced with seed placed fertilizer with the highest rate causing the greatest reduction. This reduction in plant stand caused a significant reduction in flat pod dry matter yield.

Starter fertilizer rate and placement had no significant effect on dry bean seed yield, seed weight, nodulation or plant height.

Table 3. Response of Othello pinto bean to starter fertilizer under irrigation.

Fertilizer Treatment			Yield		Seed Weight	Flat Pod DM Yield		Plant Stand	Plant Height	Nodule Rating[1]
Place	Rate				mg			$\#/m^2$	cm	
	kg/ha	lb/ac	kg/ha	lb/ac		kg/ha	lb/ac			
Check	0	0	3745	3337	378	6275	5591	35	44	7.5
Seed	50	45	3840	3421	365	5233	4663	31	44	6.5
	100	90	3529	3144	369	4552	4056	27	46	6.5
	150	135	3719	3314	363	4093	3647	26	43	7.0
Side	50	45	3705	3301	373	5594	4984	33	46	7.0
	100	90	3665	3266	366	5922	5277	31	43	7.0
	150	135	3845	3426	373	5336	4754	31	48	6.8
LSD(0.05)			NS[2]	NS	NS	1602	1427	6	NS	NS

[1] 0 = no N-fixation potential; 8 = fully effective nodulation
[2] not significant

Response of Irrigated Pea and Dry Bean to Potassium Fertilizer

T. Hogg[1], M. Pederson[1]

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

Progress: *Year two of five*

Objective: *To determine the effect of potassium fertilizer on yield and seed quality of irrigated pea and dry bean.*

Pulse crops require adequate soil fertility to maintain optimum yield. Large quantities of the macronutrients N, P, K and S are removed by pulse crops. Available soil potassium levels have generally been considered adequate. Fertilizer response may occur under certain conditions, for example soils testing low in soil available potassium, or under cool soil temperatures associated with early seeding.

[1]*SIDC, Outlook*

A potassium fertilizer response trial was established in the spring of 1998 at the SIDC. A separate trial was established for dry bean and pea. Treatments included potassium rates of 0, 10, 20, 30 and 40 kg K_2O/ha (9, 18, 27 and 36 lb K_2O/ac) applied as a side band application at seeding. Potassium chloride (0-0-60) was the source of potassium. Carneval pea was seeded at a target plant population of 80 seeds/m^2 (170 lb/ac) using a 20 cm (8 in) row spacing. Othello pinto bean was row crop seeded at a target plant population of 30 seeds/m^2 (105 lb/ac) using a 60 cm (24 in) row spacing. The treatments were arranged in a randomized complete block design with four replicates. Each treatment measured 2.4 m x 6 m (8 ft x 24 ft).

Current soil test recommendations indicated a requirement for 25-30 lbs P_2O_5/ac for pea and 20-25 lbs P_2O_5/ac for dry bean grown under irrigated conditions (Table 4).

Table 4. Spring soil analysis for the pea and dry bean potassium fertilizer response trial.

Crop	Depth in inches	pH	1:2 E.C. dS/m	NO_3-N	P	K	SO_4-S
				lb/ac			
Pea	0-12	8.1	0.3	24	75	675	24
	12-24	8.2	0.5	32			48
Dry Bean	0-12	7.7	0.4	62	97	1006	36
	12-24	8.0	0.5	71			73

The 1998 growing season was hot during July and August resulting in good response to irrigation. There were no observed differences among the potassium fertilizer treatments in days to flowering or maturity for either pea or dry bean. Pea required 61 days for 10% flowering and 90-95 days to reach maturity. Dry bean required 64 days for 50% flowering and 126 days to reach maturity. There was very little disease present in either crop, probably a result of the hot growing conditions.

There was no effect of potassium fertilizer application on yield, seed size, plant stand or plant height for Carneval pea (Table 5). The 40 kg K_2O/ha (36 lb K_2O/ac) rate produced the highest yield for pea but the increase was not significantly greater than for the lower rates.

Table 5. Response of irrigated Carneval pea to potassium fertilizer.

K_2O Rate		Yield		Seed Weight	Plant Stand	Plant Height
kg/ha	lb/ac	kg/ha	bu/ac	mg	#/m^2	cm
0	0	3149	46.7	235	45	62
10	9	3368	50.0	228	43	67
20	18	3087	45.8	233	47	68
30	27	3328	49.4	235	52	67
40	36	3670	54.5	238	58	73
LSD (0.05)		NS[1]	NS	NS	NS	NS

[1] not significant

For dry bean, the yield for the 30 and 40 kg K_2O/ha (27 and 36 lb K_2O/ac) treatments was less than for the low rates of application. This may indicate a toxic effect of the higher fertilizer rates on the dry bean plants even though the fertilizer was applied away from the seed (Table 6). This is substantiated by the lower plant population for the two highest rates of potassium compared to the lower rates. Yield differences were not large. There was no significant effect of potassium fertilizer application on dry bean plant height or seed weight.

Pea yield was low for irrigated production, probably due to the coarse texture of the soil on a portion of this site (Rep 1 and 2). Soil available potassium was sufficient to produce 3200 kg/ha (47.5 bu/ac) pea on the poor area and 4500 kg/ha (66.8 bu/ac) on the good area. Soil available potassium was sufficient to produce 3700 kg/ha (3297 lb/ac) of dry bean. This is considered good for irrigated dry bean.

Table 6. Response of irrigated Othello pinto bean to potassium fertilizer.

K_2O Rate		Yield		Seed Weight mg	Plant Stand #/m^2	Plant Height cm
kg/ha	lb/ac	kg/ha	lb/ac			
0	0	3718	3313	382	25	48
10	9	3498	3117	377	22	45
20	18	3890	3466	377	24	46
30	27	3271	2914	374	20	46
40	36	3251	2897	379	19	44
LSD (0.05)		NS[1]	NS	NS	NS	NS

[1] not significant

Preliminary indications are that the current soil test guidelines correctly predict the potassium requirements of irrigated pea and dry bean. Monitoring of soil fertility through an adequate soil testing program is the best way to determine fertilizer requirements.

Response of Irrigated Pea and Dry Bean to Micronutrient Fertilizer

T. Hogg[1], M. Pederson[1]

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

Progress: *Year two of five*

Objective: *To determine the effect of soil and foliar applied copper, zinc and boron micronutrient fertilizer on yield and seed quality of irrigated pea and dry bean.*

Pulse crops require adequate soil fertility to maintain optimum growth and yield. Large quantities of the macronutrients are removed by pulse crops. The micronutrients are just as essential for optimum growth and yield although they are required in much smaller quantities. Micronutrient requirements are dependent on both plant uptake and soil availability. Generally, levels of soil micronutrients have been considered adequate. Response may occur under certain conditions, such as zinc application to dry bean on high pH soils, or if early season weather is cool and wet.

[1]*SIDC, Outlook*

A micronutrient fertilizer response trial was established in the spring of 1998 at the SIDC. Separate trials were established for dry bean and pea. Treatments included three micronutrient fertilizer sources (copper, zinc and boron) side-banded during the seeding operation and foliar applied at flower initiation, plus a control. Granular micronutrients were side-banded. Liquid micronutrients were used as foliar applications. Carneval pea was seeded at a target plant population of 80 seeds/m^2 (170 lb/ac) using a 20 cm (8 in) row spacing. Othello pinto bean, CDC Expresso black bean and AC Skipper navy bean were row crop seeded at a target plant population of 30 seeds/m^2 (105, 42 and 60 lb/ac, respectively) using a 60 cm (24 in) row spacing. The trial utilized a factorial arrangement of the treatments in a randomized complete block design with four replicates. Each treatment measured 2.4 m x 6 m (8 ft x 24 ft).

Current soil test recommendations indicated the requirement for 20-25 lbs P_2O_5/ac and 3.5 -5.0 lbs copper/ac for both irrigated pea and dry bean (Table 7).

Table 7. Spring soil analysis for the irrigated pea and dry bean micronutrient fertilizer response trials.

Crop	Depth in inches	pH	1:2 E.C. dS/m	NO_3-N	P	K	SO_4-S	Cu	Mn	Zn	B	Fe
				lb/ac								
Pea	0-12	7.9	0.5	30	69	680	28	1.1	42	2.1	2.1	23
	12-24	8.1	0.7	41			59					
Dry Bean	0-12	7.7	0.2	37	99	1075	29	1.2	28	1.9	2.8	27
	12-24	8.0	0.5	69			63					

Pea

There was no effect of the micronutrient applications on irrigated Carneval pea plant stand, yield, seed weight or plant height (Table 8). There was no effect on days to 10% flowering or days to maturity. All treatments flowered 61 days after seeding and reached maturity 95 days after seeding.

Current soil test guidelines indicated that copper was low on this particular site for irrigated pea. However, there was no response to copper fertilization indicating that there was possibly some other factor limiting yield.

Monitoring of soil fertility through an adequate soil testing program is the best way to determine micronutrient fertilizer requirements.

Table 8. Response of irrigated Carneval pea to micronutrient fertilizers.

Treatment		Yield		Seed Weight	Plant Stand	Plant Height
Application	Micronutrient	kg/ha	bu/ac	mg	#/m^2	cm
Check		4106	61.0	241	48	71
Soil	Copper	4930	73.2	223	38	81
	Zinc	4101	60.9	236	49	72
	Boron	4625	68.7	232	33	83
Foliar	Copper	4360	64.7	237	47	76
	Zinc	4475	66.5	239	55	75
	Boron	4807	71.4	233	49	79
ANOVA LSD (0.05)		NS[1]	NS	NS	11	NS

[1] not significant

Dry Bean

No significant effect of micronutrient application on irrigated dry bean plant stand, yield, seed weight or plant height was observed (Table 9). There was no effect on days to 50% flowering or to maturity. All treatments flowered 53, 62 and 64 days after seeding and reached maturity 114, 111 and 116 days after seeding for CDC Expresso black bean, AC Skipper navy bean and Othello pinto bean, respectively. Variety differences were consistent with results from variety evaluation trials.

The significant difference in plant stand among the three dry bean varieties was due to the poor establishment of CDC Expresso dry bean. This was most likely due to poor quality seed.

Current soil test guidelines indicated that copper was low on this particular site for irrigated dry bean. However, there was no response to copper fertilization indicating that there was possibly some other factor limiting yield.

Monitoring of soil fertility through an adequate soil testing program is the best way to determine micronutrient requirements.

Table 9. Micronutrient source and application effects on yield of Othello pinto bean, Expresso black bean and Skipper navy bean grown under irrigation.

Treatment	Yield						Seed Weight, mg			Plant Height, cm			Plant Stand, #/m^2		
	Othello		Expresso		Skipper		Othello	Expresso	Skipper	Othello	Expresso	Skipper	Othello	Expresso	Skipper
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac									
Control	4063	3620	1246	1110	2946	2625	416	221	194	45	33	42	30	17	25
CU - Soil	3563	3175	1145	1020	2649	2360	411	226	198	45	39	44	30	14	25
Zn - Soil	3721	3315	1298	1157	2489	2218	416	218	194	47	37	39	27	13	26
B - Soil	3830	3413	1156	1030	2624	2338	413	217	203	45	35	42	26	16	23
Cu - Foliar	3964	3532	1268	1130	2754	2454	412	215	211	47	32	41	28	16	28
Zn - Foliar	3883	3460	1256	1119	2861	2549	412	218	196	48	35	46	25	16	28
B - Foliar	3804	3389	1396	1244	2807	2501	414	217	196	46	37	45	29	17	28
Mean	3833	3415	1252	1116	2733	2435	413	219	199	46	36	43	28	15	26
Factorial LSD (0.05)															
Variety (V)			206 (kg/ha)		184 (lb/ac)			5			8			2	
Treatment (T)			NS[1]		NS			NS			NS			NS	
V x T			NS		NS			NS			NS			NS	

[1] not significant

Irrigated Pea Seed Fungicide Treatment and Inoculant Formulation Trial

T. Hogg[1], M. Pederson[1]

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

Progress: *Final year*

Objective: *To evaluate pea seed fungicide and inoculant interactions under irrigation.*

Pulse crops are subjected to soil borne fungi such as *Rhizoctonia, Pythium* and *Fusarium* which can cause seed decay and root rot. These diseases can cause reduced and/or weakened stands resulting in lower yields. To counteract these diseases, seed is generally treated with a fungicide. Pulses are legumes and as such are capable of fixing a large percentage of their nitrogen requirements provided they are inoculated with specific *Rhizobium* bacteria. This inoculant is often applied as a seed coating. There is the possibility of a negative effect of the fungicide seed treatment on the beneficial *Rhizobium* seed coat inoculant. Applying the inoculant as a granular formulation to the soil instead of as a seed coating may alleviate this potential problem.

An irrigated pea fungicide seed treatment-inoculant formulation trial was established in the spring of 1998 at the SIDC. Fungicides treatments included Apron (metalaxyl), Thiram (thiram) and Apron + Thiram (metalaxyl + thiram), plus a control. Two inoculant formulations, liquid and granular, plus a control were used. The fungicides were applied to the seed in liquid form and allowed to dry. The liquid inoculant formulation was applied to the fungicide treated seed just prior to seeding. The granular inoculant was seed placed during the seeding operation. Carneval pea was seeded at a target plant population of 80 seeds/m^2 (170 lb/ac) using a 20 cm (8 in) row spacing. The trial utilized a factorial arrangement of the treatments in a randomized complete block design with four replicates. Each treatment measured 2.4 m x 6 m (8 ft x 24 ft).

The 1998 growing season was hot and dry in July and hot in August resulting in good response to irrigation. There were no observed differences among the fungicide-inoculant formulation treatments in days to flowering. The pea crop required 57 days for 10% flowering and 97 days to reach maturity. There was also very little disease present, a result of the hot dry growing conditions.

There was no effect of the fungicide-inoculant treatments on yield, seed size, plant stand, plant height, nodulation or protein content for Carneval pea (Table 10). The fungicide treatments had a lower flat pod dry matter yield than the control. There were no effects of the fungicide seed treatments or of the inoculant formulations on seed yield when compared to the control treatment. All treatments appeared healthy, with good nodulation throughout the growing season. Applying the inoculant just prior to seeding possibly prevented the fungicide seed treatments from having any detrimental effect on nodulation and plant growth.

[1]*SIDC, Outlook*

Table 10. Agronomic data for the irrigated Carneval pea fungicide seed treatment-inoculant formulation trial.

Treatment		Yield		Flat Pod DM Yield		Seed Weight	Plant Stand	Plant Height	Nodule Rating[1]	Protein
Fungicide	Inoculant	kg/ha	bu/ac	kg/ha	lb/ac	mg	#/m²	cm		%
Control	Control	5039	74.8	6356	5663	202	73	84	7.0	23.6
	Liquid	5234	77.7	6856	6109	216	73	83	5.5	23.4
	Granular	5401	80.2	5929	5194	215	66	84	6.3	23.0
Apron	Control	5353	79.5	6078	5415	204	68	87	5.0	23.1
	Liquid	4931	73.2	5093	4538	204	73	86	6.8	23.7
	Granular	5380	79.9	5178	4614	210	74	88	7.0	23.2
Thiram	Control	5030	74.7	4707	4194	209	67	85	7.0	23.0
	Liquid	5222	77.5	6006	5351	208	71	90	6.0	23.4
	Granular	5129	76.2	4778	4257	210	67	86	5.5	23.3
Apron + Thiram	Control	5007	74.4	4633	4128	214	65	86	7.0	23.6
	Liquid	5373	79.8	5596	4986	207	70	83	7.0	23.3
	Granular	5366	79.7	5192	4626	211	80	88	6.3	23.4
Factorial LSD (0.05)										
Fungicide (F)		NS[2]	NS	961	856	NS	NS	NS	NS	NS
Inoculant (I)		NS	NS	NS	NS	NS	NS	NS	NS	NS
F x I		NS	NS	NS	NS	NS	NS	NS	1.7	NS

[1] 0 = no N-fixation potential; 8 = fully effective nodulation
[2] not significant

Response of Irrigated Pea and Dry Bean to Inoculant Formulations

T. Hogg[1], M. Pederson[1], F. Walley[2]

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

Progress: *Year two of five*

Objective: *To evaluate the efficacy of granular legume inoculants, both seed placed and side banded, as compared to the more traditional peat and liquid formulations.*

Legume inoculants, which contain *Rhizobium* bacteria, are generally applied to the seed coat at seeding to help enhance nitrogen fixation. Inoculants are typically applied as peat based powders or as liquid formulations. Recently, manufacturers have begun to develop and formulate *Rhizobium* inoculants in granular form. Granular inoculant can be applied to the soil in the same manner that fertilizer can be applied before or during the seeding operation. Initial results with dry bean inoculants have indicated better nitrogen fixation and higher yields for the granular formulation applied in the seed row as compared to the peat based formulation. Further work is

[1] *SIDC, Outlook*
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required to determine application strategies for granular inoculants.

An inoculant evaluation trial was established in the spring of 1998 at the SIDC. A separate trial was used for each crop. Treatments included two each of liquid, peat and granular based inoculants, an uninoculated control and a flax control (for determining nitrogen fixation). MicroBio Rhizogen (MBR) and Liphatec were the inoculant sources used in the study. The liquid and peat based inoculants were applied to the seed just prior to seeding. The granular inoculant treatments included both seed-placed and side-band applications. Carneval pea was seeded at a target plant population of 80 seeds/m^2 (170 lb/ac) using a 20 cm (8 in) row spacing. Othello pinto bean was row crop seeded at a target plant population of 30 seeds/m^2 (105 lb/ac) using a 60 cm (24 in) row spacing. The treatments were arranged in a randomized complete block design with four replicates. Each treatment measured 2.4 m x 6 m (8 ft x 24 ft).

Current soil test recommendations indicate a requirement for 20 - 25 lbs P_2O_5/ac for pea and dry bean grown under irrigated conditions (Table 11).

Table 11. Spring soil analysis for the irrigated pea and dry bean inoculant formulation evaluation trial.

Crop	Depth inches	pH	1:2 E.C. dS/m	NO_3-N	P	K	SO_4-S
				lb/ac			
Pea	0-12	7.9	0.3	39	78	537	36
	12-24	8.0	0.3	47			47
Dry Bean	0-12	8.0	0.4	42	88	910	36
	12-24	8.0	0.7	61			65

Pea

There was no effect of inoculant formulation on irrigated Carneval pea plant stand, seed weight, plant height or nodule rating (Table 12). Overall plant stand was low for irrigated pea production. Yield was lowest for the control treatment and was significantly increased with the application of all formulations of inoculant. The yield for the liquid and side band granular MBR applications were higher than the control, but the difference was not statistically significant. There was no effect on days to 10% flowering or to maturity. All treatments flowered 57 days after seeding and reached maturity 95 days after seeding.

Table 12. Agronomic data for the irrigated Carneval pea inoculant formulation trial.

Treatment	Yield		Seed Weight	Plant Height	Plant Stand	Nodule Rating[1]
	kg/ha	bu/ac	mg	cm	#/m^2	
Control	4159	61.8	238	73	46	6
Liphatec Liquid	5149	76.5	232	83	46	6
MBR Liquid	4584	68.1	235	73	50	6
Liphatec Peat	5328	79.1	233	83	57	6
MBR Peat	5016	74.5	232	84	53	7
Liphatec Granular Seed-place	4810	71.4	235	83	44	6
Liphatec Granular Side-band	5369	79.7	228	85	47	6
MBR Granular Seed-place	5172	76.8	233	82	39	7
MBR Granular Side-band	4470	66.4	235	77	43	7
ANOVA LSD (0.05)	745	11.1	NS[2]	NS	NS	NS

[1] 0 = no N-fixation potential; 8 = fully effective nodulation [2] not significant

Dry Bean

There was no effect of inoculant formulation on irrigated Othello pinto bean plant stand, yield, seed weight, plant height or nodule rating (Table 13). There was no effect on days to 50% flowering or to maturity. All treatments flowered 64 days after seeding and reached maturity 111 days after seeding.

Table 13. Agronomic data for the Othello dry bean inoculant formulation evaluation trial grown under irrigation.

Treatment	Yield		Seed Weight	Plant Height	Plant Stand	Nodule Rating[1]
	kg/ha	lb/ac	mg	cm	$\#/m^2$	
Control	4036	3596	394	47	29	6
Liphatec Liquid	4067	3624	404	43	30	6
MBR Liquid	4060	3617	388	45	29	6
Liphatec Peat	4190	3733	394	46	30	6
MBR Peat	3709	3305	399	47	29	6
Liphatec Granular Seed-place	4012	3575	392	45	29	6
Liphatec Granular Side-band	3977	3544	393	42	28	7
MBR Granular Seed-place	3986	3552	390	43	26	7
MBR Granular Side-band	3906	3480	395	46	28	6
ANOVA LSD (0.05)	NS[2]	NS	NS	NS	NS	NS

[1] 0 = no N-fixation potential; 8 = fully effective nodulation [2] not significant

Seeding Rate and Row Spacing Effects on Irrigated Dry Bean

T. Hogg[1] , M. Pederson[1]

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

Progress: *Year two 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 is often associated with low aeration, high humidity and prolonged periods of dampness that can result in the development of white mold (*Sclerotinia*). These factors will be affected by both plant architecture and row spacing. The currently recommended seeding rate for irrigated production of dry bean is in the range of 25-30 seeds/m^2 using a row spacing ranging from 60-80 cm (24-32 in). Preliminary results from work conducted at the SIDC indicate an optimum seeding rate of 20 seeds/m^2 with small variations among the different market classes. Lower seeding rates would reduce the seeding costs for producers. Further work is required to verify these results.

A dry bean seeding rate x row spacing trial was established in the spring of 1998 at the SIDC. A separate trial was established for each of pinto, black and navy dry bean market classes.

[1] *SIDC, Outlook*

Treatments consisted of three seeding rates, three row spacings (20, 60 and 80 cm; 8, 24 and 32 in) and two varieties for each dry bean market class (Table 14). Normal fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. The treatments were arranged in a strip-split-plot design. Varieties and seeding rate treatments were randomized within the row spacing strips. All treatments were replicated four times. Each treatment measured 2.4 m x 8 m (8 ft x 24 ft).

Dry bean yield was affected by both seeding rate and row spacing. Reducing the seeding rate of navy bean from 30 to 20 seeds/m^2 did not affect yield (Table 15). This indicates that a lower seeding rate is a viable option with economic benefits to the producer.

Table 14. Seeding rates and varieties used in the irrigated dry bean seeding rate x row spacing trial.

Market Class	Variety	Plant Type	Seeding Rate (lb/ac)		
			20 seeds/m^2	25 seeds/m^2	30 seeds/m^2
Pinto	Othello	Type III indeterminate vine	69	87	104
	CDC Camino	Type I upright determinate	64	80	96
Black	UI 906	Type I upright determinate	31	39	47
	CDC Expresso	Type I upright determinate	28	35	42
Navy	Seafarer	Type I determinate bush	40	50	60
	AC Skipper	Type I upright determinate	34	42	51

For pinto and black bean market classes, a higher seeding rate should be maintained for optimum yield (Tables 16 and 17).

Table 15. Seeding rate and row spacing effects on yield of AC Skipper and Seafarer navy bean grown under irrigation.

Seeding Rate (seeds/m^2)	Row Spacing												Mean	
	20 cm (8 in)				60 cm (24 in)				80 cm (32 in)					
	AC Skipper		Seafarer		AC Skipper		Seafarer		AC Skipper		Seafarer			
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
20	2435	2170	1744	1554	2129	1897	1773	1580	1813	1615	923	822	1803	1606
25	2284	2035	1663	1482	2252	2007	1733	1544	2045	1822	1628	1451	1934	1723
30	2435	2170	1830	1631	2451	2184	1769	1576	1974	1759	1277	1138	1956	1743
Mean	2065 kg/ha		1840 lb/ac		2018 kg/ha		1798 lb/ac		1610 kg/ha		1435 lb/ac			

ANOVA	LSD (0.05)	Variety	Mean kg/ha	Mean lb/ac
Row Spacing (RS)	326			
Seeding Rate (SR)	NS[1]	AC Skipper	2202	1962
RS x SR	NS			
Variety (V)	182			
RS x V	NS	Seafarer	1401	1248
SR x V	NS			
RS x SR x V	NS			

[1] not significant

Table 16. Seeding rate and row spacing effects on yield of Othello and CDC Camino pinto bean grown under irrigation.

Seeding Rate seeds/m²	Row Spacing												Mean	
	20 cm (8 in)				60 cm (24 in)				80 cm (32 in)					
	Othello		Camino		Othello		Camino		Othello		Camino			
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
20	4057	3615	3170	2824	3818	3402	3017	2688	3358	2992	2634	2347	3342	2978
25	3824	3407	3024	2694	3594	3202	3077	2742	3423	3050	2861	2549	3301	2941
30	3667	3267	3362	2996	3702	3298	3028	2698	3766	3356	2961	2638	3414	3042
Mean	3517 kg/ha		3134 lb/ac		3373 kg/ha		3005 lb/ac		3167 kg/ha		2822 lb/ac			

ANOVA	LSD (0.05)	Variety	Mean kg/ha	Mean lb/ac
Row Spacing (RS)	NS[1]			
Seeding Rate (SR)	93	Othello	3690	3288
RS x SR	NS			
Variety (V)	94			
RS x V	NS	CDC Camino	3015	2686
SR x V	NS			
RS x SR x V	NS			

[1] not significant

Table 17. Seeding rate and row spacing effects on yield for CDC Expresso and UI 906 black bean grown under irrigation.

Seeding Rate (seeds/m²)	Row Spacing												Mean	
	20 cm (8 in)				60 cm (24 in)				80 cm (32 in)					
	Expresso		UI 906		Expresso		UI 906		Expresso		UI 906			
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
20	948	845	2108	1878	799	712	2391	2130	687	612	2173	1936	1518	1353
25	973	867	2555	2277	1013	903	2539	2262	721	642	2400	2138	1700	1515
30	1302	1160	3236	2883	1197	1067	2647	2358	981	874	2565	2285	1988	1771
Mean	1854 kg/ha		3134 lb/ac		1764 kg/ha		1572 lb/ac		1588 kg/ha		1415 lb/ac			

ANOVA	LSD (0.05)	Variety	Mean kg/ha	Mean lb/ac
Row Spacing (RS)	NS[1]			
Seeding Rate (SR)	275	CDC Expresso	958	854
RS x SR	NS			
Variety (V)	214			
RS x V	NS	UI 906	2513	2239
SR x V	NS			
RS x SR x V	NS			

[1] not significant

Row spacings of 20 cm (8 in) and 60 cm (24 in) tended to produce the highest yield for all dry bean market classes tested. The differences were statistically significant for navy bean only. Plant density of pinto, black, and navy bean was reduced at the 60 cm and 80 cm row spacings irregardless of seeding rate (Figures 1 - 3). Thin stands and lower yield at wide row spacings can be attributed to inter-row plant competition and to inefficient utilization of the growing area.

No effect of seeding rate or row spacing on days to 50% flowering or maturity or on seed weight were observed for the pinto, black or navy dry bean. There was very little disease present, probably a result of the hot dry growing conditions.

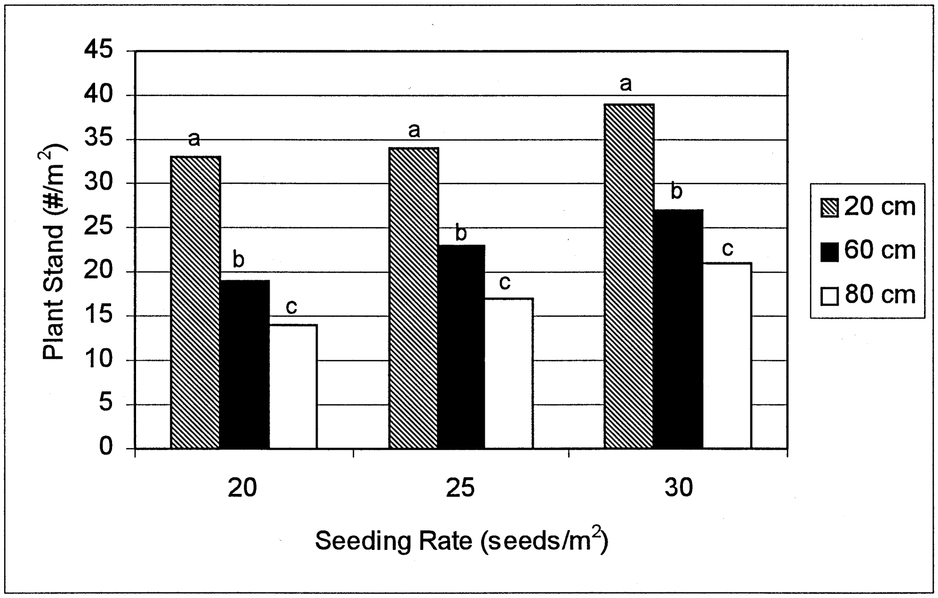

Figure 1. Seeding rate and row spacing effects on plant stand of irrigated pinto bean (row spacings within a seeding rate with the same letter are not significantly different at p=0.05).

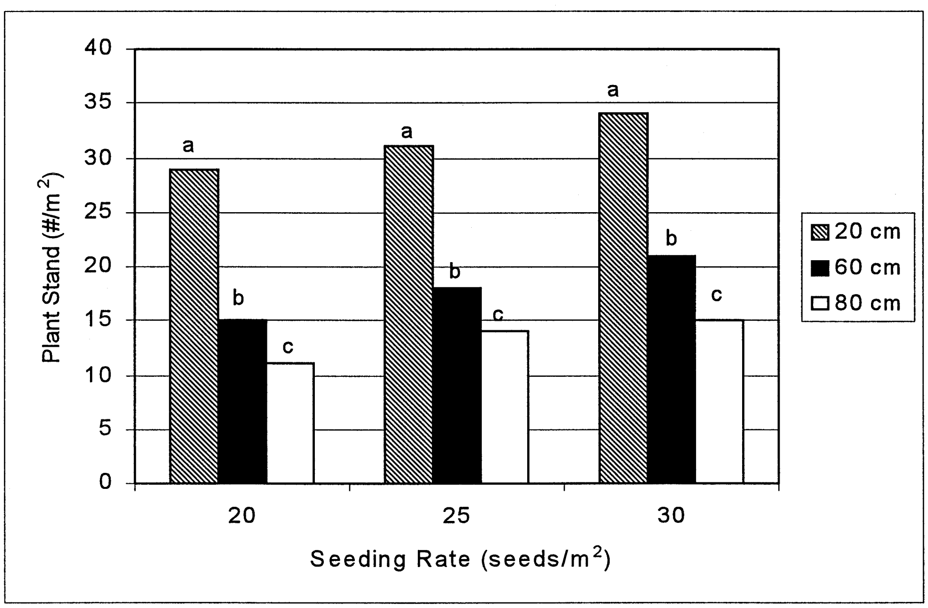

Figure 2. Seeding rate and row spacing effects on plant stand of irrigated black bean (row spacings within a seeding rate with the same letter are not significantly different at p=0.05).

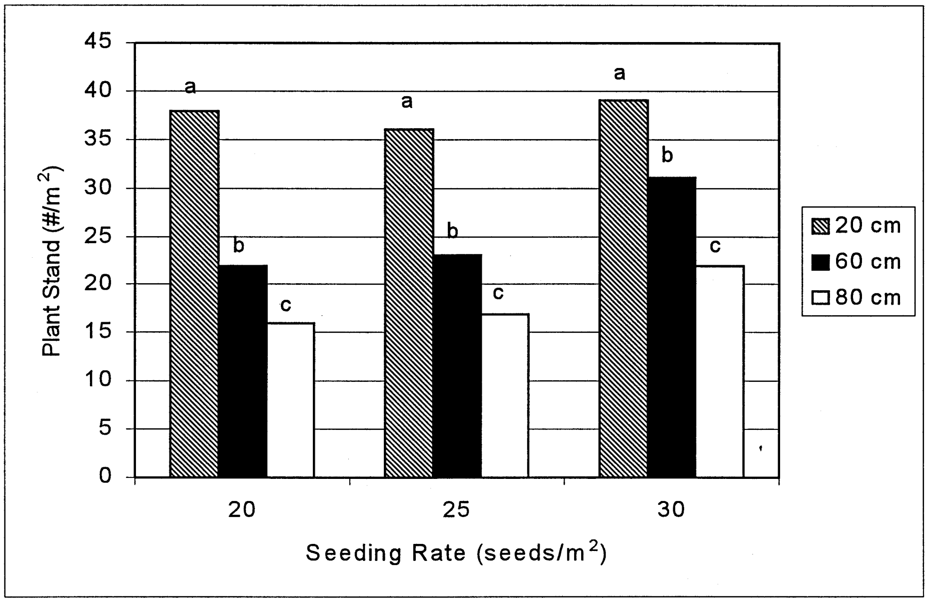

Figure 3. Seeding rate and row spacing effects on plant stand of irrigated navy bean (row spacings within a seeding rate with the same letter are not significantly different at p=0.05).

Efficacy of Seed Treatments for the Control of Halo Blight and Common Blight on Dry Edible Bean

T. Hogg[1], M. Pederson[1], R. Howard[2], Y. Leduc[2], S. Huggons[2]

Funded by Saskatchewan Pulse Crop Development Board (SPCDB)

Progress: *Year one of two*

Objective: *To determine the efficacy of alternative seed treatments as compared to streptomycin for the control of halo blight and common blight on dry edible bean.*

For the past decade, Canadian dry bean growers have relied upon Streptomycin as the only treatment to control surface-borne bacterial blight pathogens on seed. In 1997, the Pest Management Regulatory Agency (PMRA) of Health Canada notified the bean industry stakeholders that it would no longer permit the importation of bean seed pre-treated with streptomycin because of unresolved questions about possible adverse health effects caused by human pathogens resistant to this antibiotic. Therefore, the dry bean industry must find an effective replacement.

[1] *SIDC, Outlook*

[2] *Alberta Agriculture, Food and Rural Development, Crop Diversification Centre-South, Brooks, Alberta*

A dry bean seed treatment trial was established in the spring of 1998 at the SIDC. Seed treatments tested included Bluestone (copper sulfate 99% SG), Kocide LF (cupric hydroxide 23% SU), Copper 53W (tribasic copper sulfate 53% WP), Copper Oxychloride 50 (copper oxychloride 50% WP), Zineb 80W (zineb 80% WP), Dithane M-22 (maneb 80% WP), Dithane DG (manozeb 75% WDG), Agricultural Streptomycin (streptomycin sulfate 62.6% WP; equivalent to 50% streptomycin base) and Vitaflo-280 (thiram 13.2% + carbathiin 14.9% SU). US 1140 great northern dry bean seed was artificially infected with halo blight and common blight bacteria prior to application of the seed treatments. Check treatments included Vitaflo-280 alone, Vitaflo-280 + Agricultural Streptomycin and no chemical treatment. Peat based inoculant was applied to the seed just prior to seeding. The treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of four 6 m (20 ft) rows, with a 60 cm (24 in) row spacing planted at a rate of 120 seeds/m row (30 seeds/ft). Rows were trimmed to 5 m (16 ft) length after plant emergence. Normal fertilizer, weed control and irrigation practices for irrigated dry bean production were followed.

Blight levels across the trial were low to moderate (Table 18). Significant differences among treatments were observed, except for seed weight. Treating US 1140 great northern seed with Kocide LF or Copper 53W significantly reduced emergence and resulted in lower yields. Kocide LF, Copper 53W and Dithane DG were as effective as Streptomycin at reducing disease incidence and severity on leaves. From orthogonal analyses, it can be concluded that the chemical seed treatments used in this trial, as a group, did not adversely affect the emergence or yield of US 1140 beans. These treatments reduced disease incidence on plants and leaves and reduced disease severity on leaves, but not to a level that was significantly different from the Streptomycin check. Among the metal ion containing mixtures, the copper products adversely affected emergence and yields, and did appear to provide better disease control than Streptomycin.

Table 18. The effect of nine fungicidal/bactericidal seed treatments on seedling emergence, disease incidence, disease severity, seed yield and seed weight of US 1140 great northern dry bean grown under irrigated conditions.

Treatment	Rate of Product/kg seed	Emergence %	Disease Incidence %		Disease Severity	Yield g/12 m	Seed Weight mg
			Plants	Leaves	Leaves[1]		
Vitaflo-280 + Bluestone	2.60 ml + 2.00 g	78.4	16.7 b	26.8 bc	0.3 cd	4048 ab	342
Vitaflo-280 + Kocide LF	2.60 ml + 2.64 ml	59.1	7.9 b	17.0 c	0.2 d	3663 b	344
Vitaflo-280 + Copper 53W	2.60 ml + 1.66 g	60.8	10.4 b	14.1 c	0.2 d	3967 ab	349
Vitaflo-280 + Copper Oxychloride 50	2.60 ml + 1.66 g	73.8	14.9 b	24.1 bc	0.3 cd	3642 b	341
Vitaflo-280 + Zineb 80W	2.60 ml + 1.66 g	78.3	24.7 b	26.9 bc	0.3 bcd	4358 a	322
Vitaflo-280 + Dithane M-22	2.60 ml + 1.87 g	81.6	51.3 a	42.0 ab	0.6 ab	4390 a	345
Vitaflo-280 + Dithane DG	2.60 ml + 5.88 g	79.8	23.2 b	12.9 c	0.2 d	4128 ab	340
Vitaflo-280 + Agricultural Streptomycin	2.60 ml + 1.0 g	78.3	8.9 b	13.0 c	0.2 d	4632 a	347
Vitaflo-280	2.60 ml	80.1	54.1 a	41.8 ab	0.5 abc	4340 a	337
Untreated check	-	78.5	47.2 a	52.8 a	0.7 a	3960 ab	337
ANOVA (P<0.05)		0.0001	0.0	0.0	0.0	0.039	0.96
CV %		5.11	28.3	27.64	47.52	10.12	7.75

[1]Severity rating: 0 = no disease, 1 = slight (1-10% leaf area blighted), 2 = moderate (11-25% blighted), 3 = severe (26-50% blighted) and 4 = very severe (>50% blighted).

Values within a column followed by the same letter are not significantly different at the P<0.05 level.

Varietal Evaluations

Prairie Regional Dry Bean Wide-Row Co-operative Test

T. Hogg[1], M. Pederson[1], H. Mundel[2], J. Braun[2]

This project evaluates dry bean germplasm for its adaptation to Western Canada under irrigated row crop conditions. The germplasm sources include advanced lines from the Agriculture and Agri-Food Canada Lethbridge Research Centre and from the Crop Development Centre, University of Saskatchewan. These lines are compared to a standard registered variety within each market class.

Progress: *Ongoing*

Location: *Outlook*

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

An irrigated site was conducted at the SIDC. Standard fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. All entries were row crop seeded using a 60 cm (24 in) row spacing. The test consisted of 25 entries in a 5 x 5 lattice design and included five bean types (pinto, pink, small red, great northern and black). Three test entries were in the second year of co-op testing (L94D153, L94D290 and L94D292). The rest were new to the test. Individual plots consisted of two rows with 60 cm (24 in) row spacing and measured 1.2 m x 3.7 m (4 ft x 12 ft). All rows of a plot were harvested to determine yield.

The new pinto bean entry 261A-15 produced the highest overall yield but was five days later maturing than Othello (Table 19). Othello, 64-68-8 pinto bean, and NW63 small red bean also produced high yield. L95B165 was the most upright pinto bean entry. Among the pinks, L96C104 had the lowest yield, the earliest maturity and the largest seed weight. The new small red entries were lower yielding than NW63 but significantly earlier maturing. All black entries were quite upright. L96F101 was lower yielding than UI 906, but averaged comparable maturity and had large, shiny seeds. The great northern entry L96E108 had yield similar to US1140 but matured nine days earlier.

Prairie Regional Dry Bean Narrow-Row Co-operative Test

T. Hogg[1], A. Vandenberg[3], M. Pederson[1]

This project evaluates dry bean germplasm for solid seeded growing conditions in western Canada. The germplasm sources include advanced lines of entries from the Agriculture and Agri-Food Canada Lethbridge Research Centre and from the Crop Development Centre, University of

[1] *SIDC, Outlook*

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

[3] *Crop Development Centre, U of S, Saskatoon*

Saskatchewan. These lines are compared to a standard registered variety within each market class.

An irrigated site was conducted at SIDC. Standard fertilizer, weed control and irrigation practices for irrigated dry bean production were followed. All entries were seeded using a 20 cm (8 in) row spacing. The test included 36 entries in a 6 x 6 lattice design with three replicates. Market classes included pinto, pink, small red, great northern and black bean. A check variety was included for each market class. Individual plots measured 1.2 m x 3.7 m (4 ft x 12 ft). All rows of a plot were harvested to determine yield.

Progress: *Ongoing*

Location: *Outlook*

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

All market classes except pink and black had entries that produced higher yield than the check varieties (Table 20). Earlier flowering and maturity, reduced lodging, greater pod clearance and larger seed size are evident in some of the new lines. The highest overall yield was obtained for 93088 pinto, L95E101 great northern and L94D156 small red bean. CDC Camino, L96B101, 94138 and 95-12-28-PT were the most upright pinto bean varieties. L96B101 pinto bean shows promise with yield similar to Othello and pod clearance slightly less than CDC Camino. Great Northern entry L95E101 had high yield, earlier maturity and greater pod clearance than US 1140 or CDC Nordic. The small red entry L94D156 was high yielding with similar maturity to NW63. The pink entry 95-34-6PK was similar to Viva in yield and maturity and had larger seed size.

Prairie Regional Pea Co-operative Test A, Test B and Test C

T. Hogg[1], M. Pederson[1], T. Warkentin[2]

Partially funded by Manitoba Pulse Growers

Progress: *Ongoing*

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

This project evaluates pea germplasm for growing conditions in western Canada. The germplasm sources include advanced lines from the Agriculture and Agri-Food Canada Morden Research Centre, the Crop Development Centre, University of Saskatchewan, and private seed companies. Entries were divided into three tests (A, B, C) with 31 candidate entries in Test A, 27 candidate entries in Test B and seven candidate entries in Test C. Each test had five checks: Carrera, Carneval, Grande, Delta and Keoma. Relatively late maturing entries were placed in Test A.

An irrigated site was conducted at the SIDC. Standard fertilizer, weed control and irrigation practices for irrigated pea production were followed. Tests were arranged in a randomized

[1]*SIDC, Outlook*

[2]*Agriculture and Agri-Food Canada Morden Research Centre, Morden, Manitoba*

complete block design with three replicates. Individual plots measured 1.2 m x 3.7 m (4 ft x 12 ft). All rows of a plot were harvested to determine yield.

Several new yellow and some green entries had yield greater than Carneval (Table 21-23). Most new green entries yielded higher than Keoma. A few new yellow entries showed similar lodging rating to Carneval. One green entry (93132-01) had superior lodging tolerance than Carneval, but had a low yield potential. All other green entries had relatively poor lodging tolerance compared to Carneval.

Table 19. Relative yield and agronomic characteristics for the dry bean wide-row co-operative test.

Variety	Yield % of Othello[1]	Lodge Rating 1 = erect; 5 = flat	Vine Length cm	Days to 50% Flower[2]	Days to Maturity[3]	Seed Weight mg
Pinto						
Othello (check)	100	2.8	45	59	113	384
261A-15	106	2.5	47	66	118	335
64-68-8	102	3.5	45	66	112	360
287A-9	84	2.3	50	61	110	382
95-82-13-PT	80	2.3	45	58	113	467
L95B165	68	1.5	47	58	107	385
Pink						
L94C334BI	92	2.3	46	66	113	349
L94C333LE	90	2.0	44	66	112	356
Viva (check)	89	2.5	39	59	111	288
L96C104	68	2.3	38	55	99	413
Small Red						
NW63 (check)	100	3.3	42	56	115	329
L94D247LE	85	3.3	39	58	106	345
L94D153	79	2.8	41	56	110	355
L96D116	75	2.5	39	61	114	342
L94D290	71	2.0	39	56	99	389
L94D292	56	2.3	37	56	101	386
L96D104	45	1.5	39	59	97	332
Black						
UI906 (check)	87	1.0	49	64	109	189
L95F025	75	1.0	47	63	109	224
L96F101	58	1.5	43	57	107	293
CDC EXPRESSO	41	1.0	36	49	113	213
Great Northern						
US1140 (check)	88	4.0	38	58	117	347
L96E108	80	3.3	38	56	108	363
L94E118BI	65	2.5	36	55	101	339
CDC NORDIC	56	2.3	42	66	114	352

[1] Othello yield = 4317 kg/ha (3855 lb/acre)
[2] 50% of plants/plot have open flowers
[3] 50% of pods are buckskin colored

Table 20. Relative yield and agronomic characteristics for the dry bean narrow-row co-operative trial.

Variety	Yield % of Othello[1]	Lodging 1 = erect; 5 = flat	Vine Length cm	Days to 50% Flower[2]	Days to Maturity[3]	Seed Weight mg	Pod Clearance Rating %[4]
Pinto							
Othello (check)	100	3.3	46	65	113	377	63
93088	119	4.0	55	65	117	357	65
93-122-10	108	3.0	44	63	117	419	66
77-5	102	3.3	50	56	117	385	58
95-83-10-PT	95	3.0	50	56	114	472	55
L96B101	94	1.3	54	59	112	384	74
95-65-6PT	90	2.0	47	56	117	380	68
95-12-40PT	82	2.7	50	55	113	395	57
95-60-19PT	77	2.7	49	59	111	345	71
CDC Camino (check)	71	1.3	46	62	110	376	82
95-6-1PT	69	2.7	44	54	109	405	70
95-12-16-PT	66	2.0	50	56	110	389	73
94138	60	1.7	41	55	104	386	65
95-12-28-PT	58	1.3	47	59	109	394	61
Great Northern							
L95E101	118	3.0	48	56	111	355	75
US 1140 (check)	93	3.3	43	62	117	344	57
93407	89	4.3	38	56	114	416	63
L96E108	83	3.0	41	56	104	359	76
201-25LL	81	2.7	48	55	115	396	69
102-29	76	2.3	43	54	113	395	71
165-11	68	2.0	41	55	110	357	67
CDC Nordic (check)	63	2.0	43	65	115	380	65
Generatif	59	2.0	38	51	102	375	75
Small Red							
L94D156	115	2.0	50	59	115	361	66
L96D112	96	2.3	43	56	107	372	94
L94D007	95	2.3	49	55	113	367	79
296-X-7	93	2.3	43	62	112	289	78
NW63 (check)	92	3.0	42	56	114	329	69
L96D113	85	2.3	51	56	109	348	92
95-35-5R	75	2.0	45	63	113	300	74
Pink							
Viva (check)	105	2.3	39	56	115	296	58
95-34-6PK	101	3.3	46	59	114	387	71
L94C333LE	80	2.3	47	66	112	338	74
L94C356	70	2.0	45	56	101	334	79
Black							
CDC Nighthawk (check)	82	1.3	49	65	111	201	78
L95F025	80	1.7	50	65	112	230	73

[1] Othello yield = 5180 kg/ha (4626 lb/acre)
[2] 50% of plants/plot have open flowers
[3] 50% of pods are buckskin colored
[4] % pods >5 cm (2 in) above ground surface

Table 21. Relative yield and agronomic characteristics for the Pea Co-operative test A.						
Variety[1]	Yield % of Carneval[2]	Lodging 0 = erect; 9 = flat	Vine Length cm	Days to 10% Flower[3]	Seed Weight mg	Days to Maturity[4]
Yellow						
Carneval	100	5.3	88	59	220	96
Carrera	99	9.0	68	56	232	91
Delta	96	8.0	75	56	235	93
Grande (N)	76	5.7	101	61	209	97
CDC9703	97	9.0	86	58	207	96
CDC9705	110	8.0	80	57	239	96
CDC9708	106	5.0	86	57	230	97
CDC9709	112	7.7	85	59	202	97
CDC9802	88	8.7	81	59	200	96
CDC9805	102	6.7	75	61	202	96
CDC9806	99	7.7	104	58	240	96
CDC9807	84	6.0	90	51	146	100
CDC9809	99	6.3	99	60	195	98
Ceb1463	98	6.7	79	58	188	95
Ceb1466	98	8.0	84	56	234	96
Ceb1469	93	7.0	95	59	195	93
Ceb1475	104	7.3	83	56	252	96
SW955180	106	5.7	88	59	224	96
DS49279	100	8.7	95	57	237	93
DS49376	105	6.3	87	58	245	96
DS49377	98	6.3	84	56	237	96
DS49315	94	9.0	86	56	246	93
MP1466	92	8.0	77	61	246	96
4-0359.016	103	6.7	94	58	237	96
Green						
Keoma	82	9.0	69	57	194	91
CDC9801	106	6.0	83	59	245	99
CDC9803	89	9.0	88	59	192	96
CDC9804	100	7.0	76	60	298	99
Ceb1162	103	9.0	70	56	208	96
Ceb1163	94	7.3	67	60	246	96
Ceb1157	95	9.0	65	56	237	96
DS49310	105	7.0	82	60	243	99
MP1407	100	9.0	73	59	263	98
SW93601	93	6.3	92	56	205	96
SW93605	112	7.7	86	58	201	96
93132-01	67	4.7	89	56	173	97

[1] N = normal leaf; all others are semi-leafless
[2] Carneval yield = 6023 kg/ha (90 bu/ac)
[3] 10% of plants/plot have open flowers
[4] 75% of plants in a plot are yellow and dry

Table 22. Relative yield and agronomic characteristics for the Pea Co-operative test B.

Variety[1]	Yield % of Carneval[2]	Lodging 0 = erect; 9 = flat	Vine Length cm	Days to 10% Flower[3]	Seed Weight mg	Days to Maturity[4]
Yellow						
Carneval	100	6.3	75	60	220	96
Carrera	103	8.3	62	56	254	93
Delta	106	8.3	79	56	216	92
Grande (N)	81	7.0	97	61	228	96
Badminton	105	9.0	62	56	246	91
CDC9704	140	7.7	93	62	238	97
CDC9808 (N)	91	8.3	99	59	236	99
Ceb1453	87	9.0	60	55	238	90
Ceb1459	98	9.0	63	56	277	91
Ceb1476	117	8.3	75	56	248	93
CPBT91-108	68	9.0	68	57	218	94
HS13277	88	8.7	92	56	240	93
MP1566	130	9.0	75	57	251	95
SW93550	129	7.0	74	58	240	96
SWMP1794	132	7.0	83	60	215	96
SWS95-113-8	83	8.3	89	58	206	96
SWS96/1539	111	6.7	86	56	303	93
4-0409.027	95	9.0	66	56	249	91
921207	116	6.7	90	57	170	95
Green						
Keoma	83	9.0	63	57	201	92
Atomic	88	8.3	68	60	290	96
A6041/4	115	8.0	84	56	211	93
CPBT91-12	86	9.0	63	56	224	91
DS49333	109	9.0	75	58	212	96
DP1059	98	7.0	93	57	244	96
M98	136	9.0	73	56	266	92
NORD95-1416	94	9.0	67	56	278	95
SWS96-310-6	74	7.7	76	56	250	95
4L28/1	86	8.0	76	57	207	94
93124-01	87	7.7	76	57	199	95
93125-07	116	7.0	84	56	185	96
93124-09	97	7.3	73	56	211	94

[1] N = normal leaf; all others are semi-leafless
[2] Carneval yield = 4796 kg/ha (71 bu/ac)
[3] 10% of plants/plot have open flowers
[4] 75% of plants in a plot are yellow and dry

Variety[1]	Yield % of Carneval[2]	Lodging 0=erect; 9=flat	Vine Length cm	Days to 10% Flower[3]	Seed Weight mg	Days to Maturity[4]
Yellow						
Carneval	100	5.3	91	59	210	96
Carrera	101	9.0	73	55	234	91
Delta	92	8.0	84	58	224	93
Grande (N)	80	6.7	108	61	201	96
Ceb1451	103	9.0	71	54	263	90
NSA940076	90	7.0	99	56	269	95
NSA940105	99	8.7	83	55	225	91
Green						
Keoma	84	9.0	72	57	190	90
CDC9710	89	8.0	89	59	194	95
Ceb1160	92	8.7	76	56	248	93
CPBT91-62	74	9.0	65	51	281	91
CPBT91-150	83	9.0	71	55	257	93

Table 23. Relative yield and agronomic characteristics for the Pea Co-operative test C.

[1] N = normal leaf; all others are semi-leafless
[2] Carneval yield = 6495 kg/ha (97 bu/ac)
[3] 10% of plants/plot have open flowers
[4] 75% of plants in a plot are yellow and dry

Irrigated Pea Variety Test

L. Townley-Smith[1], G. Larson[1], I. Bristow[2]

Funded by the Irrigation Crop Diversification Corporation (ICDC)

Progress: *Ongoing*

Locations: *Birsay, Hanley, Outlook*

Objective: *To evaluate registered field pea varieties under irrigation.*

The irrigated pea variety tests were sown on May 11 and 12 in 1.5 m x 4.0 m (5 ft x 13 ft) plots. Three replicates were grown under normal inputs and three were managed using a high input package. All plots received 50 kg/ha N (45 lb/ac) as 46-0-0 and 50 kg/ha P (45 lb/ac) as 11-52-0. The fertilizer was side-banded at seeding. The seed was inoculated just prior to seeding.

High input plots received an additional 50 kg/ha N (45 lb/ac) as 46-0-0 broadcast on July 21. Bravo 500 foliar fungicide was applied to the high input plots. These plots retained their green color later into the season than did the normal input plots.

All three sites were desiccated August 24 to 26. The Birsay and Hanley plots were harvested September 2 and 3. The Outlook site was combined on September 10. Agronomic characteristics and seed yields are presented in Tables 24a and 24b.

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

Table 24a. Yield and agronomic data for the irrigated pea variety test: **Normal Input**							
	Days* to maturity	Height* cm	Lodging* (1-9)[1]	Yield			
				Birsay	Hanley	SIDC	Average
Radley - kg/ha				3539	3863	4498	
Radley - bu/ac				52.3	57.1	66.5	
				% of Radley			
4-9247	91	79	6.0	151	149	141	147
Ascona	91	76	6.0	123	130	112	122
CDC Vienna	99	84	2.8	127	65	89	94
Carneval	94	83	2.8	160	148	147	152
Eiffel	94	88	2.8	147	119	128	131
Highlight	90	83	4.7	157	149	129	145
MAJORET	95	85	2.3	141	153	127	140
Mandy	92	86	3.7	138	124	118	127
Obelisque	95	82	3.7	112	107	127	115
PROFI	89	89	2.7	140	146	124	137
Radley	96	81	3.5	100	100	100	100

[1] 1 = good, 9 = poor * average of three sites

Table 24b. Yield and agronomic data for the irrigated pea variety test: **High input**							
	Days* to maturity	Height* cm	Lodging* (1-9)[1]	Yield			
				Birsay	Hanley	SIDC	Average
Radley - kg/ha				4030	4036	4737	
Radley - bu/ac				59.6	59.7	70.0	
				% of Radley			
4-9247	91	75	5.6	104	135	120	120
Ascona	92	74	5.8	119	122	100	114
CDC Vienna	98	83	3.3	107	66	94	89
Carneval	95	82	2.6	118	89	121	109
Eiffel	94	85	2.9	104	105	118	109
Highlight	93	82	3.3	124	135	118	126
MAJORET	94	79	2.6	108	130	114	117
Mandy	93	85	3.5	103	108	104	105
Obelisque	94	81	4.0	80	98	103	94
PROFI	92	81	2.4	103	119	113	112
Radley	95	77	3.8	100	100	100	100

[1] 1 = good, 9 = poor * average of three sites

Regional Variety Test of Dry Bean and Chickpea

T. Hogg[1], M. Pederson[1], A. Vandenberg[2]

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

Progress: *Ongoing*

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

The potential for development of the dry bean and chickpea sectors 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.

Regional variety trials were established in the spring of 1998 at the SIDC for irrigated dry bean located on the NW12-29-08-W3 and for dryland chickpea located on the SW15-29-08-W3. Separate trials were run for dry bean under wide row (60 cm/24 in) and narrow row (20 cm/8 in) cropping. Chickpea was seeded using narrow rows. The variety treatments were arranged in a randomized complete block design with three replicates. Each treatment measured 1.2 m x 3.7 m (4 ft x 12 ft)

Dry Bean

Higher yields were obtained under narrow row compared to wide-row conditions for all bean varieties except Othello (Tables 25 and 26). US 1140 produced the highest yield of all varieties while Prim produced the lowest yield. Some of the new varieties produced yields similar to the checks within each market class. The pinto line 92235 appears to be a high yielding variety, producing 6% higher yield than Othello under narrow row conditions. The great northern line 92074 and the pink line 93318 also appear to be superior entries.

Most bean varieties flowered within a range of 55-65 days except Prim which flowered in just under 50 days. Some of the new varieties flowered earlier than the checks. AC Burrito matured 7-10 days earlier than the later maturing varieties. Most varieties required 110-115 days to mature. Generally, the higher yielding varieties had later maturity.

Pod clearance varied among the varieties. Some of the newer pinto varieties had better pod clearance than Othello. The same was found for the Great Northern varieties where the two new varieties Nordic and 92074 had better pod clearance than US 1140. Viva, 93318 and Prim had good pod clearance.

[1] *SIDC, Outlook*

[2] *Crop Development Centre, U of S, Saskatoon*

The highest seed weight was obtained for the new great northern line 93128. The great northern line 92074 had seed weight similar to Othello, 92235 and 92802A pinto bean. Pink bean seed weight was greater than that of Prim while both were less than either that of the pinto or great northern varieties.

Plant height was similar for all varieties except Prim, which was the shortest.

Table 25. Yield and agronomic data for the irrigated dry bean narrow-row regional variety test.

Variety	Yield % of Othello[1]	Seed Weight mg	Days to 50% Flower[2]	Days to Maturity[3]	Plant Height cm	Lodge Rating 0=erect; 5=flat	Pod Clearance %[4]
Pinto							
Othello	100	383	66	113	53	3	53
CDC Camino	82	385	65	109	50	1	83
AC Burrito	82	348	56	102	45	2	59
92235	106	401	67	114	52	2	71
93708	88	375	55	115	53	3	72
92802A	89	426	55	109	49	3	75
92021	73	353	57	109	52	2	64
Great Northern							
CDC Nordic	61	353	66	115	47	2	65
US 1140	108	339	66	117	42	3	60
92074	99	408	55	114	54	2	70
93128	89	421	56	107	43	3	62
Pink							
Viva	97	272	57	115	41	3	73
93318	102	280	57	115	49	2	75
Manteca[5]							
Prim	40	262	48	113	37	2	71
S.E	3.3		0.9	0.7	0.9		1.6
CV %	24.6		9.8	4.1	11.9		14.8

[1] Othello yield = 5262 kg/ha (4699 lb/acre)
[2] 50% of plants/plot have open flowers
[3] pods are 50% buckskin
[4] % pods >5 cm (2 in) above ground surface
[5] non-flatulent

Table 26. Yield and agronomic data for the irrigated dry bean wide-row regional variety test.							
Variety	Yield % of Othello[1]	Seed Weight mg	Days to 50% Flower[2]	Days to Maturity[3]	Plant Height cm	Lodge Rating 0=erect 5=flat	Pod Clearance %[4]
Pinto							
Othello	100	402	57	112	50	3	31
CDC Camino	71	369	66	109	58	2	80
AC Burrito	78	355	56	102	42	1	56
92235	80	412	57	114	52	3	45
93708	73	376	52	109	52	2	75
92802A	68	376	55	107	53	2	56
92021	61	330	57	104	54	1	72
Great Northern							
CDC Nordic	57	347	66	113	48	2	68
US 1140	93	359	55	117	43	3	49
92074	88	406	55	115	53	2	59
93128	80	428	53	111	44	2	64
Pink							
Viva	89	285	55	114	44	3	55
93318	86	284	59	112	53	2	69
Manteca[5]							
Prim	31	237	47	112	38	1	77
SE	2.9		0.8	0.7	1		2.9
CV %	24.8		9	4.1	13		24.8

[1] Othello yield = 5453 kg/ha (4870 lb/acre)
[2] 50% of plants/plot have open flowers
[3] pods are 50% buckskin
[4] % pods >5 cm (2 in) above ground surface
[5] non-flatulent

Chickpea

Yield was greater for the desi than the kabuli type chickpeas. CDC Chico was the only kabuli type with a yield within the range of the desi chickpeas. Sanford yield was low, likely due to of poor emergence.

Days to flower, days to maturity and plant height indicated the kabuli varieties were slightly later maturing and taller than the desi varieties (Table 27).

Seed weight was generally greater for the kabuli type chickpea than for the desi chickpea. The kabuli type CDC Chico has a small seed size. CDC Xena had the largest overall seed size followed closely by Sanford. The desi line, 93113-16K, had the largest overall seed size among the desi type chickpeas. The smallest seed sizes were observed for 92040-10 and Myles. Entry 92040-10 has a plumper seed shape and a lighter tan seed coat color than Myles. These are key characteristics for the marketing of desi chickpea.

Table 27. Yield and agronomic data for the chickpea regional variety test.					
Variety	Yield % of Myles[1]	Seed Weight mg	Days to 50% Flower[2]	Days to Maturity[3]	Plant Height cm
Kabuli					
Sanford	50	366	60	101	65
CDC Yuma	68	328	57	95	67
CDC Chico	108	235	55	96	68
CDC Xena	78	398	55	98	58
Desi					
Myles	100	167	55	95	61
Indian-20	92	230	59	95	54
92040-10	103	153	55	92	53
92050-26D	105	253	55	96	63
93113-16K	121	293	53	95	61
92117-25D	91	238	56	95	63
92040-52	118	191	58	97	54
92056-50	122	207	55	95	61
SE	4.0		1	0.5	1
CV %	25.1		4	3.2	10.2

[1] Myles yield = 3050 kg/ha (2724 lb/ac)
[2] 50% of plants/plot have open flowers
[3] majority of pods are straw yellow

Prairie Regional Lentil Co-operative Test

T. Hogg[1], M. Pederson[1], A. Slinkard[2], A. Vandenberg[2]

Progress: *Ongoing*

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

This project evaluates lentil germplasm for growing conditions in western Canada. The germplasm sources include advanced lines from the Crop Development Centre, University of Saskatchewan. These lines are compared to standard varieties registered for western Canada.

An irrigated site was conducted at the SIDC. Normal fertilizer, weed control and irrigation practices for irrigated lentil production were followed. The test included 24 entries planted in a randomized complete block design with three replicates. Market classes evaluated included large yellow (14), medium yellow (2), small yellow (2) and red (6). Individual plots measured 1.2 m x 3.7 m (4ft x 12ft). All rows of a plot were harvested to determine yield.

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

Data are presented on the basis of commercial market classes, with an appropriate check variety included for each type (Table 28). Eight large yellow entries had yield equivalent to or greater than Laird. A number of the new large yellow entries have ascochyta resistance. The highest yielding entry overall was the medium yellow entry CDC Vantage (638-23) followed closely by CDC Milestone, a small yellow variety. CDC Redwing was the highest yielding small red lentil. Small red entry 599-23 has resistance to both ascochyta and anthracnose.

Table 28. Relative yield and agronomic characteristics for the lentil co-operative test.

Variety	Yield % of Laird[1]	Vine Length cm	Days to 25% Flower[2]	Seed Weight mg	Days to Maturity[3]
Large Yellow					
Laird	100	43	66	69	100
930-4Y	112	43	66	68	101
930-6Y	106	42	66	76	101
CDC Glamis (578-28)	105	45	67	60	100
946-7-Y	102	40	63	74	98
652	102	42	66	68	101
752-19	101	37	65	69	98
804-3	100	42	66	66	98
752-37	100	37	66	72	100
932-10Y	93	42	66	64	100
752-13	90	40	66	69	98
934-16Y	87	40	66	66	100
942-40Y	80	40	66	65	100
658-8	78	37	66	71	98
942-26Y	93	35	65	59	98
Medium Yellow					
CDC Vantage (638-23)	129	39	62	49	96
Small Yellow					
CDC Milestone	125	36	62	36	93
800-21	103	36	66	34	96
Small Red					
CDC Redwing	117	37	63	38	96
803-18	113	35	62	35	91
877-19-R	108	37	62	44	98
837-5	107	38	62	42	96
599-23	106	38	62	26	96
Crimson	99	32	63	35	96

[1] Laird yield = 2335 kg/ha (2085 lb/ac)
[2] 25% of plants/plot have open flowers
[3] bottom 30% pods are dry and seed rattles

Regional Adaptation of Pulse Crops

T. Hogg[1], M. Pederson[1]

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

Progress: *Year two of five*

Objective: *To demonstrate a variety of pulse crop types in large plots, determining relative performance in the irrigated area of Saskatchewan.*

Pulse crops are an important part of the rotation. They fix a large proportion of their own nitrogen requirements and they help to break up the disease cycle of other crops. Variety evaluation is important to determine the best crop type for a given agro-ecological region.

A pulse crop variety demonstration was established at the SIDC in the spring of 1998. Six varieties of dry bean, pea and lentil; three chickpea varieties; and two varieties each of faba bean and soybean were sown. Separate tests were conducted for each pulse crop type due to differences in irrigation requirements. The dry bean varieties were row crop cultivated using 60 cm (24 in) row spacing. All other pulse crops were solid seeded using a row spacing of 25 cm (10 in).

Dry Bean

The data collected for dry bean is presented in Table 29. Plant stand for all varieties was in the range recommended for irrigated production. CDC Expresso was the first variety to reach 50% flowering with little difference among the other varieties. CDC Camino pinto bean was the earliest maturing variety while NW63 small red bean required a longer period to reach maturity than the other dry bean classes. Yield was on the order pink > small red > pinto > great northern > black. Yields were exceptionally good, indicating the favourable growing conditions in 1998. Black bean, which had the lowest yield, was affected by bacterial blight to the greatest extent.

Pod clearance rating, an indicator of suitability for direct cut harvesting, varied among dry bean classes as well as between varieties within a class. Black bean had the best pod clearance overall. The newly registered pinto bean variety, CDC Camino, had a pod clearance rating equivalent to that of the black bean. It rated superior to Othello, the pinto bean variety generally recommended for irrigated production. The pod clearance rating for the pink, small red and great northern varieties was less than the black varieties, but greater than Othello.

Pea

The data collected for pea is presented in Table 30. The plant stand for Ascona, Carneval and GRANDE was lower than that recommended for irrigated production. Ascona and PROFI were the earliest flowering varieties. GRANDE was the latest. PROFI, Ascona and GRANDE were the latest of the varieties to mature. Powdery mildew and *mycosphaerella* was present on all varieties, with GRANDE, Ascona and PROFI being infected to the greatest extent. The green pea varieties were shortest and lodged to the greatest extent. The yellow pea variety Carneval stood up best throughout the growing season and was least affected by disease. Yield was greatest for Carneval while GRANDE had the lowest yield.

[1]*SIDC, Outlook*

Table 29. Yield and agronomic data for the irrigated dry bean adaptation test.								
Variety	Days to 50% Flowering	Days to Maturity	Pod clearance rating %[1]	Plant Height cm	Lodging Rating 0 = erect 5 = flat	Yield @ 16% moisture		Seed Weight mg
						kg/ha	lb/ac	
Pinto								
Othello	55	99	47	42	3	3767	3356	388
CDC Camino	53	94	83	47	2	3494	3113	379
Black								
CDC Expresso	50	98	88	44	1	2463	2195	216
Great Northern								
Nordic	52	97	66	43	5	3156	2812	367
Small Red								
NW63	53	101	65	42	3	3832	3414	331
Pink								
Viva	52	96	77	38	3	4045	3604	284
SE	0.4	0.8	4.1	0.8		138.7	125	14.9
CV %	2.9	3.3	24.3	8.4		17	17	19.3

[1]% pods > 5 cm (2 in) above ground surface.

Table 30. Yield and agronomic data for the irrigated pea adaptation test.							
Variety	Days to 10% Flowering	Days to Maturity	Plant Height cm	Lodging Rating 0 = erect 9 = flat	Yield @ 16% moisture		Seed Weight mg
					kg/ha	bu/ac	
Yellow							
GRANDE	67	96	102	6	3164	47.0	183
Carneval	62	90	100	5	4609	68.4	207
PROFI	55	94	102	6	3826	56.8	208
Green							
Keoma	58	89	75	9	3468	51.5	169
Ascona	57	97	73	8	4183	62.1	243
MAJORET	59	89	88	8	4171	61.9	224
SE	1	0.8	3.4		136.2	2.0	6.4
CV %	7	3.9	15.9		14.8	14.8	13.2

Faba bean

The data collected for faba bean is presented in Table 34. Plant stand was slightly higher than recommended for irrigated production. There was no difference between the two varieties for flowering date. Days to maturity were greater for Aladin than CDC Fatima. Chocolate spot disease was present to the same extent on both varieties. Aladin yielded more than CDC Fatima in this trial.

Table 34. Yield and agronomic data for the irrigated faba bean adaptation test.							
Variety	Days to 50% Flowering	Days to Maturity	Plant Height cm	Lodging Rating 0 = erect; 9 = flat	Yield @ 16% moisture		Seed Weight mg
					kg/ha	lb/ac	
Aladin	65	116	129	4	4278	3812	417
CDC Fatima	65	113	121	6	4036	3596	513
SE		0.7	2.8		135	121	23
CV %		1.4	5.5		7.8	7.8	12.2

Lentil

The data collected for lentil is presented in Table 35. Plant stand was slightly lower than that recommended for irrigated production. There was little difference among the varieties for time to flowering or maturity. A severe disease out break was evident in some of the varieties. CDC Richlea, a medium yellow type lentil, had the highest yield while CDC Redwing, a red cotyledon type lentil, had the lowest yield. CDC Redwing was severely infected with disease. The ascocyta resistant large yellow type, CDC Glamis, yielded higher than Laird, probably due to its disease resistance.

Table 35. Yield and agronomic data for the irrigated lentil adaptation test.						
Variety	Days to 25% Flowering	Days to Maturity	Plant Height cm	Yield @ 14% moisture		Seed Weight mg
				kg/ha	lb/ac	
Large Yellow						
Laird	67	101	46	1068	952	61
CDC Glamis	67	101	43	1209	1077	58
Small Yellow						
Eston	63	96	43	1390	1238	30
CDC Milestone	63	96	44	1512	1347	33
Medium Yellow						
CDC Richlea	63	99	45	1731	1542	50
Red						
CDC Redwing	67	91	42	520	463	25
SE	0.5	0.9	1.1	127	113	4
CV %	3.2	1.8	10.3	43.3	43.3	34.3

Chickpea

The data collected for chickpea is presented in Table 36. Plant stand was slightly less than the range recommended for chickpea. Sanford and B90, kabuli type chickpeas, were later maturing than Myles, a desi type, as indicated by the time to 50% flowering and to maturity. Sanford and B90 were taller than Myles and had larger pods, an indication of the difference in seed size for the two chickpea types. Yield was not determined due to a heavy infestation of weeds.

Table 36. Irrigated chickpea adaptation variety trial agronomic data.				
Variety	Days to 50% Flowering	Days to Maturity	Plant Height cm	Lodging 0 = erect 9 = flat
Kabuli				
Sanford	60	115	60	2
B90	58	115	57	5
Desi				
Myles	55	112	50	1
S.E.	0.7	0.5	1.9	
CV %	3.8	1.3	10.2	

Soybean

The data collected for soybean is presented in Table 37. Plant stand was in the range recommended for soybean. Pioneer flowered earlier than AGX11 but was later maturing. Pioneer was shorter, but had larger seed size and a higher yield than AGX11.

Table 37. Irrigated soybean adaptation variety trial agronomic data.						
Variety	Days to 50% Flowering	Days to Maturity	Plant Height cm	Yield @ 14% moisture (kg/ha)		Seed Weight mg
				kg/ha	lb/ac	
Pioneer	59	132	87	3706	3302	152
AGX11	66	125	98	3537	3151	147
SE	1.6	1.6	2.5	61	54	3
CV %	6.1	3.0	6.7	4.1	4.1	4.2

Pea and Bean Preliminary Yield Trials

A. Vandenberg[1]

Funded by Saskatchewan Agriculture Development Fund (SADF); Saskatchewan Pulse Growers (SPG), and the Canada-Saskatchewan Agri-Food Innovation Fund (AFIF)

Progress: *Ongoing*

Location: *SIDC*

Objectives:
- *To develop high yielding, early, green and yellow pea varieties.*
- *To develop high yielding, adapted dry bean varieties.*

Pea Trials

Field pea trials conducted at Outlook identified several high-yielding green and yellow field pea breeding lines. Six two-replicate trials of 36 entries each were grown under irrigation. Most of the lines were resistant to powdery mildew. Lines with the highest yield and best lodging tolerance were advanced to registration recommendation trials for the 1999 season. Green-seeded lines were evaluated for tolerance to bleaching.

[1] *Crop Development Centre, U of S, Saskatoon*

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 and pink market classes for the narrow row production system. Three 18-entry trials and four 36-entry trials were grown. Each trial had two replications. Data collected in 1998 were combined with data from other locations to decide which lines to advance to the 1999 Prairie Dry Bean Co-op Trials - Narrow Row.

Development of a Uniform Disease Nursery for Mycosphaerella Blight of Pea

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

Progress: *Ongoing*

Location: *Saskatoon, Outlook*

Objective: *To develop a technique to screen field pea germplasm for resistance to mycosphaerella blight, the most economically important disease in field pea production.*

This experiment was conducted for a second year in collaboration with pea breeders and pathologists across western Canada. The objective is to develop a reliable and repeatable scoring system for both stem and foliar infection of *Mycosphaerella* blight. Stem and leaf ratings were recorded for 10 genotypes that represent the complete range of tolerance to the disease. Data were summarized from all locations to determine which rating scale is the most consistent with least effort.

Industrial Hemp Varietal Analysis for △-9 THC Testing

L. Townley-Smith[2] G. Larson[2]

Four fibre hemp varieties were evaluated for THC content and for relative performance under irrigation. The hemp was sown on July 7 (after receiving regulatory approval) in 1.5 x 6 m (5 x 20 ft) plots on a 25 cm (10 in) row spacing. The plots were harvested for dry matter yield on September 29. Sub-samples were collected for chemical analysis.

A wide range in growth habit, from spindly to tall and bush-like, was noted for the four varieties. One line was particularly vigorous, reaching a height of approximately 2.4 m (8 ft).

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

Fresh weight production of the varieties are shown in Table 38. None of the varieties produced viable seed. THC levels were near or below detectable limits in laboratory testing.

Table 38. Fresh weight yield of four hemp varieties under irrigation

Cultivar	Fresh wt. kg/plot
USO 14	44
USO 31	42
Fedora	76
Fasamo	20

Weed Control in Special Crops

L. Townley-Smith[1], G. Larson[1]

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

Progress: *Year two of five*

Location: *Outlook*

Objective: *To gather efficacy and crop safety data in support of minor use registration of herbicides for specialty crops.*

Successful production of special crops depends on good weed control. One important means of weed control is the use of herbicides. For many special crops there are few, if any, herbicides available. Outlook is one of six Saskatchewan sites where minor use registration data for special crops was collected in 1998.

The seeding and herbicide application information is included with each trial. All trials were four replicate randomized complete block design grown under irrigated conditions. Irrigation and fertility management were done in accordance with standard practice for that crop. All crops received P_2O_5 as 11-52-0 and all non-legume crops received at least 100 kg/ha (90 lb/ac) of nitrogen.

Pinto Bean

Table 39 summarizes the results for the pinto bean herbicide trial. Imazamox + imazapyr treatments delayed crop development and maturity of pinto beans, but gave excellent grassy and broadleaf weed control. Broadleaf weeds were Redroot pigweed, Lamb's-quarters and Kochia. Grass weeds were Green foxtail and volunteer cereals. Control of broadleaf weeds was superior with imazamox + imazapyr than with ethalfluralin treatments. Imazamox + imazapyr caused initial crop injury, but the crop stand recovered through the season. Better weed control improved yield.

Seeding date:	*May 21*
Seeding rate:	*30 seeds/m^2*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Pre-emergent application:	*May 20*
Post-emergent application:	*July 9*

[1]*SIDC, Outlook*

Table 39. Control of green foxtail and crop tolerance of Pinto bean to herbicides.									
Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Ethalfluralin	1.680	84	95	3	87	93	2	1843	1636
Ethalfluralin	0.840	85	94	2	87	93	2	1968	1747
Imazamox Imazapyr	0.015	95	94	4	94	98	4	2632	2337
Imazamox Imazapyr	0.030	98	93	10	99	97	14	2831	2513
Check (weedy)		0	0	0	0	0	0	1313	1165
LSD		9	6	2	7	9	4	753	669

[1]0 = no damage; 100 = complete control

Great Northern Bean

Table 40 summarizes results for the Great Northern dry bean study. Imazamox + imazapyr gave better control of broadleafed weeds and, thus, had greater yields. Great Northern bean tolerated both products. Broadleaf weeds were Redroot pigweed, and Kochia. Grass weeds were Green foxtail and volunteer cereals.

Seeding date:	*May 21*
Seeding rate:	*30 seeds/m^2*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Table 40. Control of weeds and crop tolerance of Great Northern bean to herbicides.									
Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Imazamox Imazapyr	0.015 0.015	96	95	4	96	96	4	2997	2661
Imazamox Imazapyr	0.030 0.030	97	95	4	98	96	9	3035	2695
Clethodim Amigo	0.046 0.005	0	97	3	0	99	2	1953	1734
Clethodim Amigo	0.092 0.005	0	96	2	0	98	2	1626	1443
Check (weedy)		0	0	0	0	0	0	1669	1482
LSD		6	5	4	3	5	3	590	524

[1] 0 = no damage; 100 = complete control

Black Bean

Results of the Black bean herbicide trial are shown in Table 41. Imazamox + imazapyr had higher yields than clethodim treatments due to superior control of broadleaf weeds. Crop tolerance to both products was excellent, with slight injury and a delay in maturity with imazamox + imazapyr. Broadleaf weeds were Redroot pigweed, Lamb's-quarters and Kochia. Grass weeds were Green foxtail and volunteer cereals.

Seeding date:	*May 21*
Seeding rate:	*30 seeds/m²*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Table 41. Control of weeds and crop tolerance of Black bean to herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Imazamox Imazapyr	0.015 0.015	96	97	3	96	96	5	2239	1988
Imazamox Imazapyr	0.030 0.030	96	99	4	0	95	8	2292	2035
Clethodim Amigo	0.046 0.005	0	97	1	0	97	2	513	455
Clethodim Amigo	0.092 0.005	0	96	1	0	99	2	461	409
Check (weedy)		0	0	0	0	0	0	1011	898
LSD		5	5	2	4	6	5	423	376

[1] 0 = no damage; 100 = complete control

Kabuli Chickpea: Pre-emergence Herbicides

Ethalfluralin was incorporated to a depth of 8 cm (3 in) by a rotovator. Imazamox + imazapyr was applied pre-plant without incorporation.

Establishment of Kabuli chickpea was poor with less than 2% plant stand. The experiment was abandoned.

Kabuli Chickpea: Post-Emergence Herbicides

Establishment was poor with less than 2% plant stand. The experiment was abandoned.

Desi Chickpea: Pre-emergence Herbicides

The data for the chickpea herbicide study is summarized in Table 42. Ethalfluralin was rotovated to a depth of 8 cm (3 in) to incorporate. Imazamox + imazapyr was applied pre-plant without incorporation.

Seeding date:	*May 21*
Seeding rate:	*40 plants/m²*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*May 20*

Both products had acceptable crop tolerance and control of weeds. The chickpeas, including the check plots, continued their vegetative growth by aborting pods until late in the growing season, resulting in reduced yield. Broadleaf weeds were Redroot pigweed, and Kochia. Grass weeds were Green foxtail and volunteer cereals.

Table 42. Control of weeds and crop tolerance of Desi chickpea to herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]			Seed Yield	
		Broadleaf	Grass	Crop	kg/ha	lb/ac
Ethalfluralin	0.84	85	97	3	378	375
Ethalfluralin	1.680	84	93	4	528	469
Imazamox Imazapyr	0.015 0.015	96	93	13	392	348
Imazamox Imazapyr	0.030 0.030	94	88	5	267	237
Check (weedy)		0	0	0	382	339
LSD			9	3	NS	NS

[1] 0 = no damage; 100 = complete control

Desi Chickpea: Post-Emergence Herbicides

Application of metribuzin at the four-node stage caused stunting and a delay in crop growth. Other treatments, including the early application of metribuzin, had acceptable tolerance. The chickpeas continued their vegetative growth by aborting pods until late in the growing season, resulting in reduced yield (Table 43). Broadleaf weeds were Redroot pigweed and Kochia. Grass weeds were Green foxtail and volunteer cereals.

Seeding date:	*May 21*
Seeding rate:	*40 plants/m²*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*2 node: June 9* *4 node: June 16*

Table 43. Weed control and tolerance of Desi chickpea to post-emergence herbicides.

Treatment	Rate kg/ha ai	Visual rating[1] 14 Days Broadleaf	14 Days Grass	14 Days Crop	28 Days Broadleaf	28 Days Grass	28 Days Crop	Seed Yield kg/ha	Seed Yield lb/ac
Metribuzin-2 node	0.135	90	0	3	90	0	7	538	477
Metribuzin-2 node	0.210	90	0	3	91	0	7	881	782
Metribuzin-2 node	0.270	93	0	3	96	0	7	399	354
Metribuzin-4 node	0.135	96	0	30	88	0	16	532	472
Metribuzin-4 node	0.210	95	0	43	96	0	23	346	307
Metribuzin-4 node	0.270	95	0	48	94	0	28	742	659
Clethodim Amigo	0.092 0.005	0	99	2	0	95	3	556	494
Clethodim Amigo	0.046 0.005	0	92	3	0	97	2	542	482
Diquat	0.400	0	0	0	0	0	0	822	730
Diquat	0.800	0	0	0	0	0	0	789	700
Check (weedy)		0	0	0	0	0	0	593	527
LSD		8	5	5	7	2	5	385	342

[1] 0 = no damage; 100 = complete control

Application of bentazon caused injury (Table 44). Clethodim and sethoxydim had acceptable tolerance. The chickpeas, including the check plots, continued their vegetative growth by aborting pods until late in the growing season, resulting in reduced yield. Broadleaf weeds were Redroot pigweed, and Kochia. Grass weeds were Green foxtail and volunteer cereals.

Seeding date:	*May 21*
Seeding rate:	*40 plants/m²*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*June 26*

Table 44. Weed control and tolerance of Desi chickpea to post-emergence herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Bentazon	0.840	83	0	23	87	0	25	86	76
Bentazon	1.680	90	0	41	88	0	35	80	71
Clethodim Amigo	0.050 0.005	0	95	3	0	95	2	192	170
Sethoxydim	0.200	0	93	4	0	95	3	210	186
Sethoxydim	0.400	0	93	5	0	98	3	144	128
Check (weedy)		0	0	0	0	0	0	124	110
LSD		7	5	7	6	4	5	83	74

[1] 0 = no damage; 100 = complete control

Sunflower

Sunflower showed excellent tolerance to clethodim (Table 45).

Seeding date:	*May 19*
Seeding rate:	*2 plants/m²*
Row spacing:	*60 cm*
Application volume:	*100 L/ha*
Herbicide application:	*June 15*

Table 45. Weed control and tolerance of Sunflower to clethodim.

Treatment	Rate kg/ha ai	Visual rating[1]				Yield	
		14 days		28 days			
		Sunflower	Grass	Sunflower	Grass	kg/ha	lb/ac
Clethodim Amigo	0.046 0.005	0	93	0	100	3668	3257
Clethodim Amigo	0.092 0.005	0	100	0	100	3336	2962
Check (weedy)		0	0	0	0	2961	2629
LSD		0	3	0	0	NS[2]	

[1] 0 = no damage; 100 = complete control [2] not significant

Borage

Borage suppressed both the broadleaf and grassy weeds. It was damaged by both imazamethabenz and clopyralid (Table 46). Yields were low due to shattering.

Seeding date:	*May 21*
Seeding rate:	*10 kg/ha*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Table 46. Weed control and crop tolerance of Borage to herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]		Seed Yield	
		14 days	28 days	kg/ha	lb/ac
Imazamethabenz	0.250	5	10	473	420
Imazamethabenz	0.500	11	24	489	434
Imazamethabenz	1.000	16	44	438	389
Clopyralid	0.150	2	12	489	434
Clopyralid	0.300	5	24	480	426
Sethoxydim	0.200	2	2	453	402
Sethoxydim	0.400	3	3	457	406
Clethodim Amigo	0.046 0.005	2	3	636	565
Clethodim Amigo	0.092 0.005	2	3	351	312
Check (weedy)		0	0	464	412
LSD		3	9	NS	NS[2]

[1] 0 = no damage; 100 = complete control [2] not significant

Canary Seed

All treatments had yields lower than the weedy check (Table 47). All treatments reduced crop height relative to the weedy check. Broadleaf weeds were Kochia, Red-root pigweed and Lamb's quarters.

Seeding date:	*May 21*
Seeding rate:	*400 seeds/m²*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Caraway

Broadleaf weeds present were Kochia, Redroot pigweed and Lamb's-quarters. Grassy weeds were Green foxtail and volunteer cereals. Sethoxydim/linuron gave acceptable control of grass and broadleaf weed. Clethodim/linuron gave good grass weed control and fair broadleaf weed control. Linuron produced slight stunting of the caraway (Table 48).

Seeding date:	*May 20*
Seeding rate:	*10 kg/ha*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*June 21*

There was no harvestable yield from the clethodim and clethodim/linuron treatments due to severe competition from a second flush of broadleaf weed competition. Yield from the sethoxydim/linuron treatments were higher than the weed free check, but the differences were not significant.

Table 47. Tolerance of Canary seed to selected herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Green foxtail	Crop	Broadleaf	Green foxtail	Crop	kg/ha	lb/ac
Thifensulfuron Tribenuron methyl Agral 90	0.010 0.005 0.200	98	0	13	99	0	26	2233	1982
Thifensulfuron Tribenuron methyl Agral 90	0.020 0.010 0.200	99	0	19	99	0	43	1887	1676
Fluroxypyr 2,4-D ester	0.108 0.546	98	0	8	99	0	8	1217	1081
Fluroxypyr 2,4-D ester	0.216 1.092	95	0	16	97	0	14	952	845
Quinclorac Difenzoquat	0.100 0.700	0	93	3	0	98	1	1831	1626
Quinclorac Difenzoquat	0.200 1.400	0	92	4	0	96	2	1210	1075
Quinclorac Difenzoquat Bromoxynil MCPA ester	0.100 0.700 0.280 0.280	80	91	8	74	94	4	961	853
Quinclorac Difenzoquat Bromoxynil MCPA ester	0.200 1.400 0.560 0.560	79	94	14	78	98	7	807	717
Check (weedy)		0	0	0	0	0	0	2829	2512
LSD		8	4	5	5	3	5	460	408

[1] 0 = no damage; 100 = complete control

Table 48. Weed control and crop tolerance of Caraway to selected herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]						Seed yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Check (weed free)	--	0	0	0	0	0	0	404	359
Clethodim Amigo	0.046 0.005	0	99	2	0	98.5	1.25	NC[2]	
Clethodim Amigo	0.092 0.005	0	95	3	0	96	1.5	NC	
Clethodim Amigo Linuron	0.046 0.005 0.800	92.5	94	10	88	94.5	6.5	NC	
Clethodim Amigo Linuron	0.092 0.005 1.600	94.5	97.5	10	87	96.5	4	NC	
Sethoxydim Amigo Linuron	0.200 0.005 0.800	95.5	99	9	94.5	98.5	6	578	513
Sethoxydim Amigo Linuron	0.400 0.005 1.600	97.5	95	9.5	94	95.5	7	548	486
LSD		4.7	5.7	6.4	5.4	4.7	2.4	149	132

[1] 0 = no damage; 100 = complete control [2] No crop harvested due to heavy weed infestation

Coriander

Crop tolerance to clethodim, clethodim/linuron, and sethoxydim/linuron was good. Yield was unaffected by treatment (Table 49). Broadleaf weeds were Kochia, Red-root pigweed and Lamb's quarters.

Seeding date:	*May 20*
Seeding rate:	*18 kg/ha*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Table 49. Weed control and crop tolerance of Coriander to herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 Days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Clethodim Amigo	0.046 0.005	0	99	3	0	97	1	1444	1283
Clethodim Amigo	0.092 0.005	0	97	4	0	93	2	1211	1075
Clethodim Amigo Linuron	0.046 0.005 0.800	94	94	8	95	96	4	1599	1420
Clethodim Amigo Linuron	0.092 0.005 1.600	93	99	9	91	96	5	1396	1240
Sethoxydim Linuron	0.200 0.800	93	95	8	91	95	4	1501	1333
Sethoxydim Linuron	0.400 1.600	94	97	9	91	96	3	1392	1236
Check (weedy)		0	0	0	0	0	0	1343	1193
LSD		7	5	4	9	6	3	NS[2]	

[1] 0 = no damage; 100 = complete control

[2]not significant

Fenugreek

Ethalfluralin was incorporated to 8 cm (3 in). Imazamox + imazpyr was applied pre-plant without incorporation. Other products were applied on July 9.

Grass and broadleaf weeds were controlled by imazamox + imazpyr. Although this treatment caused significant stunting of the fenugreek, it was the highest yielding (Table 50a). Lack of broadleaf weed control in the clethodim treatment reduced yield. Broadleaf weeds were Redroot pigweed, and Kochia. Grass weeds were Green foxtail and volunteer cereals.

Seeding date:	*May 21*
Seeding rate:	*80 seeds/m^2*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*May 20*

Table 50a. Weed control and crop tolerance in Fenugreek.									
Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Ethalfluralin	0.840	88	98	2	91	99	1	2462	2186
Ethalfluralin	1.680	87	98	2	88	98	2	2047	1817
Imazamox Imazapyr	0.015 0.015	99	98	18	100	99	38	2632	2337
Imazamox Imazapyr	0.030 0.030	99	99	23	100	99	48	3033	2693
Clethodim Amigo	0.046 0.005	0	98	2	0	99	1	1620	1439
Clethodim Amigo	0.092 0.005	0	99	2	0	98	0	1900	1687
Check (weedy)		0	0	0	0	99	0	1650	1465
LSD		7	3	13	7	2	5	542	481

[1] 0 = no damage; 100 = complete control

Bentazon treatments burned, stunted, and reduced the field of Fenugreek. Control of broadleaf weeds was good (Table 50b). Sethoxydim treatments had good grass weed control. Broadleaf weeds were Kochia, Redroot pigweed and Lamb's quarters. Grass weeds were Green foxtail, volunteer cereals and Quackgrass.

Seeding date:	*May 21*
Seeding rate:	*80 seeds/m²*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Table 50b. Weed control and crop tolerance in Fenugreek.									
Treatment	Rate kg/ha ai	Visual Rating[1]						Seed Yield	
		14 days			28 days				
		Broadleaf	Grass	Crop	Broadleaf	Grass	Crop	kg/ha	lb/ac
Bentazon	0.840	93	0	15	83	0	8	1471	1306
Bentazon	1.680	99	0	31	92	0	13	648	575
Sethoxydim	0.200	0	99	2	0	100	2	2119	1881
Sethoxydim	0.400	0	99	2	0	100	1	2584	2295
Check Weedy		0	0	0	0	0	0	1874	1664
LSD		2	2	4	1	1	3	470	417

[1] 0 = no damage; 100 = complete control

Dill

All clethodim tank-mix treatments gave excellent control of broadleaf weeds (Table 51). The grass weed herbicides gave good control. Yield differences were not significant. Broadleaf weeds were Kochia, Redroot pigweed and Lamb's quarters. Grass weeds were Green foxtail and volunteer cereals.

Seeding date:	*May 21*
Seeding rate:	*8 kg/ha*
Row spacing:	*25 cm*
Application volume:	*100 L/ha*
Herbicide application:	*July 9*

Table 51. Weed control and crop tolerance of dill to selected herbicides.

Treatment	Rate kg/ha ai	Visual rating[1]						Seed Yield	
		14 Days			28 days				
		Broadleaf	Grass	Coriander	Broadleaf	Grass	Coriander	kg/ha	lb/ac
Clethodim Amigo	0.046 0.005	0	98	0	0	99	0	1813	1610
Clethodim Amigo	0.092 0.005	0	99	2	0	99	1	1627	1445
Clethodim Amigo Linuron	0.046 0.005 0.8	96	100	5	99	100	2	1858	1650
Clethodim Amigo Linuron	0.092 0.005 1.6	99	99	11	100	100	3	1929	1713
Sethoxydim	0.2	0	95	0	0	95	0	1622	1440
Sethoxydim	0.4	0	98	2	0	98	2	1627	1444
Check (weedy)		0	0	0	0	0	0	1906	1693
LSD		3	3	1	1	3	1	NS[2]	NS

[1] 0 = no damage; 100 = complete control
[2] not significant

Potato Development Program

Potato Development Program

Progress: *Ongoing*

Location: *Outlook*

Objectives:

- *To evaluate 'seed', 'processing', and 'table' potato clones suitable for domestic and export markets;*
- *To develop cultivar specific management practices for sustainable production.*

The agronomic studies include:

i. cultivar evaluation
ii. fertility management (nitrogen, phosphorus, potassium)
iii. seed handling
iv. irrigation management
v. planting methods
vi. seed vigour studies

The concept of Northern Vigor™ has made Saskatchewan a leading potato producer in North America[1]. Consequently, the potato industry is growing rapidly in Saskatchewan. Potato acreage in Saskatchewan has increased from 2 800 ha (6,900 ac) in 1996 to 5 500 ha (13,600 ac) in 1998. This expansion is occurring mainly in the Lake Diefenbaker Development Area.

To support the needs of this rapidly expanding industry, the Saskatchewan Irrigation Diversification Centre is conducting extensive applied research and development work in potato production. This project is co-funded by the Agri-Food Innovation Fund and being carried out in collaboration with the Saskatchewan Seed Potato Growers Association, the University of Saskatchewan (Dr. Doug Waterer), the Lethbridge Research Centre, Agriculture and Agri-Food Canada (Dr. Dermot Lynch), and private industry.

Field tests were conducted at SIDC fields on a Bradwell sandy loam soil. The crop was raised using recommended production practices with various treatments applied as appropriate. The general agronomic practices included a 90 cm (36 in) row spacing; pre-plant weed control with Eptam; a fertilizer program of 200 kg N/ha, 120 kg P_2O_5/ha, and 100 kg K_2O/ha; insect control with Sevin and Ripcord; disease control using Bravo 500 and Ridomil; and pre-harvest desiccation using two applications of Reglone. The harvested tubers were graded into 'seed' and 'consumption' grades according to tuber diameter. 'Seed' grade includes tubers between 25 mm (1 in) and 80 mm (3 in) for oblong types and between 25 mm (1 in) and 90 mm (3.5 in) for round types. The 'consumption' grade included tubers larger than 45 mm (1.75 in) diameter.

[1] *Northern Vigor™ is a Trade Mark of the Saskatchewan Seed Potato Growers Association.*

Cultivar Evaluation

Prairie Regional Trials

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

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

The Prairie Regional 'Early' and 'Main Crop' Replicated trials were conducted at SIDC. The tests were grown under irrigation using standard agronomic practices. Eleven advanced generation clones and check cultivars were evaluated in the 'Early' trial. 25 entries were included in the 'Main Crop' trial. The 'Early' trial was harvested at 80 and 100 days after planting and the 'Main Crop' trial was harvested at 120 days after planting for yield estimation and for quality evaluation. Results of these trials are used to support cultivar registration.

Western Seed Potato Consortium

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

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

Promising new clones offered by the Western Seed Potato Consortium were grown in single row plots for yield evaluation and to demonstrate their potential to the potato industry. These clones were harvested and displayed to consortium members from the prairie provinces at a field day on August 11, 1998.

Can-AGRICO Cultivar Evaluation

J. Wahab[1],

Potato cultivars Agate, Cornado, Honsul, Maranca and Signal from the Can-AGRICO Potato Corporation were evaluated in comparison with Russet Burbank and Shepody.

The Can-AGRICO cultivars produced more stems than the two standard cultivars tested (Table 1). The stem counts for Can-AGRICO cultivars ranged between 2.4 (Cornado) and 3.5 (Agate), whereas Russet Burbank and Shepody produced 1.8 and 2.2 mainstems per hill respectively.

Flowering was recorded when 50% of the plants in each plot produced flowers. Cornado was the earliest flowering (55 DAP) cultivar and Russet Burbank was the latest flowering (68 DAP) entry (Table 1). Flowering dates for the other Can-AGRICO cultivars ranged between 60 and 63 days.

[1]*SIDC, Outlook*

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

The yield components for the various tuber size grades are summarized in Table 1. The Can-AGRICO entries generally produced higher yields of smaller sized tubers compared to Russet Burbank or Shepody. Cornado and Shepody tended to produce over-size (>90 mm) tubers with average yields of 0.9 t/ha (20 Cwt/ac) and 2.8 t/ha (62 Cwt/ac), respectively.

Agate and Maranca produced the highest yield of 45 - 90 mm tubers (58.9 and 56.7 t/ha; 524 and 505 Cwt/ac, respectively). Agate and Maranca outyielded Russet Burbank by 40% and by 35% respectively. The corresponding yield advantage for these Can-AGRICO cultivars over Shepody was 20% and 16%.

Table 1. Growth and yield characteristics for Can-AGRICO and standard potato cultivars grown under irrigation at SIDC, Outlook

Cultivar	Main stem #/hill	Days to 50% flower	25-45 mm tuber yield		45-90 mm tuber yield		>90 mm tuber yield	
			t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Agate	3.5	63	6.1	54	58.9	524	0.0	0
Cornado	2.4	55	2.0	18	38.2	340	0.9	8
Honsul	2.5	60	2.6	23	53.9	480	0.0	0
Maranca	2.9	63	4.0	36	56.7	505	0.0	0
Signal	3.1	62	4.5	40	46.6	415	0.0	0
R. Burbank	1.8	68	2.6	23	42.0	374	0.0	0
Shepody	2.2	61	1.1	10	49.1	437	2.8	25
Significance	0.001	0.004	0.000		0.01		-	-
LSD(5.0%)	0.3	5	1.7		10.3		-	-
CV (%)	7.2	4.6	25.5		12.1		-	-

Processing Characteristics

Tuber specific gravity, and boiling, baking, and fry characteristics for the five Can-AGRICO cultivars and the two standard commercial cultivars are presented in Table 2.

The tuber specific gravities obtained for the different cultivars including the check cultivars were relatively low. Signal recorded the highest specific gravity (1.0803) and Maranca the lowest specific gravity (1.0565) compared to 1.0705 for Russet Burbank and 1.0797 for Shepody.

The colour, flavour, and texture after boiling and baking were variable for the different cultivars. Agate, Cornado, Honsul and Maranca had distinct yellow flesh while Signal produced off-white flesh after boiling and baking.

All the cultivars except Maranca produced acceptable flavour after boiling and baking. Maranca had unacceptable flavour after baking. Shepody, Cornado and Honsul showed moderate after-cooking discolouration. The other cultivars did not exhibit after-cooking discolouration.

All Can-AGRICO entries except Signal produced superior french fries according to USDA standards. Signal tended to produce darker fries than other cultivars. Agate Honsul and Maranca produced lighter coloured fries than did Russet Burbank or Shepody. Fry colour was slightly variable for Agate, Cornado, and Maranca. Honsul and Signal produced uniform fries.

Table 2. Tuber specific gravity and quality characteristics for Can-AGRICO and standard potato cultivars.

Cultivar	Specific gravity	Boiled					Baked			Fried		
		Colour	Texture	Flavour	Sloughing	After cooking darkening	Colour	Texture	Flavour	Colour	Uniformity	Texture
Agate	1.0664	3	2	1	3	3	3	2	1	1	2	2
Cornado	1.0687	3	2	1	3	2	3	2	1	3	2	2
Honsul	1.0607	3	2	1	3	2	3	2	1	1	3	2
Maranca	1.0565	3	2	1	3	3	3	2	2	2	2	1
Signal	1.0803	2	3	1	3	3	2	2	1	4	3	3
R. Burbank	1.0705	2	1	1	3	3	1	3	1	3	3	2
Shepody	1.0797	1	2	1	2	2	2	3	1	3	3	2
Significance	.0000	-	-	-	-	-	-	-	-	-	-	-
LSD (5.0%)	0.0001	-	-	-	-	-	-	-	-	-	-	-
CV (%)	0.5	-	-	-	-	-	-	-	-	-	-	-

Texture:
1 - Wet
2 - Slightly wet
3 - Slightly mealy
4 - Mealy

Sloughing:
1 - Severe
2 - Moderate
3 - Little or none

Colour:
1 - White
2 - Off white
3 - Yellow
4 - Deep yellow

After cooking discolouration:
1 - Severe
2 - Moderate
3 - None

Flavour:
1 - Acceptable
2 - Unacceptable

Fry colour:
USDA Standards

Fry Colour Uniformity:
1 - Very variable
2 - Variable
3 - Uniform
4 - Very uniform

Agronomic Investigations

Nitrogen and Phosphorus Study

J. Wahab[1], T. Hogg[1], D. Waterer[2]

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

Progress: *Ongoing*

Location: *Outlook*

Objective: *This study examined the influence of nitrogen, phosphorus, and plant spacing on 'seed' and 'consumption' grade yield, tuber specific gravity and processing quality for Russet Norkotah (mid-season table), Ranger Russet (late-season french fry), and Shepody (mid/late-season french fry) potato.*

Nitrogen and phosphorus are the two most limiting nutrients for potato production in Saskatchewan. Proper fertility management is necessary to optimize yields and to improve processing quality. It is likely that nutrient requirements may vary between cultivars or plant populations. Careful management of these nutrients is essential to produce economic returns under the relatively short Saskatchewan growing season.

Treatments in this study included four nitrogen levels (50, 100, 150, 200 kg N/ha; 45, 90, 135, 180 lb N/ac), two phosphorus levels (60, 120 kg P_2O_5/ha; 55, 110 lb P_2O_5/ac), and two within-row seed piece spacings (15, 30 cm; 6 in, 12 in).

Spring soil analysis indicated 39 kg (35 lb), 32 kg (28 lb), and 620 kg (552 lb) of N, P, and K respectively at 0 - 30 cm (0 - 12 in) depth. A summary of analyses of variance on the effects of nitrogen, phosphorus, and seed piece spacing for 'seed' and 'consumption' grade yields is presented in Table 3.

Table 3. Analyses of variance for yield components in relation to nitrogen, phosphorus and seed piece spacing for selected french fry potato cultivars

Source	'Seed' yield			'Consumption' yield		
	R. Norkotah	R. Russet	Shepody	R. Norkotah	R. Russet	Shepody
Nitrogen (N)	NS[1]	**	NS	NS	***	NS
Phosphorus (P)	NS	NS	*	NS	NS	***
Spacing (S)	***	***	***	***	***	NS
N x P	NS	NS	NS	NS	NS	NS
N x S	NS	NS	NS	NS	NS	NS
P x S	NS	NS	NS	NS	NS	NS
N x P x S	NS	NS	NS	*	NS	NS
CV (%)	9.9	11.4	18.8	10.8	13.3	20.5

[1]not significant

[1]*SIDC, Outlook*

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

Nitrogen Response

Nitrogen application produced higher yields of 'seed' (Figure 1) and 'consumption' (Figure 2) grade tubers. For Russet Norkotah, the 'seed' grade yield was optimized at approximately 150 kg N/ha (135 lb/ac). The 'consumption' grade increased with increasing nitrogen rate. Both market classes for Shepody responded positively to increasing nitrogen application, up to 200 kg N/ha. For Ranger Russet, both 'seed' and 'consumption' grade yields increased up to 150 kg N/ha. Yield of Ranger Russet dropped with further addition of nitrogen.

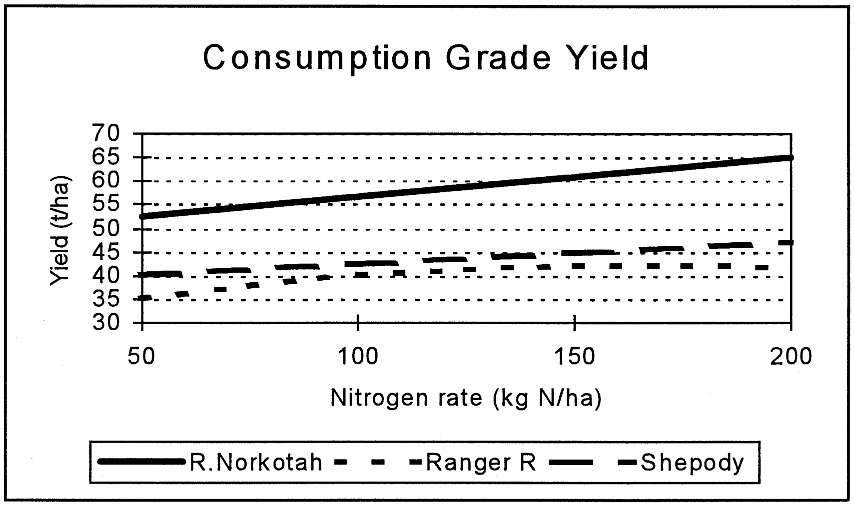

Figure 1. Nitrogen rate effects on 'consumption' grade yield for Russet Norkotah, Ranger Russet and Shepody potato.

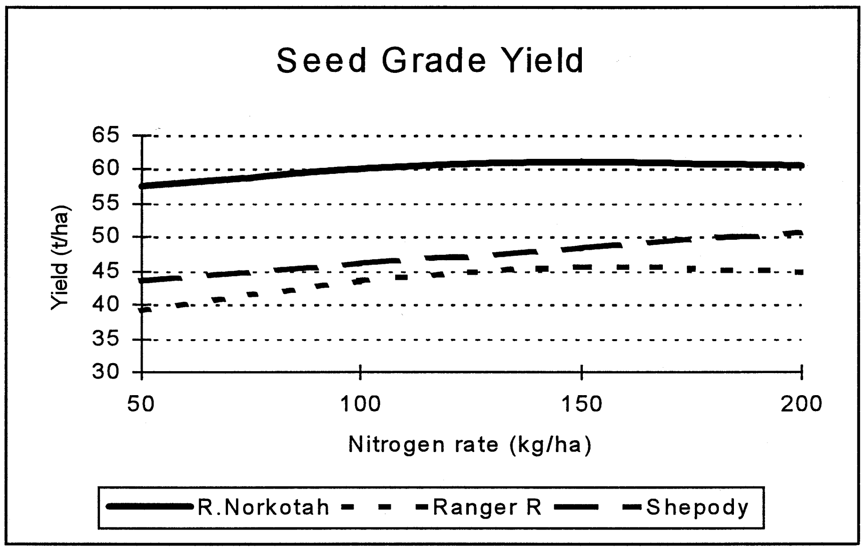

Figure 2. Nitrogen rate effects on 'seed' grade yield for Russet Norkotah, Ranger Russet and Shepody potato.

Phosphorus Response

As in 1997, Shepody potato responded positively to phosphorus application. By contrast, Russet Norkotah and Ranger Russet did not produce any significant responses to phosphorus application (Table 3). For Shepody, addition of 120 kg P_2O_5/ha (110 lb P_2O_5/ac) produced 11% higher 'seed' grade yield (Table 4) and 10% higher 'consumption' grade yield (Table 5) than the 60 kg P_2O_5/ha (55 lb P_2O_5/ac) rate. The optimal phosphorus level for 'seed' and 'consumption' grade yields for both Ranger Russet and Russet Norkotah was 60 kg P_2O_5/ha (55 lb P_2O_5/ac). Additional phosphorus application did not translate into yield increases (Tables 4 and 5).

The 15 cm (6 in) seed piece spacing produced significantly higher 'seed' and 'consumption' grade yields than the 30 cm (12 in) seed piece spacing for all three cultivars. The yield superiority with closer seed spacing over the wider spacing was 24% for Russet Norkotah, 33% for Ranger Russet, and 25% for Shepody (Table 4). The corresponding yield advantage for 'consumption' grade tuber yield was 17% for Russet Norkotah, 27% for Ranger Russet, and 22% for Shepody (Table 5).

Tuber specific gravity was measured for 'consumption' grade tubers. The relatively warm temperatures during late July and early August resulted in an overall decrease in specific gravities. Tuber specific gravity was not affected by nitrogen, phosphorus, or seed piece spacing (Table 6).

Ranger Russet tended to produce the lightest coloured fries and Shepody the darkest. The colour grades were within acceptable limits as required by the industry (Table 7). There were no identifiable trends for fry colour in relation to nitrogen or phosphorus application for the different cultivars.

Table 4. Effect of phosphorus and seed piece spacing on 'seed' grade yield for selected french fry potato cultivars.

Treatment	Russet Norkotah		Ranger Russet		Shepody	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Phosphorus[1], kg P_2O_5/ha						
60	59.7	533	43.7	390	45.0	402
120	60.0	536	42.9	383	50.0	447
Seed piece spacing[2], cm						
15	66.2	591	49.3	440	52.4	468
30	53.6	479	37.1	331	42.0	375

[1]Average of nitrogen and seed piece spacing. [2]Average of nitrogen and phosphorus.

Table 5. Effect of phosphorus and seed piece spacing on 'consumption' grade yield for selected potato cultivars.

Treatment	Russet Norkotah		Ranger Russet		Shepody	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Phosphorus[1], kg P_2O_5/ha						
60	55.8	498	40.5	362	41.5	371
120	56.2	502	39.4	352	45.7	408
Seed piece spacing[2], cm						
15	60.3	538	44.7	399	47.9	428
30	51.7	462	35.2	314	39.3	351

[1]Average of nitrogen and seed piece spacing. [2]Average of nitrogen and phosphorus.

Table 6. Effect of nitrogen, phosphorus and seed piece spacing on tuber specific gravity for selected french fry potato cultivars.			
Treatment	Russet Norkotah	Ranger Russet	Shepody
Nitrogen[1], kg N/ha			
50	1.0802	1.0860	1.0823
100	1.0778	1.0853	1.0787
150	1.0779	1.0864	1.0764
200	1.0777	1.0849	1.0815
Phosphorus[2], kg P_2O_5/ha			
60	1.0783	1.0860	1.0814
120	1.0785	1.0853	1.0762
Seed piece spacing[3], cm			
15	1.0791	1.0865	1.0801
30	1.0777	1.0847	1.0788
Analysis of variance			
Source			
Nitrogen (N)	NS[4]	NS	NS
Phosphorus (P)	NS	NS	NS
Spacing (S)	NS	NS	NS
N x P	NS	NS	NS
N x S	NS	NS	NS
P x S	NS	NS	NS
N x P x S	NS	NS	NS
CV (%)	0.6	0.3	0.9

[1]Average of phosphorus and seed piece spacing.
[2]Average of nitrogen and seed piece spacing.
[3]Average of nitrogen andphosphorus.
[4]not significant

Table 7. Effect of nitrogen and phosphorus on USDA standard fry colour for Russet Norkotah, Ranger Russet and Shepody potato.			
Treatment	Russet Norkotah	Ranger Russet	Shepody
Nitrogen (kg N/ha):			
50	2	1	3
100	3	0	3
150	2	2	3
200	2	1	3
Phosphorus (kg P_2O_5/ha)			
60	2	0	3
120	2	0	3

Effects of Nitrogen Source, Rate and Time of Application on Russet Burbank and Russet Norkotah Potato

J. Wahab[1], T. Hogg[1], D. Waterer[2]

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

Progress: *Ongoing*

Location: *Outlook*

Objective: *Previous studies in Europe and U.S.A have shown differential response to nitrogen fertilizer sources on potato production. This study examined the effects of urea and ammonium sulphate on yield of 'seed' grade yield for Russet Burbank (late-season) and Russet Norkotah (mid-season) potato.*

This test contained two nitrogen sources (urea and ammonium sulphate) three nitrogen rates (100, 200, 400 kg N/ha; 90, 180, 360 lb N/ac) and two methods of application (all at planting and planting + hilling). Spring soil analysis indicated 38 kg (34 lb) N, 29 kg (26 lb) P, and 499 kg (444 lb) K, at the 0 - 30 cm (0 - 12 in) depth.

Nitrogen source, rate, or application method had no effect on 'seed' and 'consumption' grade tuber yield for Russet Burbank (Tables 8 and 9). Russet Norkotah produced significantly (7%) higher yield when nitrogen was applied in two applications (planting + hilling) than nitrogen applied at planting only (Tables 8 and 9). Russet Norkotah did not respond to either nitrogen source or rate of application.

Table 8. Effect of nitrogen source, rate and time of application on 'seed' grade tuber yield for Russet Burbank and Russet Norkotah potato.

Treatment	Russet Burkank		Russet Norkotah	
	t/ha	Cwt/ac	t/ha	Cwt/ac
Nitrogen source[1]				
Amm. Sulphate	44.0	393	59.9	535
Urea	41.3	369	58.1	519
Nitrogen rate[2], kg N/ha				
100	44.0	393	58.1	519
200	43.6	389	60.7	542
400	40.3	360	58.1	519
Application time[3]				
At planting	42.1	376	56.9	508
At planting + hilling	43.1	385	61.1	546
Analysis of variance				
Source				
Source (S)	NS[4]		NS	
Rate (R)	NS		NS	
Application (A)	NS		**(2.9 t/ha)	
S x R	NS		NS	
S x A	NS		NS	
R x A	NS		NS	
S x R x A	NS		*(7.2 t/ha)	
CV (%)	15.9		8.5	

[1]Average of nitrogen rate and time of application. [2]Average of nitrogen source and time of application.
[3]Average of nitrogen source and rate. [4]not significant
Values in parentheses are LSD (0.05) estimates for the respective treatments.

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Table 9. Effect of nitrogen source, rate and time of application on 'consumption' grade tuber yield for Russet Burbank and Russet Norkotah potato.

Treatment	Russet Burbank tuber yield		Russet Norkotah tuber yield	
	t/ha	Cwt/ac	t/ha	Cwt/ac
Nitrogen source[1]				
Amm. Sulphate	39.7	355	56.3	503
Urea	37.7	337	54.9	490
Nitrogen rate[2], kg N/ha				
100	39.7	355	54.7	488
200	39.4	352	55.2	493
400	36.9	330	51.2	457
Application time[3]				
At planting	38.0	339	53.7	480
At planting & hilling	39.4	352	57.5	513
Analysis of variance				
Source				
Source (S)	NS[4]		NS	
Rate (R)	NS		NS	
Application (A)	NS		**	
S x R	NS		NS	
S x A	NS		NS	
R x A	NS		NS	
S x R x A	NS		**(8.3 t/ha)	
CV (%)	17.4		8.7	

[1]Average of nitrogen rate and time of application. [2]Average nitrogen source and time of application.
[3]Average of nitrogen source and rate. [4]not significant
Values in parentheses are LSD (0.05) estimates for the respective treatments.

Effects of Split Application of Nitrogen on Tuber Yield and Specific Gravity

J. Wahab[1], T. Hogg[1], D. Waterer[2]

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

Progress: *Ongoing*

Location: *Outlook*

Objective: *This study examines the effect of split applying urea nitrogen on productivity for Russet Norkotah (mid-season table), Shepody (mid-season french fry), and Ranger Russet (late-season french fry) potato.*

Rate and timing of nitrogen application is essential to increase tuber yields and maintain desired specific gravity for processing. This is particularly important in the short Saskatchewan growing conditions. It is likely that the growth and yield responses will be influenced by the maturity classes of potato.

Study treatments included two rates of nitrogen (150, 200 kg N/ha; 135, 180 lb N/ac), and four application methods: (i) all at planting, (ii) planting and hilling, (iii) planting, hilling, and three weeks

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after hilling, and (iv) planting, hilling, and three and five weeks after hilling.

There were no significant responses to rate or timing of nitrogen application for both 'seed' grade yield (Table 10), 'consumption' grade yield (Table 11), or tuber specific gravity (Table 12). As observed in the previous study, Russet Norkotah produced slightly higher yield when nitrogen was applied in two split applications (at planting and hilling) compared to all nitrogen applied at planting.

Ranger Russet produced lighter coloured fries than the other two cultivars (Table 13). Nitrogen rate or application methods did not appear to have any effect on fry colour.

Table 10. Effect of time of application of nitrogen fertilizer on 'seed' grade tuber yield for selected potato cultivars.

Time of application	R. Norkotah		Ranger R.		Shepody		Mean	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Planting	65.5	585	49.0	438	51.5	460	54.6	488
Plant.+Hill	67.8	605	54.6	488	56.0	500	59.4	530
Plant+Hill+3w	63.8	570	54.6	488	56.2	502	58.2	520
Plant+Hill+3w+2w	63.2	564	54.5	487	57.7	515	58.5	522
Mean	64.6	577	53.2	475	55.4	495		

Analysis of variance

Source	
Cultivar (C)	***(3.2t/ha)
Rate (R)	NS[1]
Application (A)	NS
C x R	NS
C x A	NS
R x A	NS
C x R x A	
CV (%)	11.1

[1]not significant. Values within parenthesis are LSD (0.05) estimates for the respective treatments.

Table 11. Effect of time of application of nitrogen fertilizer on 'consumption' grade tuber yield for selected potato cultivars.

Time of application	R. Norkotah		Ranger R.		Shepody		Mean	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Planting	59.6	532	46.6	416	48.1	430	51.5	460
Plant.+Hill	63.3	565	52.1	465	51.4	459	55.6	497
Plant+Hill+3w	58.9	526	53.2	475	52.9	472	55.0	491
Plant+Hill+3w+2w	58.0	518	51.9	463	53.6	479	54.5	487
Mean	59.9	535	51.0	455	51.5	460		

Analysis of variance

Source	
Cultivar (C)	***(3.3t/ha)
Rate (R)	NS[1]
Application (A)	NS
C x R	NS
C x A	NS
R x A	NS
C x R x A	NS
CV (%)	12.4

[1]not significant Values within parentheses are LSD (0.05) estimates for the respective treatments.

Table 12. Effect of nitrogen rate and time of application on tuber specific gravity for selected potato cultivars.					
Nitrogen rate[1]	Specific gravity	Time of nitrogen application[2]	Specific gravity	Cultivar[3]	Specific gravity
150 kg N/ha	1.0843	Planting	1.0836	R.Norkotah	1.0809
200 kg N/ha	1.0844	Plant.+Hill	1.0841	R. Russet	1.0907
		Plant+Hill+3w	1.0849	Shepody	1.0813
		Plant+Hill+3w+2w	1.0847		

[1]Average of time of application and cultivar.
[2]Average of nitrogen rate and cultivar.
[3]Average of nitrogen rate and time of application.

Table 13. Effect of nitrogen rate and time of application on USDA standard french fry colour for selected potato cultivars					
Cultivar	Fry colour	Nitrogen rate	Fry colour	Nitrogen Application	Fry colour
R. Norkotah	3	150 kg N/ha	2	Planting	2
R. Russet	1	200 kg N/ha	2	Plant.+Hill	2
Shepody	3			Plant+Hill+3w	3
				Plant+Hill+3w+2w	2

Potassium Source and Rate Effects for French Fry Cultivars

J. Wahab[1], T. Hogg[1], D. Waterer[2]

This study examined the requirement of supplementary potassium for Russet Burbank, Ranger Russet, and Shepody potato with respect to yield and quality. Treatments included two sources of potassium (potassium chloride and potassium sulphate) and three rates (50, 100, 200 kg K_2O/ha; 45, 90, 180 lb K_2O/ac) of application. Spring soil analysis of the test site indicated 80 kg (71 lb) N, 39 kg (35 lb) P, and 440 kg (392 lb) K at the 0 - 30 cm (0 - 12 in) depth.

The source and rate of potassium application had no effect on 'seed' grade tuber yield for Ranger Russet or Shepody (Table 14) and 'consumption' grade yield for all three cultivars (Table 15). The significant source x rate interaction for 'seed' grade yield of Russet Burbank indicates that higher rates of potassium sulphate decreased yield. By contrast, higher rates of potassium chloride had no effect on yield (Figure 3). It is likely that the yield reduction for higher rates of potassium sulphate is due to sulphate toxicity. Additional work is needed to confirm this phenomenon.

For Russet Burbank, potassium sulphate produced tubers with higher specific gravity compared to potassium chloride. Source of potassium fertilizer had no effect on tuber specific gravity for

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Ranger Russet or Shepody (Table 16).

Ranger Russet tended to produce lighter coloured fries than Russet Burbank or Shepody (Table 17). No significant effects on fry colour were observed for the source or rate of potassium.

Table 14. Effect of potassium source and rate on 'seed' grade tuber yield for selected french fry potato cultivars.

Treatment	Russet Burbank		Ranger Russet		Shepody	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Potassium source[1]:						
Chloride	36.6	327	40.4	361	45.3	405
Sulphate	38.4	343	41.1	367	49.9	446
Potassium rate[2], kg K_2O/ha						
50	35.7	319	40.3	360	46.0	411
100	38.9	347	40.4	361	45.3	405
200	38.0	339	41.5	371	45.6	407
No potassium check	37.4	334	36.7	328	39.9	356
Analysis of variance						
Source						
Source	NS[3]		NS		NS	
Rate	NS		NS		NS	
Source x Rate	*(4.8t/ha)		NS		NS	
CV (%)	9.3		13.2		9.9	

[1]Average of potassium rates. [2]Average of potassium source. [3]not significant
Values within parenthesis are LSD (0.05) estimates for the respective treatments.

Table 15. Effect of potassium source and rate on 'consumption' grade tuber yield for selected french fry potato cultivars.

Treatment	Russet Burbank		Ranger Russet		Shepody	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Potassium source[1]:						
Chloride	33.4	298	39.2	350	44.4	396
Sulphate	34.7	310	39.4	352	44.1	394
Potassium rate[2], kg K_2O/ha						
50	32.7	292	38.5	344	44.0	393
100	35.5	317	39.4	352	44.0	393
200	33.9	303	40.0	357	44.7	399
No potassium check	33.5	299	35.0	313	38.6	345
Analysis of variance						
Source						
Source	NS[3]		NS		NS	
Rate	NS		NS		NS	
Source x Rate	NS		NS		NS	
CV (%)	9.4		13.3		11.7	

[1]Average of potassium rates. [2]Average of potassium source. [3]not significant

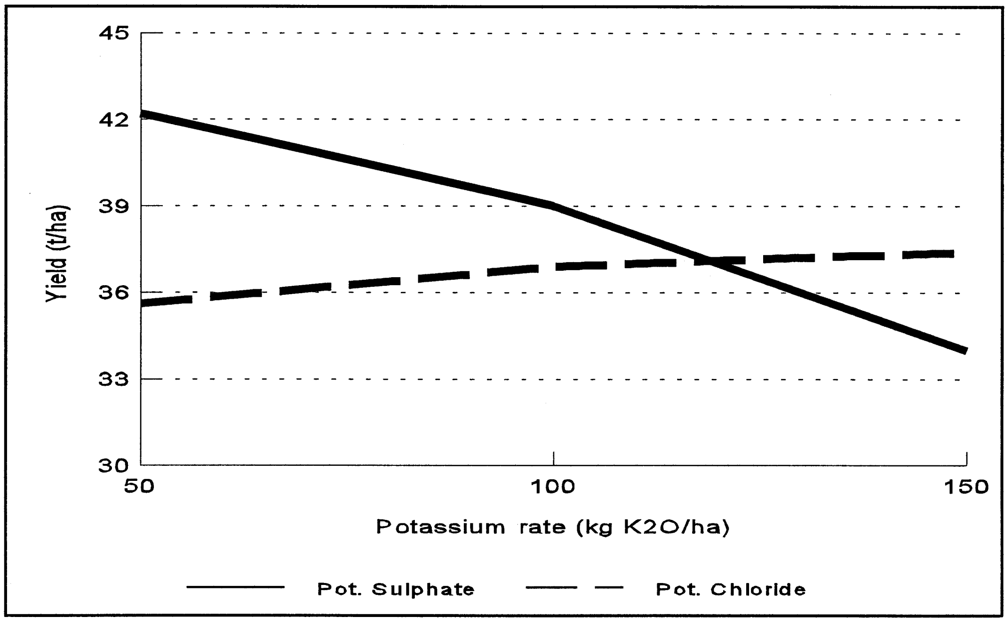

Figure 3. Potassium source and rate effects on 'seed' grade tuber yield for Russet Burbank potato.

Table 16. Effect of potassium source and rate on tuber specific gravity for selected french fry potato cultivars.			
Treatment	Russet Burbank	Ranger Russet	Shepody
Potassium source[1]:			
Chloride	1.0739	1.0884	1.0797
Sulphate	1.0757	1.0897	1.0813
Potassium rate[2], kg K_2O/ha			
50	1.0781	1.0906	1.0841
100	1.0731	1.0892	1.0782
200	1.0758	1.0873	1.0792
No potassium check	1.0766	1.0924	1.0833
Analysis of variance			
Source			
Source	*	NS	NS
Rate	NS[3]	NS	NS
Source x Rate	NS	**	NS
CV (%)	0.4	0.3	0.5

[1]Average of potassium rates.
[2]Average of potassium source.
[3]not significant

Table 17. Effect of potassium source and rate on fry colour for Russet Burbank, Russet Norkotah, and Shepody potato.			
Treatment	Russet Burbank	Ranger Russet	Shepody
Check treatment	2	1	3
Potassium source			
Chloride	2	2	3
Sulphate	3	2	3
Potassium Rate (kg K_2O/ha)			
50	2	2	3
100	3	2	3
200	3	1	3

Irrigation and Seed Piece Spacing Study

J. Wahab[1], T. Hogg[1], D. Waterer[2]

Potato responds well to irrigation. Moisture stress, depending on the crop growth stage, can reduce tuber yields and/or affect processing quality. For example, transient moisture stress during stolon formation or tuber initiation can reduce tuber set, while moisture stress at tuber bulking stage can reduce tuber size. It should be possible to maximize yields of smaller sized 'seed' grade tubers or larger 'consumption' grade tubers through careful water management. It is likely that the optimum moisture requirement may be different for 'seed' and 'consumption' grade market classes depending on cultivars and plant population. This study examined the effects of seed piece spacing (15, 20, and 30 cm; 6 in, 8 in, and 12 in) for five potato cultivars (Atlantic, Norland, Russet Burbank, Russet Norkotah, and Shepody) grown under dryland, 40% Field Capacity, and at 65% Field Capacity (F.C.). The 1998 growing season received 265 mm (10.4 in) precipitation. Supplementary irrigation of 203 mm (8 in) and 305 mm (12 in) was provided to maintain soil moisture levels of 40% and 65% F.C respectively.

Potato grown under dryland conditions produced the lowest 'seed' grade yield of 40.8 t/ha (363 Cwt/ac). Plots maintained at 40% F.C and 65% F.C produced the highest and intermediate yields respectively (Table 18). The 40% soil moisture regime produced 41% higher 'seed' grade yield than dryland production. The 65% F.C. produced on the average 7% lower yield than the 40% F.C. soil moisture treatment.
Norland produced the highest and Shepody the lowest 'seed' grade yields under all irrigation regimes. The yield differences were 68% under dryland, 104% under 40% F.C., and 80% under 65% F.C. (Table 18).

Increasing plant population by decreasing seed piece spacing increased 'seed' grade tuber yields under all moisture regimes. The yield differences were more marked between the 30 cm (12 in) and 20 cm (8 in) spacing compared to the 20 cm (8 in) and 15 cm (6 in) spacing (Table 18). The 20 cm (8 in) spacing outyielded the 30 cm (12 in) spacing by 9%, 18%, and 19% under dryland,

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40%F.C, and 65% F.C respectively. The corresponding differences between the two higher plant populations were 5%, 6%, and 1%.

The yield trends for 'consumption' grade tubers were generally similar to the 'seed' grade yields under the various soil moisture conditions (Table 19). On dryland, the 30 cm (12 in) seed piece spacing produced the highest 'consumption' grade yield and the 15 cm (6 in) seed piece spacing produced the lowest yield. Under supplemental irrigation (40% and 65% F.C.), the 30 cm (12 in) seed spacing produced the lowest yield. Closer spacings produced highest tuber yields (Table 19).

Tuber specific gravity in this test was relatively low. Atlantic potato produced the highest specific gravity under all moisture regimes (Table 20). Seed piece spacing had no effect on tuber specific gravity.

Potatoes grown under dryland conditions in 1998 tended to produce lighter coloured fries than those grown under irrigation (Table 21). Atlantic potato produced the lightest coloured fries under all moisture regimes. Further work is necessary to determine the effects of soil moisture on fry characteristics for potato cultivars.

Table 18. 'Seed' grade tuber yield for potato cultivars grown under different seed piece spacings and soil moisture regimes.

Treatment	Dryland		40% Field capacity		65% Field capacity	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Cultivar[1]						
Atlantic	45.8	409	58.7	524	54.4	486
Norland	47.6	425	72.7	649	68.0	607
Russet Burbank	37.3	333	51.2	457	43.3	387
Russet Norkotah	44.8	400	69.0	616	64.1	572
Shepody	28.3	253	35.6	318	37.7	337
Spacing[2]						
15 cm	43.3	387	62.7	560	56.8	507
20 cm	41.3	369	59.3	530	56.3	503
30 cm	37.8	338	50.4	450	47.4	423
Analysis of variance						
Source						
Cultivar (C)	***(5.1 t/ha)		***(4.8 t/ha)		***(5.0 t/ha)	
Spacing (S)	*(3.9 t/ha)		**(7.6 t/ha)		***(3.9 t/ha)	
C x S	NS[3]		NS		NS	
C.V. (%)	15.1		20.7		11.4	

[1]Average of seed piece spacing. [2]Average of cultivars. [3]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

Table 19. 'Consumption' grade tuber yield for potato cultivars grown under different seed piece spacings and soil moisture regimes.						
Treatment	Dryland		40% Field capacity		65% Field capacity	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Cultivar[1]						
Atlantic	41.4	370	55.3	494	51.0	455
Norland	51.7	462	69.5	621	64.1	572
Russet Burbank	24.9	222	36.2	323	35.3	315
Russet Norkotah	38.6	345	64.3	574	60.1	537
Shepody	24.6	220	31.9	285	33.6	300
Spacing[2]						
15 cm	35.1	313	56.3	503	50.1	447
20 cm	34.7	310	51.0	455	51.1	456
30 cm	39.0	348	47.0	420	45.2	404
Analysis of variance						
Source						
Cultivar (C)	***(10.8 t/ha)		***(6.5 t/ha)		***(5.1 t/ha)	
Spacing (S)	NS[3]		**(5.1 t/ha)		**(4.0 t/ha)	
C x S	NS		NS		N	
CV (%)	36.1		15.4		12.8	

[1]Average of seed piece spacing. [2]Average of cultivars. [3]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

Table 20. Tuber specific gravity for potato cultivars grown under different seed piece spacings and soil moisture regimes.			
Treatment	Dryland	40% Field capacity	65% Field capacity
Cultivar[1]			
Atlantic	1.092	1.084	1.084
Norland	1.075	1.066	1.065
Russet Burbank	1.071	1.064	1.069
Russet Norkotah	1.081	1.069	1.071
Shepody	1.078	1.062	1.066
Spacing[2]			
15 cm	1.082	1.070	1.071
20 cm	1.080	1.069	1.072
30 cm	1.076	1.068	1.071
Analysis of variance			
Source			
Cultivar (C)	***(0.0081)	***(0.003)	***(0.005)
Spacing (S)	NS[3]	NS	NS
C x S	NS	NS	NS
CV (%)	0.9	0.3	0.3

[1]Average of seed piece spacing. [2]Average of cultivars. [3]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

Table 21. USDA french fry colour for potato cultivars grown under different irrigation regimes.

Cultivar	Dryland	40% Field capacity	65% Field capacity
Norland	2	3	3
Shepody	3	4	4
Russet Norkotah	3	3	4
Russet Burbank	00	3	3
Atlantic	00	0	1

Seed Generation Study

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

Seed potatoes are grown for several generations before being marketed as seed. Seed potato certification standards require greater levels of disease tolerance for higher seed generations. Presently, higher generation mini-tubers are grown in protected greenhouses and lower generations are grown in the field. This could result in a progressive accumulation of tuber-borne diseases that could affect crop vigour and productivity. Due to lower pressure from virus-carrying insects in Saskatchewan, it is likely that even lower seed generations grown in this province will be relatively free from seed-borne diseases.

Several seed generations of popular 'table' and 'processing' potato cultivars were compared under irrigation using standard management practices. The cultivar and generation combinations studied in this test are as follows:

Cultivar	**Seed Generation**
Alpha	E-1, E-2
Norland	Pre-Elite, E-1, E-2, E-3
Dark Red Norland	Pre-Elite, E-1, E-2, E-3
Amisk	Pre-Elite, E-1, E-2
Russet Burbank	Pre-Elite, E-1, E-2
Russet Norkotah	Pre-Elite, E-1, E-2
Shepody	Pre-Elite, E-1
Yukon Gold	Pre-Elite, E-1, E-2, E-3

The effects of seed generation on 'seed' and 'consumption' grade yields for the different cultivars are presented in Tables 22 and 23 respectively. In this study, there was no indication that higher seed generations were more productive than lower generations.

[1] *SIDC, Outlook*

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

Table 22. Seed generation effects on 'seed' grade tuber yield for selected potato cultivars								
Cultivar	Seed generation							
	Pre-Elite		E-1		E-2		E-3	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Alpha	-	-	35.6a	318	44.1a	394	-	-
Norland	50.4a	450	42.1a	376	50.8a	454	51.1a	456
D.R. Norland	56.7b	506	47.8ab	427	45.6a	407	48.3ab	431
Amisk	36.5a	326	47.2b	421	47.5b	424	-	-
R.Burbank	29.0a	259	42.5b	380	39.6ab	354	-	-
R.Norkotah	63.3b	565	56.5ab	505	51.0a	455	-	-
Shepody	39.6a	354	44.8a	400	-	-	-	-
Yukon Gold	44.9a	401	40.5a	362	37.1a	331	36.7a	328
Mean	45.8	409	44.6	398	45.1	403	45.4	405

Values within a column followed by the same letter are not significantly (P<0.05) different.

Table 23. Seed generation effects on 'consumption' grade tuber yield for selected potato cultivars								
Cultivar	Seed generation							
	Pre-Elite		E-1		E-2		E-3	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Alpha	-	-	28.2a	252	38.4a	343	-	-
Norland	58.1a	519	46.3a	413	56.0a	500	51.2a	457
D.R. Norland	60.2a	538	48.4a	432	53.9a	481	52.1a	465
Amisk	33.2a	296	44.4ab	396	46.1b	412	-	-
R.Burbank	17.4a	155	38.2b	341	37.4b	334	-	-
R.Norkotah	60.5a	540	57.0a	509	50.0a	447	-	-
Shepody	37.4a	334	42.7a	381	-	-	-	-
Yukon Gold	44.8a	400	46.8a	418	39.6a	354	39.8a	355
Mean	44.5	397	44.0	393	45.9	410	47.7	426

Values within a column followed by the same letter are not significantly (P<0.05) different.

Effects of Soil Moisture Status During Seed Production on the Performance of the Progeny

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

Previous studies in Europe and North America have shown conflicting results on the productivity of seed potato raised under irrigation and dryland. Some studies showed a positive influence on productivity by irrigating the seed crop and others showed no effect.

This study examined the mainstem count and productivity for seed potato crop grown under dryland, at 40% Field Capacity, and at 65% Field Capacity. The varieties included in the study were Atlantic, Norland, Russet Burbank, Russet Norkotah, and Shepody. The seed crop was raised in 1997 and the performance was evaluated in 1998.

Seed potato obtained from dryland produced the highest number of mainstems. The mainstem count decreased with increase in the soil moisture status under which the seed crop was produced (Table 24). Norland potato produced the highest number of mainstems. Cultivars responded similarly to change in soil moisture levels when raising the seed crop.

Soil moisture conditions under which the seeds were grown had no effect on 'seed' grade (Table 25) or 'consumption' grade (Table 26) yield of the progeny.

Table 24. Effect of soil moisture during seed production on mainstem count of progeny tubers for selected potato cultivars.

Cultivar	Dryland	40% F.C.	65% F.C.	Mean
Atlantic	2.2	1.9	1.5	1.9
Norland	3.0	2.8	2.1	2.9
Russet Burbank	1.9	1.7	1.8	1.8
Russet Norkotah	2.5	2.1	2.2	2.3
Shepody	1.9	1.9	1.8	1.9
Mean	2.3	2.1	2.0	

Analysis of variance

Source	
Cultivar (C)	***(0.2 t/ha)
Irrigation (I)	***(0.1 t/ha)
C x I	NS[1]
CV (%)	11.3

[1]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

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

Table 25. 'Seed' grade tuber yield from seed potato produced under different soil moisture regimes.								
Cultivar	Dryland		40% F.C.		65% F.C.		*Mean*	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Atlantic	56.7	506	51.4	459	53.7	480	53.9	481
Norland	50.7	453	57.5	513	54.0	482	54.0	482
R.Burbank	47.6	425	45.2	404	47.8	427	46.9	419
R.Norkotah	56.9	508	62.5	558	53.9	481	57.7	515
Shepody	48.7	435	49.0	438	48.4	432	48.7	435
Mean	52.1	465	53.1	474	51.6	461		
Analysis of variance								
Source								
Cultivar (C)	***(4.0 t/ha)							
Irrigation (I)	NS[1]							
C x I	NS							
CV (%)	9.3							

[1]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

Table 26. 'Consumption' grade tuber yield from seed potato produced under different soil moisture regimes.								
Cultivar	Dryland		40% F.C.		65% F.C.		*Mean*	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac
Atlantic	58.7	524	53.3	476	54.2	484	55.4	495
Norland	50.1	447	57.2	511	53.8	480	53.7	480
R.Burbank	44.0	393	41.6	371	44.3	396	43.3	387
R.Norkotah	55.1	492	60.2	538	54.1	483	56.5	505
Shepody	48.5	433	49.0	438	47.3	422	48.3	431
Mean	51.3	458	52.2	466	50.7	453		
Analysis of variance								
Source								
Cultivar (C)	***(4.3 t/ha)							
Irrigation (I)	NS[1]							
C x I	NS							
C.V. (%)	10.2							

[1]not significant
Values within parentheses are LSD (0.05) estimates for the respective treatments.

Effects of Planting Date and Seed Piece Spacing of the Seed Crop on Productivity of the Progeny

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

Environmental conditions such as temperature and day length during potato seed production could influence the performance of the progeny tubers.

This study examined the productive potential of Shepody and Russet Norkotah seed obtained from crops planted at three different times (Mid-May, Late-May, and Early June) and at two seed piece spacings (15, 30 cm; 6 in, 12 in).

There were no significant effects of planting date and seed piece spacing of the seed crop on both 'seed' (Table 27) and 'consumption' (Table 28) grade yields of the progeny.

Table 27. Effect of planting time and seed spacing of the seed crop on 'seed' grade tuber yield of the progeny.

Treatment	Shepody		Russet Norkotah	
	t/ha	Cwt/ac	t/ha	Cwt/ac
Seed crop planting date[1]				
Early planting	54.2	484	49.0	438
Mid planting	54.8	489	49.6	443
Late planting	55.0	491	55.7	497
Seed crop seed spacing[2]				
15 cm	54.7	488	51.1	456
30 cm	54.6	488	51.8	463
Analysis of variance				
Source				
Cultivar (C)	NS[3]			
Planting date (D)	NS			
Seed spacing (S)	NS			
C x D	NS			
C x S	NS			
D x S	NS			
C x D x S	NS			
CV (%)	11.0			

[1]Average of seed piece spacing.
[2]Average of seed planting date.
[3]not significant

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

Table 28. Effect of planting time and seed spacing of the seed crop on 'consumption' grade tuber yield of the progeny.

Treatment	Shepody		Russet Norkotah	
	t/ha	Cwt/ac	t/ha	Cwt/ac
Seed crop planting date[1]				
Early planting	52.2	466	46.5	415
Mid planting	53.7	480	48.0	429
Late planting	53.2	475	53.7	480
Seed crop seed spacing[2]				
15 cm	53.1	474	48.9	437
30 cm	52.9	472	50.0	447
Analysis of variance				
Source				
Cultivar (C)	NS[3]			
Planting date (D)	NS			
Seed spacing (S)	NS			
C x D	NS			
C x S	NS			
D x S	NS			
C x D x S	NS			
CV (%)	11.8			

[1]Average of piece spacing.
[2]Average of seed planting date.
[3]not significant

Seed Piece Type and Planting Depth on Productivity of Russet Burbank and Shepody

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

In Saskatchewan, potato planting is done in the spring when the soil temperatures are relatively low. It is possible that emergence would be slow for deeper planted potato compared to shallow planting. It is likely that whole-seed and cut pieces may respond differently to planting depth. This study examined the growth (mainstem count) and productivity of whole and cut seed for Russet Burbank and Shepody potato planted at 15, 20, and 30 cm (6 in, 8 in, and 12 in) depths.

No significant effects were observed for cultivar and planting depth in relation to 'seed' and 'consumption' grade yields (Tables 29 and 30). In this study, single-cut seed pieces produced more stems and higher tuber yields ('seed' and 'consumption') than whole-seed. This yield increase was associated with higher tuber numbers for single-cut seed. However, single-cut seed produced smaller 'seed' and 'consumption' grade tubers than whole-seed.

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

Table 29. Mainstem count and 'seed' grade tuber yield for Russet Burbank and Shepody potato as influenced by seed piece form and by planting depth.					
Treatment	Number of mainstems per hill	'Seed' grade tuber yield t/ha	'Seed' grade tuber yield Cwt/ac	Number of tubers per hill	Average tuber weight g
Cultivar[1]					
Russet Burbank	1.6	56.1	501	6.3	247
Shepody	2.1	53.5	478	5.8	255
Seed piece form[2]					
Single cut	2.2	58.0	518	6.5	245
Whole seed	1.5	51.5	460	5.5	257
Planting depth[3]					
15 cm	1.8	55.2	493	6.0	251
20 cm	1.8	54.3	485	6.0	249
30 cm	1.9	54.9	490	6.0	252
Analysis of variance					
Source					
Planting depth (D)	NS[4]	NS		NS	NS
Cultivar (C)	***	NS		NS	NS
Seed form (F)	***	**		***	***
D x C	NS	NS		NS	NS
D x F	NS	NS		NS	NS
C x F	NS	NS		NS	NS
D x C x F	NS	NS		NS	NS
C.V (%)	14.2	12.8		11.0	9.8

[1]Average of seed piece form and planting depth. [2]Average of cultivar and planting depth.
[3]Average of cultivar and seed piece form. [4]not significant

Table 30. 'Consumption' grade tuber yield for Russet Burbank and Shepody potato as influenced by seed piece form and planting depth.				
Treatment	'Consumption' grade tuber yield t/ha	'Consumption' grade tuber yield Cwt/ac	Number of tubers per hill	Average tuber weight, g
Cultivar[1]				
Russet Burbank	52.4	468	4.9	296
Shepody	51.3	458	4.7	301
Seed piece form[2]				
Single cut	54.2	484	5.1	289
Whole seed	49.5	442	4.4	306
Planting depth[3]				
15 cm	52.8	472	4.8	300
20 cm	49.9	446	4.8	289
30 cm	52.8	472	4.8	306
Source				
Planting depth (D)	NS[4]		NS	NS
Cultivar (C)	NS		NS	NS
Seed form (F)	***		***	**
D x C	NS		NS	NS
D x F	NS		NS	NS
C x F	NS		NS	NS
D x C x F	NS		NS	NS
CV (%)	9.0		9.7	6.4

[1]Average of seed piece form and planting depth.
[2]Average of cultivar and planting depth.
[3]Average of cultivar and seed piece form.
[4]not significant

Haulm Covering Study

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

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

Tuber set in a potato plant is dependant upon the number of stolons produced on mainstems. This is a function of the cultivar and the number of buried nodes. It is likely that higher yields of 'seed' grade tubers can be obtained by covering a greater proportion of the stem at emergence. This study examined the effect of covering haulms at two stages, 5 cm (2 in) and 10 cm (4 in) after emergence compared to standard practice (no covering) on 'seed' and 'consumption' grade tuber yields. Seven cultivars with diverse growth and maturity characteristics were examined in the study. They included Alpha, Atlantic, Norland, Russet Burbank, Russet Norkotah, Ranger Russet, and Shepody.

All cultivars responded similarly to the different haulm covering treatments. There were significant cultivar effects for 'seed' and 'consumption' grade yield components (Tables 31 and 32). Covering haulms produced higher 'seed' and 'consumption' grade tuber yields than the standard management practice. This yield increase was associated with an increase in tuber number for covering haulms compared to the check treatment.

Table 31. Effect of haulm covering stage on yield components of 'seed' grade tubers for selected potato cultivars.

Treatment	'Seed' grade tuber yield		Tuber number per hill	Average tuber weight, g
	t/ha	Cwt/ac		
Cultivar[1]				
Alpha	47.2	421	13.6	95
Atlantic	53.5	478	4.7	198
Norland	48.8	436	6.8	199
R.Burbank	49.1	438	6.2	217
R.Norkotah	42.5	380	5.2	226
Ranger Russet	39.6	354	4.7	233
Shepody	39.5	353	4.9	219
Haulm cover[2]				
Control	40.7	363	6.3	199
At 5 cm	43.1	385	6.7	196
At 10 cm	44.7	399	6.8	197
Analysis of variance				
Source				
Cultivar (C)	***(3.8 t/ha)		***(0.6 t/ha)	***(14 t/ha)
Haulm cover (H)	**(2.5 t/ha)		**(0.4 t/ha)	NS
C x H	NS[3]		NS	NS
CV (%)	10.8		11.4	8.4

[1]Average of haulm covering treatment.
[2]Average of cultivar.
[3]not significant

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

Table 32. Effect of haulm covering stage on yield components of 'consumption' grade tubers for selected potato cultivars.				
Treatment	'Seed' grade tuber yield		Tuber number per hill	Average tuber weight (g)
	t/ha	Cwt/ac		
Cultivar[1]				
Alpha	31.9	285	6.0	144
Atlantic	41.9	374	4.6	254
Norland	50.0	447	5.6	244
R.Burbank	52.1	465	5.3	270
R.Norkotah	52.5	469	4.8	300
Ranger Russet	44.8	400	4.4	283
Shepody	50.6	452	4.7	297
Haulm cover[2]				
Control	44.1	394	4.8	257
At 5 cm	46.4	414	5.2	252
At 10 cm	48.3	431	5.2	259
Analysis of variance				
Source				
Cultivar (C)	***(3.9 t/ha)		***(0.5 t/ha)	***(20 t/ha)
Haulm cover (H)	**(2.5 t/ha)		**(0.4 t/ha)	NS
C x H	NS[3]		NS	NS
C.V (%)	10.3		11.4	9.4

[1]Average of haulm covering treatment. [2]Average of cultivar.
[3]not significant

Seed Potato Agronomy

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

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

Progress: *Year two of three*

Location: *Saskatoon*

Objective: *To develop production practices which enhance yield and quality of Saskatchewan grown seed potatoes.*

Influence of seed handling regimes on Shepody yield and tuber size distribution

In seed production, the emphasis is increasingly on production of good yields of tubers suited for use as drop or single cut seed. In varieties such as Shepody, this objective is difficult to achieve

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as the plants tend to produce low numbers of very large tubers. This situation is exacerbated if young seed is planted, as it already has a tendency to produce low numbers of larger tubers.

This study was designed to determine if tuber size distribution of Shepody could be improved by artificially aging the seed, ideally without excessive sacrifice in total yields.

The trial was conducted in 1996 through 1998 at the University of Saskatchewan Potato Field Research Station in Saskatoon. Saskatchewan grown Elite 2 seed of Shepody which had been stored at 4°C since harvest was subjected to one of the following treatments:

a) Greensprouting - Beginning in late March, whole seed was exposed to banks of fluorescent light (350 $uM/M^2/s$) for 24h/day at 15°C for 3-6 weeks. Following treatment, the seed was returned to 4°C storage until planting in mid-May.

b) Dark Sprouting - Beginning in late March, whole seed was held at 15°C in the dark until sprouts were 5 cm long. This seed was also returned to 4°C storage until planting in mid-May.

c) Advanced Aging - Whole seed was held at 15°C in the dark from early April until planting (40-45 days). This seed was de-sprouted just prior to planting.

d) No Aging /whole - Whole seed was stored cold (4°C) until one week prior to planting.

e) No Aging/cut - Seed stored cold until one week prior to planting was cut to produce seedpieces approximately the same size as the drop seed used in Treatment D.

As the various seed treatments had similar effects on yields in all three test seasons, treatment averages are presented in Table 33. Whole seed stored cold until just prior to planting performed well in all trials. This demonstrates the superior stress tolerance of whole seed versus cut seed. Greensprouting clearly accelerated crop emergence relative to all other treatments, but did not produce any consistent improvement in yields or tuber size distribution relative to any of the other aging treatments.

The most significant seed treatment effect was that seed stored cold until just prior to planting, and then cut, produced yields which were consistently lower.

The yield and tuber size distribution responses to the seed handling treatments used in this trial were limited. Shepody may simply be unresponsive to seed handling treatments of this nature. Alternatively, production conditions may not have been conducive to the expression of treatment effects. More vigorous treatments involving longer pre-treatment or more extreme temperatures might produce more dramatic results. Most treatments were already approaching the practical limit imposed by the need to handle the seed without excessive damage to the sprouts.

Table 33. Influence of seed handling regimes on yields and tuber size distribution of Shepody seed potatoes (average 1996-1998).				
	Yield, t/ha			Average tuber wt
	Total	Medium	Drop seed	g
Green Sprouted	42.8	34.0 (80)	3.1 (7)	218
Short Term Aged	43.4	34.8 (80)	3.1 (7)	220
Long Term Aged	38.6	31.0 (81)	3.7 (10)	185
No Aging (Whole)	40.4	32.8 (81)	3.7 (10)	201
No Aging (Cut)	35.0	27.4 (81)	3.1 (10)	187
LSD (0.05)	7.8	6.5	1.1	28
	Yield, Cwt/ac			Average tuber wt
	Total	Medium	Drop seed	oz
Green Sprouted	381	303 (80)	28 (7)	7.8
Short Term Aged	391	310 (80)	28 (7)	7.9
Long Term Aged	344	276 (81)	33 (10)	6.6
No Aging (Whole)	360	292 (81)	33 (10)	7.2
No Aging (Cut)	312	244 (81)	33 (10)	6.7
LSD (0.05)	70	58	10	1.0

Values in brackets represent the % of the crop falling into each size category

Shepody and Norkotah planting/harvest date trial

Seed growers attempting to control tuber size by shortening the growing season, have the option of planting late or of harvesting early.

This study examined yields and tuber size distribution for Shepody and Russet Norkotah potatoes grown for three different 90 day intervals.

The trials were conducted in Saskatoon on the Plant Sciences Department Potato Research Plots. Elite III single cut seed was planted in mid-May, late May or mid-June for harvest 90 days later (mid-Aug, late Aug or mid-September). Plots were irrigated once soil water potentials reached -60 kPa. Standard crop management practices were employed. The trials were arranged in a randomized complete block design with four replicates. The cultivars and irrigation treatments were managed in separate trials. The crop was managed, harvested and graded as previously described.

1996 Results

For both cultivars, the growing season running from late May to late August produced substantially (20-54%) higher yields of medium or marketable size tubers than either the earlier or later regimes (Table 34). The degree by which yields from the late May to late August regime exceeded the other options was unexpectedly large. The cold and wet spring conditions could have contributed to the poor performance of the early regime, atlhough conditions did not improve significantly until after all three plantings were well established.

1997 Results

The earliest planting/harvest combination produced the highest yields of large and medium size tubers for the Norkotahs. The middle combination was optimal for the Shepodys (Table 35). Yields of drop sized seed and average tuber size were not influenced by changes in planting/harvest dates.

The results from the trial can be attributed to the exceptionally hot and dry conditions experienced from July through mid-August of 1997. Under irrigated conditions, this heat was favourable to canopy development resulting in superior yields for the first and second planting combinations.

Table 34. Yield and tuber size distribution for Russet Norkotah and Shepody potatoes grown for three different 90 day intervals during the 1996 season.

	Total		Medium		Drop		Avg. Wt.	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	g	oz
Russet Norkotah								
mid-May to mid-Aug	36.0 ab	321 ab	30.6 ab	273 ab	4.5 a	40 a	159 a	5.7 a
late May to late Aug	43.4 a	387 a	34.6 a	309 a	5.4 a	48 a	176 a	6.3 a
mid-June to mid-Sept 15id-	34.6 b	308 b	27.2 b	243 b	4.6 a	41 a	168 a	6.0 a
Shepody								
mid-May to mid-Aug	25.0 b	223 b	18.6 b	166 b	5.1 a	45 a	130 c	4.6 c
late May to late Aug	34.3 a	306 a	27.6 a	246 a	4.1 b	36 b	156 b	5.6 b
mid-June to mid-Sept 15id-	29.0 b	259 b	24.8 a	221 a	2.6 c	23 c	186 a	6.6 a

For each cultivar, values within columns followed by the same letter are not significantly different.

Table 35. Yield and tuber size distribution for Russet Norkotah and Shepody potatoes grown for three different 90 day intervals during the 1997 season.

	Total		Medium		Drop		Ave. Weight	
	t/ha	cwt/ac	t/ha	cwt/ac	t/ha	cwt/ac	g	oz
Russet Norkotah								
mid-May to mid-Aug	47.8 a	426 a	38.5 a	343 a	3.0 a	26 a	209 a	7.5 a
late May to late Aug	35.0 b	312 b	29.8 b	265 b	2.2 a	20 a	209 a	7.5 a
mid-June to mid-Sept	33.2 b	296 b	27.6 b	246 b	3.2 a	29 a	212 a	7.6 a
Shepody								
mid-May to mid-Aug	17.4 b	155 b	12.3 b	109 b	2.2 a	20 a	150 a	5.4 a
late May to late Aug	28.2 a	251 a	22.8 a	203 a	2.2 a	20 a	178 a	6.4 a
mid-June to mid-Sept	18.9 b	168 b	14.8 b	132 b	2.8 a	25 a	155 a	5.5 a

For each cultivar, values within columns followed by the same letter are not significantly different.

1998 Trial

The middle planting/harvest combination produced the highest total yields for Norkotah, with a large proportion of the crop reaching the oversize category. The latest planting/harvest combination produced the highest proportion of drop-size seed tubers. For Shepody, the latest planting/harvest combination produced significantly lower yields of medium and large sized tubers; but again, late planting increased yields of drop-sized seed. The average size of the tubers for Shepody decreased progressively as the time of planting/harvest was delayed (Table 36).

Table 36. Yield and tuber size distribution for Russet Norkotah and Shepody potatoes grown for three different 90 day intervals during the 1998 season.

	Total		Medium		Drop		Ave. Weight	
	t/ha	Cwt/ac	t/ha	Cwt/ac	t/ha	Cwt/ac	g	oz
Russet Norkotah								
mid-May to mid-Aug	27.7 b	247 b	24.4 a	218 a	2.6 b	23 b	183 a	6.5a
late May to late Aug	35.8 a	319 a	28.6 a	255 a	2.2 b	20 b	199 a	7.1a
mid-June to mid-Sept	30.8 ab	274 ab	25.5 a	227 a	4.2 a	37a	180 a	6.4a
Shepody								
mid-May to mid-Aug	25.4 a	226 a	12.3 b	109 b	2.0 b	18 b	163 a	5.8a
late May to late Aug	28.7 a	256 a	22.8 a	203 a	3.3 ab	29 ab	151 a	5.4a
mid-June to mid-Sept	13.4 b	119 b	14.8 b	132 b	4.1 a	36 a	111 b	4.0b

For each cultivar, values within columns followed by the same letter are not significantly different.

The 1998 growing season was exceptionally dry from planting through late July. When irrigation was available, the heat was favorable to canopy development. Yields for Norkotah were largely unaffected by the planting/harvest date. By contrast, in the slower developing Shepody at the latest planting/harvest combination produced exceptionally poor yields. Although growing conditions were generally favorable throughout the development of this treatment, it was exposed to high populations of Colorado Potato Beetles (CPB). The defoliation caused by the beetles may have contributed to the poor showing of the late planted treatment. Populations of CPB in 1998 were much higher than in previous test years.

Summary

The potential productivity of any planting/harvest date combination is determined by the conditions prevailing during key developmental periods. For example, it is crucial to avoid timing tuber set and bulking during periods of drought or heat stress. Unfortunately, weather conditions are inherently unpredictable. In the three years of trials none of the planting/harvest combinations tested completely avoided problems with adverse conditions at tuber set. One obvious concern for late planted crops under both dryland and irrigated conditions is the increased potential for damage by insects such as Colorado Potato Beetles and by the aphids responsible for spreading viral diseases. Populations of both pests tend to increase as the growing season progresses, placing the late planted crop at increased risk for damage.

Processing Potato Agronomy

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

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

Progress: *Year one of three*

Location: *Saskatoon*

Objective: *To develop production practices which enhance yield and quality of Saskatchewan grown seed potatoes. This series of studies examined the impact of top kill timing and method on yield and processing quality of several varieties of potatoes under Saskatchewan growing conditions.*

Vine kill and yield as a function of time after top kill

Trials were conducted on the Plant Sciences Department Potato Research plots located in Saskatoon. Seed of Russet Burbank, Ranger Russet and Russet Norkotah was planted in mid-May. The crop was irrigated whenever soil water potentials fell below -60 kPa. In early September, the desiccant Reglone (diquat) was applied at 1.0 l/ac in 120 l/ac of water. The plots were sprayed in the evening to maximize efficacy of the product. Seven days after the initial application of top killer, a second application was made (0.75 l/ac). The crop was harvested at specific intervals after top killing with a small plot harvester and graded into size categories (small = < 44 mm diam., medium = 44 to 88 mm diam., and oversize = > 88 mm diam.). Table stock yields included the medium and oversize categories while the seed category included the pooled yield of small and medium size tubers.

Timing of harvest:

a) Fresh harvest (September 3) - this approximates the typical time of top kill for seed and table potatoes in Saskatchewan.

b) Top-Kill + 14 days (September 17) - 10-14 days after top killing represents the earliest growers can typically expect to harvest after top killing.

c) Top-Kill + 21 days (September 24) - by this point, growers expect that the crop should be ready to harvest. Any further delay increases the risk of frost damage.

One third of the plot was harvested at each interval. The plots for each harvest were 8 m (25 ft) long with four replicates of each treatment arranged in a randomized complete block design. Three plants in each replicate for each cultivar were used to determine the moisture content of the vines just prior to each harvest.

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Results

Despite the differences in canopy size and vigour at the time of top kill, vine moisture content and yields of the three cultivars tested responded similarly as time after top killing increased (Table 37). At 14 days after top killing, the vine moisture content had fallen by only 17% (Table 37). The vines were still sufficiently green at this time that harvesting was difficult. By 21 days after treatment, the vine moisture content had dropped to 24%. Harvest proceeded smoothly once the vines had dried to this degree.

Yields of medium size tubers increased substantially as the time from top killing increased. The extent of this increase was uniform for the three varieties tested.

Table 37. Changes in vine moisture content and yield with time after top killing for three varieties of potatoes.

	Vine Moisture Content (%)	Tablestock		Seed	
		t/ha	Cwt/ac	t/ha	Cwt/ac
Top Kill + 0 Days	91	35.8	319	31.7	282
Top Kill + 10 Days	73	41.2	367	37.3	332
Top Kill + 20 Days	24	45.2	403	41.4	369
LSD (0.05)	6	7.4	66	6.6	59
Russet Norkotah	60	52.6	469	49.2	430
Ranger Russet	64	37.7	336	34.7	309
Russet Burbank	63	33.6	300	28.3	252
LSD (0.05)	NS	7.2	64	6.6	59

Excellent growing conditions, coupled with abundant fertility and moisture, caused all the varieties to produce a large, healthy and therefore difficult to kill canopy. Temperatures in September were above normal which would favour drying of the vines. Precipitation levels were also above normal which would slow vine die back. Fall frost also typically helps in top killing, but in 1998 there was no frost until early October. Drying of the canopy was limited at 10 days after top killing, yet this is the standard interval used by growers to develop their harvest schedule. Delaying harvest until three weeks after top kill insured adequate vine desiccation, but increased the risk of frost damage. The extended period of tuber bulking caused by the slow die back of the tops maximized yield potentials in this trial. Although this increase in yields was beneficial, it came at a substantial risk of increased frost damage. Ideally growers need to combine a delayed harvest with a rapid method of top kill which is effective irrespective of the crop vigour and prevailing conditions.

The yield increase observed following top killing in this trial was substantially greater than expected.

Changes in yields and processing quality after chemical top killing for four potato varieties at four dates

The previous trial indicated the potential for significant increases in yields from the time the top killer is applied through until harvest. The crop was top killed at four dates to determine if the stage of crop maturity and prevailing weather conditions influence changes in yield and processing quality.

Trials were conducted in Saskatoon using Russet Burbank, Ranger Russet, Shepody and Russet Norkotah. The crop was top killed on August 7, August 21, September 8 or September 22.

September 8 approximates the standard date for chemical top kill of potatoes in Saskatchewan. On each date, half of the test plot was sprayed with the standard chemical desiccant Reglone (diquat) applied at 1 l/ac using a ground sprayer in 120 l/ac of water. The plots were sprayed in the evening to maximize efficacy of the product. Seven days after the initial application of top killer, a second application was made (0.75 l/ac). The other half of the plot was top killed by mechanical removal of the vines at or near the soil surface. This treatment fixed yields at the instant of top kill. The plots were harvested once the tops in the desiccant treated plots had died back (2-3 weeks after the top killing treatment) using a small plot harvester. The crop was graded into size categories (small = < 44 mm diam., medium = 44 to 88 mm diam., and oversize = > 88 mm diam.). Table stock yields included the medium and oversize categories while the seed category included the pooled yield of small and medium size tubers. Fry colour, texture and uniformity were evaluated using samples stored for 6 weeks at 4°C after harvest.

This trial evaluated the relative changes in yields and processing quality which occurred following chemical top kill for four processing varieties

Results

The four cultivars responded similarly to the top killing treatments. The data for Russet Burbank is presented. The two week period allowed for dry back of the tops following application of the desiccant was just barely adequate in all cases. On average, marketable yields increased by 25% from the time of application of the top killer until harvest two weeks later. This effect was consistent across harvest dates (Figure 4). This yield increase was due more to an increase in average tuber size rather than an increase in tuber numbers following top kill (Figure 5). Specific gravities did not change significantly after top killing. The fry colours for the chemically desiccated crop were significantly better than when the vines were mechanically removed.

Flailing appears to represent a higher yielding option than chemical desiccation where long season cultivars are grown in areas with a limited production season.

Weather conditions and management practices employed in this trial combined to produce a difficult-to-kill canopy. In the two weeks it took for the tops treated with chemical desiccants to die back adequately, the crop continued to support tuber bulking. By contrast, flailing the tops stopped bulking instantaneously. Yields for the chemically desiccated crop were consequently higher than for a crop flailed on the same date. Since a flailed crop is actually ready for harvest immediately, the flailing treatment can be delayed relative to chemical top kill. This can result in substantial yield advantage over chemical top kill. For example, the crop chemically desiccated on August 21, gained 4 t/ha (88 Cwt/ac) in weight by September 8 at which time the tops had dried enough to allow harvest. During this two week period, the non-treated crop gained 9 t/ha (198 Cwt/ac).

When evaluating the relative merits of chemical versus mechanical top killing, a range of additional factors must be considered beyond basic yields:

a) cost in time and equipment
b) impact on disease levels
c) impact on ease of harvest (stolon removal)
d) storage characteristics of the crop.

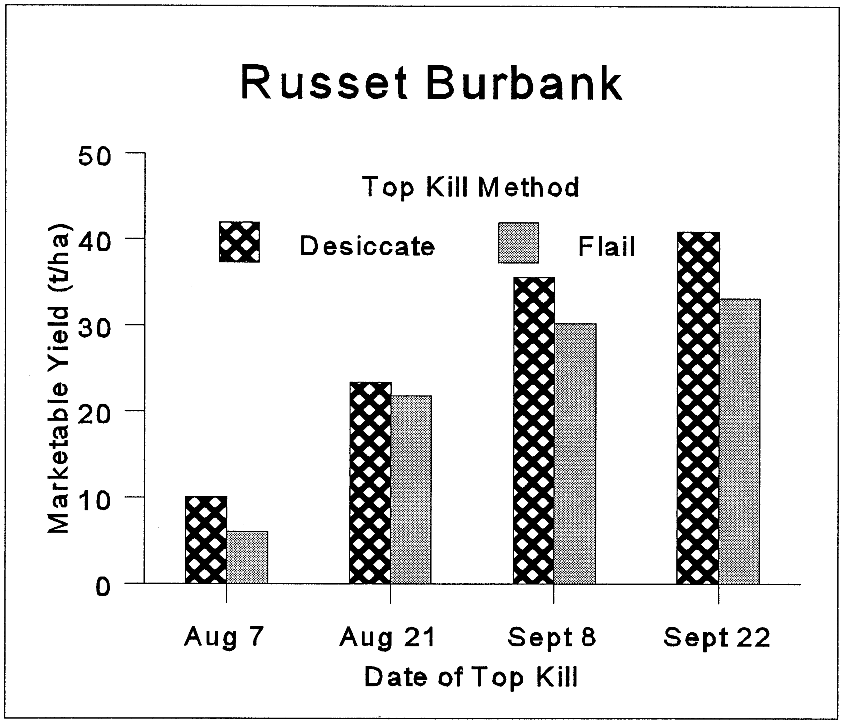

Figure 4. Effect of time and method of top-killing on marketable yield of Russet Burbank potato.

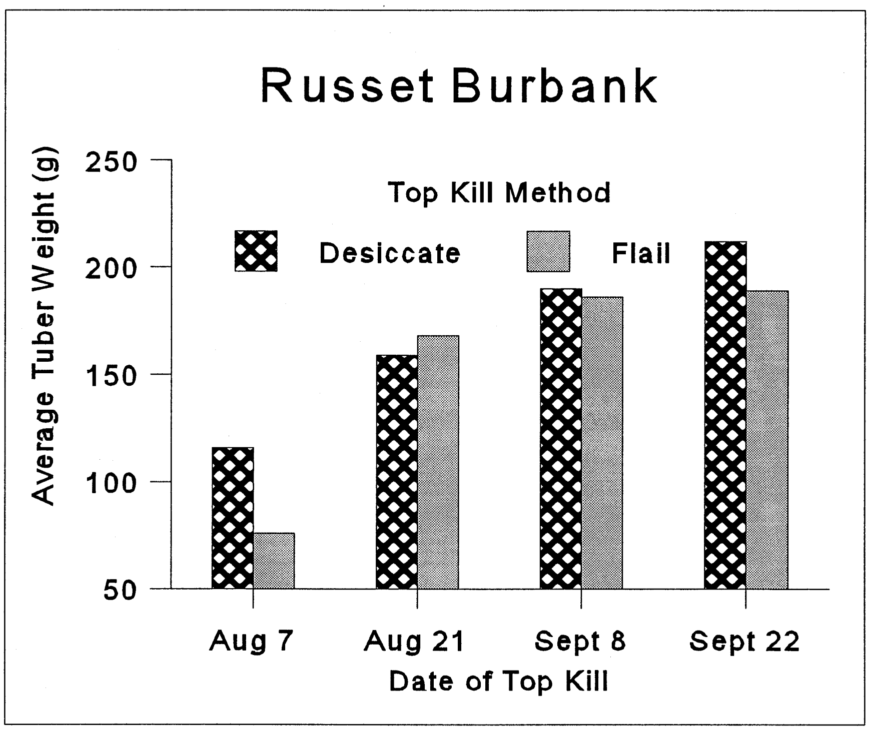

Figure 5. Effect of time and method of top-killing on average tuber weight of Russet Burbank potato.

Agronomics of New Potato Cultivars

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

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

New Red-Skinned Cultivars

Progress: *Year one of three*

Location: *Saskatoon*

Objective: *To evaluate the agronomic characteristics and management requirements of newly released cultivars of interest to Saskatchewan's potato industry.*

Cultivar characteristics

Norland is the standard red skinned variety on the Canadian Prairies. It is early maturing with excellent yields of fairly uniform tubers. Norland tends to fade from red to pink during storage.

NorDonna is a newly released North Dakota variety with very dark red skin. NorDonna is slow maturing and may lack the yield potential of Norland.

Cherry Red is a Colorado variety that is exceptionally red and holds its colour well. This variety may be too slow to mature for local growing conditions.

Trials were conducted on the Plant Sciences Potato Research plots located in Saskatoon using standard production practices for commercial potatoes. The crop was seeded mid-May in rows 1m (3 ft) apart. Irrigated plots were watered once soil water potentials fell below -60kPa. Typically,
2.5 cm (1 in) of water was applied at each irrigation. The dryland plots relied solely on rainfall. Yields were evaluated at 90 and 120 days after planting. At both harvests, the crop was graded into size categories: Small (< 44 mm), medium (44 to 88 mm), and oversize (> 88 mm diameter). Table stock yields included the medium and oversize categories while the seed category included the pooled yield of small and medium size tubers.

Results

The crop canopy for NorDonna was more uniform than for Norland but was slower to establish. While the Norland crop had senesced by early September, the NorDonna crop was still growing vigorously at top kill in mid-September. The growth habit of Cherry Red was intermediate between the two other cultivars.

The Norland crop canopy in the dryland plots was substantially larger than for the other two cultivars, suggesting greater drought tolerance.

Yields under irrigation averaged over three cultivars and two harvest dates exceeded those on dryland by three fold (Tables 38a and 38b). Norland was the highest yielding cultivar irrespective of harvest date or moisture treatment. NorDonna performed poorly while

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Cherry Red was intermediate between Norland and NorDonna. Increasing the plant population by reducing the in-row spacing had little effect on yields when moisture was limiting. When moisture was abundant, yields progressively increased as the in-row spacing narrowed.

Performance of advanced potato breeding lines

This project evaluates the most promising cultivars generated by the Agriculture Canada Potato Breeding Program at Lethbridge (Dr. D. Lynch), or by other breeders, for potential licencing and/or market demand (Table 39). Trials are conducted at the University of Saskatchewan, at the Saskatchewan Irrigation Diversification Centre, and in commercial potato fields following standard commercial production practices. In the commercial fields the test cultivars are grown in large blocks (rows running the length of the field). The test cultivars are compared to industry standards for; a) time of emergence and stand quality, b) incidence of disease and crop vigor, c) early yield - 90 days after planting, and d) main yield - 120 days after planting. Samples are placed into commercial storage and are recovered at intervals during the storage season for quality evaluation.

At harvest, and at intervals during storage, the crop is evaluated for:

a) physical damage - bruising, shattering, skinning, shrinkage, sprouting
b) appearance - color, skin texture
c) taste and appearance following baking and boiling
b) sugar content and composition
c) specific gravity.

Table 38a. Yield of red-skinned potato cultivars harvested 90 days after planting.

	Tablestock, t/ha				Seed, t/ha				Avg. Tuber Wt., g			
	15 cm	25 cm	35 cm	L/Q*	15 cm	25 cm	35 cm	L/Q	15 cm	25 cm	35 cm	L/Q
DRYLAND												
Cherry Red	8.1	8.3	7.6	NS	12.5	11.3	11.6	NS	72	118	78	Q
Norland	13.2	10.5	8.8	NS	19.9	16.1	13.1	L	82	81	76	NS
NorDonna	0.2	1.9	0.9	NS	2.4	4.0	4.6	NS	29	56	34	NS
LSD 0.05	**4.9**	**4.9**	**6.5**		**5.3**	**5.8**	**7.3**		**13**	**55**	**28**	
IRRIGATED												
Cherry Red	39.2	34.6	31.2	L	39.8	31.5	27.5	L	166	182	204	L
Norland	50.5	54.8	43.3	Q	48	45.9	34.4	L,Q	185	208	210	L
NorDonna	16.9	11.7	14.8	NS	22.8	17.4	18.4	NS	116	78	106	Q
LSD 0.05	**5.8**	**6.3**	**7.2**		**5.8**	**3.0**	**6.2**		**33**	**22**	**24**	
FINAL HARVEST - 120 DAYS												
DRYLAND												
Cherry Red	11.4	7.7	10.8	Q	15.7	11.5	13.8	NS	101	83	96	Q
Norland	15.5	15.6	14.8	NS	20.4	19.7	18.3	NS	107	117	113	NS
NorDonna	2.0	4.2	3.6	NS	6.2	8.5	6.6	NS	56	64	80	L
LSD 0.05	**7.7**	**3.6**	**4.4**		**7.1**	**4.7**	**4.9**		**28**	**28**	**17**	
IRRIGATED												
Cherry Red	56.7	48.3	39.2	L	45.1	36.7	29.5	L	187	241	251	L
Norland	70.4	56.7	56.6	L	55.6	46	40.8	L	216	220	234	NS
NorDonna	38.3	34.4	41.5	NS	41.2	34.8	38.8	NS	133	148	177	L
LSD 0.05	**11.1**	**10.9**	**10.3**		**7.4**	**9.2**	**7.8**		**60**	**52**	**25**	

*Linear (L) or Quadratic (Q) relationship between variable and in-row spacing (P=0.05);
NS = not significant

Table 38b. Yield of red-skinned potato cultivars harvested 90 days after planting.												
	Tablestock, cwt/a				Seed, cwt/a				Avg. Tuber Wt., oz			
	6 in	10 in	14 in	L/Q*	6 in	10 in	14 in	L/Q	6 in	10 in	14 in	L/Q
DRYLAND												
Cherry Red	72	74	68	NS	111	100	103	NS	2.5	4.1	2.7	Q
Norland	117	94	78	NS	177	143	117	L	2.9	2.9	2.7	NS
NorDonna	2	17	8	NS	21	36	41	NS	1	2.0	1.2	NS
LSD 0.05	**35**	**44**	**58**		**47**	**51**	**65**		**0.5**	**2.0**	**1.0**	
IRRIGATED												
Cherry Red	350	308	278	L	355	280	245	L	5.9	6.4	7.2	L
Norland	450	488	386	Q	428	409	306	L,Q	6.6	7.3	7.4	L
NorDonna	150	104	132	NS	203	155	164	NS	4.1	2.7	3.7	Q
LSD 0.05	**52**	**56**	**64**		**5.8**	**27**	**55**		**1.1**	**0.8**	**0.8**	
FINAL HARVEST - 120 DAYS												
DRYLAND												
Cherry Red	101	69	96	Q	140	102	123	NS	3.6	2.9	3.4	Q
Norland	138	139	127	NS	181	175	163	NS	3.8	4.1	4.0	NS
NorDonna	18	37	32	NS	55	75	59	NS	2	2.3	2.8	L
LSD 0.05	**68**	**32**	**39**		**63**	**42**	**44**		**1**	**1.0**	**0.6**	
IRRIGATED												
Cherry Red	505	430	350	L	402	327	263	L	6.7	8.5	8.8	L
Norland	627	505	505	L	495	410	363	L	7.7	7.7	8.2	NS
NorDonna	341	307	370	NS	367	310	346	NS	4.8	5.2	6.2	L
LSD 0.05	**99**	**97**	**92**		**66**	**82**	**70**		**2.1**	**1.8**	**0.9**	

*Linear (L) or Quadratic (Q) relationship between variable and in-row spacing (P=0.05);
NS=not significant

Table 39. Comparisons between new potato cultivars and industry standards.

	LONG-TERM AVERAGE		1998 RESULTS								
			Marketable Yield, cwt/ac		Specific Gravity						
	Marketable Yield, cwt/ac	Specific Gravity	Early	Final	Early	Final	Uniformity	Eye Depth	Skin Colour	Flesh Colour	Scab %
RUSSETS											
Norkotah	318	1.081	302	416	1.082	1.086	Good	M	Rus	OW	15
FV9649-6	---	---	296	320	1.086	1.081	Good	S	Rus	OW	10
REDS											
Norland	338	1.072	362	458	1.078	1.076	Medium	M	Red	W	10
AV8081-10	---	---	336	488	1.071	1.078	Poor	M	L. Red	OW	15
ND 2937-3	---	---	344	434	1.07	1.084	Good	M	D. Red	OW	20
ND 3001-2	---	---	260	398	1.069	1.081	Medium	M	D. Red	OW	25
VO498-1	---	---	320	422	1.065	1.064	Medium	M	Red	W	15

Eye Depth: S=Shallow, M=Medium
Skin Colour: D.Red=Dark red, L. Red=Light Red, Rus=Russet
Flesh Colour: W=White, OW=Off White
Early: 90 days after planting
Final: 120 days after planting

Summary

Fresh Market Russets (check variety: Russet Norkotah)

FV 9649-6 — A fresh market russet type with shallow eyes. Resistant to hollow heart, to after-cooking discoloration, and to sloughing.

Reds (check variety: Dark Red Norland)

AV8081-10 — An early, light red variety with shallow eyes. Resistant to after-cooking discoloration. Moderately sensitive to scab and early blight.

ND2937-3 — A round/oval dark red skinned line with shallow eyes. Moderate after-cooking discoloration.

ND3001-2 — Early oval red skinned line with moderately shallow eyes. Resistant to after-cooking discoloration.

VO498-1 — Red skinned mid-season table potato.

Table 40. Attributes of potential potato cultivars

	Positive	Neutral	Negative
FV 9649-6	uniformity cooking quality		final yield
AV8081-10	early and final yields		light color, cracking, poor flavor, sensitive to scab, elongated shape
ND2937-3	uniform size and shape color at harvest	yield	sensitivity to scab
ND3001-2		uniformity resistance to scab color	yield cracking
VO498-1		scab resistance color yield under irrigation	poor yield on dryland

Dormancy Management in Seed and Table Potatoes Phase II

K. Tanino[1], M. Bandara[1], D. Waterer[1], J. Wahab[2], P. Dyck[3]

***Progress:** Final year of two*

***Objective:** To examine the potential for utilizing carvone extracted from locally grown caraway and dill seeds and for using various plant growth regulators [Abscisic acid (ABA), methyl jasmonate (MJ), GA_3, paclobutrazol and Na-salt of NAA (αNaphtalic acetic acid)] as a means of inhibiting sprout growth in table potatoes and extending or breaking dormancy in seed potatoes. Treatments with CIPC and maleic hydrazide were included to serve as standard treatments for extending dormancy in table potatoes.*

Effective suppression of sprout growth during storage is critical for cost-effective production of table, processing and seed potatoes. Treatment with CIPC is the standard means for sprout suppression in table and processing potatoes in North America. CIPC is presently under regulatory review due to suspected health problems associated with low level residues of the products and due to concerns that CIPC may be involved in depletion of atmospheric ozone. Excessive sprout growth during storage is a common problem, particularly when growers are storing cultivars with a short natural dormancy period. The effects of any sprout inhibition treatment must be reversible and without any adverse impact on the vigor of seed potatoes. This project examines the potential for utilizing extracts from caraway and dill seeds, the pure form of carvone (major active component of caraway and dill seed extracts), and natural and synthetic plant growth regulators (mainly for seed potatoes) as a means of regulating dormancy in seed potatoes and a means of inhibiting sprout growth in table and processing potatoes. Treatments with CIPC (post-harvest treatment) and maleic hydrazide (10 g/L; pre-harvest foliar-treatment) were included to serve as standard treatments for sprout suppression in table potatoes.

Norland and Snowden potatoes were treated with (+) carvone or methyl jasmonate (MJ) at 300 mg a.i./kg (0.005 oz a.i./lb) of potatoes, or 150 mg of carvone + 150 mg of MJ/kg (0.0025 oz of carvone +0.0025 oz of MJ/lb) of potatoes, in powder form, using perlite as a carrier. Treatments were imposed as repeated applications at about five weeks (first application) and ten weeks (second application) after storage at 9^{O}C.

In a separate study, tubers of both cultivars were treated with water (control), aqueous solutions of 2% or 4% (+) carvone, caraway seed extract containing 4% (+) carvone, 2% MJ, and 2% MJ + 2% (+) carvone at 5 mL of solution/kg of potatoes. Applications were made at five weeks and ten weeks after storage at 9^{O}C. Both CIPC and maleic hydrazide were found to be the most effective treatments for suppressing sprout growth in potatoes. Carvone and MJ applied as a powder, and carvone, caraway seed extract, or MJ applied as an emulsion effectively suppressed sprout growth of both cultivars for more than eight weeks relative to the controls.
In a separate study, Norland and Snowden potatoes were treated with (+) carvone vapour at 60

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or 100 mL/m^3, (1.6 or 2.8 oz/yard^3), caraway seed extract at 60 mL/m^3 (1.6 oz/yard^3), 30 ml of MJ + 30 mL of carvone/m^3 (0.8 oz of MJ + 0.8 oz of carvone/yard^3), or diallyl disulphide at 60 mL/m^3 (1.6 oz/yard^3), as vapours by exposing tubers to the compounds for four days. Applications were made after five weeks (first application) and ten weeks (second application) of storage at 9°C. The treatments effectively suppressed sprouting in both potato cultivars for at least eight weeks longer than the untreated controls. Diallyl disulphide vapour treatments appear to be the most effective sprout suppressant compared to the carvone and MJ treatments. Its effect was similar to that of CIPC and maleic hydrazide.

Field-grown Norland, Snowden and Russet Burbank potatoes were foliar-treated with ABA, MJ or jasmonic acid derivative (PDJ) (at 100 mg/L at early stolon initiation, and at 100 mg/L at mid bulk stage), paclobutrazol (at 450 mg/L at early stolon initiation, and at 1000 mg/L at mid bulking stage) or giberellic acid (at 200 mg/L at mid bulking stage) to examine the treatment effect on sprout behaviour in storage at 4°C. Both treated and untreated tubers of the three cultivars are still dormant and the investigation is in progress.

Integrated Control of Potato Common Scab

D. Waterer[1]

pH Effects

> ***Progress:*** *Final Report*
>
> ***Objective:*** *To develop an integrated strategy for common scab control through management of soil fertility, soil moisture and crop development.*

The common scab organism (*Streptomyces scabies*) prefers soil pH from 5.5 - 8.0, which corresponds to the pH of most Saskatchewan soils. This trial (1995-1997) examined whether scab could be controlled by shifting the soil pH without adversely affecting the crop. The soil pH in plots at Outlook and Saskatoon was altered by applying $CaCO_3$ or S to achieve a range of pH levels. The moderately scab resistant variety Norland was used as the test variety. Where possible, the Norland seed used at the Outlook site was heavily infested with scab in order to introduce adequate inoculum. Each test plot consisted of four 8 m (26 ft) long rows arranged in a randomized complete block design with four replicates. Standard production and irrigation practices were employed. The crop was harvested for yield and was graded. 100 tubers were evaluated for scab damage.

The pH treatments tested ranged from 6.5 to 9.0. Yields of marketable size tubers were similar at all pH levels at both sites in both years. There was only scattered scab on any of the treatments at the Outlook site, despite the fact that the seed was heavily infested. At the Saskatoon site in 1995 and 1996, the highest pH levels tested (pH 8.5 and 9.0) greatly reduced the incidence and severity of scab on the crop. There were few differences between the other levels tested (Table 41). In 1997 shifting the pH to 7.5 or 8.0 resulted in a substantial reduction in scab levels relative to the control (pH 8.5). Shifting the pH to higher levels by the application of lime worsened the scab situation.

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Adjusting the pH to 8.5 or 9.0 will reduce losses to scab without adversely affecting yields on Saskatchewan soils with a history of scab problems. Growers are cautioned that the availability of some soil nutrients begins to decline at these high pH levels and that all cultivars may not respond similarly to high pH levels.

Table 41. Influence of soil pH on grade out to excessive scab for Norland potatoes (Saskatoon 1995-1997).

pH	1995	1996	1997	Mean
	% Grade Out to Scab			
6.5	33	37	-	35
7.0	31	34	-	32
7.5	38	33	20	30
8.0	41	29	20	30
8.5	15	20	29	21
9.0	-	-	36	-
9.5	-	-	36	-

Horticultural Crops Program

Evaluation of Cool Season Vegetable Crops at Three Sites in Saskatchewan

D. Waterer[1]

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

Trials conducted in 1997 and 1998 evaluated the yields and quality of two cool season vegetable crops produced at differing locations across central Saskatchewan. The objective was to determine the suitability of each production area for anticipated expansion of the vegetable industry.

Progress: *Year two of three*

Location: *Saskatoon, Outlook, Nipawin*

Objective: *To evaluate the yield and quality of cabbage and carrots produced at three locations in Saskatchewan.*

The characteristics of the test sites were:

Outlook	***Saskatoon***	***Nipawin***
SIDC Field Research Station	Horticulture Field Research Station	Grindstone Market Gardens (Rod Peterson)
- *sandy loam soil* - *pH 8.0. E.C. 1.5 dS/m, with minimal shelter*	- *clay soil,* - *pH 6.9, E.C. <1.0 dS/m, with extensive shelter*	- *sandy loam soil,* - *pH 7.4, E.C. <1.0 dS/m*
This site is irrigated and has been cropped to vegetables for the last 4 years.	This site is irrigated and has been cropped to vegetables for 20 years.	This site has extensive shelter. Part of the site was irrigated and part was rainfed.

Carrot

This trial evaluated the yield and quality of Danvers, Nantes and Imperator carrots. Cultivars were selected based on superior performance in previous trials. The crop was seeded early May in twin rows spaced 15 cm (6 in) apart. Each plot was 8 m (25 ft) long and was replicated three times. No significant pest or disease problems were observed, except some Aster Yellows at the Nipawin and Saskatoon sites. Plots were sampled for yield and root quality in the third week of August and again in mid-October. The crop was graded for size, uniformity and freedom from defect. Samples were analysed for sugar content.

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The data for 1998 (Table 1) illustrates the trends observed in both seasons. Yields at all sites were above provincial averages (20 t/ha). Total yields at the final harvest were much higher than at the early harvest. Grade out was greater for the later harvest, consequently marketable yields were similar for the two harvests. Yields for the Saskatoon and Outlook sites were greater than in Nipawin at both harvests. Yields on dryland were poor in both years. Sugar levels generally increased as the crop matured, but the effect on flavour was inconsistent. There were no consistent differences in taste between trial sites. Sugar content of the irrigated crop in Nipawin was lower than for the other sites.

Table 1. Yield and quality characteristics for carrots grown at several sites in Saskatchewan in 1998.

Variety	Total t/ha		Marketable t/ha		Marketable %		Length cm		Taste 0-5[1]		Brix %[2]	
	90 d	120 d	90 d	120 d	90 d	120 d	90 d	120 d	90 d	120 d	90 d	120 d
Bolero	16.1	61.3	8.4	13.4	50.0	28.0	16.0	18.0	2.1	2.6	9.0	10.2
Carobest	19.9	56.6	11.1	22.6	55.0	38.0	20.0	20.0	1.8	1.8	9.0	9.4
Cheyenne	16.4	57.4	11.5	17.9	64.0	34.0	23.0	22.0	2.5	2.1	8.4	9.3
Choctaw	23.6	61.2	14.5	10.8	58.0	18.0	21.0	20.0	1.4	1.6	8.6	9.9
Eagle	25.9	67.6	18.6	15.9	68.0	23.0	20.0	23.0	2.2	1.6	8.7	9.4
Earlibird Nantes	25.7	53.0	19.2	19.3	71.0	37.0	15.0	16.0	2.5	3.0	8.3	9.2
Healthmaster	28.7	76.1	16.5	24.7	53.0	30.0	15.0	16.0	2.6	1.8	8.4	9.4
Kamaran	32.4	88.8	17.0	24.3	49.0	28.0	16.0	16.0	3.8	3.2	8.5	9.6
Nandrin	25.7	71.2	17.1	23.9	65.0	34.0	16.0	18.0	2.9	3.2	7.9	9.2
Presto	35.9	72.7	21.9	22.9	59.0	30.0	15.0	15.0	2.8	3.2	7.6	8.5
LSD	11.9	26.6	9.1	13.5	15.0	17.0	1.0	3.0	1.3	1.1	0.7	1.1
Nipawin Dryland	13.4c	37c	6.3c	7.2c	46b	20b	17b	16.0	2.3ab	2.3	8.8	10.3
Nipawin Irrigated	24.9b	95.7a	16.5b	15.7b	67a	17b	17b	18.0	3.0a	2.4	8.1	8.7
Outlook	30.6b	67.4b	20.3b	32.5a	66a	47a	18ab	20.0	2.2ab	2.2	8.7	9.6
Saskatoon	43.6a	64.6b	26.2a	29.1a	56b	44a	19a	21.0	2.1b	2.8	8.3	9.1
LSD	6.9	12.8	5.2	7.0	9.0	8.0	1.0	2.0	0.8	0.8	0.5	0.5

[1]Taste: 0 = poor, 5 = excellent

[2]Brix % = % sucrose dissolved in the water solution extracted from the carrots

Values within columns followed by the same letter are not significantly different (P = 0.05).

In 1997, there were no significant differences in yields between the carrot varieties tested. In 1998, 'Presto', 'Kamaran' and 'Healthmaster' produced the highest yields. Grade out for all varieties was high.

Cabbage

This trial evaluated earliness, yield and quality of several cabbage cultivars. Direct seeding was compared to planting 6-week old transplants. Twin rows of each cultivar were planted in early May. Trifluralin provided adequate early season weed control at the Outlook and Saskatoon sites, but was less effective at Nipawin. Looper pressure was heavy at all sites. Overhead irrigation was used to maintain soil water potential above -40 kPa throughout the season. The cabbage was harvested weekly through until mid-October, by which time growth had ceased. Heads were graded, weighed and measured. The density of the heads was evaluated on a 0-5 scale, with a score of 5 representing a very dense head.

Direct seeding produced a stand comparable to transplanting. 'Galaxy' produced a poor stand, while 'Rio Verde' and 'Storage #4' produced complete stands. The stand in Outlook was inferior to the other test sites. Averaged over cultivars and test sites, the transplanted crop reached the 50% harvest point 12 days earlier than the direct seeded crop (Table 2). The final harvest percentage was not improved by transplanting. Transplanting produced a slight increase in yields but had no effect on head quality.

In two years of trials, yields of carrots and cabbage were high at all three sites provided adequate moisture was available for the crop. Moisture stress delayed maturity and reduced yields but had little effect on crop quality. Transplanting cabbage accelerated crop maturity and increased yield while reducing production risk.

Crop maturity was delayed in Nipawin, especially when grown on dryland. Drought stress reduced the proportion of the crop that matured prior to freeze up. Yields were high at all irrigated sites.
'Cecile' provided the best combination of earliness and yield, coupled with good head density and a small core. Head size and density were lower in Nipawin than at the other test sites.

Table 2. Yield and quality characteristics for cabbage grown at three sites in Saskatchewan in 1998.

Variety	Stand %	Date to 50% Harvest	Yield t/ha	% Matured[1]	Head Wt. kg	Density[2] 1-5	Core/Head Ratio[3]
Bartolo	84	Oct. 21	37.6	62	1.9	3.7	0.54
Cecile	84	Sept. 12	55.0	75	2.3	3.9	0.42
Galaxy	66	Oct. 30	33.4	38	2.8	3	0.49
Greenstart	89	Aug. 16	47.0	97	1.6	3.8	0.46
Hinova	88	Oct. 15	53.1	64	2.6	3.6	0.48
Lennox	84	Oct. 19	42.7	56	2.3	3.9	0.52
Parel	88	Aug. 19	40.4	95	1.4	3.7	0.48
Rio Verde	95	Sept. 20	62.6	88	2.3	3	0.54
Storage #4	95	Oct. 24	44.8	66	2.1	4.1	0.53
LSD	9	11	10.2	14	0.3	0.3	0.02
Direct Seeded	84	Oct. 6	42.7	69	2.2	3.7	0.49
Transplanted	88	Sept. 24	49.7	73	2.1	3.6	0.50
LSD	4	5	4.8	6	0.1	0.1	0.01
Nipawin Dryland	86	Oct. 22	22b	47b	1.6c	3.5b	.49b
Nipawin Irrigated	89	Sept. 28	51.8a	79a	2.3b	3.4b	.53a
Outlook	80	Sept. 13	59.6a	80a	2.5a	3.8a	.47c
Saskatoon	89	Sept. 21	57.6ab	87a	2.3b	4a	.48bc
LSD	6	8	7.2	10	0.2	0.2	0.01

[1]% Matured: % of heads that were ready prior to season end
[2]Density: 1 = poor, 5 = excellent
[3]Core/Head Ratio is based on core height/head height

Commercial Vegetable Production Demonstration

B. Vestre[1], O. Green[1]

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

Progress: *Ongoing*

Location: *SIDC*

Objectives:
- *To produce selected vegetable crops on a commercial scale to determine suitability for the wholesale and retail markets.*
- *To determine costs of production and net returns for potential vegetable growers.*

Saskatchewan is approximately 7% self sufficient for 'in-season' fresh vegetables (based on unload data). This compares to 33% in Alberta and to 57% in Manitoba. The value of 'in-season' imports into Saskatchewan is about $20,000,000 annually. More than half of this originates from the U.S.A.

SIDC conducted the first commercial vegetable demonstration project in 1996. A three year program followed in 1997 to develop and demonstrate commercial production of pumpkin, slicing cucumber, pepper, cabbage and carrots. A second project was initiated in 1998 to evaluate and demonstrate production of cantaloupe, romaine lettuce, broccoli, cauliflower, celery and Brussels sprouts.

New production methods, such as drip irrigation, mulch, high and mini-tunnel, floating row cover, sequential planting and specialized equipment are being demonstrated. Such technologies are designed to increase yield, to extend the marketing period, to improve quality and uniformity, and to increase the productivity of vegetable crops. Cost of production analyses specific for Saskatchewan growing conditions are being developed to support the vegetable industry.

Pumpkin

Spirit pumpkin was direct seeded May 20 with a hand planter into new IRT (Infrared transmissible) mulch in a double row configuration (6 rows on 3 mulch rows) at a 90 cm (36 in) in-row spacing. Surface drip irrigation was used for watering. No mouse damage was observed in 1998 most likely a result of using new IRT mulch rather than re-using existing mulch.

The quality was excellent, with good size and uniform shape.....all were orange by shipping.

Mature orange pumpkin were observed as early as August 10 in spite of early hail damage. The pumpkins were cut September 23 to 25, were gathered September 28 with the use of a picking aid and were placed directly into pallet bins. The quality was excellent, with good size and uniform shape. Most were completely orange at harvest and all were orange by shipping. They were packed in 386 kg (850 lb) bins for shipment to the wholesale rket at an average selling price of $0.295/kg ($0.134/lb). The pumpkin yield was equivalent to 142 283 kg/ha (126 948 lb/ac). The gross return was $42 036/ha ($17,012/ac), resulting in a net return of $21 675/ha ($8,772/ac) on the basis of actual and estimated costs.

[1]SIDC, Outlook

Slicing Cucumber

Eight rows of 'Jazzer' cucumber were direct seeded on May 22 into four 137m (450 ft) IRT mulch rows in a double row configuration using a 60cm (24 in) in-row spacing. Drip irrigation was used.

Harvest commenced on July 23 and was concluded on September 22. In 1997, excessive disturbance of the vines resulted in abrasion and subsequent scarring of the young fruit. In 1998 the harvest crew was instructed to move the vines as little as possible when looking for cucumbers and to remove cucumbers with a minimal amount of vine disturbance. This resulted in less scarring and a product more acceptable to the wholesale market. The retain shelf life was inadequate, creating some marketing difficulty. Storage conditions need to be refined in order to provide a reasonable shelf life, and to maintain quality through to the consumer.

The cucumbers were marketed either as a 24 or a 36 count pack. An equivalent total of 5 799 24 count cases/ha (2,347cases/ac) were marketed at an average price of $5.36 per case. The gross return was equivalent to $31 063/ha ($12,571/ac). Approximately 20% of production was harvested and not sold due to the storage and marketing difficulties noted above.

Pepper

Two varieties of pepper, Valencia and Ultraset, were started as transplants in the greenhouse on April 16 and were field planted into IRT mulch using a waterwheel transplanter on May 25. There were six 137 m (450 ft) rows of each variety planted in a double row configuration on three mulch rows with drip irrigation installed under the mulch. One additional row was planted in a triple row configuration. In-row spacing was 30 cm (12 in) in both cases. Mini-tunnels were installed over the rows immediately following transplanting. The mini-tunnels were removed June 29 to July 3, at which time blossoming was well underway. An aphid problem was encountered, but a combination of greenhouse and field spraying controlled the infestation.

The quality was good to excellent. The Valencia variety proved to have an acceptable shape and size for the green retail market....

Harvest commenced on August 14 and concluded on September 17. An equivalent of 38 557 kg/ha (34,400 lb/ac) of fresh peppers were harvested and marketed through the wholesale trade as retail and chopper peppers. An additional 10 386 kg/ha (9,267 lb/ac) equivalent were harvested just before freeze up. These were cut, diced, blanched, packaged, frozen and sold for processing. Total pepper yield was equivalent to 48 942 kg/ha (43,667 lb/ac).

The gross return for the peppers sold fresh was equivalent to $48,441/ha ($19,604/ac) while the frozen diced peppers returned $10,383/ha ($4,204/ac) for a total gross return of $58,824/ha ($23,808/ac) equivalent. The average selling price for the fresh peppers was $1.257/kg ($0.57/lb). This was made up of an average of $0.794/kg ($0.360/lb) for green chopper grade peppers, $1.310/kg ($0.594/lb) for green retail quality, $1.742/kg ($0.790/lb) for red choppers and $2.601/kg ($1.18/lb) for red retail quality peppers. The gross return is a dependant upon the percentage of red peppers sold.

The majority were sold in a 25 pound pack, although some were sold as a 5 kg pack. The quality was good to excellent. The Valencia variety proved to have an acceptable shape and size for the green retail market but had poor red colour. Ultraset had an excellent red colour but poor shape and size for the green pepper market. The size of the red peppers must be larger to gain better market acceptance.

The frozen diced peppers were packed in 2 kg (4.4 lb) plastic bags with six per case. While the quality was acceptable, excess moisture retained in the frozen pack resulted in a reduced yield for the processor.

Cabbage

The cabbage variety 'Lennox' was grown both as transplants and direct seeded. The transplants were started April 16 and field planted May 15 with the waterwheel transplanter. Field seeding using a 'Stanhay' precision seeder was done May 15. Both trials were grown under sprinkler irrigation on 60 cm (24 in) rows with an in-row spacing of 45 cm (18 in).

The transplanted cabbage matured earlier with the majority being harvested on October 9. The direct seeded cabbage and the remaining transplanted cabbage were harvested October 20. The transplanted yield was equivalent to 56 228 kg/ha (50,166 lb/ac). The direct seeded yield was equivalent to 10 361 kg/ha (9,244 lb/ac). A severe infestation of flea beetles and root maggot damage may have contributed to the lower yield of the direct seeded plots despite insecticide applications.

The quality of the transplanted cabbage was superior to direct seeded cabbage, producing larger, heavier and more uniform heads.

Previous analysis in 1997 indicated that transplanted cabbage must return an additional $4 670/ha ($1,890/ac) to cover the added expenses of transplanting (based on a labour cost of $6.50/hr).

The average selling price for processing cabbage was $0.236/kg ($0.107/lb). The return for transplanted production was equal to $13 279/ha ($5,374/ac). The quality of the transplanted cabbage was superior to direct seeded cabbage, producing larger, heavier and more uniform heads.

Carrot

Pelleted seed of the Imperator carrot variety 'Carobest' was direct seeded on May 20 with a 'Stanhay' planter at 100 to 120 seeds/m (30 to 35 seeds/ft) into raised beds on 60 cm (24 in) centres. A wheel move sprinkler system was used for irrigation.

The quality was excellent with good size and colour, and a sweet flavor.

The carrots were harvested on October 7 and 8, washed, pallet binned and stored in the root cellar. The quality was excellent with good size and colour, and a sweet flavor. The marketable yield was equivalent to 44 754 kg/ha (39,930 lb/ac) of which 32 208 kg/ha (28,737 lb/ac) was graded and marketed as a Canada No. 1 consumer pack in 5 lb poly bags (10 per baler bag). The remaining 12 545 kg/ha (11,193 lb/ac) was moved for processing.

The average price received was $0.488/kg ($0.221/lb) for a gross return of $21 826 /ha ($8,833/ac).

Cantaloupe

Transplanted 'Alaska' and 'Earligold' cantaloupe were started in the greenhouse on April 27, were hardened and field planted on May 21 into four 137 m (450 ft) IRT mulch rows in a double row configuration (three rows of Earligold, one row of Alaska). The in-row spacing was 60 cm (24 in).

An additional mulch row was planted at the same time using Earligold transplants started May 11. Drip tube was used to provide irrigation. Floating row covers were installed on May 27.

The first fruit was harvested July 27 (Earligold) and July 28 (Alaska) from the earlier transplants. Fruit from the later transplants were not ready until August 10. Based on test strips, yields averaged 2 984 cases/ha (1,208 cases/ac) for Earligold and 1 614 cases/ha (653 cases/ac) for Alaska. Fruit weights averaged 1.287 kg (2.84 lb) for Earligold and 1.080 kg (2.39 lb) for Alaska. The highest test yield of Earligold was equivalent to 5 681 cases/ha (2,299 cases/ac). Cantaloupe are normally packed by 12, 15, 18 or 23 count per 40 pound case. The average selling price was $12.45 per case.

The quality of the cantaloupe at full slip was excellent with the sugar content about twice the level found in imported cantaloupe.

The quality of the cantaloupe at full slip was excellent with the sugar content about twice the level found in imported cantaloupe. Although the quality was excellent, there was resistance at the wholesale level since the shelf life of full slip cantaloupe is not sufficient to accommodate the normal routing through to the consumer. Identification of a unique Saskatchewan product along with in-store promotion and faster movement through the system will be required to establish a market for a quality Saskatchewan grown cantaloupe.

Broccoli

Sequential planting of broccoli (Arcadia) was attempted using both transplants and direct seeding. Sixty cm (24 in) rows with an in-row spacing of 30 cm (12 in) were used in both cases. The transplants were started April 15, were hardened and were field planted with a waterwheel transplanter on May 15. The first direct seeding was completed on May 15, a second seeding on June 3 and a third on June 26 using a 'Stanhay' precision planter. A wheel move sprinkler system provided irrigation.

Flea beetles were a serious problem despite appropriate insecticide applications. A root maggot infestation was severe enough to warrant spraying. Damage to the direct seeded broccoli decimated the stand to the point where harvest was not warranted. The transplanted broccoli were harvested July 22. The yield was equivalent to 257 cases (14 count) per hectare (104 cases/ac). This did not meet the expected yield of 3 850 cases/ha (1,550 cases/ac). The average return was $10.84/case.

The quality was excellent and was well received. Because case icing is required, and must be sufficient to last one week, a lack of adequate pre-cooling and icing facilities prevented the marketing of the entire production.

Cauliflower

Sequential planting of 'Serrano' cauliflower was attempted using both transplants and direct seeding. Sixty cm (24 in) rows with an in-row spacing of 45 cm (18 in) were used. Transplants started April 16 were hardened, and were field planted with a waterwheel transplanter on May 15. The first direct seeding was sown on May 15, a second on June 3 and a third on June 26 using a 'Stanhay'

Yields of up to 3 000 cases per hectare... of cauliflower should be achievable.

precision planter. A wheel move sprinkler system was used for irrigation.

Flea beetles were a serious problem despite appropriate insecticide applications. Root maggots were sufficiently severe to warrant spraying. Damage to the direct seeded cauliflower decimated the stand to the point where harvest was not warranted. The transplanted cauliflower were harvested on July 20, packed 9 count per case and shipped. A yield equivalent to 1 853 cases/ha (750 cases/ac) was achieved. Yields of up to 3 000 cases/ha of 12 count cauliflower (1,200 cases/ac) should be achievable. The average selling price was $12.00/case.

Leaf growth was insufficient to cover the curd to prevent discolouration of the curd prior to harvest. The result was that some of the cauliflower was not acceptable to the trade. Proper nutrient balance and adequate watering is required to ensure maximum vegetative growth to cover the developing curd. This keeps the curd white until harvest.

Romaine Lettuce

Romaine lettuce (Green Tower) was planted sequentially using both transplants and direct seeding. An in-row spacing of 23 cm (9 in) on 60 cm (24 in) rows was used. Transplants were started in the greenhouse on April 15, were hardened and field planted with the waterwheel transplanter in four 137 m (450 ft) rows on May 14. Direct seeding with a Stanhay seeder was done May 15 (8 rows) and June 3 (8 rows). A wheel move sprinkler was used for irrigation.

While the transplants did well, the emergence of the direct seeded lettuce was approximately 40%. Some re-planting was required. Browning of the leaf margins was noted during hot weather, indicating a calcium deficiency. Some bolting was also experienced.

An attempt was made to hydro-cool the lettuce immediately after harvest on July 13 (transplants) and August 18 (direct seeded). It was packed 24 count per waxed case and shipped to the wholesale market, returning an average $11.99 per case. An equivalent of 1 107 cases/ha (448 cases/ac) was marketable. A yield in the range of 3 000 cases/ha (1,200 cases/ac) should be feasible.

Celery

An observational plot of Utah 52-70 celery was grown from transplants started March 15 and field planted with the waterwheel transplanter on June 11. An in-row spacing of 30 cm (12 in) on 60 cm (24 in) rows was used. Irrigation was by overhead sprinkler.

The celery was harvested September 15, packed 24 count per case and shipped to the wholesale market. The quality was excellent. Projected yields are approximately 4 485 cases/ha (1,815 cases/ac). The selling price was $12.00 per case.

Brussels Sprouts

An observational plot of Brussels sprouts (Catskill Long Island) was grown from transplants started April 15 in the greenhouse. Hardened transplants were field planted on May 15 with the waterwheel transplanter on 60 cm (24 in) rows with an in-row spacing of 45 cm (18 in). The plants grew well despite a severe flea beetle infestation, although no harvestable sprouts were produced.

High Tunnel Demonstration Project

D. Waterer[1], B. Vestre[2]

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

Progress: *Year one of three*

Objective: *To evaluate high tunnel growing systems for high value horticultural crops under Saskatchewan growing conditions.*

Yield, crop quality and production economics of several high value horticultural crops grown under an innovative *high tunnel* system were compared with standard plasticulture techniques during the 1998 growing season. *High tunnels* are similar to low tunnels in design and function, except that; a) one high tunnel covers several rows, b) the high tunnels are wide enough to allow crop growth to full maturity under the tunnels, and c) the tunnels are tall enough to allow for most cultural practices, i.e. spraying, cultivation and harvesting to occur with the tunnels intact. Typical *high tunnels* are 5 m (16 ft) wide and 2.5 m (8 ft) high with the length determined by the field dimensions. The structure consists of aluminum arch ribs driven into the ground and covered with 6 mil polyethylene. There is no active heating or cooling system. Rolling up the sides and/or opening the end doors of the high tunnel provides both ventilation and access to the crop by pollinating insects.

1998 Trials

The trials were conducted at the Horticulture Science Field Research Station in Saskatoon and at the Saskatchewan Irrigation Diversification Centre, Outlook. The crops tested in Saskatoon were: Muskmelon, pepper, tomato and day neutral strawberry. In Outlook, pepper and melon were evaluated. Two cultivars of each crop were grown to test for differences in response to the high tunnel treatments. All crops were transplanted. Plants in the standard management plots were covered from transplanting until late June by tunnels constructed of clear perforated polyethylene (melon) or spun bonded polyester (pepper) installed over metal hoops. The tomatoes were not covered. The crops were harvested twice weekly once fruit reached maturity. Fruit were counted, weighed and graded for acceptability based on normal standards.

Harvesting of the standard management plots continued until the first killing frost (September 30) at which time all remaining fruit were harvested. Harvesting of the high tunnels was discontinued on October 26 at which time all plants inside the tunnel were dead or had effectively ceased fruit production.

General Observations

High Tunnel Structure: The high tunnels were easily erected with minimal construction skill or tools required. At the conclusion of the growing season, the structure was in good condition with no tears or obvious deterioration of the main plastic cover.

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[2] *SIDC, Outlook*

Management: On cloudless days, temperatures within the high tunnels rapidly jumped to alarming levels if the sides were left down. Raising the sides cooled the high tunnels rapidly. **The high tunnels provided about 3°C of frost protection only**, suggesting limited potential for extension of the growing season. Any aphids or thrips introduced on the transplants thrived in the continuously warm, humid conditions of the high tunnels. In Saskatoon, three rows of crop were grown within the 5 m (16 ft) wide high tunnel whereas only two rows were grown in Outlook. The more dense planting in Saskatoon had the potential to increase production per unit area but there were some problems associated with the dense planting: Working space was minimal once the plants matured (this made harvesting difficult) and damage to plants by worker traffic was intensified, particularly once harvest began. Staking the plants should be tested as a potential solution to these problems.

Cantaloupe:

Saskatoon: The growing conditions within the high tunnels promoted rapid vegetative growth of the melons. Flowering began 21 days earlier inside the high tunnels than in the standard regime. The first fruit matured 2-3 weeks earlier in the high tunnels than in the standard treatments (Figure 1). The time required for 50% of the fruit to mature was about one week less for the high tunnel than the standard treatment (Figure 1). Total yields of mature fruit of the variety Fastbreak was 15% greater in the high tunnels than for the standard treatment. For Earligold the yield advantage for the high tunnels was 23%. Fruit in the high tunnels were on average 10-20 % larger than on the outside. Fruit flavor and sugar content were comparable for fruit produced both inside and outside the high tunnels.

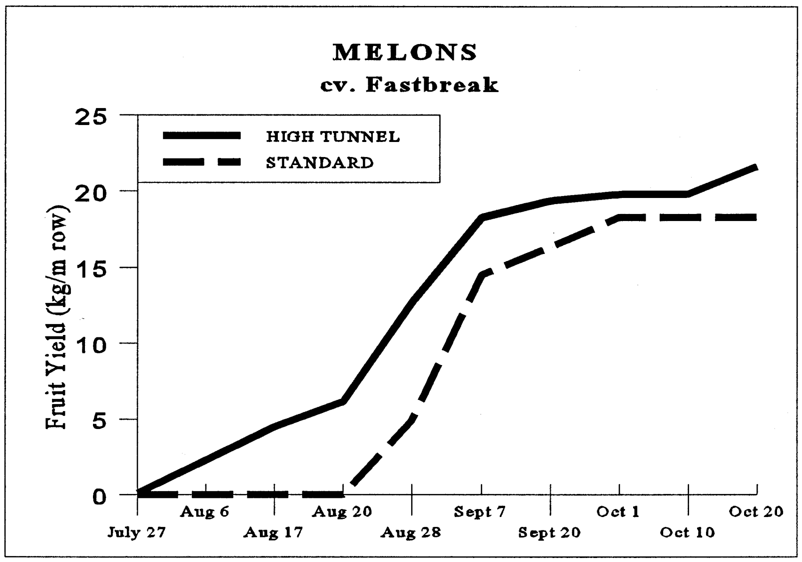

Figure 1. Melon yield in a high tunnel production system compared to standard practice, Saskatoon, Sask.

Outlook: Similar results were obtained in Outlook. Transplants for both the high tunnel and the standard treatment were started April 27. The fruit in the high tunnel matured approximately a week earlier than field grown melons. Transplants started on May 11 and field planted on May 21 matured 25 days later than in the high tunnel (Figure 2).

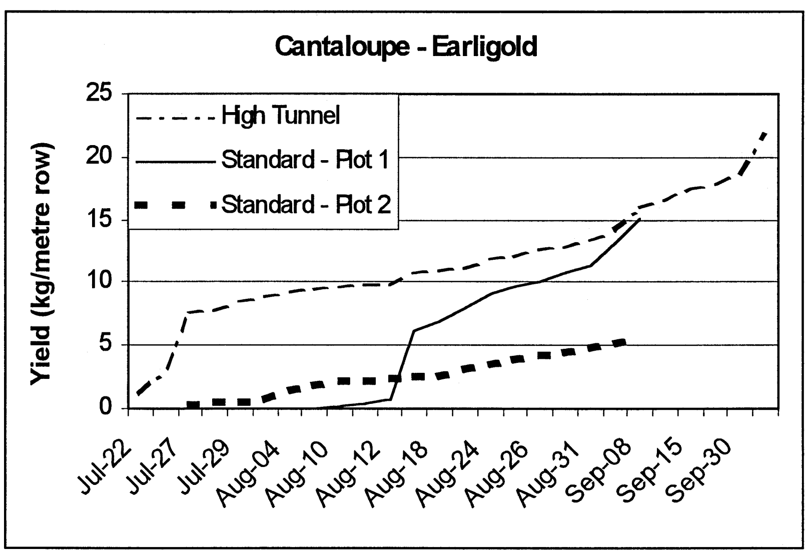

Figure 2. Melon yield in a high tunnel production system compared to standard practice, Outlook, Sask.

Yield of Earligold in the tunnel was 74% greater than the early field planting, and was 31% greater than the late field planting. Fruit produced in the tunnel averaged 1.52 kg (3.35 lb) compared to 1.11 kg (2.45 lb) for the early planted field plot, and 1.48 kg (3.25 lb) for the late field planting.

Tomato:

Saskatoon: Tomatoes inside the high tunnels survived -1°C outside temperatures on June 3. All the plants in the standard management treatment were frost damaged. Fruit set and fruit quality were excellent inside the high tunnels. The first fruit matured 2-3 weeks earlier in the high tunnels than in the standard treatments (Figure 3). The time required for 50% of the fruit to mature was about one week less for the high tunnel than the standard treatment. Frost terminated harvesting of the standard treatments in early October. Plants in the high tunnels were largely unaffected by frost through until the termination of the trial in late October. Total yield of mature fruit of the variety Spitfire was 33% greater in the high tunnel than for the standard treatment (data not shown). The yield advantage for Roadside Red in the high tunnels was 23% (Figure 3). Fruit of Spitfire grown outside the tunnel was significantly larger than inside. Fruit taste and overall appearance was comparable inside or outside the high tunnels. The incidence of fruit rot was lower inside the tunnels than outside.

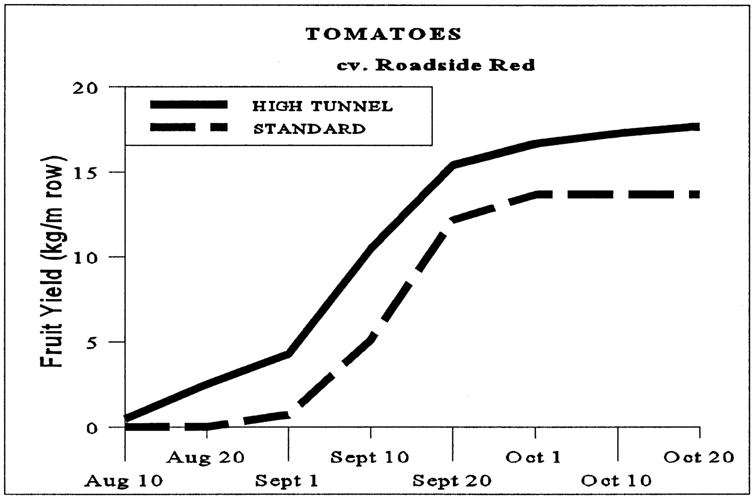

Figure 3. Tomato yield in a high tunnel production system compared to standard practice, Saskatoon, Sask.

Peppers

Saskatoon: The peppers in the high tunnels in Saskatoon were slow growing, chlorotic and brittle throughout the season. No definitive cause of this problem could be determined. This problem was not encountered for peppers grown within high tunnels at Outlook. The crop in open field plots was healthy. The first fruit matured 2-3 weeks earlier in the high tunnels than in the standard treatments (Figure 4). The time required for 50% of the fruit to mature was about one week less for the high tunnel than for the standard treatment (Figure 4). Yields of mature fruit were 73% greater in the high tunnels than for the standard treatment. Average fruit size was 17% larger on plants grown outside the tunnels. An unusually high proportion of the fruit in the high

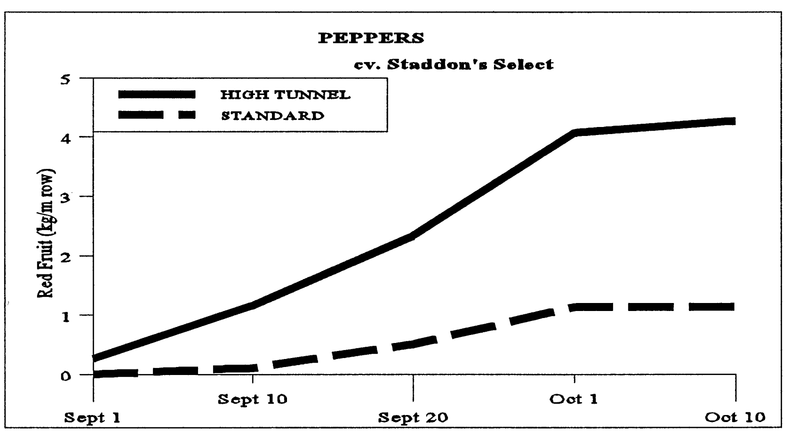

Figure 4. Pepper yield in a high tunnel production system compared to standard practice, Saskatoon, Sask.

tunnels was graded out either to blossom end rot or to sunscald. Fruit taste and overall appearance was comparable for fruit produced both inside and outside the high tunnels.

Outlook: Fruit matured approximately two weeks earlier in the high tunnel (Figure 5). The variety Valencia yielded 27% higher in the tunnel than for the standard treatment despite an aphid infestation in the tunnel. The difference in yield was due to a longer harvest period made possible by the frost protection afforded by the high tunnel. Harvest of field grown peppers ceased on September 15, while the last harvest date in the tunnel was October 9. Quality of fruit grown in the tunnel was good to excellent, with many fruit maturing to a red color.

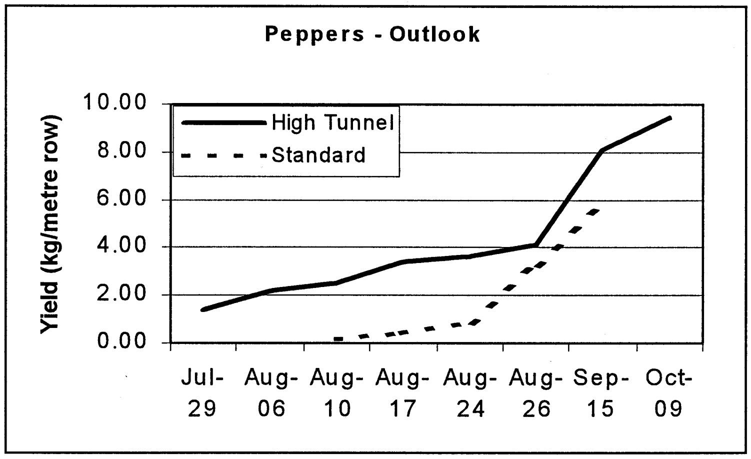

Figure 5. Pepper yield in a high tunnel production system compared to standard practice, Outlook, Sask.

Conclusion

Early yields of all crops were enhanced by the high tunnels, but the impact on total yields was crop specific. Selection of better adapted cultivars (heat tolerant and higher yielding) coupled with use of appropriate production practices (staking) should substantially improve the performance of crops grown within the high tunnels. The 1998 growing season was exceptionally favorable which would tend to minimize the benefits of micro-climate modification systems, including the high tunnels. Construction costs for the high tunnels are substantially higher than standard practices, but the structures appear sufficiently durable to last several seasons.

Outlook: Cantaloupe production from one row in the 4.3 m x 29 m (14 ft x 96 ft) high tunnel was 26 cases. The selling price for the produce was $12.45 per case providing a gross return of $325. Pepper yield from one row in the tunnel was to 278 kg (610 lb). The selling price was $1.29/kg ($0.57/lb) for a gross return of $360. Total value of the produce grown in the high tunnel was $685. Management practices which allow three mulch rows to be grown in the high tunnel should increase returns by approximately 30% without a significant increase in costs.

The cost of materials for the high tunnel was $1,945. This cost must be amortized over the life of the tunnel structure, and the life of the plastic cover in order to determine the annual cost of operating a high tunnel. The lifespan of the high tunnel, primarily the plastic cover, will be determined over the course of this demonstration.

Cultivar Evaluation Trials and New Cultivar Development for Native Fruit Species

R. St-Pierre[1], L. Tollefson[2], B. Schroeder[3]

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

Progress: *Ongoing*

Location: *SIDC, Outlook;*
PFRA, Indian Head;
Martin Neuhoffer, Yorkton

Objectives:
- *To collect agronomic and fruit quality data from previously established cultivar trials.*
- *To evaluate and select new cultivars suitable for production*

Native fruit crops, such as black currant, chokecherry, highbush cranberry, and pincherry have substantial potential to contribute to the diversification of Saskatchewan's agricultural economy. Native and traditional fruit cultivar evaluation trials were established previously under the Canada/Saskatchewan Partnership Agreement on Water-Based Economic Development (PAWBED). The following is a summary of the activity continued at the Saskatchewan Irrigation Diversification Centre (Outlook) under AFIF funding.

All native fruit crops tested at this site were planted in the fall of 1994 and the spring of 1995. During the 1998 season, survival and growth data were collected from black currant, chokecherry, highbush cranberry, and pincherry cultivar trials. Fruit yield and size data were collected from the black currant and chokecherry trials.

<u>Black Currant</u>

All cultivars performed equally well in terms of growth and survival. Differences in flowering time were observed between cultivars. The cultivar Consort flowered earliest and Willoughby flowered last. A significant amount of bee activity was observed during flowering. The average yield from this trial was greater than last year, however the cultivar Consort produced less fruit. Bush yields and fruit size were greatest for the cultivar Wellington (Table 3).

Table 3. Survival, shoot growth, and fruit yield of three black currant varieties.

Crop	Cultivar	Survival %	Shoot Growth		Bush Yield		Fruit Size (# fruit/cup)
			cm	in	kg	lb	
Black Currant	Consort	100	47.2	18.9	0.21	0.5	353
	Wellington	100	46.7	18.7	1.03	2.3	180
	Willoughby	100	46.4	18.7	0.2	0.4	250

[1] *Horticulture Department, U of S, Saskatoon*
[2] *SIDC, Outlook*
[3] *PFRA Shelterbelt Centre, Indian Head*

Chokecherry

The growth performance of all three cultivars was similar. Some fruit production was observed during the 1998 season but these plants are still several years away from full production (Table 4). Lee Red produced the largest fruit but yields were low relative to the cultivars Garrington and Yellow.

Table 4. Survival, shoot growth, and fruit yield of three chokecherry varieties.

Crop	Cultivar	Survival %	Shoot Growth cm	in	Sucker Production	Bush Yield kg	lb	Fruit Size (# fruit/cup)
Chokecherry	Garrington	100	38.9	15.6	2.2	0.24	0.52	266
	Lee Red	100	44.4	17.8	1.8	0.06	0.13	205
	Yellow	100	46.7	18.7	2.2	0.26	0.59	252

Highbush Cranberry

All three highbush cranberry cultivars grown performed similarly at this site (Table 5). No fruit were produced this year. This was probably the result of below-freezing temperatures during flowering.

Table 5. Survival and shoot growth of three highbush cranberry varieties

Crop	Cultivar	Survival %	Shoot Growth cm	in	Sucker Production
Highbush Cranberry	Alaska	100	19.0	7.6	2.2
	Phillips	100	21.6	8.6	0
	Wentworth	100	24.6	9.8	0

Pincherry

All cultivars are well-established at this site. The cultivar Lee #4 appears to have a dwarf habit. Fruit yields from this trial were too low to be harvested (Table 6).

Table 6. Survival and shoot growth of three pincherry varieties.

Crop	Cultivar	Survival %	Shoot Growth cm	in
Pincherry	Jumping Pound	100	40.8	16.3
	Lee #4	100	53.9	21.7
	Mary Liss	100	57.9	23.2

Development of Irrigation Guidelines to Enhance Saskatoon and Chokecherry Production and Fruit Quality

R. St-Pierre[1], L. Tollefson[2], B. Schroeder[3]

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

Progress: *Ongoing*

Location: *SIDC, Outlook;*
PFRA, Indian Head

Objectives:
- *To determine how the timing and quantity of irrigation affect growth, yield and fruit quality in saskatoons and chokecherries*
- *To define guidelines for irrigation of these crops.*

Scientifically established guidelines for irrigation of chokecherry and saskatoon are currently not available. Chokecherry and saskatoon irrigation trials were established previously at SIDC (Outlook) and the PFRA Shelterbelt Centre (Indian Head) under the Canada/Saskatchewan Partnership Agreement on Water-Based Economic Development (PAWBED). Continuation of these trials under AFIF funding will help address the needs for improved management guidelines for these crops. The irrigation treatments were simplified this season to apply irrigation at six soil moisture levels.

Yield data was not collected from these trials. The chokecherry trial has not started significant fruit production. A small amount of fruit was produced in the saskatoon irrigation trial but it did not ripen properly due to hail damage. Survival, shoot growth and sucker production data were collected.
No differences were observed between any of the data collected although there appears to be a trend to increased sucker production in saskatoon at soil moisture levels between 30 and 45 centibars (Tables 7 and 8).

Irrigation Treatment Summary.

Treatment #	Soil moisture where irrigation is applied
1	15 Centibars
2	30 Centibars
3	45 Centibars
4	60 Centibars
5	75 Centibars
6	90 Centibars

Table 7. Saskatoon irrigation trial.

Treatment	Survival %	Shoot Growth cm	Shoot Growth in	Suckers Produced
1	100	34.8	13.9	5.6
2	100	33.9	13.6	7
3	100	32.4	13.0	8.8
4	100	33.3	13.3	6.2
5	100	34.9	14.0	5.4
6	100	33.6	13.4	5.8

[1]*Horticulture Department, U of S, Saskatoon*
[2]*SIDC, Outlook*
[3]*PFRA Shelterbelt Centre, Indian Head*

Table 8. Chokecherry irrigation trial.				
Treatment	Survival %	Shoot Growth cm	in	Suckers Produced
1	100	40.6	16.2	3.4
2	100	33.9	13.6	3.2
3	100	39.2	15.7	2.5
4	100	38.2	15.3	2.9
5	100	36.8	14.7	2.8
6	100	36.4	14.6	2.8

Herb Agronomy

J. Wahab[1]

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

Progress: *Year two of five*

Location: *Outlook*

Objectives:
- *To evaluate the adaptability of promising medicinal and culinary herbs for Saskatchewan conditions.*
- *To develop management practices for mechanized commercial production.*
- *To develop labour saving agronomic practices.*
- *To compare yield and quality under dryland and irrigated production.*
- *To assess the feasibility of direct seeding and transplanting under both dryland and irrigated conditions.*
- *To determine stage and method of harvesting to increase recovery and to maintain quality.*

The shrinking budgets for mainstream health care has lead to the resurgence of alternative medicine. Natural products are increasingly being used as food flavouring, cosmetics, and for medicinal purposes. The medicinal plant industry in North America is believed to be growing at a rate of 20% or more annually. The global annual trade of medicinal plants is estimated to be in excess of $3 trillion. The Canadian trade is greater than $100 million. Medicinal and aromatic plant production and processing are fast growing industries in Canada, including Saskatchewan.

With direction from the Saskatchewan Herb and Spice Association, and financial assistance from the Agri-Food Innovation Fund, the Saskatchewan Irrigation Diversification Centre (SIDC) has expanded its herb research program to address the needs of this rapidly expanding industry. This project is in its second year of activity. Agronomic studies are being conducted for several herb species that are considered to be commercially important. They include *Echinacea angustifolia*, feverfew, German chamomile, milk thistle, stinging nettle, and valerian.

Studies with perennial species were initiated in 1997 and in 1998 and were carried through to harvest at pre-determined stages. Field trials for annual species were established in the spring

[1]*SIDC, Outlook*

of 1998 and were harvested in the fall for yield estimation and quality analysis. Harvest material was supplied to the Department of Agricultural and Bioresource Engineering, University of Saskatchewan for post-harvest handling studies, and to the Department of Plant Sciences Herb Program, University of Saskatchewan for chemical analysis.

Plots of milk thistle, feverfew, and German chamomile were grown at SIDC to evaluate mechanical harvesting, method and timing of harvest, and to supply material for processing studies conducted by the Department of Agricultural and Bioresource Engineering, University of Saskatchewan.

Field tests were conducted at the SIDC field plots. Many herb species are difficult to direct seed due to extremely small seed size and due to seed dormancy. Therefore, most agronomy trials were conducted using transplants. A small plot seeder was used for direct seeding and a water wheel planter was used for transplanting. A plant spacing of 60 cm x 30 cm (24 in x 12 in) was d for all studies except the plant spacing trials. Soil moisture status was maintained at approximately 50% Field Capacity on all irrigation trials.

Composite samples from dryland and irrigated tests will be analysed for active ingredient levels to examine the effects of management on crop quality.

Echinacea angustifolia

The following studies were carried out during the 1998 growing season. Root and plant samples were taken for yield and quality analysis.

Effect of seeding rate and row spacing on stand establishment, yield potential and processing quality for direct seeded Echinacea angustifolia

This study examined the effects of five seeding rates (60, 90, 120, 150, and 180 seeds/m^2; 6, 9, 12, 15, and 18 seeds/ft^2) and two row spacings (40 and 60 cm; 16 and 24 in). The study was conducted under dryland and irrigated conditions. Yield and quality assessment will be made at various harvest stages.

Fertilizer response studies for direct seeded Echinacea angustifolia

Three nitrogen rates (0, 50, and 100 kg N/ha; 0, 45, and 90 lb/ac) applied both in the spring and split applied in the spring and fall, and two phosphorus levels (50 and 100 kg P_2O_5/ha; 45 and 90 lb P_2O_5/ac) were evaluated under irrigated and dryland cropping. Yield and quality assessment will be made at various harvest stages.

Effect of type of planting material on productivity of transplanted Echinacea angustifolia

Different types of planting material were evaluated under both irrigation and dryland. The planting material included:

- 1997 Transplants over-wintered in the greenhouse
- 1997 Transplants over-wintered in a straw-covered pit
- 1998 Transplants
- 1998 Transplants direct from germination trays

Yield and quality assessment will be made at various harvest stages.

Direct seeding demonstration of Echinacea angustifolia from different seed sources when grown under irrigated and dryland conditions

Echinacea angustifolia seed from Richter's and from William's Lake were direct seeded in single plots under both irrigation and dryland. Seeding was done as shown in Table 9. Yield and quality assessment will be made at different harvest stages.

Table 9. Seeding treatments for two seed sources.

Seed source	Row spacing(cm)	seed rate (seeds/m^2)	seed depth (mm)
William's Lake	20	100	5
	60	100	5
	20	200	5
	60	200	5
	20	100	0
	60	100	0
	20	200	0
	60	200	0
Richter's	20	100	5
	60	100	5
	20	100	0
	60	100	0

Fertilizer response studies for transplanted Echinacea angustifolia

Three nitrogen rates (0, 50, and 100 kg N/ha; 0, 45, and 90 lb/ac) applied both in spring and split applied in spring and fall, and two levels of phosphorus (50 and 100 kg P_20_5/ha; 45 and 90 lb P_2O_5/ac) were examined under irrigation and dryland. Yield and quality assessment will be made at different harvest stages.

Effect of fertilizer and within-row spacing on transplanted Echinacea angustifolia

This study examined the effects of two nitrogen rates (0 and 100 kg N/ha; 0 and 90 lb N/ac) and two phosphorus rates (0 and 60 kg P_2O_5/ha; 0 and 53 lb P_2O_5/ac) grown at within-row spacings of 15 cm (6 in) and 30 cm (12 in). The rows were spaced at 60 cm (24 in). The trials were conducted under both irrigation and dryland. Yield and quality assessment will be made at different harvest stages.

Feverfew

Effects of fertilizer and plant spacing on transplanted feverfew

Two nitrogen rates (0 and 100 kg N/ha; 0 and 90 lb N/ac) and two phosphorus rates (0 and 60 kg P_2O_5/ha; 0 and 53 lb P_2O_5/ac) were evaluated for transplanted feverfew grown at within-row spacings of 15 cm (6 in) and 30 cm (12 in). The rows were spaced 60 cm (24 in) apart. The study was done under both irrigation and dryland.

The test was planted on June 10 (dryland) and June 12 (irrigated). Harvesting was done at the 100% flowering stage (August 19). Plants were cut at ground level for yield estimation.

The crop grown under irrigation outyielded the crop grown under dryland (Table 10). Higher plant density, i.e. closer spacing, produced significantly higher fresh and dry herbage yields. Fresh herbage yields under irrigation relative to dryland were 29% greater at the low plant population (54 500 plants/ha) and 45% greater at the high plant population (109 000 plants/ha). Under dryland conditions, the higher plant population produced higher fresh and dry herbage yields than the lower plant density.

Feverfew grown with 100 kg/ha (90 lb/ac) of applied nitrogen produced lower herbage yields than the crop grown without any added nitrogen. The corresponding yield losses were approximately 22% under dryland and about 10% under irrigation (Table 10).

Phosphorus application tended to produce slightly, but not statistically significant, higher fresh and dry herbage yields under both irrigation and dryland (Table 10). The yield improvements ranged between 4-6% for fresh herb and between 2-6% for dry herb.

Effects of plant population and of cutting height on productivity, processing quality, and winter survival of transplanted feverfew

This study compared cutting heights of 5 cm and 10 cm (2 in and 4 in) above ground level for trans-planted feverfew grown under irrigation.

The lower cutting height produced more than double the herbage yield of the higher cutting height (Table 11).

Dry plant material from both these treatments have been sent for quality evaluation.

Table 10. Effect of nitrogen, phosphorus, and plant population on herbage yield for feverfew grown under irrigation and dryland.

Treatment		Dryland yield				Irrigated yield			
		Fresh		Dry		Fresh		Dry	
		kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ha	kg/ha	lb/ac
Plant population[1]:	54,500/ha	4756	4233	1358	1209	6133	5476	1606	1429
	109, 000/ha	6914	6153	1967	1750	10063	8956	2465	2194
Nitrogen[2]:	Check	6597	5871	1923	1711	8592	7647	2199	1957
	100 kg N/ha	5174	4605	1401	1247	7625	6786	1871	1665
Phosphorus[3]:	Check	5709	2081	1618	1440	7877	7010	2012	1791
	60 kg P_2O_5/ha	5961	5305	1708	1520	8339	7422	2059	1833

Analysis of Variance

Source	Dryland fresh	Dryland dry	Irrigated fresh	Irrigated dry
			***(725 kg/ha)	
Plant population (D)	*** (1080 kg/ha)	*** (278 kg/ha)	** (725 kg/ha)	*** (194 kg/ha)
Nitrogen (N)	** (1080 kg/ha)	** (278 kg/ha)	NS	** (194 kg/ha)
Phosphorus (P)	NS[4]	NS	NS	NS
D x N	NS	NS	NS	NS
D x P	NS	NS	NS	NS
N x P	NS	NS	NS	NS
D x N x P	*(1724)	*(444)		NS
			12.2	
CV (%)	20.1	20.1		13.0

[1]Average of nitrogen and phosphorus [2]Average of plant population and phosphorus
[3]Average of plant population and nitrogen [4]not significant
Values within parentheses are LSD (5.0%) estimates.

Table 11. Effect of cutting height on herbage yield for transplanted feverfew grown under irrigation.

Cutting height	Herbage yield			
	Fresh		Dry	
	kg/ha	lb/ac	kg/ha	lb/ac
5 cm	5354	4765	1352	1203
10 cm	1990	1771	529	471
Analysis of variance				
Source				
Cutting height	***		***	
CV (%)	14.9		16.6	

German chamomile

Fertilizer response study for transplanted German chamomile

Two rates of nitrogen (0 and 100 kg N/ha; 0 and 90 lb N/ac), two levels of phosphorus (0 and 60 kg P_2O_5/ha; 0 and 53 lb P_2O_5/ac) and two levels of potassium (0 and 50 kg K_2O/ha; 0 and 45 lb K_2O/ac) were evaluated under dryland and irrigated conditions.

Field plots were established on June 23, 1998 using transplants raised in the greenhouse. The various fertilizer treatments were applied the day after transplanting. The crop was harvested on August 19 when the plants were at approximately 100% bloom.

Application of nitrogen, phosphorus or potassium did not produce any significant yield responses (Table 12). Additional phosphorus and potassium tended to increase yields slightly. By contrast, nitrogen application tended to reduce fresh and dry herbage yields.

Plant material is being analysed to examine the effects of fertilizer on active ingredients.

Table 12. Effect of nitrogen, phosphorus and potassium on herbage yield of German chamomile grown under irrigation.

Nutrient[1]	Rate of application (kg/ha)	Herbage Yield			
		Fresh		Dry	
		kg/ha	lb/ac	kg/ha	lb/ac
Nitrogen[2]	0	4149	3693	962	856
	100	3518	3131	793	706
Phosphorus[3]	0	3798	3380	874	778
	60	3868	3443	881	784
Potassium[4]	0	3658	3256	829	738
	50	4009	3568	925	823
Analysis of variance					
Source					
Nitrogen (N)		NS[5]		NS	
Phosphorus (P)		NS		NS	
Potassium (K)		NS		NS	
N x P		NS		NS	
N x K		NS		NS	
P x K		NS		NS	
N x P x K		NS		NS	
CV (%)		40.9		41.6	

[1]Fertilizer rates are represented as N, P_2O_5, and K_2O for nitrogen, phosphorus and potassium respectively.
[2]Average of phosphorus and potassium.
[3]Average of nitrogen and potassium.
[4]Average of nitrogen and phosphorus.
[5]not significant

Effect of plant population and method of harvest on yield, quality and regeneration potential of transplanted German and Roman chamomile

Within-row spacings of 15 (6 in) and 30 cm (12 in), and mechanical and manual harvest methods were tested for irrigated chamomile. The crop was planted in 60 cm (24 in) rows.

Field plots were established on June 23, 1998 using transplants raised in the greenhouse. The crop was harvested on August 19 when the plants were at approximately 100% bloom.

The lower plant population of 54 500 plants/ha on a 60 x 30 cm spacing (22,000 plants/ac on a 24 in x 12 in spacing) produced 2 172 kg/ha (1,933 lb/ac) fresh herbage yield. Doubling plant population by reducing within-row spacing to 15 cm (6 in) produced twice the yield of fresh and dry herbage (Table 13).

Table 13. Effect of plant population and harvest methods on herbage yield of German chamomile grown under irrigation.

Treatment	Herbage yield				Drying percentage[3] (%)
	Fresh		Dry		
	kg/ha	lb/ac	kg/ha	lb/ac	
Plant population[1]					
54 500 plants/ha	2172	1933	502	447	23.1
109 000 plants/ha	5088	4528	1129	1005	22
Harvest method[2]					
Hand harvesting	5228	4653	1191	1060	22.8
Mechanical harvesting	2032	1808	440	392	22.4
Analysis of variance					
Source					
Plant population (P)	***(695)		***(166)		*(1.0)
Harvesting method (H)	***(695)		***(166)		NS[4]
P x H	NS		NS		NS
CV (%)	26.3		28.0		6.0

[1]Average of harvest methods.
[2]Average of plant population.
[3]Dry weight yield as a % of the fresh weight yield.
[4]not significant
Values within parentheses are LSD (5.0%) estimates.

Machine harvesting German chamomile resulted in a two-fold yield loss compared to hand harvesting (Table 13). On average 20-22% flowers were recovered from the harvested material. It is essential to devise efficient harvest methods if mechanical harvesting of chamomile is to become feasible.

Valerian

Effect of plant population and fertilizer on growth, productivity and quality of transplanted Valerian

Two nitrogen rates (0 and 75 kg N/ha; 0 and 68 lb N/ac), and two rates of phosphorus (0 and 60 kg P_2O_5/ha; 0 and 53 lb P_2O_5/ac) were evaluated for Valerian grown at plant spacings of 15 cm (6 in) and 30 cm (12 in) under irrigated and dryland conditions.

This trial will be harvested in 1999 for yield and quality evaluation.

Effect of rate and time of fertilizer application on growth, productivity, and quality ofr transplanted Valerian

The effects of two nitrogen rates (50 and 100 kg N/ha; 45 and 90 lb N/ac) applied in the spring and split applied spring and fall were studied. Phosphorus was spring applied at the rate of 50 kg P_2O_5/ha (45 lb P_2O_5/ac) during each year of this study.

This trial will be harvested in 1999 for yield and quality evaluation.

Stinging Nettle

Comparison of planting material over-wintered under different conditions

Herbage yield of the following types of planting material were compared under dryland and irrigated conditions:

- 1997 Transplants over-wintered in the greenhouse
- 1997 Transplants over-wintered in a straw-covered pit
- 1998 Transplants

The three types of transplants were planted in rows 60 cm (24 in) apart with a within-row spacing of 30 cm (12 in). Field trials were planted on June 10 and were harvested on August 24 (dryland) and 25 (irrigated). Plant stand counts were taken four weeks after planting.

Stand establishment and productivity of stinging nettle grown from different types of planting material are presented in Table 14.

Stinging nettle grown from transplants raised in 1997 produced approximately double the fresh herbage yield compared to the crop grown from 1998 transplants under both irrigation and dryland (Table 14). Similar yield responses were also obtained for dry herbage yield. This yield increase can be attributed to better stand establishment for the older transplants compared to the current year's planting material (Table 14).

Table 14. Stand establishment and herbage yield for stinging nettle grown under dryland and irrigation using different types of planting material.

Treatment[1]	Dryland				Irrigation			
	Stand estab. %	Fresh yield kg/ha	Dry Yield		Stand estab. %	Fresh yield kg/ha	Dry Yield	
			kg/ha	lb/ac			kg/ha	lb/ac
97-OW-GH	87.5b	13081b	3458b	3085	89.6c	10960b	2466b	2200
97-OW-PIT	86.1a	15922c	4229b	3773	79.2b	10035b	2154b	1922
98-TP	75.7a	7288a	2518a	2247	55.2a	5520a	1358a	1212
Analysis of variance [2]								
Source								
Significance	***	***	***		***	***	***	
CV (%)	5.6	9.9	19.5		11.8	18.6	8.3	

[1]Treatments:

97-OW-GH - Transplants raised during 1997 and continue growing in the greenhouse until field planting.

97-OW-PIT - Transplants raised during 1997 and over-wintered in a straw covered pit until field planting.

98-TP - Transplants produced in the spring of 1998.

[2]ANOVA for stand establishment was performed using arcsine transformed data values. Means followed by a different letter within a column are significantly different at P<0.05 level of probability.

Rate and time of fertilizer application on growth, productivity, and quality for transplanted stinging nettle

Dryland Study:

Two rates of nitrogen (50 and 100 kg N/ha; 45 and 90 lb N/ac), applied in the spring or split applied spring and fall, and two rates of phosphorus (50 and 100 kg P_2O_5/ha; 45 and 90 lb P_2O_5/ac) applied at planting were evaluated under dryland conditions. Test plots were planted on June 10, 1998 using a spacing of 60 cm (24 in) between row and 30 cm (12 in) within row. Harvesting was done on August 24 and the plants were cut approximately 10 cm (4 in) above ground level.

The various treatment combinations had no effect on fresh or dry herbage yield (Table 15). Neither analysis of variance nor orthogonal comparisons showed any significant differences between individual treatments or group comparisons.

Table 15. Effect of nitrogen and phosphorus on herbage yield of stinging nettle grown under dryland.						
Treatment			Herbage yield			
Nitrogen rate kg N/ha	Nitrogen timing of application	Phosphorus rate kg P_2O_5/ha	Fresh		Dry	
			kg/ha	lb/ac	kg/ha	lb/ac
50	Spring	50	5494	4902	2073	1850
50	Spring	100	4092	3651	1224	1092
50	Spring & Fall	50	4541	4051	1493	1332
100	Spring	50	4037	3602	1281	1143
100	Spring	100	4317	3852	1314	1172
100	Spring & Fall	100	4990	4452	1381	1232
Analysis of variance						
Source						
Treatment			NS		NS	
CV (%)			20.5		33.6	
Orthogonal comparison						
Nitrogen:	50 kg vs 100 kg	NS[1]				
Nitrogen:	One app. vs two app	NS				
Phosphorus:	50 kg vs 100 kg	NS				

[1]not significant

Irrigation Study:

Two nitrogen rates (50 and 100 kg N/ha; 45 and 90 lb N/ac) applied in the spring or split applied spring and fall, and two rates of phosphorus (50 and 100 kg P_2O_5/ha; 45 and 90 lb P_2O_5/ac) were tested under irrigation and dryland.

Yield responses to fertilizer application for irrigated stinging nettle are summarized in Table 16. Rate or timing of nitrogen application had no effect on herbage yield. Application of 100 kg P_2O_5/ha produced approximately 30% higher fresh and dry herbage yield than 50 kg P_2O_5/ha.

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

Table 16. Effect of nitrogen and phosphorus on herbage yield of stinging nettle grown under irrigation.				
	Fresh herbage yield		Dry herbage yield	
Treatment	kg/ha	lb/ac	kg/ha	lb/ac
Nitrogen rate, kg N/ha[1]				
50	5037	4494	1242	1108
100	5769	5147	1385	1236
Nitrogen application[2]				
Spring	5805	5179	1416	1263
Spring and Fall	5001	4462	1211	1080
Phosphorus rate, kg P_2O_5/ha[3]				
50	4692	4186	1136	1014
100	6114	5455	1491	1330
Analysis of variance				
Source				
Nitrogen rate (N)	NS		NS	
Nitrogen timing (T)	NS		NS	
Phosphorus rate (P)	**		**	
N x T	NS		NS	
N x P	NS		NS	
T x P	NS		NS	
N x T x P	NS		NS	
CV (%)	20.6		20.7	

[1]Average of nitrogen timing and phosphorus rate.
[2]Average of nitrogen and phosphorus rates.
[3]Average of nitrogen rate and nitrogen timing.
** and NS indicate significance at P<0.01 probability level and not significant respectively.

Effects of plant population and cutting height on herbage yield and quality, and on the subsequent regeneration of stinging nettle

The effects of plant population of 54 500 and 109 000/ha (22,000 and 44,000/ac) and of cutting heights at ground level, 10cm (4 in), and 15 cm (6 in) on herbage yield were studied for stinging nettle grown under irrigation and dryland.

Increasing plant population had no effect on herbage yield under both irrigated and dryland production (Table 17).

Lowering cutting height increased herbage yields. The differences were relatively less between the 10 cm (4 in) and 15 cm (6 in) cutting treatments as compared to cutting at ground level (Table 17).

Table 17. Effect of plant population and cutting height on stinging nettle grown under dryland and irrigation.

Treatment	Dryland yield				Irrigated yield			
	Fresh		Dry		Fresh		Dry	
	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac	kg/ha	lb/ac
Plant population[1]:								
54 500/ha	5961	5318	1786	1593	8092	7220	1999	1784
109 000/ha	6316	5635	1915	1709	9661	8620	2281	2035
Cutting height[2]:								
Ground level	8437	7527	2543	2269	12670	11304	3130	2793
10 cm	5634	5027	1774	1583	7540	6727	1779	1587
15 cm	4344	3876	1235	1102	6419	5727	1511	1348
Analysis of variance								
Source								
Plant population (P)	NS[3]		NS		NS		NS	
Cutting height (C)	***(1527)		***(475)		***(1843)		***(469)	
P x C	NS		NS		NS		NS	
CV (%)	23.3		24.1		19.5		20.6	

[1]Average of cutting height
[2]Average of plant population
[3] not significant

Milk Thistle

Effect of seeding rate and row spacing on plant stand, seed yield, and quality

Milk thistle was evaluated under three seeding rates (50, 100, 200 seed/m^2; 5, 10, and 20 seeds/ft^2) on three row spacings (20, 40, 60 cm; 8, 16, and 24 in). The crop was grown under dryland conditions.

Test plots were sown on June 5, 1998. Mature flower heads were harvested on September 11, September 14 and October 1 by hand. The final harvest was taken using a small plot combine on October 16. Reglone was sprayed on October 2 to dessicate the crop prior to combining.

Stand establishment and total yield in response to seeding rate and row spacing is presented in Table 18.

Table 18. Seeding rate and row spacing effects on stand establishment and seed yield for milk thistle.

Treatment	Plant stand plants/m^2	Total seed yield kg/ha	lb/ac
Seeding rate (seed/m^2)[1]			
50	9.4	521.9	465.6
100	12.1	689.9	615.5
200	17.2	805.1	718.3
Row spacing (cm)[2]			
204	11.8	531.4	474.1
40	14.1	757.5	675.8
60	12.8	727.9	649.4
Analysis of variance			
Source			
Seeding rate (R)	***(2.6)	**(179.1)	
Row spacing (S)	NS	*(179.1)	
R x S	NS	NS	
CV (%)	34.9	46.1	

[1]Average of row spacing.
[2]Average of seeding rate.
***, **, * and NS indicate significance at P <0.001, 0.01, 0.05 probability levels and not significant respectively.
Values within parentheses are LSD (5.0%) estimates.

Higher seeding rates resulted in a denser plant stand and produced higher seed yields (Table 18). The increase in plant stand at higher seeding rates was not proportional to the seeding rate increase.

Row spacing had no effect on plant stand (Table 18). Higher seed yields were recorded at the wider row spacings as compared to the 20 cm (8 in) spacing.

Observational Studies

Transplanting herbs into plastic mulch with drip irrigation

Echinacea, feverfew, Valerian, German chamomile and Roman chamomile were transplanted into plastic mulch using the water wheel planter. The crops will be irrigated.

Post-harvest Studies

Feverfew, chamomile and milk thistle were grown for the Department of Agricultural and Bioresource Engineering, University of Saskatchewan, for harvesting and post-harvest handling studies.

Soil and Water Management Program

Soil and Water Management Program

Development and Extension of Precision Farming Techniques for Saskatchewan Producers

T. Hogg[1], M. Pederson[1], D. Pennock[2], F. Walley[2], M. Solohub[2]

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

Progress: *Year two of three*

Location: *R. Pederson (SE 20-28-7-W3)*

Objective: *To develop an agronomic information package which can be used to tailor management practices to variable soil and moisture conditions within a given field.*

There is little basic agronomic information available for producers wanting to implement precision farming technology. The success of precision farming technology ultimately rests on our ability to develop effective management maps to guide producers in choosing appropriate input rates. Therefore, an agronomic information package must be developed which can be used to tailor management practices to variable soil and moisture conditions within a given field. The generation of seeding and fertilizer application equipment currently under development by major Saskatchewan equipment manufacturers will allow on-the-go adjustment of fertilizer and seeding rates.

In the spring of 1998, a plot was established at the selected site to determine the effect of variable nitrogen and phosphorus fertilizer and seeding rates on the establishment, harvest index, grain yield and grain quality of irrigated AC Barrie wheat across different landscape positions. Fertilizer treatments consisted of nitrogen and phosphorus applications based on soil test recommendations (Table 1). The treatments were applied as a side band application utilizing urea (46-0-0) and monoammonium phosphate (12-51-0) as the nitrogen and phosphorus fertilizer sources. Each treatment strip was seeded over the complete range of landscape

Table 1. Treatments for the precision farming trial.

Treatment #	Seeding Rate		Nitrogen rate[1]	Phosphorus rate[1]
	kg/ha	bu/ac		
1	100	1.5	0	0
2	100	1.5	1x	0
3	100	1.5	0	1x
4	100	1.5	0.5x	1x
5	100	1.5	1x	1x
6	100	1.5	1.5x	1x
7	100	1.5	2x	1x
8	67	1.0	1x	1x
9	134	2.0	1x	1x
10	100	1.5	1x	2x

[1] Recommended rates based on standard soil testing procedures (nitrogen 1x = 100 lb/ac; phosphorus 1x = 25 lb/ac).

[1] *SIDC, Outlook*

[2] *Dept. of Soil Science, U of S, Saskatoon*

management units in a strip plot design and was replicated six times.

Irrigated AC Barrie wheat showed significant differences among the landscape management units and fertility treatments. Yield and protein content increased with nitrogen application and was of the order lower>mid>upper for the different landscape positions (Tables 2 and 3). Differences were greatest at the low nitrogen application rates indicating the greater inherent soil fertility of the lower slope position. Phosphorus application and an increase in seeding rate also increased yield. More straw was produced at the lower slope position (Table 4). Yield increases were due to an increase in the number of seeds produced since seed size decreased with increased nitrogen application. Water use showed little difference among the landscape management units.

These results are considered preliminary. Data from several site years is required before an agronomic information package can be developed to tailor management practices to variable soil and moisture conditions within a given field.

Table 2. Landscape position and fertilizer effects on yield of irrigated AC Barrie wheat.

N Rate[1]	P_2O_5 Rate[2]	Seeding Rate		Yield						Treatment Mean	
				Upper		Mid		Lower			
		kg/ha	bu/ac	kg/ha	bu/ac	kg/ha	bu/ac	kg/ha	bu/ac	kg/ha	bu/ac
0	0	100	1.5	842	12	1065	16	1596	24	1167	17
1x	0	100	1.5	1666	25	1955	29	2117	31	1913	28
0	1x	100	1.5	915	14	1111	17	1597	24	1208	18
0.5x	1x	100	1.5	1672	25	1938	29	2341	35	1984	29
1x	1x	100	1.5	1992	30	2298	34	2804	42	2365	35
1.5x	1x	100	1.5	1963	29	2340	35	3062	45	2455	36
2x	1x	100	1.5	2171	32	2323	35	2750	41	2415	36
1x	1x	67	1.0	1546	23	1999	30	2449	36	1998	30
1x	1x	134	2.0	2137	32	2495	37	2905	43	2513	37
1x	2x	100	1.5	2098	31	2683	40	2991	44	2591	38
Landscape Position Mean				1700	25	2021	30	2461	37		

ANOVA LSD (0.05)

	kg/ha	bu/ac
Landscape Position (LP)	175	2.6
Treatment (T)	242	3.6
LP x T	NS[3]	NS

[1] 1x = 112kg N/ha (100 lb N/ac)
[2] 1x = 28 kg P_2O_5/ha (25 lb P_2O_5/ac)
[3] not significant

Table 3. Landscape position and fertilizer effects on protein content of irrigated AC Barrie wheat.

N Rate[1]	P_2O_5 Rate[2]	Seeding Rate		% Protein			Treatment Mean
		kg/ha	bu/ac	Upper	Mid	Lower	
0	0	100	1.5	12.3	12.5	13.4	12.7
1x	0	100	1.5	13.1	13.4	14.0	13.5
0	1x	100	1.5	12.9	13.1	14.0	13.3
0.5x	1x	100	1.5	13.3	14.0	14.3	13.9
1x	1x	100	1.5	13.4	13.7	14.6	13.9
1.5x	1x	100	1.5	14.0	14.2	14.8	14.4
2x	1x	100	1.5	14.1	14.1	14.6	14.3
1x	1x	67	1.0	13.5	13.9	14.5	14.0
1x	1x	134	2.0	13.4	13.7	14.8	14.0
1x	2x	100	1.5	13.4	13.8	14.5	13.9
Landscape Position Mean				13.3	13.6	14.4	

ANOVA LSD(0.05)	
Landscape Position (LP)	0.4
Treatment (T)	0.5
LP x T	NS[3]

[1] 1x = 112kg N/ha (100 lb N/ac) [2] 1x = 28 kg P_2O_5/ha (25 lb P_2O_5/ac)
[3] not significant

Table 4. Landscape position and fertilizer effects on the harvest index of irrigated AC Barrie wheat.

N Rate[1]	P_2O_5 Rate[2]	Seeding Rate		Harvest Index[3]			Treatment Mean
		kg/ha	bu/ac	Upper	Mid	Lower	
0	0	100	1.5	0.21	0.17	0.21	0.20
1x	0	100	1.5	0.22	0.22	0.23	0.22
0	1x	100	1.5	0.19	0.21	0.21	0.20
0.5x	1x	100	1.5	0.22	0.23	0.24	0.23
1x	1x	100	1.5	0.25	0.24	0.25	0.24
1.5x	1x	100	1.5	0.23	0.23	0.26	0.24
2x	1x	100	1.5	0.25	0.24	0.24	0.24
1x	1x	67	1.0	0.20	0.22	0.23	0.22
1x	1x	134	2.0	0.25	0.27	0.25	0.26
1x	2x	100	1.5	0.24	0.27	0.28	0.26
Landscape Position Mean				0.23	0.23	0.24	

ANOVA LSD (0.05)	
Landscape Position (LP)	0.4
Treatment (T)	0.5
LP x T	NS[4]

[1] 1x = 112kg N/ha (100 lb N/ac) [2] 1x = 28 kg P_2O_5/ha (25 lb P_2O_5/ac)
[3] Harvest index = grain weight/total plant weight
[4] not significant

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

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Funded by the National Soil and Water Conservation Program

Progress: *Year one of two*

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

Seed potatoes (*cv* Penta) were grown with four nitrogen-fertilizer treatments typically used in potato production:

1. 300 kg N/ha incorporated prior to seeding

2. 200 kg N/ha incorporated prior to seeding

3. 100 kg N/ha incorporated prior to seeding and 100 kg N/ha applied at hilling

4. 100 kg N/ha incorporated prior to seeding and 56 kg N/ha applied through fertigation according to petiole analysis.

Urea (46-0-0) was used for all applications except fertigation where urea-ammonium nitrate solution (28-0-0) was used. P and K were applied to meet crop requirements at the same rate on each plot. Pesticide applications included seed treatment and insecticide, herbicide, and fungicide applications. They were the same for all treatments.

Soil samples were taken at 30 cm (12 in) increments to 1.8 m (6 ft) from six locations in each plot prior to the pre-plant fertilizer application, and after harvest. Additional soil samples were taken at 0-30 cm (12 in) and 30-60 cm (24 in) depths from the same locations in all plots in both early June and early August, and from the split application plots in early July (after hilling). Stainless steel groundwater wells were installed centrally in each plot in April. Water samples were taken every week from May to September (less frequently in the fall and winter) and were analyzed for nitrate (NO_3), ammonia, total and ortho phosphorus, and for the pesticides applied to the potatoes. We will continue to monitor the soil and shallow groundwater for leached nutrients, and the shallow groundwater for pesticides next season when a cereal crop will be grown. Potato yield and size grade were measured on samples from six locations in each plot.

Preliminary analysis of the data indicates that there was no significant effect of fertilizer treatment on tuber yield or size. There was significantly more NO_3-N in the profile of the plot that received 300 kg N/ha than the other plots at fall soil sampling. There was an increase in NO_3-N in the profile from spring to fall on all plots except the 200 kg N/ha split application. Significantly greater increases in NO_3-N were measured in the 0-30 cm (12 in) and 30-60 cm (24 in) depths than deeper in the profile, but NO_3 gains occurred throughout the profile. Concentrations of NO_3-N in the shallow groundwater beneath all plots increased during the growing season.

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

Product Development Contracts

Product Development Contracts

The Saskatchewan Irrigation Diversification Centre offers a wide range of facilities, equipment, and expertise in the area of applied field crop research. Private industry entered into a number of contracts with SIDC to provide a site, field operations, and data collection in support of their new product development programs. A brief description of this work is reported. Details of the projects and of the results are the property of the contract holder.

Rainfast study

The study evaluated the effect of simulated rainfall on the efficacy of an experimental herbicide for wheat. Herbicides were applied at specific times to create intervals of 5, 30, 60, 120, 240, and 360 minutes between herbicide application and irrigation. Applications of 3 mm (0.12 in) and 18 mm (0.7 in) were applied using the research linear to simulate rainfall. The research linear irrigation system was ideally suited for this work.

Weed control in alfalfa

This study evaluated an experimental fall applied herbicide for perennial weed control on dormant alfalfa. Ratings for weed control and for crop tolerance taken in mid-May showed the product to have potential for weed control in irrigated alfalfa stands.

Fibre flax

The purpose of the study was to evaluate varieties and management practices of fibre flax. The trials included a date of seeding/seed rate study, and seed treatment and fungicide studies.

Biological control of root rot pathogens of dry bean by beneficial soil micro-organisms

The objective was the examination of the effect of several potential biological root rot control agents on dry bean. Inoculants were applied at the rate indicated by the manufacturer. Plants from each treatment were carefully removed. Nodule counts and weight, root rot ratings, and grain yield were determined. Several of the biological control agents were equal to, or were better than, the fungicide control.

Market Analysis and Economics

Market Analysis and Economics

H. Clark[1]

The objectives of the market analysis and economics program are met in part by assembling and analysing information on the major irrigated crops and on a wide range of specialty crops. Price and expected returns of these crops are summarized and presented each spring. This information is available from SIDC, or may be found on the internet at *http://www.agr.ca/pfra/sidcpub.*

The market analyst prepares updates and reports which are circulated to internal and external clients on a regular basis.

Objectives:
- *To assist producers to diversify by identifying higher value market opportunities.*
- *To help direct the SIDC applied research and demonstration program by evaluating the potential for irrigated crops.*
- *To assist the establishment of value-added processing by identifying markets.*
- *To assist rural development by evaluating crop diversification and processing opportunities.*

Market analysis and economics projects completed over the past year include:

- Presentation of "Finding and Developing an Export Market for Medicinal Herbs" at the Prairie Medicinal and Aromatic Plants Conference, March, 1998.
- Regular updates of medicinal herb and spice prices at the grower, wholesale, and retail levels.
- Researching herb marketing information for Agri-Food Innovation Fund projects.
- Regular updates and public presentations on vegetable production costs and returns.
- Development of market newsletters for vegetables, major field crops, and selected specialty crops.
- Assisting Sask. Agriculture and Food in analyzing costs of production for seed potato and other specialty crops.
- Presentation of a paper at the Soils and Crops Workshop entitled "A Comparison of the Costs and Returns for Irrigated and Dryland Crop Production in Saskatchewan."
- Annual distribution of the "Crop Market Outlook."

[1] *SIDC, Outlook*

Demonstrations

Crop Manager Demonstration

I. Bristow[1]

Introduction

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 SIDC and other institutions. The fields 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 cooperators pay $2.00 an acre to have their field monitored. ICDC lets the producer know of any problems occurring in the crop. ICDC reimburses the co-operator for any extra cost involved in hosting the demonstration plot.

The 1998 demonstration program was conducted by Ian Bristow (ICDC) and Footprint Field Consulting (Alice Wilson, Debbie Oram, Bill King, John Harrington, and Kevin Bligh).

Foliar Feed on Dry Beans

This project involved the application of micronutrient fertilizer on dry beans in order to increase crop yield. This is a common practice among bean producers from other regions and has been readily adopted in Saskatchewan because it is a relatively small cost in the production of dry beans. Research in Saskatchewan hasn't shown any yield benefits with micronutrient fertilizers. ICDC demonstrations in 1998 show yield increases, as well as some yield decreases. The application of micronutrient fertilizer to dry beans in 1998 was economically beneficial in two of the five trials. More testing will be done in 1999 in order to formulate a recommendation.

Nitrogen Fertility for Dry Beans

This project was started in order to show the benefit of putting on high rates of nitrogen to increase yield. Beans are poor fixers of nitrogen and have responded well to the extra nitrogen applied to our trials in 1998. Total soil nitrogen levels of 80 to 100 pounds per acre were showing excellent yields. 1998 was hot and dry in July and August, therefore disease pressure was low. More testing needs to be done in order to determine the effects of the extra nitrogen on crop maturity and on disease severity.

Deep Ripping Of Dry Bean

The objective is to show the benefits of sub-soiling and in-crop ripping. One site on a clay loam soil was sub-soiled to a depth of 45 cm (18 in) in the spring. Water infiltration and plant growth was improved on the ripped area. The yield of the sub-soiled crop was 475 kg/ha (425 lb/ac) higher than the unripped crop. One site that was in-crop ripped during row crop cultivation. The

[1] *ICDC, Outlook*

final depth was 20 cm (8 in). Plant growth and water infiltration were improved. The yield was 245 kg/ha (220 lb/ac) higher on the ripped crop.

Clay loam soils respond well to deep ripping. Water infiltration is increased, allowing the crop to make better use of irrigation. Some soils are not well suited to sub-soiling or in-crop ripping. More trials will be conducted in 1999 to further study the effects of sub-soiling and in-crop ripping.

Cereal Fungicide Trial

Fungicide seed treatments and foliar sprays can be used to control root and leaf diseases in cereal crops. This project demonstrated the benefits of using fungicides. Dividend, a new seed treatment from Novartis, was used to control common root rot and take-all. Disease pressure was low in 1998, but an average yield response of 335 kg/ha (5bu/ac) was measured for the Dividend treated crop.

Foliar fungicides were tested to control leaf diseases. In some trials it was economical. We are currently trying to develop some guidelines to help make the decision as to when it is economical to spray the crop with fungicide.

Pulse Crops In Rotation

This trial was done in 1997 and 1998 to show the benefits of including pulse crops in the rotation. Increased yield, protein, and soil nitrogen supplying power was successfully demonstrated. This trial will not be continued.

Protein Enhancement In Durum

The objective of this trial is to show increased protein levels in durum wheat by adding nitrogen to the crop at the flowering stage. The nitrogen is applied with a high clearance sprayer or through the pivot. An average increase in protein of 0.88% was achieved. This increase is not profitable. Application of nitrogen through the pivot has been demonstrated to be the most effective method. We will test this practice for one more year to attempt to increase the efficiency of the nitrogen application.

Variety Testing

This project was started in 1998 at the request of many producers. The newly released varieties AC Navigator and AC Avonlea were tested on a field scales. Both varieties have excellent lodging resistance, as well as high yield and acceptable grades.

A field scale comparison of two canola varieties, Hyola 401 and Invigor 2163, was made. Hyola 401 was earlier maturing and yielded slightly less than the Invigor 2163.

Forage Manager Demonstration

L. Bohrson[1], K. Olfert[1]

Forage Manager Highlights

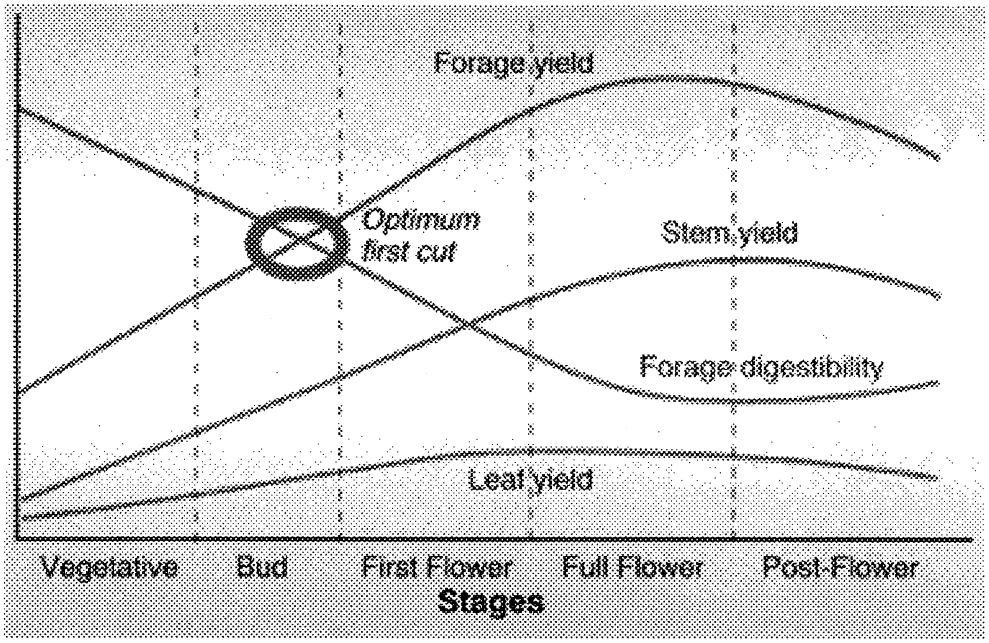
Along with numerous variety comparison and establishment/maintenance management demonstrations, this was the first year of data collection in the Haywatch Saskatchewan program. This program is designed to determine the proper cutting date for optimum quality and yield of alfalfa. Fertilizer application, weed and pest control methods were also evaluated.

A full report detailing each of the projects is available from the Irrigation Crop Diversification Corporation in Swift Current.

1998 Forage Manager Demonstrations

Co-operator	Project
R. Stokke	Irrigated Alfalfa Establishment and Phosphorus Management
A. Tittle	Alfalfa Variety Comparison and Soil Inoculation
A. Facette	Alfalfa Variety Comparison and Establishment Practices
M. Green	Irrigated Alfalfa Establishment, with Peas and SMART Herbicides
D. Morvik	Alfalfa Variety Comparison and Establishment Practices
G. Reimer	Wetland Grass Variety Selection and Management Practices
I. Blakley	Rapid Forage Re-establishment, Normal vs Aggressive Inputs
F. Halladay	Forage Harvest & Renovation Optimum Inputs
T. Scherger	Winter Cereal Selection & Forage Renovation
C. Grondhovd	Forage Harvest & Renovation Optimum Inputs
J. Leroy	Winter Cereal Selection for Forage Re-establishment
H. Gerbrandt	Forage Renovation after Frost, Optimum Inputs
R. Bascom	Alfalfa Variety Comparison and Soil Inoculation
D. Arendt	Alfalfa Establishment with High Rate Phosphate Deep Banding
O. Legault	Forage Harvest and Renovation with Optimum Inputs
J. Wiebe	Soil Inoculation for Established and Seedling Alfalfa
M. Green	Haywatch Saskatchewan
D. Green	Haywatch Saskatchewan
R. Mathies	Haywatch Saskatchewan
K. Krahn	Haywatch Saskatchewan
B. Stuart & H. Greer	Haywatch Saskatchewan
D. Napper	Haywatch Saskatchewan
L. Horvey	Phosphate Placement in Established Alfalfa
G. Oldhaver	Forage Renovation with Second Cut Cereal Greed Feed Selection
B. Bachman	ICDC Intensive Sprinkler Site

[1] *ICDC, Swift Current*



The optimum time for first cut may not be at late-bud, early-flower stage.

1998 Southwest Pawbed Demonstrations

Co-operator	Project
H. Gold	Sprinkler Irrigated Alfalfa, 18" vs 12" Water Management
D. Halvorson	Alfalfa Establishment and Variety Comparison
J. Weibe	Alfalfa Variety Comparison and Seedling Rates
Treasure Valley Markets	Trickle Irrigation of Fruit Crops for Southwest Saskatchewan
Butte Hutterite Colony	Trickle Irrigation of Market Garden Crops for Southwest Sask

Special Thanks to the ICDC Demonstration Sponsors and Objective Partners

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Direct Seeding Do's and Don'ts 98

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Progress: *Ongoing*

Objective: *To demonstrate common mistakes that are often made as producers switch to a direct seeding system.*

Grain producers converting from a conventional seeding system to direct seeding may have difficulty adapting their seeding practices to the new system. The common errors focused on in this year's demonstrations were depth of seeding, seed placement of fertilizer, and travel speed when seeding.

Two crops were included in the trials: Durum wheat and canola. A Flexi-coil 5000 air drill equipped with Stealth openers was used to seed the trials. Half of the drill was set up on a 12 inch row spacing, and half was on a 9 inch row spacing. For the double shoot fertilizer placement trials, three of the 12 inch spaced shanks had Stealth paired-row openers while the rest were equipped with Stealth side-band openers. Some single shoot treatments were done by placing all the fertilizer behind the Stealth knife, and the remainder were done using 3 inch spread tip openers.

The plots were seeded on May 4. The durum wheat was seeded at 125 kg/ha (110 lb/ac) with 185 kg/ha (165 lb/ac) of 34-17-0 fertilizer applied at seeding. Canola was sown at 5.5 kg/ha (5 lb/ac) with 185 kg/ha (165 lb/ac) of 37-17-0 fertilizer applied at seeding. Soil conditions were dry, but the seed was placed into moisture. Plant counts and grain yield were measured.

Similar Do's and Don'ts demonstrations were set up at ten other locations in the province.

Fertilizer Placement

As the concentration of seed placed fertilizer is increased, the plots generally show poorer crop establishment. Plant counts in the canola trials at SIDC demonstrated this effect (Table1). The wheat treatment with seed placed fertilizer using the narrow knife opener had reduced counts, but yield was unaffected. Using a spreader type of opener reduces the toxicity of seed placed fertilizer.

Deep seeded trials with seed placed fertilizer generally show that combinations of mistakes are cumulative. The crop has greater difficulty recovering from these conditions. This was especially evident in the form of reduced plant stands across all the demonstration plots of canola and of wheat in 1998. Wheat yields were not affected, but canola yields were reduced. Maturity of canola was delayed by up to one week by the seed placed fertilizer treatments in some locations.

Paired Rows

Paired row seeding was compared to side-banding. Producers want a paired-row opener to

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create denser stubble to hold up swaths. Measurements of cereal stubble row width at swathed height on these trials revealed that the paired-row has on average a 1 inch wider bearing surface than the side band opener. No paired row was visible.

Table 1. Results for Direct Seeding Do's and Don'ts 98.

Treatment	Row spacing in	Plant counts				Yield bu/ac	
		SIDC		Sask. Average			
		#/ m row	$\#/m^2$	#/ m row	$\#/m^2$	SIDC	Sask.
Durum wheat							
Proper seed depth N side-banded 6.5 km/h seeding speed	9 12	30 37	130 120	41 49	181 159	42 40	35 32
Proper seed depth N side-banded 9.5 km/h seeding speed	9 12			40 52	176 171		31 33
Proper seed depth N seed placed with knife	9 12	30 20	130 65	35 38	151 124	47 46	35 35
Proper seed depth N seed placed with spoon	9 12	35 25	152 81	45 46	195 150	47 45	34 36
Deep (8 cm) seed depth N seed placed with knife	9 12	11 9	48 29	31 38	136 125	43 33	35 33
Canola							
Proper seed depth N side-banded 6.5 km/h seeding speed	9 12	45 50	194 162	37 40	160 132	27 37	33 35
Proper seed depth N side-banded 9.5 km/h seeding speed	9 12	43 44	186 143	40 36	176 120	27 33	34 31
Proper seed depth N seed placed with knife	9 12	6 13	26 42	12 13	52 41		26 28
Proper seed depth N seed placed with spoon	9 12	13 17	56 55			35 34	29 28
Deep (8 cm) seed depth N seed placed with knife	9 12	2 2	9 7	10 8	46 28	30 28	24 23

Row Spacing

Observations on the differences between row spacing over all sites showed no yield advantage for narrow row spacings, except for one dry site where the canopy did not close across the wide row. Plant counts per meter row were higher on the 12 inch row spacing, but the plant count per square meter was lower. This did not affect yield.

Speed

The recommended speed for direct seeding in 8 km/h (5 mph) or less. No significant differences in plants counts or in grain yield between a speed of 6.5 km/h (4 mph) and a speed of 9.5 km/h (6 mph) were noted. The higher speed treatments had deeper troughs, disturbed more soil, and had a rougher field finish.

Seeding equipment was provided by Flexi-coil. Seed, fertilizer, weed control, and yield measurements were provided by SIDC.