Research and Demonstration

Highlights 1992

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- Contents -

SIDC

Introduction

Introduction

Manager's Report

On behalf of the Centre Management Committee, it is my pleasure to present the annual progress report for the Saskatchewan Irrigation Development Centre (SIDC). This report summarizes the work conducted, funded or facilitated by the Centre in 1992. I trust you will find this report informative and useful.

Interest in diversification and cropping alternatives remained extremely high in 1992. The success of the Centre is dependent upon its ability to influence this diversification by increasing the number of viable cropping options available to irrigation farmers and by increased productivity on a sustainable basis. The addition of a Market Analyst to SIDC has helped intensify this process through indentification and evaluation of potential markets for irrigated production. This will help us focus our limited research and demonstration dollars.

Research and demonstration results are now beginning to accumulate. Concerted efforts will be made to ensure this information is communicated and made available to the irrigation farmer.

The completion of the SIBED agreement along with research and demonstration budget reductions have necessitated a rethinking of the future strategy and role for SIDC. Since much of SIDC has been built on agreement funding, the recent announcement of the PAWBED Agreement has provided optimism for future funding to continue irrigated research and demonstration activity.

Year's Highlights

Many highlights occurred at the Centre in 1992. The following are a few of the more noteworthy:

1. A major role of the Saskatchewan Irrigation Development Centre has been to fund irrigated research and demonstration activity. This has been done primarily using funding from the Canada/Saskatchewan Irrigation Based Economic Development Agreement. To date 89 research applications have been received for funding and 33 have been approved. In addition, 143 demonstration applications have been received with 89 being approved. Reduced demonstration funding in 1992 necessitated a different approach to this activity. A total of 16 on-farm demonstrations were conducted by SIDC using dollars provided from the operational fund.

2. Thirty-six tours were hosted by SIDC in 1992. In total, over 1,800 guests visited the Centre. Particular highlights included our annual field day, a summer evening tour and our annual report back session.

3. Lectures, papers and/or poster sessions were presented at the Soils & Crops Workshop; Pulse Crop Growers Association Meeting; Expert Committee on Grain Production; SIDC Report Day; Salinity and Sustainable Agriculture Workshop; Herbs and Spice Growers Annual Meeting; Forage Production Seminar; Manitoba Irrigators Meeting; Symposium on the Role of Field Stations in the USA and Canada; and the World Bank Environmental Conference. In addition, an SIDC booth was staffed at the Crop Production Show and the SUMA Convention.

4. Drainage installed to remove excess surface water.

5. Construction was initiated on a new office/laboratory complex.

Canada-Saskatchewan Irrigation Development Centre

The Saskatchewan Irrigation Development Centre (SIDC) originated as the Prairie Farm Rehabilitation Administration Farm (PFRA), at Outlook, Saskatchewan. The PFRA Predevelopment Farm was established in Outlook in 1949, prior to the development of Gardiner Dam. The farm was designed as a centre to demonstrate irrigation methods to aid 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.

However, irrigated research and demonstration programs by Agriculture Canada, PFRA, the University of Saskatchewan and by Saskatchewan Agriculture were limited and programs addressed specific organizational or scientific objectives on an independent basis. The need existed for a coordinated, co-operative program. A joint federal-provincial agency called the Saskatchewan Irrigation Development Centre was formed in 1986, at Outlook, Saskatchewan, to help better address these needs.

Objectives of the Centre

1. To direct the focus of research and demonstration activities to meet the needs of irrigation farmers in Saskatchewan.

2. To develop, refine and test modern irrigation technology, cropping systems and soil conservation measures by conducting activities at the Development Centre and off-station sites in close co-operation with research organizations.

3. To demonstrate irrigation technology, cropping systems and soil conservation measures under irrigation at off-station sites throughout Saskatchewan.

4. To promote advanced irrigation technology, cropping systems and soil conservation measures under irrigation in co-operation with extension agencies.

5. To provide suitable land, facilities and technical support to research agencies to conduct research into irrigation technology, cropping systems and soil conservation measures under irrigation.

The Organization

The Centre consists of 80 hectares of federal land at Outlook, 65 hectares (leased with Saskatchewan Irrigation Based Economic Development (SIBED) funding) north of Outlook and 260 hectares at Rudy Rosedale Community Pasture. Research and demonstrations are conducted both at the Centre and on selected satellite sites.

The organizational structure at the Centre is shown in Figure 1.

1. The Centre Management Committee is the main governing body of the Centre. It consists of a federal and provincial representative, one from Agriculture Canada, PFRA, and one from Saskatchewan Water Corporation.

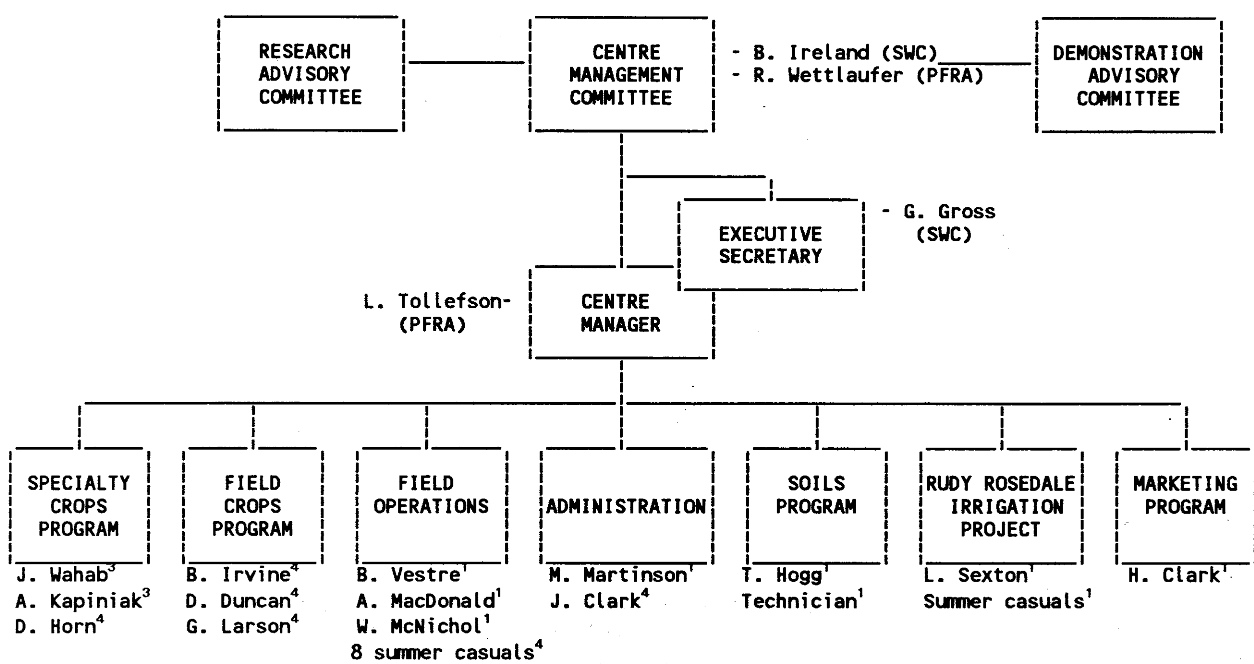
2. The Research Advisory Committee includes representatives from the University of Saskatchewan, Agriculture Canada, the provincial government and industry. This Committee identifies, reviews and suggests proposals for irrigation research work to be conducted, prioritizes and recommends the proposals to the Centre Management Committee and advises the Centre Management Committee on all matters related to irrigation research and extension. They also review and assess research work at the request of the Centre Management Committee.

3. The Demonstration Advisory Committee, comprised of mainly irrigation farmers, reviews and suggests proposals to the Centre Management Committee, and advises the Centre Management Committee on all matters related to irrigation research and extension. They also review and assess research work at the request of the Centre Management Committee.

4. The Centre Manager is staffed by Agriculture Canada, PFRA, and is responsible to manage staff, programs, contracts and budgets assigned to the SIDC.

5. The Executive Secretary position is staffed by the Saskatchewan Water Corporation. The duties of this position include preparation and supervision of off-centre contracts, preparation of centre agreements and implementation of an SIDC extension program.

Figure 1. Organizational Chart



1. PFRA 2. SASKATCHEWAN WATER CORPORATION 3. SPECTRUM SPECIALTY SEEDS INC. (SIBED CONTRACT) 4. AGRI-FARM CONSULTANTS LTD. (SIBED CONTRACT)

Centre Funding

The base funding for the Saskatchewan Irrigation Development Centre is provided by PFRA and Saskatchewan Water Corporation. Additional funds were provided by the Canada/Saskatchewan Irrigation Based Economic Development Agreement (SIBED).

Table 1. Base Funding

	(Ag Canada) PFRA	1992 SIBED	Sask Water
Salaries	329,000	350,606	32,016
Operating	179,300	80,617	
Capital	208,900		
Research		498,046	
Demonstration		232,283	
TOTAL	717,200	1,161,552	32,016

Total expenditures for the year were $1,910,768.

In addition to funding "on-centre activity", SIDC is responsible for managing all irrigation research, development and demonstration activity in Saskatchewan. The financial support for this expanded activity is through the SIBED agreement. This agreement identified $7.0 million for irrigated research and demonstration.

SIDC

List of Projects

Irrigation Based Economic Development Fund (IBED):

IBED Research Projects: (1)

PROJECT NAME AND CO-OPERATOR	TERM	1992 EXPENDITURES	TOTAL $
The Design and Field Testing of a Vertical Mulcher for Irrigated Conditions Principal: Paragon Consultants Ltd., T. Tollefson	Four years Completed 1992	$5,275.00	$73,750.00
Alfalfa Cultivar Evaluation on Flood Irrigated Clay Soils in South West Saskatchewan Principal: P. Jefferson, Ag Canada, Swift Current	Four years Completed 1992	$57,900.00	$210,000.00
Diseases of Irrigated Wheat to Evaluate Fungicide Sprays for Foliar Disease Control Principal: L. Duczek, Ag Canada, Saskatoon	Three years Completed 1992	$18,838.00	$40,859.00
Management of Alfalfa for Seed Production under Irrigation Principal: B. Goplen, Ag Canada, Saskatoon	Three years Completed 1992	$7,360.00	$38,440.00
Irrigated Production of Hybrid Canola Seed Principal: D. Hutcheson, Ag Canada, Saskatoon	Three years Completed 1992	$24,427.00	$91,161.00
Herbicide, Pesticide and Nutrient Loss Using Low Pressure (High Volume) Irrigation Systems Principal: W. Nicholaichuk, NHRI	Three years Completed 1992	$8,200.00	$98,200.00
Grass Species for Irrigated Pastures Principal: B. Goplen, Ag Canada, Saskatoon	Three years Completed 1992	$65,079.00	$170,007.00
Management of Forage Production under Irrigation Principal: B. Goplen, Ag Canada, Saskatoon	Three years Completed 1992	$51,553.00	$192,400.00
Evaluation of High-yielding, Disease-resistant Durum Wheat Breeding Lines for Irrigated Production Principal: J.M. Clarke, Swift Current Research Station	Three years Completed 1992	$80,900.00	$168,300.00
Nutrient Requirements of Irrigated Crops Principal: L. Henry, U of S	Three years Completed 1992	$60,692.00	$233,950.00
Barley Development and Evaluation for Irrigation in Saskatchewan Principal: B. Rossnagel, U of S	Three years Completed 1992	$73,335.00	$191,376.00
Screening for Phytopath Resistance in Cereal and Pulse Crops for Saskatchewan Principal: B. Rossnagel, U of S	Three years Completed 1992	$35,086.00	$74,990.00
Establishment and Seed Production of Turf and Forage Grasses under Irrigation Principal: Newfield Seeds Limited	Three years Completed 1992	$9,400.00	$27,200.00

IBED Demonstration Projects: (1)

PROJECT NAME AND CO-OPERATOR	TERM	1992 EXPENDITURES	TOTAL $
Alfalfa Varieties on Border Dyke Irrigation - Yield and Stand Longevity Contractor: Normac AES Ltd.	Five years Completed 1992	$2,300.00	$11,839.00
Alfalfa Establishment and Fertility for Increased Yield Contractor: Normac AES Ltd.	Five years Completed 1992	$16,055.00	$55,088.00
Maximum Economic Yield Co-operator: Outlook Irrigation Production Club	Four years Completed 1992	$3,365.00	$65,554.00

[1] Projects conducted in 1992 only. A complete list of research and demonstration projects is available upon request.

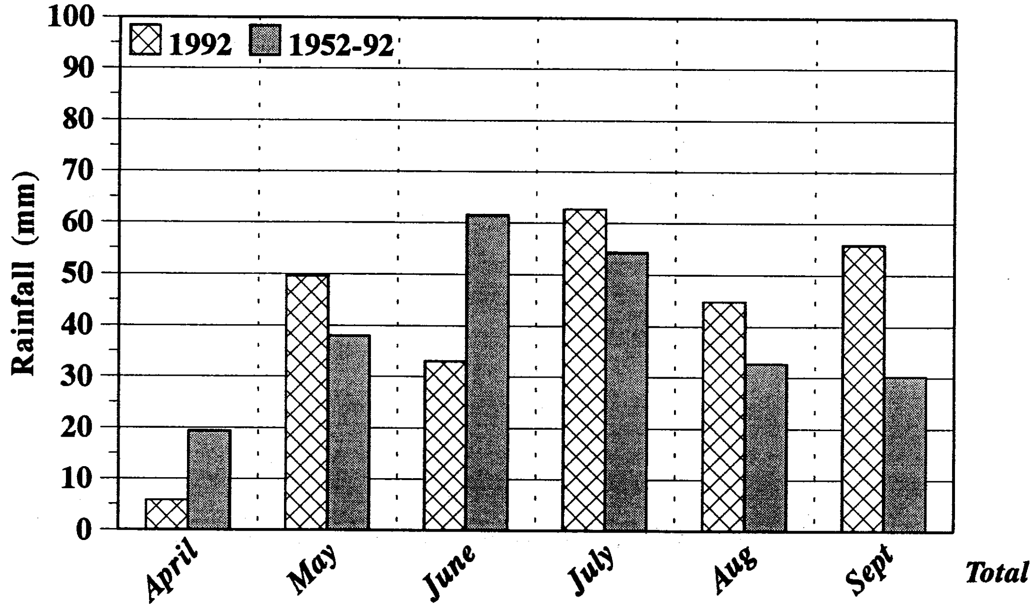
PROJECT NAME AND CO-OPERATOR	TERM	1992 EXPENDITURES	TOTAL $
Grasses for Irrigated Pastures Co-operator: N. MacLeod	Two years Completed 1992	$1,237.00	$4,406.00
Hay Certification and Forage Market Access Project Co-operator: V. Racz, U of S	Three years Completed 1992	$48,490.00	$147,500.00
Grasses vs. Alfalfa Production and Nutritional Value on Border Dyke Irrigation in SW Saskatchewan Contractor: Normac AES Ltd.	Three years Completed 1992	$5,220.00	$17,750.00
Testing Grain Crop Varieties under Irrigation Co-operator: B. Harvey	Three years Completed 1992	$92,805.00	$179,050.00
Adaptation and Recommendation Testing of Forage Crop Varieties in Saskatchewan Co-operator: Sask Forage Council/Newfield Seeds	Three years Completed 1992	$29,712.00	$57,500.00
Demonstration of Techniques for the Seed Production of Meadow Bromegrass Co-operator: R., M. & R. Larson	Three years Completed 1992	$3,500.00	$10,500.00
Fertilizing Grass Alfalfa Mixtures Co-operator: E. William	Two years Completed 1992	$960.00	$2,260.00
Response of Established Irrigated Alfalfa to Potassium Fertilization Co-operator: J. Torrie	Two years Completed 1992	$603.00	$2,090.00
Response of Established Irrigated Alfalfa to Potassium Fertilization Co-operator: B. & B. Spigott	Two years Completed 1992	$603.00	$2,090.00
Seed Yields of Forage, Turf and Amenity Grass Species and Varieties under Irrigated Conditions Co-operator: Saskatchewan Forage Council	Two years Completed 1992	$4,372.00	$25,000.00
Response of Established Irrigated Alfalfa to Potassium Fertilization Co-operator: L. Knapik	Two years Completed 1992	$603.00	$2,090.00
Irrigated Fababean Agronomy: Row Spacing Evaluation Co-operators: L. Lee/R. Pederson/L. Ward	One year Completed 1992	$2,625.00	$2,625.00
Irrigated Pinto Bean Seed Source Comparison: Idaho vs. Saskatchewan (dryland) Co-operators: M. Purcel/K. Carlson/A. Hamer	One year Completed 1992	$5,750.00	$5,750.00
Irrigated Pinto Bean Seeding Equipment Comparison Co-operators: B. Davison/M. Kasper	One year Completed 1992	$4,500.00	$4,500.00
Irrigated Pinto Bean Agronomy: N Application Timing Co-operators: J. Konst	One year Completed 1992	$2,250.00	$2,250.00
Irrigated Fababean Agronomy: Seeding Rate Evaluation Co-operators: K. Carlson/J. Kasper	One year Completed 1992	$1,750.00	$1,750.00
Irrigated Field Pea Agronomy: Inoculant Comparison Co-operators: L. Bagshaw/R. Duncan/G. McNeill, L. Sjovold	One year Completed 1992	$3,500.00	$3,500.00
Evaluation of Combine Modifications for Reducing Dry Bean Harvest Losses Co-operator: L. Zyla, U of S	One year Completed 1992	$2,083.00	$2,083.00

SIDC

Meteorological and Irrigation Data

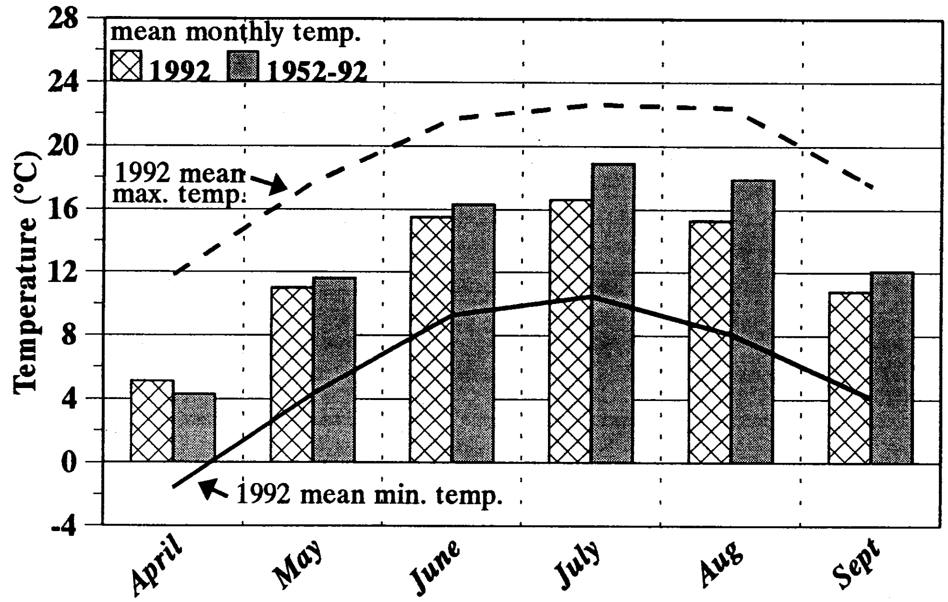
SIDC Meteorological Data

GROWING SEASON PRECIPITATION



	April	May	June	July	Aug	Sept	Total
1992	*5.8mm*	*49.6mm*	*33.0mm*	*62.7mm*	*44.8mm*	*55.8mm*	*251.7mm*
1952-92	*19.3mm*	*38.0mm*	*61.5mm*	*54.3mm*	*32.7mm*	*30.2mm*	*236.0mm*

GROWING SEASON TEMPERATURE



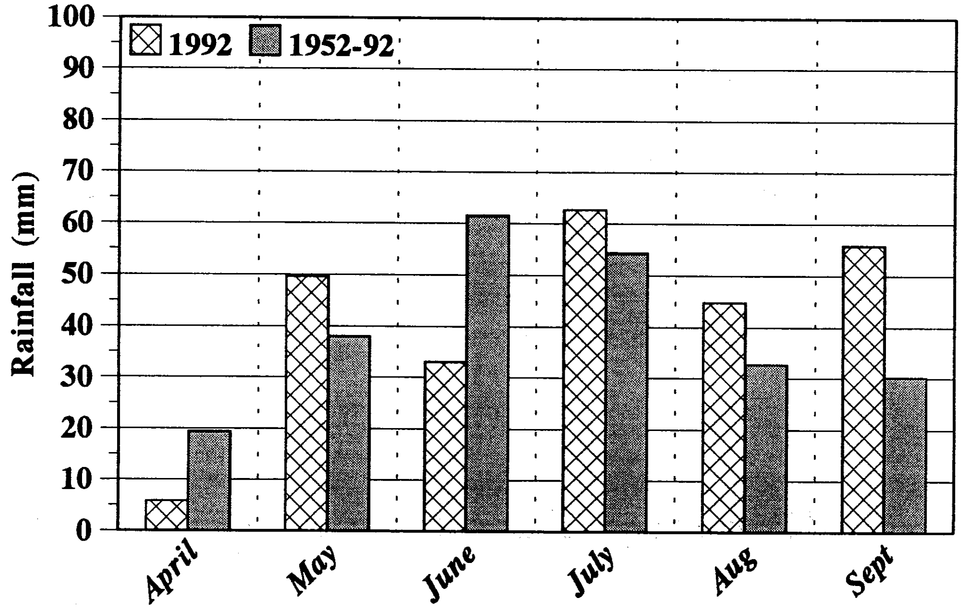
	April	May	June	July	Aug	Sept
1992	*5.1°C*	*11.0°C*	*15.5°C*	*16.6°C*	*15.3°C*	*10.8°C*
1952-92	*4.3°C*	*11.6°C*	*16.3°C*	*18.9°C*	*17.9°C*	*12.1°C*

SIDC

Meteorological and Irrigation Data

SIDC Meteorological Data

GROWING SEASON PRECIPITATION



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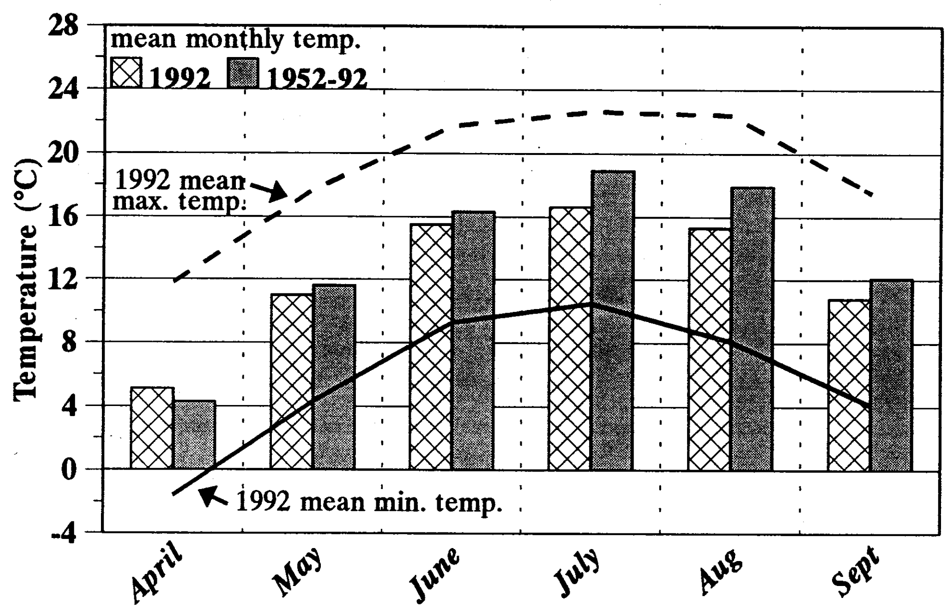
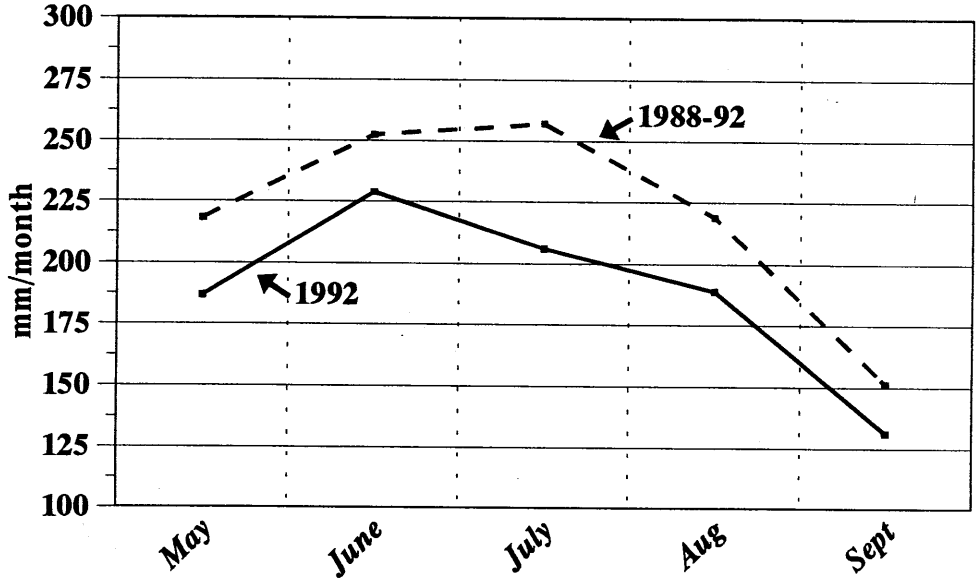


	April	May	June	July	Aug	Sept
1992	*5.1°C*	*11.0°C*	*15.5°C*	*16.6°C*	*15.3°C*	*10.8°C*
1952-92	*4.3°C*	*11.6°C*	*16.3°C*	*18.9°C*	*17.9°C*	*12.1°C*

CLASS "A" PAN EVAPORATION



		May	June	July	Aug	Sept
1992	-▪-	*186.8mm*	*228.9mm*	*206.1mm*	*189.0mm*	*131.2mm*
1988-92	-▪-	*218.4mm*	*252.6mm*	*257.2mm*	*219.0mm*	*151.2mm*

Pan Evaporation x 65% = estimated crop use (P.E.T.) at full canopy

1992 Irrigation Data (mm)

CROP	PLOT	MAY	JUNE	JULY	AUGUST	SEPTEMBER	Total through Growing Season	Fall Irrigation	Total Irrigation
Barley (Duke)	1	0.0	77.0	47.0	22.0	0.0	146.0	0.0	146.0
Winter Wheat	1	26.0	138.0	73.0	23.0	0.0	260.0	0.0	260.0
Double Cropping	1	24.0	138.0	72.0	45.0	0.0	279.0	0.0	279.0
Trans-Genic Canola	1	0.0	77.0	46.0	45.0	0.0	168.0	0.0	168.0
Alfalfa	2B	0.0	One Flood	One Flood	One Flood	0.0	0.0	0.0	0.0
Soft Wheat (Fielder)	2A	0.0	32.0	141.0	0.0	0.0	173.0	0.0	173.0
Soft Wheat (Fielder)	3	0.0	52.0	77.0	45.0	0.0	174.0	0.0	174.0
Alfalfa	4	22.0	67.0	62.0	42.0	0.0	193.0	0.0	193.0
Barley (Duke)	5	0.0	63.0	78.0	18.0	0.0	159.0	0.0	159.0
Malt Collaborative	7	0.0	65.0	0.0	0.0	0.0	65.0	0.0	65.0

CROP	PLOT	MAY	JUNE	JULY	AUGUST	SEPTEMBER	Total through Growing Season	Fall Irrigation	Total Irrigation
Malt Collaborative	7	0.0	65.0	0.0	0.0	0.0	65.0	0.0	65.0
Grass Seed	8	51.0	113.0	0.0	23.0	0.0	187.0	0.0	187.0
CPS (Biggar)	8	0.0	45.0	86.0	44.0	0.0	175.0	0.0	175.0
Durum Variety	8	0.0	42.0	82.0	43.0	0.0	167.0	0.0	167.0
Durum Fungicide	8	0.0	42.0	82.0	73.0	0.0	197.0	0.0	197.0
Soft Wheat Co-op	8	0.0	45.0	83.0	41.0	0.0	169.0	0.0	169.0
Semi-Dwarf Barley	9	0.0	46.0	81.0	42.0	0.0	169.0	0.0	169.0
Cereal Diseases	9	0.0	46.0	81.0	43.0	0.0	170.0	0.0	170.0
CPS (Biggar)	9	0.0	45.0	83.0	44.0	0.0	172.0	0.0	172.0
Flax	9	0.0	45.0	82.0	42.0	0.0	169.0	0.0	169.0
Sunflower Co-op	9	0.0	45.0	90.0	64.0	0.0	199.0	0.0	199.0
Canary Seed/Millet	9	0.0	45.0	82.0	42.0	0.0	169.0	0.0	169.0
Sweet Corn	9	0.0	45.0	90.0	64.0	0.0	199.0	0.0	199.0
CPS (Biggar)	10	0.0	45.0	90.0	64.0	0.0	199.0	0.0	199.0
Barley (Duke)	11	0.0	69.0	63.0	37.0	0.0	169.0	0.0	169.0
Early Seeded Cereals	11	0.0	69.0	63.0	0.0	0.0	132.0	0.0	132.0
Late Seeded Cereals	11	0.0	69.0	63.0	69.0	0.0	201.0	0.0	201.0
Gene Mapping	11	0.0	69.0	63.0	0.0	0.0	132.0	0.0	132.0
K Response	11	0.0	69.0	63.0	69.0	0.0	201.0	0.0	201.0
Pulse Block	12	0.0	51.0	70.0	50.0	0.0	171.0	0.0	171.0
P Response	12	0.0	50.0	70.0	51.0	0.0	171.0	0.0	171.0
Alfalfa/Grass Nitrification	12	0.0	51.0	70.0	50.0	0.0	171.0	0.0	171.0
Soft Wheat Seed Increase	12	0.0	54.0	63.0	50.0	0.0	167.0	0.0	167.0
Triticale	12	0.0	54.0	70.0	50.0	0.0	174.0	0.0	174.0
Durum (Sceptre)	12	0.0	55.0	68.0	50.0	0.0	173.0	0.0	173.0
Demo Site	NW	0.0	75.0	88.0	89.0	0.0	252.0	0.0	252.0
Demo Site	NE	0.0	75.0	62.0	88.0	0.0	225.0	0.0	225.0
Demo Site	SW	0.0	75.0	116.0	65.0	0.0	256.0	0.0	256.0
Demo Site	SE	0.0	75.0	116.0	65.0	0.0	256.0	0.0	256.0

Cereals

Barley Development and Evaluation for Irrigation in Saskatchewan

Principal:	B.G. Rossnagel, Crop Development Centre University of Saskatchewan, Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigator:	B.L. Harvey, Dept. of Crop Science and Plant Ecology
Co-operators:	SIDC; J. Stanger, Bradwell
Progress:	Final year
Locations:	Saskatoon, Bradwell and Outlook
Objective:	To continue efforts to develop superior six-row and two-row feed and malting barley cultivars for irrigated conditions in Saskatchewan and to evaluate currently available barley varieties under irrigation.

During the second year of this project, 437 advanced Crop Development Centre barley breeding lines and selections, as well as introductions from the United States, Scandinavia and Europe, were evaluated under irrigation at one to three locations. Test locations included Saskatoon, Bradwell and Outlook. Materials under test included both two-row and six-row feed and malting types, with varying maturities, disease resistance attributes and market end-use quality features.

Superior straw strength achieved via the introgression of semi-dwarf genes is a major criterion in selection of materials for testing and their retention for further evaluation. In addition to evaluation for yield potential, straw strength and maturity, genotypes are tested for superiority in physical and chemical grain quality traits including plumpness, test weight, kernel weight, protein, viscosity and beta-glucan (hulless types) and alpha-amylase and saccharifying activity (malting types) and for resistance to various diseases, in particular net blotch and scald.

Based on 1990-92 data, several lines appear to have promising combinations of straw strength, yield potential and maturity. Several two-row genotypes yielded at levels similar to that of the check cultivar, Harrington, but did not lodge and in some cases were several days earlier to maturity and have superior disease resistance. Seven to ten lines from this project will be advanced to 1993 Co-op trials.

In addition to these breeding and development activities, the project evaluated all currently registered barley varieties suggested for production in Saskatchewan at the three irrigated sites. The results were provided to the barley coordinator of the Saskatchewan Advisory Council on Crops, Grain Crops Sub-committee. That information is then added to the data base of information regarding barley variety performance under irrigation in Saskatchewan, which is, in turn, utilized to develop the Barley Irrigation Section within the annual "Varieties of Grain Crops for Saskatchewan" publication.

This project will assist in the development of more consistently productive and marketable barley varieties for production under irrigation. The eventual results of these efforts will provide more variety choices to irrigation area producers including two-row and six-row, hulled and hulless, feed, malting and specialty food market types.

Screening for Phytopath Resistance in Cereal and Pulse Crops in Saskatchewan

Principal: B.G. Rossnagel, Crop Development Centre
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-investigator: A.E. Slinkard, P.J. Hucl and D.B. Fowler, Crop Development Centre
B.L. Harvey, R.J. Baker, G.R. Hughes and D.R. Knott, Dept. of Crop Science and Plant Ecology
Progress: Final year
Location: Saskatoon
Objective: To operate intensive irrigated disease resistance selection nurseries at the Crop Development Centre, Saskatoon, screening for genetic disease resistance in barley, wheat and lentil varieties for Saskatchewan.

The Crop Development Centre irrigated disease resistance selection nurseries completed another successful year of operation. Intensive screening and selection for genetic disease resistance to eight different diseases in wheat (five classes), barley (six classes) and lentil was carried out. The use of irrigation is imperative to the success of establishing and maintaining disease infection in the breeding nurseries at Saskatoon. Once this is achieved, using a computer controlled high frequency low intensity irrigation system, the normally disease-free environment at Saskatoon becomes an ideal site at which to screen en-mass in the field for resistance to the diseases in question. Ascochyta screening in chickpea and anthracnose screening in lentil was added in 1993.

Some 30,000 early generation individuals and 1,667 advanced two-row and six-row, feed and malting hulled and hulless barley lines were tested/screened for improved tolerance to the spot-form of net blotch (*Phrenophora teres* f. sp. *maculata*) and to stem rust (*Puccinia graminus* f. sp. *trici*). More than 20,000 individual Hard Red, Soft White and Canada Prairie Spring and Durum wheat genotypes were evaluated for resistance to stem and leaf rust (*P. graminus* and *P. recondita*) as were 2,085 Winter Wheat breeding lines. Nearly 1,900 wheat lines were tested for better tolerance to various races of *Septoria sp.* and 590 wheat genotypes were scored for resistance to Black Point, Bunt and Loose Smut. Finally, in excess of 2,500 lentil selections and 200 chickpea lines were evaluated for tolerance to Ascochyta leaf blight.

Based on the results of these screening trials, susceptible genotypes are discarded and tolerant/resistant lines are advanced to the next stage of the breeding and selection process, where they will normally be retested for disease reaction to verify previous tests. Verification normally require three years of data.

The overall value of this critical activity is in the assistance it provides in the overall selection of improved cereal and pulse crop cultivars for Saskatchewan producers. Disease resistance selection activities are especially critical to irrigators since crop disease losses are consistently more important under high moisture conditions.

Diseases of Irrigated Wheat to Evaluate Fungicide Sprays for Foliar Disease Control

Principal:	L. Duczek, Agriculture Canada Research Station, Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	L. Tollefson, H. Harding
Location:	Saskatchewan Irrigation Development Centre
Progress:	Final year
Objective:	To evaluate the efficacy of registered fungicides and to evaluate the effect of timing on application of fungicides.

Yield increased and foliar disease levels decreased in Katepwa and Fielder wheat by applications of the fungicides, Tilt and Dithane DG. The rate and time of application was according to directions on the label, and the trials were done on small plots at Outlook from 1990 to 1992. One spray of Tilt was as effective as two sprays. The data also indicate the optimal time to spray for foliar diseases to maximize yield is between the flag leaf sheath emerging to the medium milk growth stages. This means there is about a two to three week period within which to spray. This usually occurs from July 1 to 21 with a mid-May seeding date. The major foliar disease was septoria leaf spot caused by *Septoria nodorum*. Other foliar diseases also occurred but they were less common.

Yield losses occurred in years which favoured foliar disease development. Results from this study and a previous study showed that from 1987 to 1992, yield losses occurred in four of six years. There were differences between cultivars. The average yield increase from fungicide spray applications in 1987, 1990, 1991 and 1992 for Katepwa, a hard red spring wheat, was 6% while for Fielder, a soft white spring wheat, the yield increase was 12%.

Studies were initiated on disease prediction. On July 3, 1991 at the flag leaf sheath extending to the boots swollen growth stages, the disease incidence was over 50% on the second (penultimate) leaf and spraying increased yield by 9 to 14%. On June 30 and July 7, 1992 at the flag leaf emerging to heads completely emerged growth stages, disease incidence was greater than 50% on the third leaf and spraying increased yield by 0 to 12%. On July 13 at the heads completely emerged to flowering half way completed growth stages, disease incidence was greater than 50% on the second leaf, and spraying increased yield by 4 to 11%. This data suggests that spraying should be done if disease incidence is greater than 50% on the third leaf between the booting and flowering growth stages. However, it will only be worth spraying when the anticipated yield increase is greater than the costs of spraying.

Evaluation of High-Yielding, Disease Resistant Durum Wheat Breeding Lines for Irrigated Production in Saskatchewan

Principal:	J.M. Clarke, Agriculture Canada Research Station, Swift Current, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	M. R. Fernandez, R. B. Irvine, R.E. Knox, J.G. McLeod, R.M. DePauw and T.N. McCaig
Location:	Swift Current and Outlook
Progress:	Final year
Objective:	To determine the levels of disease resistance and agronomic characteristics, such as yield and straw strength, required for successful production of durum wheat under irrigation in Saskatchewan.

During the three years 1990 to 1992, approximately 200 lines of durum and several common wheat check varieties were grown under dryland and irrigated conditions at Swift Current, and under irrigation at Outlook. The lines included registered durum varieties and short-strawed durum breeding lines. Data for some of the registered varieties and a few experimental lines are summarized in Tables 1 and 2.

Lodging was most severe at Outlook (Table 1), where the crop was tallest. The tall, weak-strawed varieties Genesis, Kyle, and Wakooma suffered the worst lodging. In comparison, lodging was light in the short, non-registered lines DT369 and Westbred 881. These lines are classified as 'semidwarf', as are Biggar, AC Taber and Fielder. Varieties of this height class would be desirable for irrigation, providing improved straw strength and reduced straw production.

Grain yields averaged over 50% higher under irrigation than on dryland (Table 1). Yields were highest at Outlook, where Arcola, Plenty, and Sceptre were particularly responsive to irrigation compared to the common wheats. Several of the short-strawed experimental durums showed even higher yields.

Grain protein concentration was lower for the irrigated than for the dryland tests (Table 2). However, several lines showed high protein under both dryland and irrigated conditions. It is interesting to note that the registerd durum cultivars produced higher yield than the CWRS cultivars under irrigation, but had similar protein levels.

Kyle, Wakooma, and Plenty were graded #1 in all locations in 1991, as were the common wheat varieties (Table 2). Several of the other experimental durums and varieties were down-graded to #2, particularly in the Outlook irrigated experiment. With the exception of Sceptre, which was down-graded due to immaturity and Arcola due to low test weight, the major cause of downgrading was smudge. We found genetic variation for resistance to both leaf and kernel diseases such as smudge, so it should be possible to breed improved varieties.

Durum has good potential as an irrigated cereal crop. The yield advantage of the registered durum varieties at Outlook, and the price of durum relative to other wheat classes, particularly Canada Western Soft White Spring and Canada Prairie Spring, makes it an attractive rotation crop for irrigation. Development of semidwarf, disease-resistant varieties would improve the performance of durum under irrigation, and reduce the risk of crop lodging.

Table 1. Average lodging, height, and grain yield of registered durum varieties, experimental durum lines, and common wheat checks grown 1990 - 1992 under dryland (Dry) and irrigation (Irr) at Swift Current, and under irrigation (Out) at Outlook.

Variety	Lodging[1]			Height			Yield		
	Dry	Irr	Out	Dry	Irr	Out	Dry	Irr	Out
				----- cm -----			-- kg/ha --		
Kyle	3	2	6	101	109	128	4006	6090	8110
Registered durums							- Rel. Kyle[2] -		
Arcola	3	2	5	95	102	118	90	103	111
Kyle	3	2	6	101	109	128	100	100	100
Medora	2	2	4	96	103	119	98	97	97
Plenty	3	2	3	101	108	127	103	97	110
Sceptre	2	2	3	93	93	111	103	100	114
Wakooma	3	3	7	101	108	129	98	96	90
Experimental durums									
8567-BD4E	3	3	4	90	97	111	107	107	104
8667-*D031B	2	2	3	91	91	111	97	103	124
8667-*D037A	2	1	3	92	91	111	103	103	115
8667-*D216C	2	2	5	97	97	109	106	106	118
8667-*D369B	2	1	5	89	92	112	103	102	118
DT 369	2	2	2	81	84	101	107	102	113
Westbred 881	2	2	2	70	75	95	93	84	97
Common wheats									
Biggar	3	2	3	79	84	92	125	103	98
AC Taber	2	2	5	86	91	95	112	107	91
Genesis	3	3	7	100	104	114	122	113	82
Fielder	2	2	4	85	88	104	114	96	92
Katepwa	3	2	4	100	105	110	103	83	85
Laura	3	2	3	100	98	112	98	84	84

DT 369, Westbred 881, Biggar, AC Taber, and Fielder are semidwarfs.

Biggar, AC Taber, and Genesis are Canada Prairie Spring Class; Fielder is Canada Western Soft White Spring; Katepwa and Laura are Canada Western Red Spring.

[1]Lodging is on a 1 to 9 scale, 1 is vertical, 9 is horizontal.

[2]Yield as a % of Kyle.

Table 2. Grain protein concentration (average 1990 to 1992) and commercial grades (1991 only) of registered and experimental durums and common wheats grown in dryland (Dry) and irrigated (Irr) tests at Swift Current, and under irrigation at Outlook (Out).

	Protein (%)			Grade		
	Dry	Irr	Out	Dry	Irr	Out
Registered durums						
Arcola	14.4	13.0	14.3	2 CWAD	1 CWAD	1 CWAD
Kyle	14.8	11.7	13.7	1 CWAD	1 CWAD	1 CWAD
Medora	15.1	13.3	14.3	1 CWAD	1 CWAD	2 CWAD
Plenty	14.0	12.5	14.1	1 CWAD	1 CWAD	1 CWAD
Sceptre	14.1	12.6	13.1	1 CWAD	1 CWAD	2 CWAD
Wakooma	15.1	13.0	14.0	1 CWAD	1 CWAD	1 CWAD
Experimental durums						
8567-BD4E	15.0	12.7	14.1			
8667-*D031B	14.4	13.3	13.6			
8667-*D037A	15.1	13.7	14.0	1 CWAD	1 CWAD	2 CWAD
8667-*D216C	14.8	12.6	15.4			
8667-*D369B	14.5	12.7	13.8			
DT 369	13.4	12.4	12.7	1 CWAD	1 CWAD	2 CWAD
Westbred 881	13.9	13.1	13.3	1 CWAD	1 CWAD	2 CWAD
Common wheats						
AC Taber	12.4	11.9	12.1			
Biggar	12.3	11.0	11.1	1 CPSR	1 CPSR	1 CPSR
Fielder	11.4	10.5	10.9	1 CWSWS	1 CWSWS	1 CWSWS
Genesis	12.4	11.0	11.7	1 CPSW	1 CPSW	1 CPSW
Katepwa	14.2	13.7	14.5	1 CWRS	1 CWRS	1 CWRS
Laura	14.7	14.4	14.4	1 CWRS	1 CWRS	1 CWRS

Testing Grain Crop Varieties under Irrigation

Principal: B.L. Harvey, Dept. of Crop Science and Plant Ecology, University of Saskatchewan, Saskatoon, Saskatchewan

Funding: Irrigation Based Economic Development Agreement

Progress: Final year

Objective: To evaluate current and potential grain crop varieties for irrigated production. Data obtained from replicated yield trials over a number of seasons and locations is necessary to provide information to producers allowing them to make informed choices of varieties under irrigation.

Selected varieties of the major grain, oilseed and specialty crops were evaluated at four irrigated locations in 1992: Birsay, Broderick, Outlook and Riverhurst. In total, 67 varieties and advanced lines were seeded at each site with plot establishment completed by May 7. The last of the harvest was completed by October 23. The project progressed well in 1992 and the targeted collection of yield data was completed. The information provided by this project is vital to producers in making informed choices of crop varieties under irrigation.

Table 1. Grain yields of crop varieties, 1990-92.

WHEAT

VARIETY	% OF KATEPWA
Hard Red Spring Wheat	
Katepwa	100
AC Minto	95
CDC Makwa	101
CDC Merlin	95
CDC Teal	97
Laura	93
Pasqua	93
Roblin	95
BW 152	105
BW 158	98
BW 649	94
BW 653	98
Canada Prairie Spring	
AC Taber	125
Biggar	114
Soft Wheat	
AC Reed	116
Fielder	118

BARLEY

VARIETY	% OF HARRINGTON
2-Row Barley	
Harrington	100
AC Oxbow	104
Bridge	112
Deuce	114
Ellice	108
Manley	116
TR 118	106
6-Row Barley	
Argyle	96
Tankard	106
Virden	119
BT 926	117
HB 314	101
HB 501	101
SD 402	116
SD 503	128

DURUM

VARIETY	% OF KYLE
Kyle	100
Arcola	112
Medora	109
Plenty	113
Sceptre	114

FABABEAN

VARIETY	% OF OUTLOOK
Outlook	100
Aladin	97
Pegasus	101
Encore	89

CANOLA

VARIETY	% OF WESTAR
Westar	100
Crusher	128
Cyclone	135
AC Excel	113
Global	145
Hyola 401	125
Pivot	117
Topas	121

FIELD PEA

VARIETY	% OF EXPRESS
Yellow Field Pea	
Express	100
Bellevue	71
Century	78
Miko	126
Patriot	115
Tara	87
Titan	75
Green Field Pea	
Radley	93
Danto	122
Emerald	110
Orb	133
Trump	108

FLAX

VARIETY	% OF McGREGOR
McGregor	100
AC Linora	117
Andro	94
Flanders	117
Norlin	106
Somme	109

Soft White Spring Wheat Co-operative Trial

Principal: R.J. Baker, Dept. of Crop Science & Plant Ecology
University of Saskatchewan
Saskatoon, Saskatchewan

Twenty Soft White Spring wheat cultivars were evaluated in a four-replicate test at the Saskatchewan Irrigation Development Centre in Outlook. This test formed part of the official testing program for Soft White Spring wheat cultivars in Western Canada. The same test was grown at Saskatoon and at several locations in southern Alberta.

A further 25 advanced lines from the University of Saskatchewan Soft White Spring wheat breeding program were also tested in a four-replicate test at SIDC. This test was also grown under dryland and irrigation at Saskatoon. While none of these 25 entries had sufficient improvement to warrant testing in the 1993 Cooperative trial, four are being retained for a second year of advanced testing.

Irrigation Scheduling of Sprinkler Irrigated Cereal and Oilseed Crops

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Saskatchewan Irrigation Development Centre (SW 15-29-08-W3)
Progress: Year two of ongoing
Objective: To determine the effect of delaying the initiation of irrigation on the yield of sprinkler irrigated cereal and oilseed crops.

In 1992, an irrigation scheduling experiment was established for the second year to determine the effect of delaying the initiation of irrigation on the yield of sprinkler irrigated cereal and oilseed crops. The site selected had been fall irrigated in 1991. The crops selected were Biggar CPS wheat, Sceptre durum wheat, Global canola and McGregor flax. Growth stages selected for irrigation initiation were tillering (Zadoks 21), stem elongation (Zadoks 32) and initial flowering (Zadoks 60).

Delaying the application of irrigation until flowering in 1992 did not significantly reduce the yield for any of the crops (Table 1). An adequate reserve of available soil moisture, due to fall irrigation at this site and a cool growing season in 1992, likely prevented the plants from being subjected to water stress for prolonged periods of time.

Total water use increased as the amount of water applied increased for all crops (Table 2) but did not result in a significant increase in yield.

This experiment will be continued in subsequent years. Results over several seasons will provide irrigation growers with the appropriate timing of irrigation initiation on fall irrigated soils to obtain maximum economic production of sprinkler irrigated cereal and oilseed crops.

Table 1. Grain yield for the cereal and oilseed crops irrigation scheduling experiment.								
Water Treatment	Grain Yield (kg/ha)							
	Biggar CPS Wheat (14%)	CV (%)	Sceptre Durum Wheat (14%)	CV (%)	Global Canola (10%)	CV (%)	McGregor Flax (10%)	CV (%)
1	6524	16	6021	22	2644	17	3746	8
2	6281	10	6569	13	2830	11	3485	7
3	6712	8	5831	7	2972	15	3492	7
LSD(0.05)	NS		NS		NS		NS	

NS-Not significant

Table 2. Seasonal moisture budget for the cereal and oilseed crops irrigation scheduling experiment.					
Crop	Water Treatment	Rainfall	Irrigation	Seasonal Soil Moisture Change	Total Water Use
		-----	----- mm -----	-----	-----
Biggar CPS Wheat	1	236	170	21	427
	2	236	130	14	380
	3	236	92	20	348
	LSD(0.05)			NS	19
Sceptre Durum Wheat	1	236	170	33	439
	2	236	130	30	396
	3	236	92	26	354
	LSD(0.05)			NS	20
Global Canola	1	236	170	28	434
	2	236	130	24	390
	3	236	92	25	353
	LSD(0.05)			NS	15
McGregor Flax	1	236	170	47	453
	2	236	130	39	405
	3	236	92	32	360
	LSD(0.05)			NS	20

NS - Not significant

Winter Wheat Co-op

Principal: B. Fowler, Crop Development Centre
Progress: Ongoing
Objective: To develop winter wheat varieties.

Several experimental winter wheat lines have yields in excess of Norstar under irrigated conditions at Saskatoon and Outlook (Table 1).

Norstar should not be grown under irrigated conditions. Although Norwin is slightly less winter hardy, it has excellent lodging tolerance. Low grain protein levels can sometimes be a problem in the winter wheat cultivars available at this time.

Table 1. Winter wheat varieties.

Variety	Grain % Norstar	Lodging (0 - 9)*	Stem Rust	Leaf Rust
Norstar	100	8.0	60 s	20 ms-s
CDC Kestrel	160	4.4	30 ms	5 mr-ms
Norwin	151	0.3	5 mr	80 s
S86-353	167	3.7	5 ms	60 s
S86-403	171	2.7	20 ms	40 s
S86-715	111	8.1	50 s	20 ms-s
S86-736	149	1.4	50 ms	5 mr
S86-740	150	3.4	5 r	0 r
S86-784	158	3.4	5 ms	30 s

*9 flat

Relative Yields of Cereal Cultivars

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year four of ongoing
Objectives: To determine the yields of all major classes of cereal grains when grown under the same "non-yield limiting" conditions at early and late seeding dates.

Plots were 24 m^2 or larger each season to improve the expression of lodging. The crops were planted in a four replicate randomized complete block. Soil moisture was maintained at or above 50% of field capacity at the Outlook site and at the same level as the producer at the Birsay site.

Grain yields are reported at 14% moisture. Yields of all grains are expressed as (%HRS). The HRS check yield is the mean yield of the cultivars Katepwa and Roblin.

Yields varied considerably from year to year (Table 1). Late maturing cultivars in the late seeded test in 1992 were frozen and, therefore, yields may be lower than normally would be expected. In the three seasons where early and late seeded comparisons are available, early seeded hard red spring outyielded the late seeded crops by 17%. This comparison is not statistically valid since the tests were grown side by side rather than in the same test. Over the four growing seasons and 10 site years of data, Biggar (CPS wheat) has yielded 12% more than the mean of Roblin and Katepwa while Fielder (soft wheat) and Sceptre (durum wheat) have yielded 8% more than Hard Red Spring (Table 1). When only the five early seeded sites are considered, Biggar and Fielder outyielded the hard red spring checks by 18% and 16%, respectively. Duke barley has produced 30% more grain than Hard Red Spring but the $50 per tonne price difference makes feed barley production unprofitable. Malt barley can be produced under irrigated conditions but unless the crop is selected for malting, at least 70% of the time the returns from malting barley would be lower than for CPS wheat.

Lodging continues to be a significant problem in all but the semi-dwarf plant types (Table 2). Wapiti, Frank and Banjo triticales are very tall (125-130 cm) but lodging was limited. As in previous seasons, cultivars which were prone to lodging had higher lodging indices when planting was delayed until the end of May.

The cool 1992 growing season greatly increased the days to maturity (Table 3). The triticale lines were up to seven days later than CPS wheats but yields in 1992 were similar to barley. If prices of feed wheat and triticale are similar, this crop could have merit as feedstock for ethanol production.

Table 1. Yield of cereal cultivars.

	Grain yield (% of hard red spring checks)									
Cultivar	E1989	L1989	E1990	L1990	B1990	L1991	B1991	E1992	L1992	B1992
DUKE	110	139	138	130	140	104	112	124	135	184
HARRINGTON	88	113	113	93	102	91	91	127	109	143
HD501								133	103	127
MANLEY	91	114	123	101	104	94	98	115	93	167
SD502								142	95	171
SD503								149	127	169
BIGGAR	122	113	121	111	126	91	102	96	111	120
TABER						99	118	97	98	131
ARCOLA	103	103	99	92	94	84	105	113	103	122
KYLE								104	56	105
MEDORA	102	96	102	88	99	100	129	125	101	122
PLENTY						93	103	152	94	119
SCEPTRE	114	101	111	96	103	108	125	134	99	112
KATEPWA	100	98	104	104	99	88	100	96	93	112
KENYON								75	90	94
MAKWA			106	94	96	95	102	87	97	109
MINTO								94	74	97
PASQUA								86	85	97
ROBLIN	100	102	96	96	101	112	100	104	107	98
TEAL								107	105	110
FIELDER	115	112	113	102	113	91	90	129	101	120
REED								110	128	134
BANJO								129	102	112
FRANK								129	89	126
WAPITI								153	96	131
HRS * kg/ha	5436	4335	5047	4569	4565	3748	4082	5189	4480	4268
CV	7	9.6	7.8	10.9	9.4	10.5	6.7	13.3	12.5	7.8
LSD	582	566	610	702	648	164	404	1135	782	845

*Yield is average of Roblin and Katepwa

Table 2. Lodging of cereal grain cultivars.

Cultivar	Lodging 1-9							
	EAR89	LAT89	EAR90	LAT90	BIR90	LAT90	EAR92	LAT92
DUKE	1.3	2.4	1.0	4.5	1	1.3	2.5	1.8
HARRINGTON	5.3	6	5.5	8.8	5.8	6.3	6.0	8.3
HD501							1.0	1.3
MANLEY	4	6	5.5	9.0	4.5	7.3	7.0	8.3
SD502							7.3	7.5
SD503						1	1.8	2.0
BIGGAR	1.3	3.6	1.0	2.8	1	1	1.8	1.8
TABER							2.0	3.8
ARCOLA	2.8	6.6	3.8	8.0	3.3	6.5	4.3	6.8
KYLE							5.5	8.8
MEDORA	2	7	3.5	8.5	2.3	6	4.3	6.0
PLENTY						5	5.0	6.0
SCEPTRE	1.8	5.8	2.3	7.8	2.3	5	2.3	3.5
KATEPWA	3.5	4.6	1.5	7	3	5	3.0	5.3
KENYON							3.8	4.8
MAKWA			1.5	6.5	3.5	3.5	3.8	7.3
MINTO							4.5	7.0
PASQUA							4.0	5.5
ROBLIN	1.3	4	1	3.3	1	1.5	1.0	4.0
TEAL							1.8	3.8
FIELDER	1	1.6	1	4.5	1	1.3	1.3	3.8
REED							1.5	2.0
BANJO							1.0	1.3
FRANK							2.8	2.8
WAPITI							1.5	2.5
CV	51.6	39	31.5	17.2	40.8	43.3	48	30
LSD	2	2.5	1.3	1.5	1.6	2.4	1.6	2

Table 3. Maturity of cereal grain cultivars.

Cultivar	Maturity in days from planting						
	EAR89	LAT89	EAR90	LAT90	LAT91	EAR92	LAT92
DUKE	96	93	100	101	87	106	111
HARRINGTON	91	88	98	93	83	101	102
HD501						110	112
MANLEY	92	92	100	99	87	114	110
SD502						115	111
SD503						105	111
BIGGAR	103	109	113	113	102	119	123
TABER					102	118	122
ARCOLA	103	105	110	105	97	120	120
KYLE						123	121
MEDORA	104	106	112	103	97	123	122
PLENTY					99	127	121
SCEPTRE	104	105	111	104	97	123	122
KATEPWA	101	101				116	118
KENYON						115	118
MAKWA			109	103	96	118	117
MINTO						119	118
PASQUA						116	118
ROBLIN	99	101	109	105	96	114	118
TEAL						118	120
FIELDER	104	107	109	105	95	121	122
REED			115	111	100	119	119
BANJO						129	125
FRANK						127	124
WAPITI						130	126
CV	1.8	2.1	1.1	1.7	1.3	3.8	1.6
LSD	2.6	2.7	1.6	2.5	1.5	6.4	2.6

Effect of Tillage and Residue Management of Flax, Durum Wheat and Canola on the Subsequent Yields of Wheat and Barley

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objective: To determine the effect of plowing, discing and spiking combined with removal or retention of crop residues on the yields of subsequently grown wheat and barley crops.

Irrigation using a center pivot irrigation system maintained the top 60 cm of the soil profile at or above 50% of field capacity at all times.

Biggar CPS wheat was planted at right angles to the previously grown durum wheat, canola and flax plots to which tillage and residue management practice were applied.

Analysis of variance was performed separately on each crop and comparisons between treatments were made using linear contrasts where feasible. Contrasts are not orthogonal but do represent the necessary treatment comparisons.

Single degree of freedom comparisons indicated that removal or retention of durum crop residue did not affect grain yields in any season (Table 1-3). Likewise, plowing did not affect yields relative to spiking or discing. There was a small but statistically significant increase in wheat yields on flax and canola residue relative to durum residue in 1990 (Figure 1). In 1991, Biggar wheat on durum stubble yielded about 20% less than on canola or flax stubble at 90 kg/ha nitrogen levels (Figure 2, Figure 3). In 1992, this drop did not occur (Figure 4, Figure 5). Thus, over the three seasons the value of crop rotation for wheat crop production was limited.

There was a significant interaction between nitrogen application rate and method of applying nitrogen in 1991 but not in 1992 (analysis not shown). When 90 kg/ha of nitrogen was applied to wheat grown on durum wheat stubble, broadcasting and banding gave similar results in both seasons. Applying 45 kg/ha as a band improved yields only in 1991 when the soil nitrate levels for flax and durum stubbles were 30-40 kg/ha less than in 1992. The improved response to banding in 1991 may be due to short term immobilization or positional unavailability for the broadcast treatment on wheat or flax residue. Banding did not increase yields on canola residue in any season. Soil nitrate levels in 1992 were probably high enough to prevent adverse effects due to short term immobilization.

Soil samples taken from plots where only 15 kg/ha of nitrate was applied as fertilizer showed high levels of soil nitrate until the July 2 sampling date when plants were in the shot blade stage (Zaddocks 43-45) and had used significant amounts of soil nitrate (Figure 6). Plant nitrogen levels indicated very limited response due to previous crop or tillage method.

Table 1. ANOVA for Biggar 1990 and barley 1990-92.

		Nitrogen Application (kg/ha)							
		Biggar 1990		Barley 1990		Barley 1991		Barley 1992	
Source	df	MS	Pr>F	MS	Pr>F	MS	Pr>F	MS	Pr>F
Rep	3	517		113		793		589	
Treatment	12	233	.018	145	.008	17066		1599	.025
Durum vs flax,canola	1	98	.314	171	.075	132	.717	188	.395
Durum plow vs spike and disc	1	530	.023	285	.024	3063	.090	723	.100
Durum remove vs durum retain	1	123	.259	4.2	.776	1171	.286	1705	.014
Error	34	93		50.9		99836		253	

MS (mean squares are *1000)

Table 2. ANOVA for Biggar wheat yields 1991.

		Nitrogen Application (kg/ha)							
		45 broadcast		45 band		90 broadcast		90 band	
Source	df	MS	Pr>F	MS	Pr>F	MS	Pr>F	MS	Pr>F
Rep	2	827		1028		2407		3632	
Treatment	12	2363	.003	973	.008	510	.023	833	.008
Durum vs flax,canola	1	13850	.001	8107	.001	4467	.001	7459	.001
Durum plow vs spike and disc	1	246	.543	114	.55	17	.77	11	.84
Durum remove vs durum retain	1	214	.569	1.5	.95	102	.478	250	.338
Error	24	644		311		195		261	

MS (mean squares are *1000)

Table 3. ANOVA for Biggar wheat yields, 1992.

		45 broadcast		45 band		90 broadcast		90 band	
Source	df	MS	Pr>F	MS	Pr>F	MS	Pr>F	MS	Pr>F
Rep	3	2487		5543		952		1706	
Treatment	12	301	.405	1226	.405	5162	.182	459	.26
Durum vs flax, canola	1	90	.73	1418	.271	380	.449	800	.141
Durum plow vs spike and disc	1	425	.50	867	.388	497	.387	1.3	.952
Durum remove vs durum retain	1	11.7	.902	243	.646	359	.461	793	.143
Error	34	762		1133		648		353	

MS (mean squares are *1000)

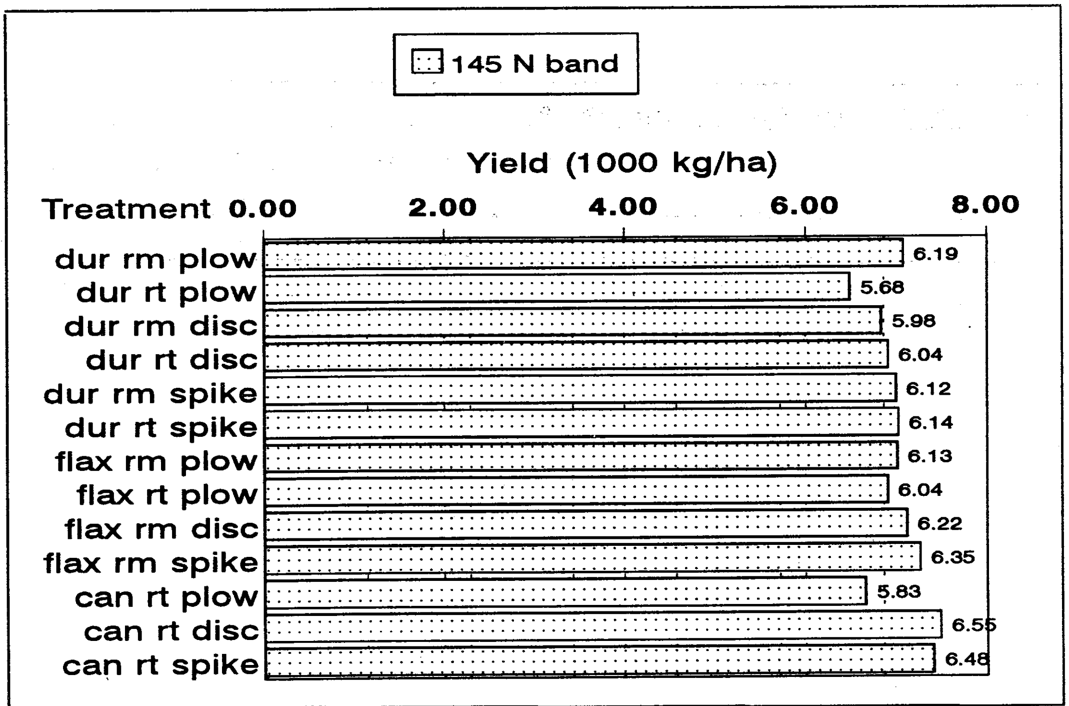


Figure 1. Nitrogen, tillage, residue and previous crop on Biggar wheat yields, Outlook, 1990.

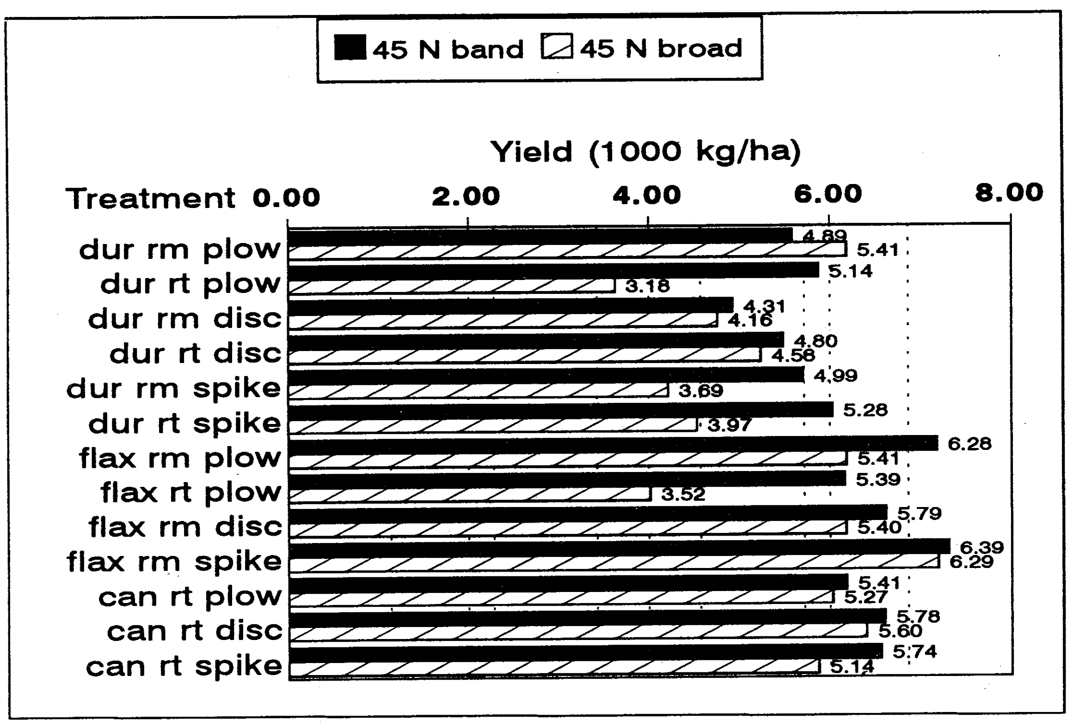


Figure 2. Nitrogen, tillage, residue and previous crop on Biggar wheat yields, Outlook, 1991, (45 kg/ha).

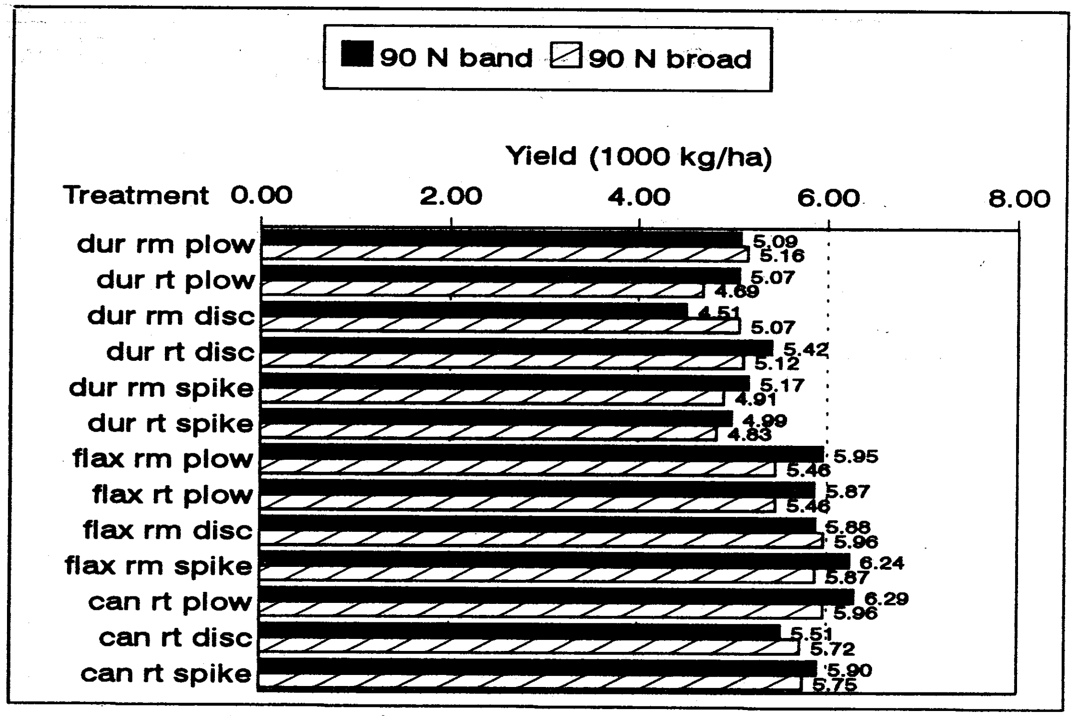


Figure 3. Nitrogen, tillage, residue and previous crop on Biggar wheat yields, Outlook, 1991, (90 kg/ha).

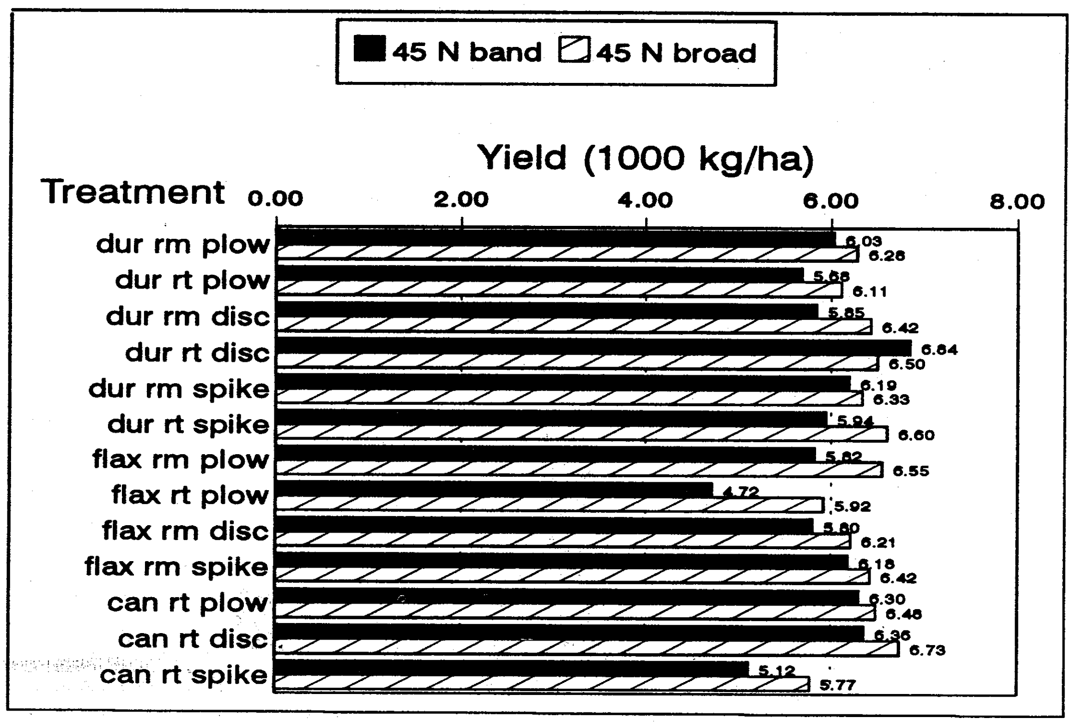


Figure 4. Nitrogen, tillage, residue and previous crop on Biggar wheat yields, Outlook, 1992.

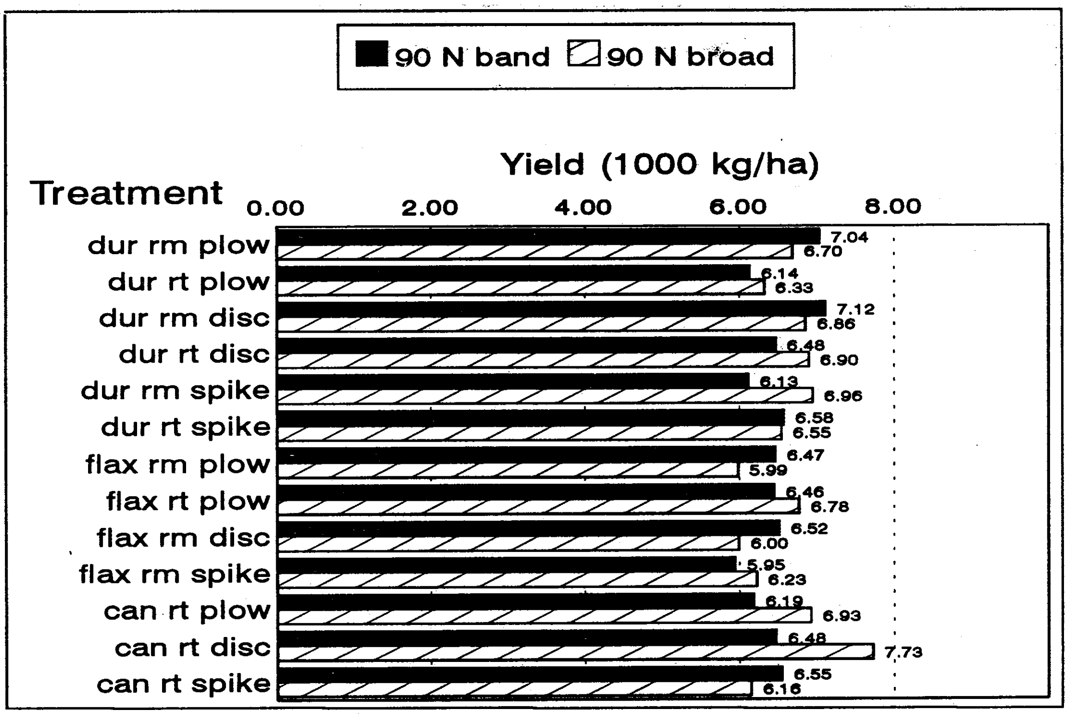


Figure 5. Nitrogen, tillage, residue and previous crop on Biggar wheat yields, Outlook, 1992, (45 kg/ha).

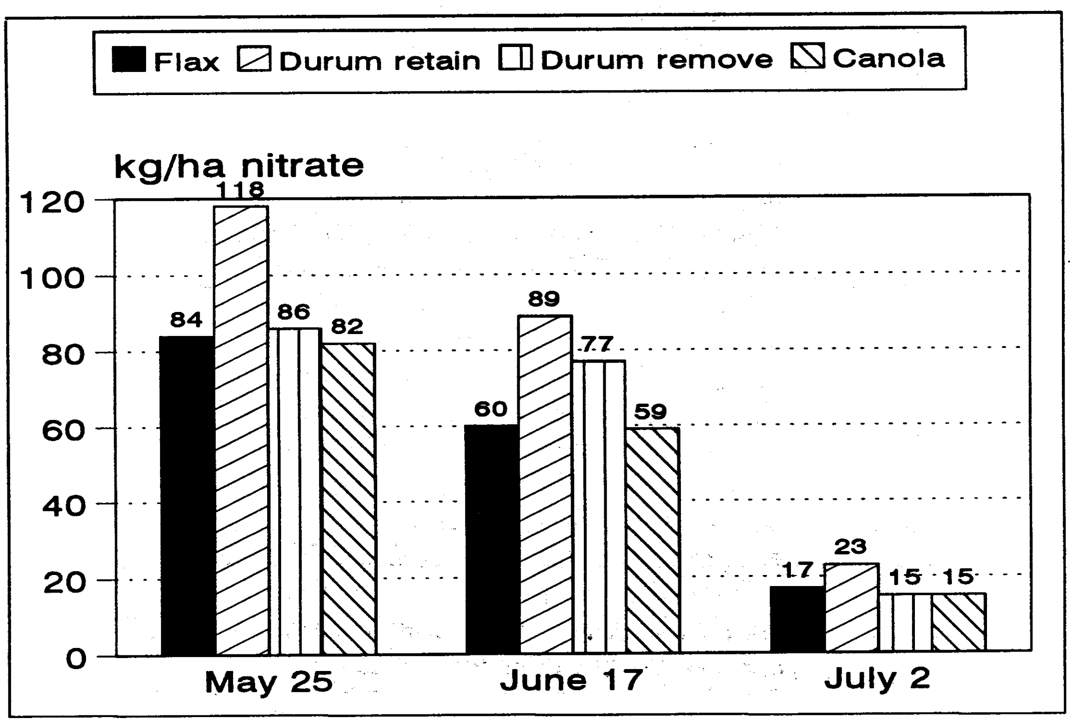


Figure 6. Effect of previous crop on soil nitrate levels at Demo Site, 1992.

Effect of Plot Size on Yield Estimates of Cereal Grains

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Progress: Ongoing
Objective: To determine the effect of the number of rows and length of plot on the expression of lodging and grain yields of the crop.

Biggar, Sceptre and Kyle wheats were planted at 225 and 450 seeds/m^2. The design employed was a split plot with the plot size as the main plot and seeding rate and cultivar as factors in the subplots. Plots contained 22 "rows" 12 m long, but during the seeding operation, the fourth row from the outside of each plot was not seeded leaving an area equivalent to 14 rows wide. Small plots were actually three plots of four rows created by not planting the nineth and 14th of the 22 rows. As soon as the small plots reached the third leaf stage, a 2 m segment from the center of the plot was removed by rotovating to create two groups of 5 m long plots comprised of three four-row plots. Prior to harvest, all plots were trimmed to 9.8 m by removing the center 2.2 m at right angles to the axis of the plot. Thus, the area harvested was exactly the same for each planting arrangement.

There was a significant effect of cultivar, seeding rate and the interaction between these factors for grain yield, however, there was no effect of plot size on grain yields. The cultivar used had a much larger effect on yield and lodging than either plot size or seeding rate.

Comparison of the Rooting Strength of Barley and Wheat Cultivars as Related to Lodging

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Progress: Ongoing
Objective: To determine if differences exist between various barley and wheat lines in degree of resistance to root lodging.

Resistance to root lodging was estimated by the use of a device employing a torque gauge measuring the force required to cause a 1 m long segment of row to bend from an upright position to 20° from horizontal.

Before measurements were taken the tops of the crops were removed to a height of 30 cm above the soil surface to eliminate differences in dry matter and grain yield. Measurements were taken after plants were fully headed but prior to significant lodging. The soil moisture in the top 8 cm of soil was 16% by weight when measurements were taken. This is equal to a soil moisture content of 75% of field capacity for this soil.

There were significant differences in the resistance to bending at the soil surface. When the soil moisture was increased in three separate plots, resistance to bending decreased by an average of 43 in/lbs. In general, the barley cultivars showed less resistance to bending than the wheat cultivars which is consistent with the long term information on lodging tolerance.

Crop Rotation on Zero and Conventional Tilled Irrigated Land

Principal:	B. Irvine, Saskatchewan Irrigation Development Centre
Progress:	Ongoing
Objective:	To determine the effect of direct seeding on the yields, weed control and disease in a wheat, pea, canola rotation established on alfalfa stubble.

It was decided to establish this test on a site which had grown alfalfa for eight seasons and, hence, had been zero-tilled for this long. The conventional till plots were rotovated to a depth of 12 cm on May, and the direct seeded plots were treated with Estaprop on May 15 at a rate of 2.4 L/ha to control dandelions and alfalfa.

This preliminary experiment lacks degrees of freedom and thus it is difficult to detect significant differences in yield.

Initial levels of soil nitrate were low perhaps as a result of insufficient time between destruction of the alfalfa stand and seeding for mineralization to have had a significant impact (Figure 1). At the early sampling dates, nitrate levels on the zero-tillage plots were lower than those on conventional tillage but this difference declined with time.

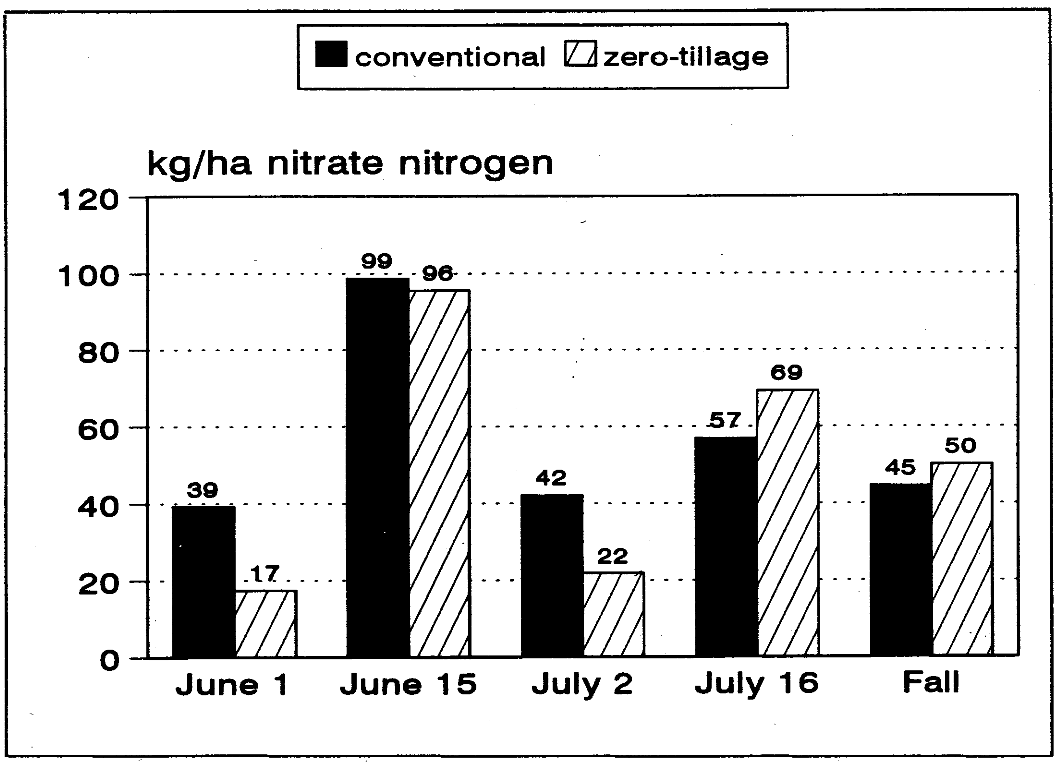


Figure 1. Nitrate levels zero tillage vs conventional tillage 1992

Soft Wheat Production Package

Principal:	D. Duncan, Saskatchewan Irrigation Development Centre
Funding:	Irrigation Based Economic Development Agreement
Location:	Outlook (NW 26-29-8-W3)
Progress:	Final year
Objective:	To develop a production package for irrigated soft wheat that will consistently produce economically high yields with acceptable seed quality.

Lodging and disease infection appeared to be the most serious constraints to irrigated soft wheat production in the 1989 and 1990 demonstrations, thus in 1991 and 1992 a series of seeding rate and row spacing combinations in conjunction with a fungicide application were compared to determine the best and most economical method of reducing the lodging and disease potential of irrigated soft wheat. Fielder soft wheat was seeded using an Amazone hoe drill at a rate of 250, 350, and 450 seeds/m^2 in rows spaced either 8 or 16 cm apart. The fungicide, Tilt (propiconazole), was applied to 50% of the plots at a rate of 500 ml/ha in 250 L/ha of water when the majority of the soft wheat plants had reached the swollen boot stage of development (ZGS 45-47). The remaining plots were left untreated.

No additional yield response was observed by increasing the seeding rate of the soft wheat above 250 seeds/m^2 (90 kg/ha) in 1992. The same results were observed in 1991. Lodging was minimal in 1992 and only one out of the two sites experienced any degree of lodging in 1991. Even when the environmental conditions did not favour lodging, there was no yield advantage to seeding at levels higher than 250 seeds/m^2. In 1992, the 8 cm row spacing was significantly higher yielding than the 16 cm row spacing by an average of 416 kg/ha. Throughout the duration of the demonstration project, only two out of six locations have shown an increase in soft wheat yield due to the 8 cm row spacing. Of the remaining four, yields were higher from the 16 cm spacing at two locations and no difference occurred between the row spacing treatments at two locations.

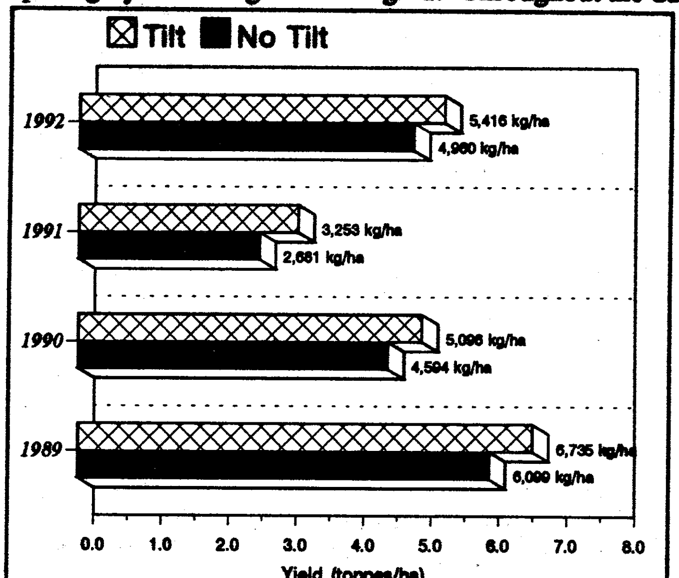


Figure 1. Effect of a single application of Tilt on the yield of Fielder soft white spring wheat, Outlook 1989-1992.

The application of a fungicide has resulted in a significant increase in yield of the soft wheat in all years of the demonstration project (Figure 1). Yield differences between the two treatments ranged from a low of 456 kg/ha in 1992 to a high of 636 kg/ha in 1989 with an average increase of 542 kg/ha (8 bu/ac) due to fungicide application. Assuming an average farm gate price for #2CW SWS of $110/tonne[1], the average increase in gross returns due to a fungicide application would be $59.62/ha ($24.14/ac). The cost of Tilt is $38/ha ($15.38/ac) per application at the recommended rate. The result is an average net gain of $21.62/ha ($8.76/ac), not including the added expense of product application.

[1]1989-92 average final price of $130/tonne - $20/tonne (freight and elevation) = $110/tonne farm gate price.

Durum Production Package

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: SIDC, Bob Tullis
Location: Outlook (NW 26-29-8-W3), Tullis (SW 15-24-8-W3)
Progress: Final year
Objective: To develop a production package for irrigated durum that will consistently produce economically high yields with acceptable seed quality.

The durum production package was designed to demonstrate the effect of various combinations of nitrogen rate, seeding rate, and row spacing on the yield of irrigated Sceptre durum. The Sceptre was seeded at a rate of 215, 320, and 430 seeds/m^2 in each of the following ways: 1) 8 cm spacing → Amazone hoe drill, 2) 16 cm spacing → Amazone hoe drill, 3) solid seeded using deflector plates attached to the underside of the cultivator shovels of an air drill, and 4) 20 cm spacing → air drill with hoe openers. The above treatment combinations were fertilized at two different nitrogen rates: 1) 112 kg/ha NO_3 → deep banded prior to seeding, and 2) 150 kg/ha NO_3 → 112 kg/ha deep banded prior to seeding + 38 kg/ha side banded at seeding. At the Outlook site only, two additional nitrogen rates of 45 and 80 kg/ha (side banded) were tested with the solid seeded and 320 seeds/m^2 treatment combination to ensure that adequate ranges of nitrogen were being used within the production package. The initial soil nitrate levels at the Outlook and Tullis sites were 95 and 26 kg/ha, respectively.

In 1992, there was no significant yield response of the Sceptre durum to nitrogen rate. Lodging was minimal to non-existent at either location. In previous years, when environmental conditions favoured lodging, increasing the level of applied nitrogen caused an increase in the lodging rate of the durum and subsequently a yield reduction occurred. Since 1990, there has never been a positive yield response to nitrogen applications in excess of 80 kg/ha at the Outlook site (initial soil nitrate levels ranged from 70 to 95 kg/ha). Even in the Birsay area, where the initial soil nitrate levels have ranged from 20 to 26 kg/ha, durum yield did not positively respond to nitrogen applications in excess of 112 kg/ha (this was the lowest rate tested at these sites).

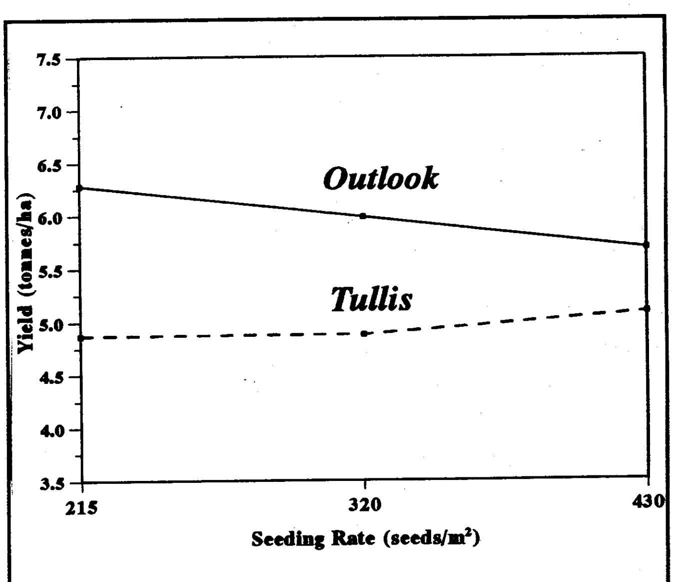


Figure 1. Effect of seeding rate on the yield of irrigated Sceptre durum, 1992.

For each incremental increase in seeding rate at the Outlook site, durum yield was significantly reduced (Figure 1). Seeding rate did not affect yield at the Tullis site. Throughout the duration of the durum production package, there has been no positive yield response to seeding rates in excess of 215 seeds/m^2 (approx. 101 kg/ha), even under lodge-free conditions. In most cases, increasing the seeding rate caused an increase in the lodging rate of the durum which resulted in a yield reduction.

From 1989-92, there has never been a significantly positive response of the yield of irrigated durum to narrow row spacing conditions.

Plant Growth Regulator Demonstration

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Location: Outlook (NW 26-29-8-W3)
Progress: Final year
Objective: To determine the effect and subsequent economics of a plant growth regulator (PGR) on the lodging rate, yield, and seed quality of irrigated durum wheat.

Results from the durum production package have indicated that under high input conditions, lodging has become the single most limiting factor in terms of yield and seed quality. The plant growth regulator demonstration was initiated to determine the economics of applying a PGR to control lodging and thus gain from the possible benefits of higher levels of inputs.

Sceptre durum solid seeded at a rate of 430 seeds/m^2 (approx. 207 kg/ha) was fertilized at two nitrogen rates: 1) 112 kg/ha NO_3 → broadcast and incorporated prior to seeding, and 2) 150 kg/ha NO_3 → 112 kg/ha broadcast and incorporated + 38 kg/ha side banded. When the flag leaf was 50% extended on the majority of the durum plants (ZGS 41), the plant growth regulator, Cerone (ethaphon) was applied to half of the plots at a rate of 0.5 L/ha (240 g a.i./ha) in 250 L/ha of water. The remaining plots were left untreated.

Increasing the total applied nitrogen from 112 kg/ha to 150 kg/ha significantly reduced the Sceptre yield by 478 kg/ha. The yield reduction was largely attributed to a drop in seed weight caused by an increase in the lodging index of the durum due to the higher nitrogen application rate. Applying Cerone significantly reduced the lodging rate of the durum and resulted in an overall average yield increase of 14%. However, there was only a 6% yield increase (379 kg/ha) when going from the lowest input system (112 kg/ha NO_3 and no PGR) to the highest input system (150 kg/ha NO_3 + Cerone) within the demonstration.

To determine the economics of using a PGR (Table 1), the yields of the low input (level 2) and high input (level 3) treatments of the Plant Growth Regulator Demonstration were compared to each other and to the yield of a low input treatment (level 1) from the Durum Production Package. Level 1 was by far the most profitable package for the producer. Although the PGR was successful in reducing the lodging and increasing the final yield of the durum, the change in yield was not large enough to make the practice economical when compared to either level 1 or level 2. When comparing level 3 to level 2, a farm gate price of \$177.78/tonne would be required in order to achieve a marginal return (MR) to marginal cost (MC) ratio of 1.5. When comparing level 3 to level 1, a phenomenal price of \$778.42/tonne of durum at the farm gate would be needed before the MR/MC equalled 1.5. Given the same scenario, but using the durum price quoted in the economic analysis (\$103.50/tonne), level 3 would have to out-yield level 1 by 1075 kg/ha before the MR/MC equalled 1.5.

Table 1. Economics of using a plant growth regulator to control lodging in irrigated durum.				
Nitrogen Rate → Seeding Rate → Plant Growth Regulator →	LEVEL 1 80 kg/ha N 320 seeds/m^2 no PGR	LEVEL 2 112 kg/ha N 430 seeds/m^2 no PGR	LEVEL 3 150 kg/ha N 430 seeds/m^2 PGR	
YIELDS: (kg/ha)	6491	6255	6634	
		level 2 vs 1	level 3 vs 1	level 3 vs 2
Yield increase/(decrease) due to added inputs	-	(236)	143	379
COSTS: ($/ha)		29.29	74.21	44.92
Extra cost of seed*	-	10.41	10.41	-
Extra cost of nitrogen*	-	18.88	41.30	22.42
Extra cost of PGR*	-	-	22.50	22.50
RETURNS: (based on a 1992 farm gate price of $103.50/tonne for #2 CWAD)**				
Extra return for added inputs ($/ha)	-	(24.43)	14.80	39.23
Net gain/(loss) for added inputs ($/ha)	-	(53.72)	(59.41)	(5.69)
RETURN PER EXTRA $ SPENT (MR/MC)***	-	($0.83)	$0.20	$0.87

* Calculated based on a cost of $0.22/kg for certified #1 Sceptre durum (average seed weight of 43 g/1000 seeds), $0.59/kg for nitrogen, and $22.50/ha for Cerone.

** The farm gate price was calculated based on the assumption that the CWB initial payment is 85% of the final price less an average freight and elevation charge of $20/tonne.

*** The desired ratio for MR/MC=1.5.

Results from the durum production package have consistently indicated that, even under lodge-free conditions, excessive levels of nitrogen and higher seeding rates did not increase Sceptre yields in an irrigated environment. In most cases, the yield of the durum was reduced by the extra inputs because lodging was increased. Using the plant growth regulator, Cerone, did significantly reduce the lodging potential created by the added inputs and a yield increase was observed. However, it appears that the lodging potential can be reduced just as effectively and more economically by cutting back on seeding rates and nitrogen rates.

Oilseeds

Irrigated Production of Hybrid Canola Seed

Principal: D. Hutcheson, Agriculture Canada Research Station, Saskatoon
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objective: To investigate the production of hybrid canola seed by conventional (separate male and female rows) and unconventional (seed mixed in the rows).

Conventional Hybrid Seed Production

In order to determine the effect of distance from a male fertile restorer block (Rf) and the male sterile row (A) five rows of restorer lines were planted on each side of 20 rows of male sterile material grown on 60 cm centers. Leafcutter bees were used to pollinate the crop. At maturity each male sterile row was harvested separately and threshed to determine seed yield.

Unconventional Method of Producing F1 Hybrid Canola Seed

In this system restorer (Rf) and male sterile (A) plants were mixed in the following proportions 0:100, 5:95, 10:90, 15:85 and 20:80. At anthesis the male sterile and male fertile plants in the center of the plot were marked and these plants harvested separately at maturity.

The percent hybridity and performance of these "hybrid" lines was determined in replicated yield trials.

The average seed yield for conventionally produced hybrid seed was 548 kg/ha vs 1428 for the unconventional system for the mixing ratios of 90:10 or 85:15. The inclusion of 10 to 15% of the male fertile restorer lines did not reduce the performance of the hybrids which included the male fertile plants (Table 1). In theory, if 15% of the plants were males and had yields of 70% of the hybrid plants, yields might be reduced by 4.5%. However, since the male fertile plants do not produce high seed yields during the seed production year and are not as vigorous as the hybrids during commercial production, this reduction was not observed.

Table 1. Yield of hybrid seed lots with various levels of the male parent.

Mixture	Mean yield kg/ha (6 sites)
100% hybrid F1	2127
95%F1:5%Rf	2276
90%F1:10%Rf	2154
85%F1:15%Rf	2212
80%F1:20%Rf	2167

1992 Regional Canola Test

Principal: R.K. Downey, Agriculture Canada Research Station Saskatoon, Saskatchewan

Co-operator: Saskatchewan Irrigation Development Centre

The test was seeded at 21 locations, 15 in Saskatchewan and six in the Northern States.

The following *B. napus* strains were registered and named: Seville (A0327), Garrison (A0337), Cyclone (Pal 10-88), Crusher (SV02406), ACS ELECT (ACS-N8).

Test was coordinated by the Saskatoon Research Station and only the Outlook results are reported here.

Table 1. Regional Canola Test for Outlook, 1992.

Variety	Yield of Seed (00's kg/ha)	Oil Content in Percent of Dry Weight	Days from Seeding to Maturity	Plant Height in Centimeters	Resistance to Lodging (1-Good: 5-Poor)
Brassica napus					
Westar	13.6	44.5	102	122	4.5
Excel	22.3	44.8	105	131	3.0
Bounty	19.5	43.4	103	131	3.2
Hyola 401	24.8	42.9	108	122	1.2
HC-120	21.0	44.1	106	124	2.0
Legend	19.9	43.7	106	123	2.5
Delta	21.9	43.2	107	136	1.2
Vanguard	19.3	44.0	107	124	2.5
Celebra	24.8	42.6	110	134	1.0
Seville	22.6	43.8	108	142	1.0
Garrison	24.5	43.4	109	152	1.0
Cyclone	27.9	43.8	106	134	1.2
Crusher	22.1	44.4	107	130	1.2
Elect	20.8	45.1	105	124	2.8
Average	21.8	43.8	106	132	2.0
C of V%	18.3	1.1			
L.S.D. 5%	5.7	1.1			
B. campestris					
Tobin	19.8	39.4	82	107	3.0
Parkland	14.8	39.9	81	112	2.8
Eclipse	14.5	40.0	81	132	2.5
Goldrush	14.7	37.3	83	124	2.5
Reward	17.1	41.1	81	111	3.2
Horizon	15.6	41.2	81	116	2.5
Average	16.1	39.8	81	119	2.8
CV %	14.9	2.5			
L.S.D. 5%	3.6	2.4			

Mustard Co-operative Trials at Outlook

Principal: R.K. Downey
Agriculture Canada Research Station
Saskatoon, Saskatchewan

Progress: Ongoing

Forge and J89-102 both have superior performance to Cutlass.

Table 1. Mustard Co-operative Test, 1992

Variety	Yield (kg/ha)				Lodging 1-5 (1 good; 5 poor)		
	1990	1991	1992	Mean	1990	1991	1992
Cutlass	2890	3159	3121	3057	2.5	2.0	2.2
Lethbridge 22A	2436	2547	2451	2478	1.8	2.8	3.8
Blaze	2698	3368		3033	2.8	2.0	
Common Brown	2475	2409	2092	2325	2.2	2.2	2.5
Forge	3140	3784	3444	3456	3.0	1.0	1.0
CBWR	2160	2510	2153	2274	2.0	2.8	2.2
J89-102		3715	3657	3686		1.2	1.2
J89-144		2957	3014	2986		1.5	2.8
Mean	2633	3056	2847	2846	2.4	1.9	2.2
CV%	14.6	9.5	10				
LSD 5%	575	427	401				
S. alba							
Gisilba	2727	2223	3066	2672	2.0	2.2	3.8
Ochre	2299	2178	3299	2592	1.8	3.0	3.8
Tilney	2255	2556	3276	2696	1.0	1.5	3.0
CW/89TY	2672	2384		2528	1.0	1.5	

Canola/Rapeseed Co-operative Trials at Outlook

Principal: R.K. Downey
Agriculture Canada Research Station
Saskatoon, Saskatchewan

The 1992 growing season started out with a dry spring, a wet cool summer and killing frost the third week of August, followed by more frost and cool weather, right into October. This resulted in very high chlorophyll content, especially in the *B. napus* entries.

With the elimination of the Co-op Canola Strain Test (Co-op B), all first, second, and third-year entries are accommodated in the one test. The entries were grouped into three tests as follows:

Co-op *B. napus* Test A: Twenty-six mostly second and third-year entries, plus four checks arranged in a 5 x 6 partially balanced lattice, grown at all locations.

Co-op *B. napus* Test B: Varying in size from 21 to 38 entries, plus four checks, depending on location, mostly first-year entries plus checks arranged in a 5 x 5, 5 x 6, 6 x 6, and 6 x 7 partially balanced lattices.

Co-op *B. napus* Test C: Either four or seven entries of mutagenic, transgenic, high erucic and low linolenic, plus appropriate checks, for a total of eight or 13 entries depending on locations, arranged as a randomized complete block design.

Allelix *B. napus* entry A0327 was registered as SEVILLE, A0337 as GARRISON, King Agro Pal 10-88 as CYCLONE, Svalöf SV02406 as CRUSHER, Agriculture Canada, Saskatoon ACS-N8 as AC-ELECT, and U of M low linolenic strain S85-1426 as APOLLO.

All seed quality analyses were done in duplicate. The fatty acid, oil, and glucosinolates were conducted at the Saskatoon Research Station. Chlorophyll content was determined at the Canada Grain Commission, Grain Research Laboratory at Winnipeg.

The test was coordinated by the Saskatoon Research Station. Only the irrigation zone results are given here in Tables 1-6.

Table 1. Co-op *B. napus* Test A. Irrigation Zone - Outlook.

B. napus	Yield (00's kg/ha)	% Avg. of Profit, Legend, Delta Checks (24.8)	% Oil	% Protein	Days to Mature	Plant Height	Lodging Resistance
Westar	15.6	62.9	44.7	41.6	103	128	4.2
ACS-H2	30.9	124.6	44.6	42.6	111	147	1.5
GSN029	25.5	102.8	43.7	39.5	104	122	2.8
AU558	20.0	80.6	44.3	45.6	105	120	4.5
AG010	23.2	93.5	44.5	44.6	108	129	2.0
ISN041	22.5	90.7	41.8	42.6	110	142	1.8
SV02412	27.2	109.7	44.5	42.6	107	143	2.5
AU419	28.5	114.9	43.6	42.8	107	147	1.5
GSN032	22.8	91.9	44.3	43.4	109	129	2.0
K478	21.7	87.5	44.4	41.1	103	128	3.8
ACS-H3	28.3	114.1	44.1	43.2	110	153	2.0
Profit	21.5	86.7	44.8	44.3	105	129	3.2
SV02414	28.7	115.7	44.2	43.2	106	147	1.2
Legend	24.3	98.0	44.4	43.6	107	130	1.8
SV02416	27.5	110.9	43.2	42.6	108	149	1.0
AU655	26.4	106.6	43.0	43.3	108	141	2.2
SV02420	30.3	122.2	44.2	41.8	109	150	1.0
AU375	25.8	104.0	43.2	43.0	105	140	2.0
AU557	26.3	106.0	44.3	44.0	107	133	1.0
K709	25.5	102.8	44.3	40.7	104	147	2.5
G86223	21.1	85.1	42.5	40.6	109	146	2.2
SV02411	30.3	122.2	44.4	43.9	108	140	1.2
AK88628	22.4	90.3	41.8	41.1	105	141	1.5
AU233	24.7	99.6	43.4	43.6	109	139	2.2
Delta	28.5	114.9	42.3	41.8	108	147	2.5
K681	26.0	104.8	44.2	42.8	108	144	1.0
AU443	24.5	98.8	42.9	42.6	103	136	1.8
SV02413	26.0	104.8	44.7	43.8	108	144	1.2
CS017	23.1	93.1	43.2	42.8	108	127	2.2
AG012	20.4	82.3	47.2	43.2	109	121	1.2
Average	25.0	--	43.9	--	107	138	2.1
C of V%	12.6	--	1.1				
LSD 5%	4.5	--	1.2				

Table 2. Co-op *B. napus* Test B. Irrigation Zone - Outlook.

B. napus	Yield (00's kg/ha)	% Avg. of Profit, Legend, Delta Checks (22.1)	% Oil	% Protein	Days to Mature	Plant Height	Lodging Resistance
Westar	14.1	63.8	43.9	43.0	103	120	4.8
PR2578	21.8	98.6	42.7	42.7	110	133	3.0
AGR-2	--	--	--	--	--	--	--
B2601	--	--	--	--	--	--	--
AU717	23.3	105.4	43.6	42.5	106	130	3.8
Profit	19.8	89.6	44.0	44.1	106	131	3.5
B990	--	--	--	--	--	--	--
AGR-1	--	--	--	--	--	--	--
AU649	29.128.	131.7	43.5	42.5	106	152	1.2
PR2580	5	129.0	43.1	41.4	110	144	1.8
PR2576	26.5	119.9	44.3	42.6	108	140	3.2
SV02421	28.4	128.6	42.9	42.2	108	144	1.0
ACS-N12	23.1	104.5	45.5	43.1	106	130	2.2
AU661	29.0	131.2	42.4	40.5	109	158	1.5
ISN042	24.9	112.7	42.2	40.5	110	134	1.5
ACS-N11	25.6	115.8	46.2	42.1	106	131	3.8
M-H3	--	--	--	--	--	--	--
B888	--	--	--	--	--	--	--
B2203	--	--	--	--	--	--	--
AU633	28.8	130.3	43.4	43.8	106	147	2.2
DP503/90	29.7	134.4	41.9	43.1	111	152	1.2
B2223	--	--	--	--	--	--	--
B2270	--	--	--	--	--	--	--
AU657	28.9	130.8	43.3	41.4	108	150	2.2
PR2577	28.0	126.7	43.7	42.5	106	131	3.0
B2014	--	--	--	--	--	--	--
SV02419	26.2	118.6	44.3	40.8	110	144	1.5
AU570	21.0	95.0	44.3	44.8	106	128	2.8
88-1409K	--	--	--	--	--	--	--
B825	--	--	--	--	--	--	--
SV02418	29.8	134.8	43.5	42.0	109	140	1.5
ACS-N14	27.2	123.1	46.3	41.7	105	136	1.5
B2220	--	--	--	--	--	--	--
PR2579	23.5	106.3	42.1	40.5	108	138	2.0
35-89	--	--	--	--	--	--	--
DP489/90	24.3	110.0	42.5	42.3	111	140	2.0
Legend	22.4	101.4	43.7	43.2	108	131	3.0
AU1031	--	--	--	--	--	--	--
M-H2	--	--	--	--	--	--	--
ISN043	28.7	129.9	41.3	40.1	107	138	3.1
Delta	24.1	109.0	43.1	40.7	107	137	3.0
B2300	--	--	--	--	--	--	--
Average	25.5	--	43.5	--	108	138	2.4
C of V%	12.3	--	1.5				
LSD 5%	4.4	--	1.3				

Table 3. Co-op *B. napus* Test C. Yield of Seed (00's kg/ha) - Irrigation.

B. napus	Outlook	Lethbridge	Average	% Average of Profit, Legend, Delta Checks (21.3)
Westar	28.1	10.2	19.2	6
Profit	30.3	10.6	20.4	3
Legend	27.9	13.3	20.6	2
Delta	31.7	14.4	23.0	1
AU239	29.7	8.5	19.1	7
AU738	28.9	10.9	19.9	4
HCN92	28.6	10.5	19.6	5
17138-164	26.8	7.1	17.0	8
Hero	--	--	--	--
Stellar	--	--	--	--
S87-2384	--	--	--	--
S86-2112	--	--	--	--
S86-970	--	--	--	--
Average	29.0	10.7	19.8	
C of V%	14.2	18.7		
LSD 5%	N.S.	2.9		

Table 4. Co-op *B. napus* Test C. Oil Content in Percent of Dry Weight - Irrigation Zone.

B. napus	Outlook	Lethbridge	Average	Rank
Westar	45.3	35.6	40.4	5
Profit	45.9	37.5	41.7	1
Legend	44.6	36.6	40.6	3
Delta	43.2	37.8	40.5	4
AU239	44.9	35.8	40.3	6
AU738	42.8	37.2	40.0	7
HCN92	44.4	38.9	41.6	2
17138-164	45.0	34.2	39.6	8
Hero	--	--	--	--
Stellar	--	--	--	--
S87-2384	--	--	--	--
S86-2112	--	--	--	--
S86-970	--	--	--	--
Average	44.5	36.7	40.6	
C of V%	0.9	1.9		
LSD 5%	1.0	1.7		

Table 5. Co-op *B. napus* Test C. Protein Content of Seed Meal - Irrigation Zone.

B. napus	Outlook	Lethbridge	Average	Rank
Westar	43.2	41.7	42.4	6
Profit	46.0	42.1	44.0	2
Legend	43.6	44.1	43.8	3
Delta	44.1	43.2	43.6	4
AU239	43.1	42.4	42.8	5
AU738	42.6	39.9	41.2	7
HCN92	44.3	44.4	44.4	1
17138-164	42.6	39.8	41.0	8
Hero	--	--	--	--
Stellar	--	--	--	--
S87-2384	--	--	--	--
S86-2112	--	--	--	--
S86-970	--	--	--	--

Table 6. 1992 - Co-op *B. napus* Test C. Chlorophyll Content (P.P.M.)		
B. napus	**Outlook**	**Average**
Westar	12.8	30.1
Profit	30.0	39.6
Legend	26.8	41.5
Delta	25.1	23.3
AU239	26.7	35.2
AU738	37.5	51.6
HCN92	25.7	33.5
17138-164	15.7	23.3
Hero	--	--
Stellar	--	--
S87-2384	--	--
S86-2112	--	--
S86-970	--	--
Average	25.0	--

Irrigated Canola Variety Demonstration Update (1986-1992)

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Locations: Outlook, Birsay, and Riverhurst
Progress: Sixth year of a continuous project
Objective: To compare the irrigated yield and seed quality of several canola varieties. Additional varieties that appear to have potential in the irrigated districts of Saskatchewan will be added to the project as they are introduced into the agricultural industry.

The irrigated canola variety demonstration was initiated at the Saskatchewan Irrigation Development Centre (SIDC) in 1986. Project location is intended to remain within the irrigation districts surrounding Lake Diefenbaker to obtain varietal information for these climatic conditions.

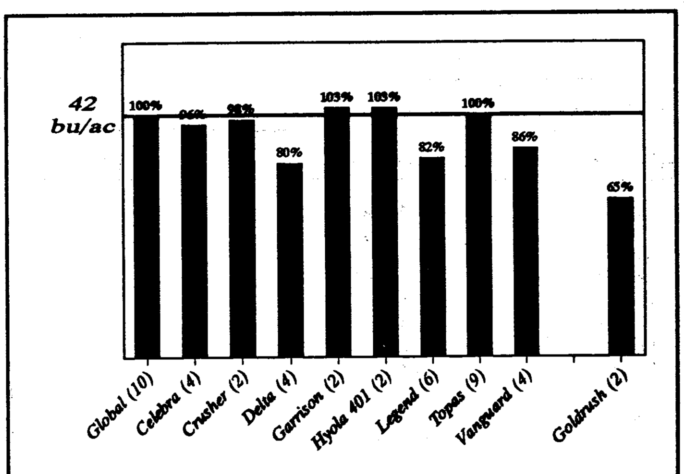


Figure 1. Yield performance, expressed as a percentage of Global, of several irrigated canola varieties (1986-1992).

Four new varieties including Crusher, Garrison, Hyola 401, and Goldrush were added to the existing compliment of Global, Celebra, Legend, Topas, and Vanguard in the 1992 irrigated variety tests conducted by SIDC. Crusher is distributed by Brett Young Seeds, Hyola 401 is distributed by ICI Seeds Canada, and Garrison and Goldrush are both property of the UGG. Goldrush is a Polish type canola and the remaining three of the newly introduced selections are all Argentine *Brassica napus* type varieties. Hyola 401 is a hybrid canola.

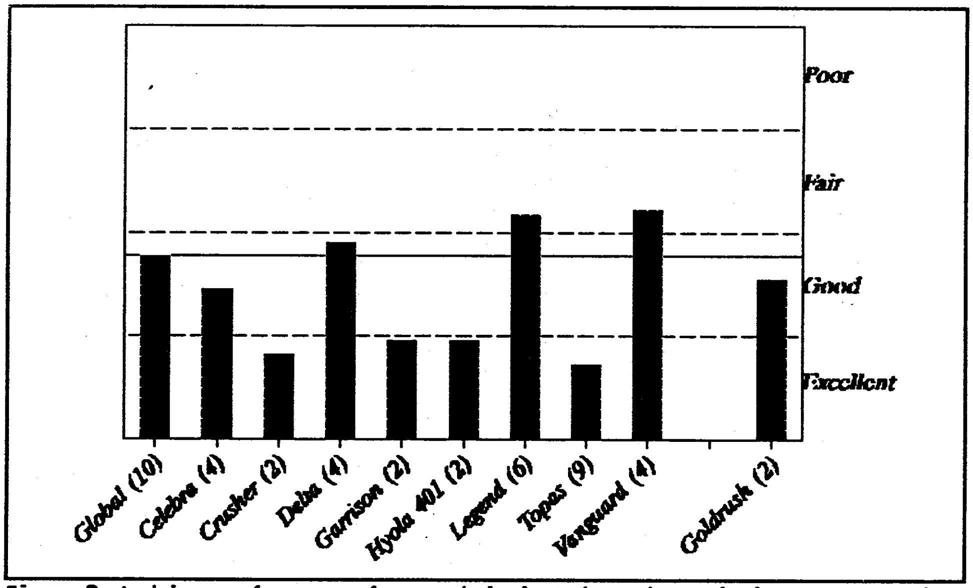


Figure 2. Lodging performance of several irrigated canola varieties as compared to Global (1986-92).

Variety performance is displayed as a measure of the performance of Global within the respective site years of each individual variety (Figures 1 - 4). The number of site years that each variety was tested is indicated in brackets behind each variety name.

Information on the seed quality of the canola varieties was not available at the time of publication.

Celebra, Delta, Vanguard, and Goldrush will be removed from the 1993 canola variety demonstration.

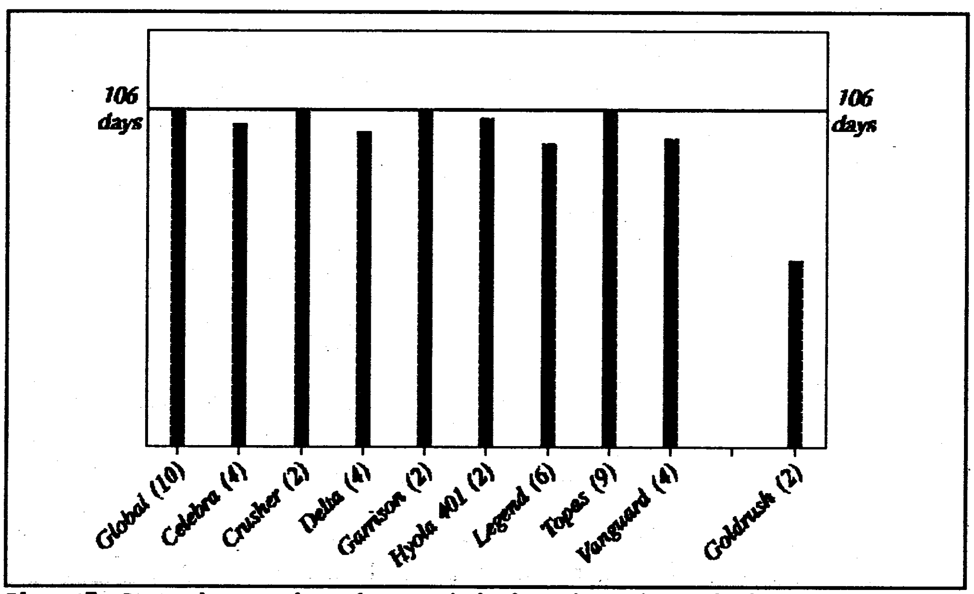


Figure 3. Range in maturity of several irrigated canola varieties as compared to Global (1986-92).

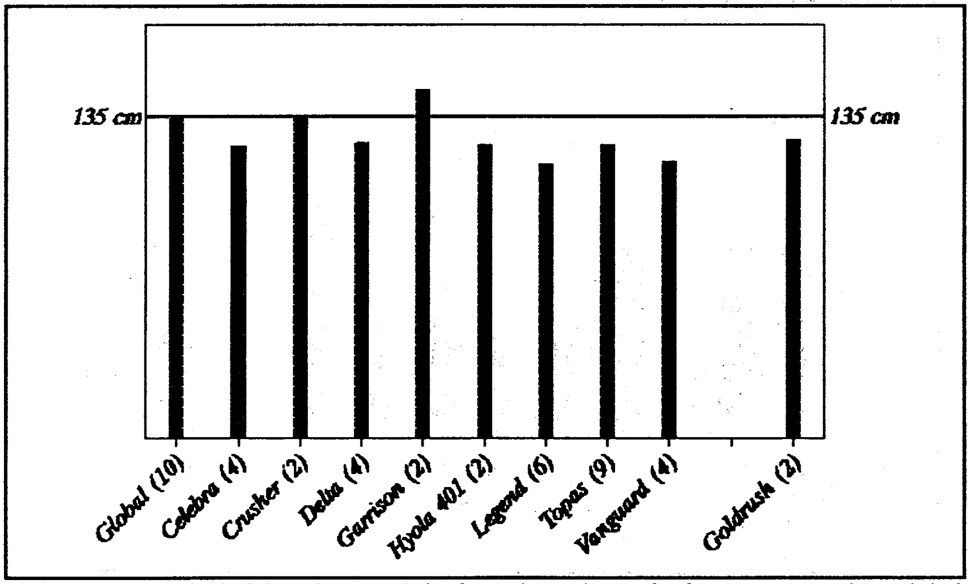


Figure 4. Range in height of several irrigated canola varieties as compared to Global (1986-92).

Canola Production Package

Principal:	D. Duncan, Saskatchewan Irrigation Development Centre
Funding:	Irrigation Based Economic Development Agreement
Co-operators:	SIDC, Gordon Kent
Location:	Outlook (NW 26-29-8-W3), Riverhurst (NW 15-22-7-W3)
Progress:	Final year
Objective:	To develop a production package for irrigated canola that will consistently produce economically high yields with acceptable seed quality.

In 1992, Global canola was seeded at a rate of 80, 150, and 220 seeds/m² in each of the five following methods: 1) 8 cm spacing → Amazone hoe drill, 2) 16 cm spacing → Amazone hoe drill, 3) broadcast and incorporated with a 2.5 cm depth cultivation → Valmar type application, 4) solid seeded using deflector plates attached to the underside of the cultivator shovels of an air drill, and 5) 20 cm spacing → air drill with hoe openers.

At the Outlook site, increasing the seeding rate from 80 to 220 seeds/m² significantly reduced the yield of the Global canola. Although not statistically significant, yields were also reduced by an increase in seeding rate at the Riverhurst site. On average, the 80 seeds/m² (3 kg/ha) seeding rate was 10% higher yielding and the 150 seeds/m² (6 kg/ha) was 5% higher yielding than the 220 seeds/m² (9 kg/ha) rate.

Lodging did not occur at the Riverhurst site and as a result the level of sclerotinia infection within the plots was almost zero. However, at the Outlook site, lodging was a problem that significantly increased with each increase in seeding rate. Subsequently, sclerotinia infections were also increased (Figure 1).

It is important to note, that even when lodging and disease did not appear to be a problem, as at Riverhurst in 1992 and Outlook in 1991, there was no yield advantage to seeding canola at rates in excess of 80 seeds/m². The most productive yields occurred when the plant populations were in the range of 50 to 80 plants/m². Densities much higher than this run the risk of increased lodging resulting in an increased sclerotinia infection potential and a crop that is more difficult to harvest.

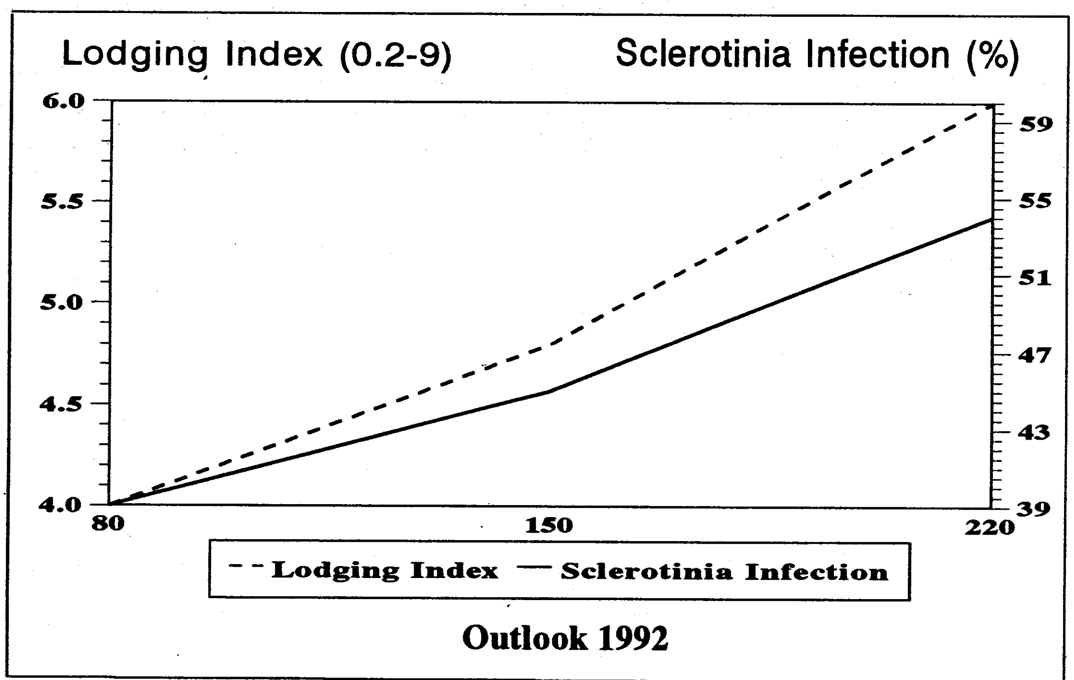


Figure 1. Relationship between lodging and sclerotinia infection of Global canola as affected by seeding rate.

The use of narrow rows to improve the spatial distribution of the seed has had no effect on the irrigated yield of canola. Yields of the canola appear to be consistent regardless of whether the crop is solid seeded or placed in rows as wide as 48 cm apart. No biologically significant interactions between seeding rate and row spacing were observed.

Canola Fungicide Demonstration

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: SIDC, Gordon Kent
Location: Outlook (NW 26-29-8-W3), Riverhurst (NW 15-22-7-W3)
Progress: Final year
Objective: To determine the effect of fungicide application on sclerotinia infection and yield of several different canola varieties under an irrigated regime.

Four Argentine (*Brassica napus*) canola varieties including Global, Celebra, Crusher, and Vanguard were compared on the basis of their response to a fungicide application in terms of sclerotinia infection and yield. Once the canola had reached the 20% bloom stage, half of the plots were sprayed with the fungicide Rovral Flo, at a rate of 3 L/ha in 250 L/ha of water. The remaining plots were left untreated.

The canola varieties did not exhibit any lodging at the Riverhurst site and as a result, sclerotinia infection levels were observed to be less than 1%. Hence, the use of a fungicide did not provide any response at this site. At the Outlook site, Vanguard was the only variety that displayed a significant reduction in the number of plants infected with sclerotinia when a fungicide was used. However, the yield of Vanguard was not affected by the fungicide application. On average, the use of a fungicide tended to result in a higher yield of the canola varieties (statistical analysis indicated a 93% chance that the difference in yield was due to the fungicide application) but the difference in yield between the average of the fungicide and no fungicide treatments was only 202 kg/ha. The cost of applying Rovral Flo at 3 L/ha is $64.70/ha ($26.20/ac). In order to break even on the cost of the product, the farm gate price of canola would have to be valued at $320.30/tonne. This does not take into account the cost of application of the fungicide.

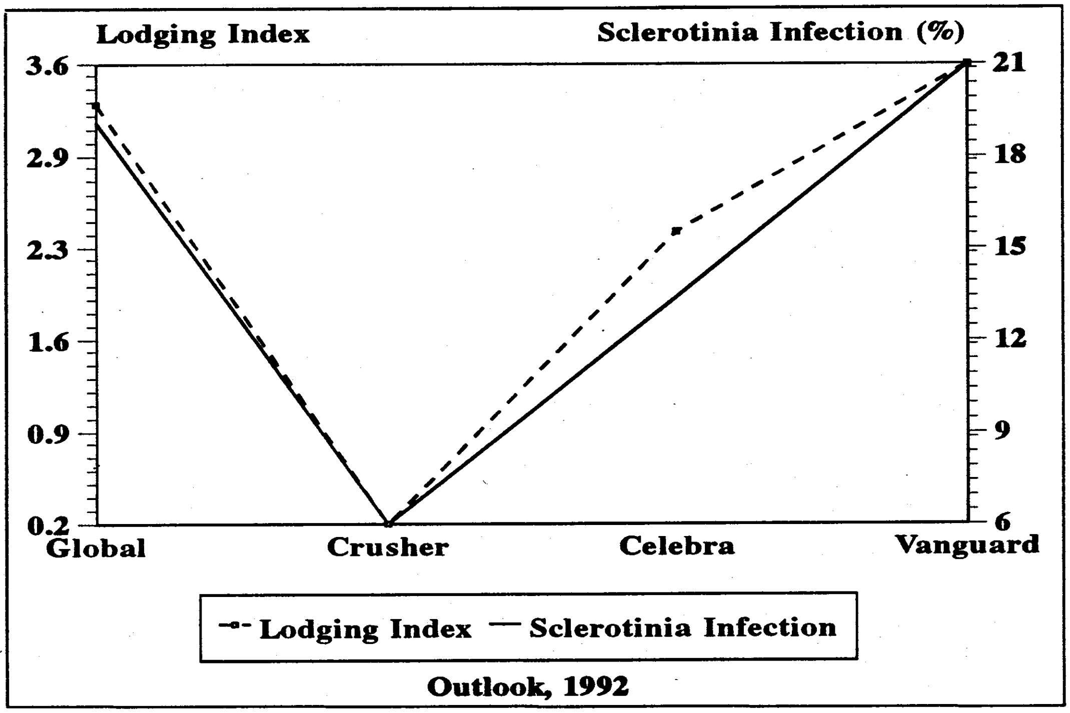


Figure 1. Relationship between lodging and sclerotinia infection of canola.

A more economical approach to controlling sclerotinia infection in an irrigated canola crop is to select a variety which is not prone to lodging (Figure 1). Even if the potential for disease infection is high, disease spread via plant contact is much less likely under lodge-free conditions (refer to Figure 2 of the canola variety demonstration update for the lodging performance of an expanded list of irrigated canola varieties).

Flax Seeding Date

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Progress: Ongoing
Objective: To determine the effect of seeding date on the performance of five cultivars of flax reported to differ in response to seeding date.

A five-replicate split plot design was planted with early, normal and late seeding dates being the main plots. In 1991, the early, normal and late dates were May 7, May 17 and May 27, respectively. These dates were May 5, 18 and 26 in 1992.

The decline in seed yield due to late seeding was more pronounced in 1992 than in 1991 due in part to the cool season and the late seeded plots being damaged by frost (Figure 1 and 2). In 1992, the

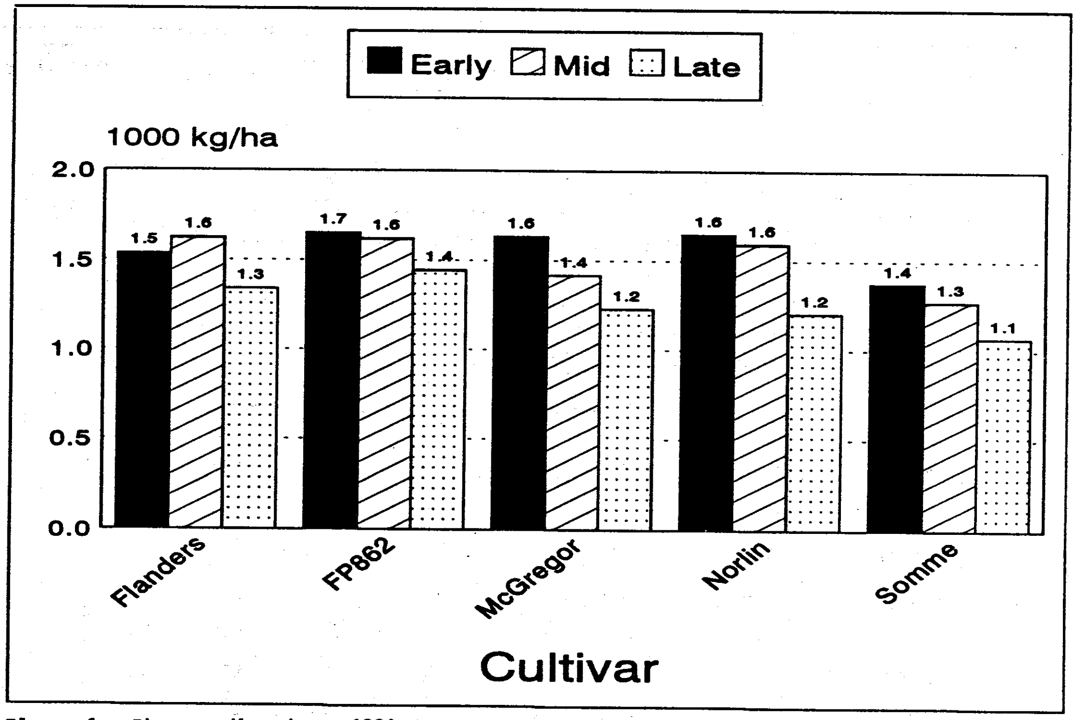


Figure 1. Flax seeding date, 1991.

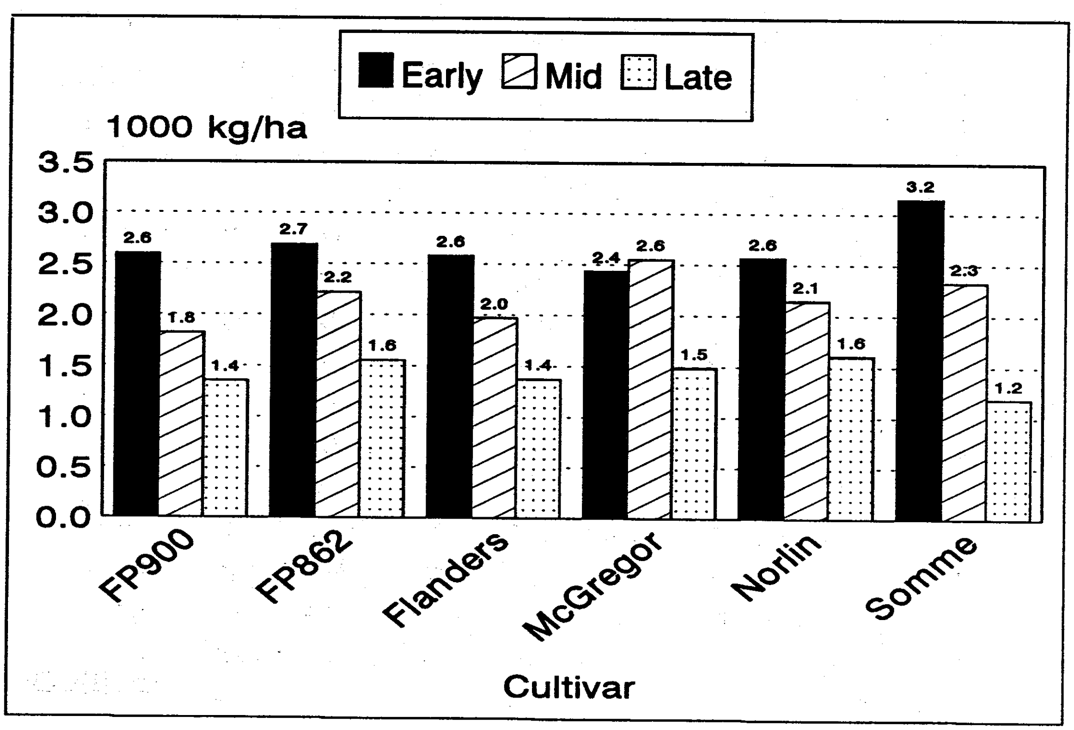


Figure 2. Flax seeding date, 1992.

In both years, delaying planting increased plant height (Table 1). Although some cultivars increased in height and lodging to a greater degree than others, both height and lodging were increased by delaying planting to near the end of May.

Maturity was delayed by 30+ days in 1992 relative to 1991 and determination of physiological maturity was nearly impossible due to late branching on almost all cultivars (Table 1). Differences between cultivars were limited and interactions not of biological significance in either season.

Table 1. Effect of seeding date on the agronomic traits of flax cultivars under irrigation.

		Lodging 1-9		Height cm		Days to mature	
Cultivar	Seeding date	1991	1992	1991	1992	1991	1992
Flanders	May 7	4.0	2.6	74	76	100	132
Flanders	May 17	6.5	3.8	79	79	98	132
Flanders	May 27	5.2	6.0	83	83	--	132
	Mean	5.2	4.1	79	74	99	132
FP862	May 7	3.8	2.6	76	76	99	127
FP862	May 17	5.6	3.0	78	79	95	129
FP862	May 27	4.4	4.2	80	83	--	128
	Mean	4.6	3.3	78	80	97	128
McGregor	May 7	2.6	3.2	80	73	102	134
McGregor	May 17	5.4	2.8	81	73	100	133
McGregor	May 27	2.2	4.8	84	82	--	132
	Mean	3.4	3.6	82	76	101	133
Norlin	May 7	3.5	2.8	73	76	101	124
Norlin	May 17	6.2	5.6	80	80	95	128
Norlin	May 27	6.8	4.0	80	85	--	126
	Mean	5.5	4.1	78	80	98	126
Somme	May 7	5.0	1.2	74	72	98	120
Somme	May 17	6.9	5.0	76	77	93	126
Somme	May 27	7.6	7.4	89	87	--	126
	Mean	6.5	4.5	80	79	96	124
FP900	May 7		1.0		72		132
FP900	May 17		2.2		74		132
FP900	May 27		1.8		82		130
	Mean		1.7		76		131
	May 7	3.8	2.2	75.2	73.2	100	128
	May 17	6.1	3.7	79.1	76.1	96	130
	May 27	5.2	4.7	83.3	83.9	--	129
CV		28	54	4.5	3.4	1.6	1.6
LSD SD*C		2.1	2.5	5.2	4.3	3.4	2.8
LSD Seed day		1.3	1.05	3.2	3.1	2.4	1.6

Pea/Canola and Mustard Intercropping

Principal:	B. Irvine, Saskatchewan Irrigation Development Centre
Funding:	Irrigation Based Economic Development Agreement
Progress:	Final year
Objective:	To determine the yield and economic performance of intercropping oilseeds with peas.

Radley, Victoria and Express pea were chosen to represent a range of pea types. Radley is an early, short semi-leafless pea. Victoria is a tall normal leaf type and Express is an early short pea with a normal leaf type. The plot design was a six-replicate split plot with Express, Radley and Victoria being the main pea plots and Cutlass (*Brassica juncea*), Global (*B. napus*) and a dwarf sunflower sunola (*Helianthus annus*) or no crop as the subplot for intercropping in 1991. All oilseed crops plus McGregor flax were grown in each replicate without pea. The dwarf sunflower was replaced with Crusher canola in 1992 due to the poor sunola yields and difficulty in separating pea from sunola seed. Seeding rates (seeds/m^2) were canola and mustard 224, flax 500, sunola 20 and pea 80. When a mixture was planted the oilseed and pea were planted in alternate rows at 50% of their normal seeding rate and only the oilseed received extra nitrogen. Therefore, although the same setting on the fertilizer box was used for pure canola as canola in mixture, the mixture received only 50% as much nitrogen on an area basis in 1991. Due to the high soil nitrogen levels in 1992 it was decided not to add more nitrogen to the oilseeds when grown in mixtures. All fertilizer was sidebanded.

Data analysis of this type of test is quite complicated since pea and canola crops have different yield potentials in mixtures and differing value of the seed. Expressing yields on a land equivalent basis (crop in mixture/crop alone) lead to extremely high variability and is not presented.

Cutlass, the highest yielding oilseed, yielded 27% and 8% of pure stand yields when grown with Victoria pea (Figure 1 and 2). The interaction between pea and oil type was highly significant in all seasons (Table 1). Canola and mustard yields in pure stands varied considerably between seasons with the greatest yields in 1992. Pea yields in pure stands were lower in 1992. This was due in part to high levels of sclerotinia damage. Sclerotinia levels were highest when Victoria and Express were grown alone and lowest when Radley was grown with Cutlass (Table 2).

The crop mixture which generated the greatest revenue varied between seasons. In 1991, where very few plants were affected by sclerotinia and oilseed yields were low, Radley or Victoria and their combinations with Cutlass or Global produced the greatest returns (Figure 3). In 1992, Radley plus Cutlass had the highest overall return. Flax grown as a monoculture was also very profitable given long term average prices (Figure 4). It would appear that intercropping is an effective means of stabilizing pea yields. An earlier maturing, shattering resistant canola type with strong straw will make this cropping system more widely accepted.

All pea cultivars had larger seeds when grown with Cutlass than with Global or when the pea cultivars were grown in pure stands (Figure 5). While this may be a direct effect of chemical compounds in the mustard plant it is more likely that the mustard supported the canola in a more upright position and improved grain filling. An increase in the seed weight of the pea cultivars appeared to be a major factor in Express and Victoria peas yielding higher when grown with Cutlass than when grown with Global or Crusher. Although Radley pea also had larger seeds when grown with Cutlass, yields of this cultivar were lower in mixtures relative to pure stands.

Table 1. ANOVA for various traits on pea and pea/oilseed combinations.													
		Grain 1991 Pea		Grain 1992 Pea		1000 seed wt 1991		1000 seed wt 1992		Sclerotinia Pea 1992		Lodging 1992	
Source	df	MS!	Pr>F	MS!	Pr>F	MS	Pr>F	MS	Pr>F	MS	Pr>F	MS	Pr>F
Rep	5	144		274		168		462		1531		.04	
Pea	2	2048	.001	1650	.009	20900	.001	19692	.001	3713	.032	.48	.001
P*R	10	123		187		137		36		676		.02	
Error a													
Oilseed	3	8493	.001	886	.004	2934	.001	3517	.001	2953	.001	.30	.001
O*P	6	333	.051	475	.021	173	.008	392	.24	771	.101	.14	.001
Error b	44	145		163		52		139		395		.02	

!MS *1000
Where Pr>F is less than .001 numbers are expressed as .001

A semi-leafless type such as Radley allows greater production of the oilseed while a tall normal leaf type appears to restrict oilseed yields. It should be possible to manipulate the relative composition of pea and canola by changing the plant type of the pea. Planting canola with the pea may make pea harvesting easier and reduce nitrogen costs for producing canola.

Table 2. Agronomic and disease estimates for pea grown alone and with oilseed 1992.

Pea	Oilseed	Lodging[1]	% of plant with Sclerotinia	Plants /m^2	Pea kg/ha
Radley	none	1.54	66	48	3385
Radley	Cutlass	.79	13	45	3100
Radley	Crusher	1.31	53	46	3000
Radley	Global	1.41	38	49	2379
Express	none	1.59	72	45	1984
Express	Cutlass	1.42	27	34	2844
Express	Crusher	1.52	59	43	2601
Express	Global	1.51	51	46	2216
Victoria	none	1.64	76	42	2525
Victoria	Cutlass	1.53	72	45	3086
Victoria	Crusher	1.54	60	50	2553
Victoria	Global	1.54	71	51	2790
LSD P*O		.10	18.9	6.6	315
LSD Pea		.10	14.5	3.8	295
LSD Oil		.19	28.8	5.3	511

[1]Smallest numbers indicate the least lodging.

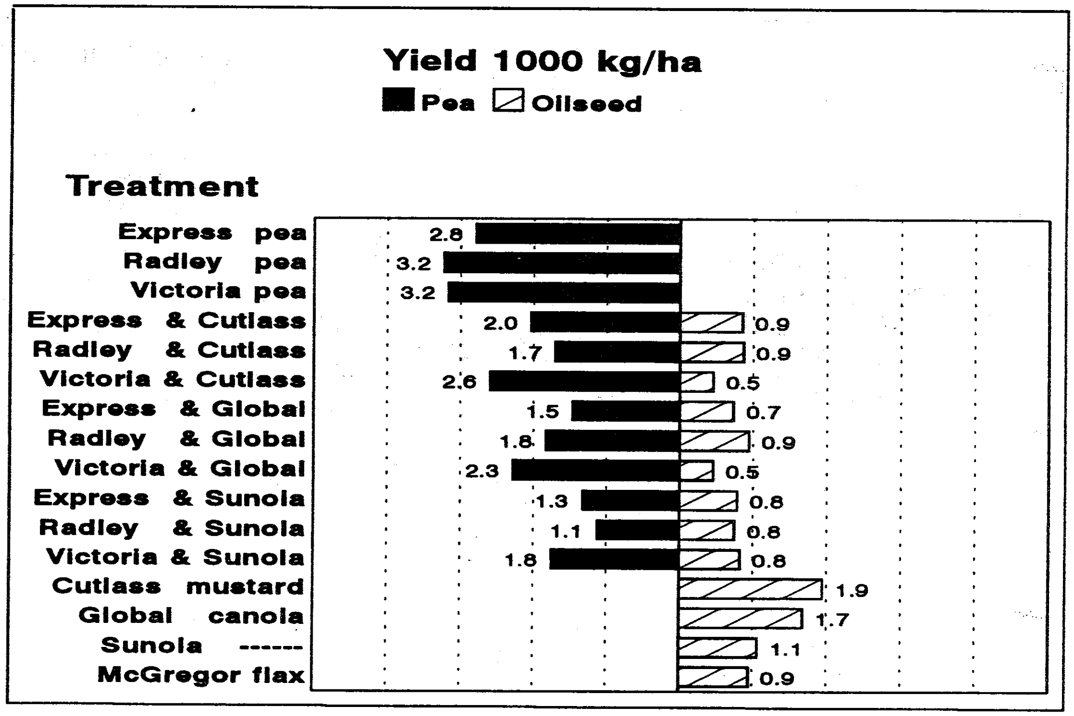


Figure 1. Intercropping pea and oilseed, 1991, Outlook.

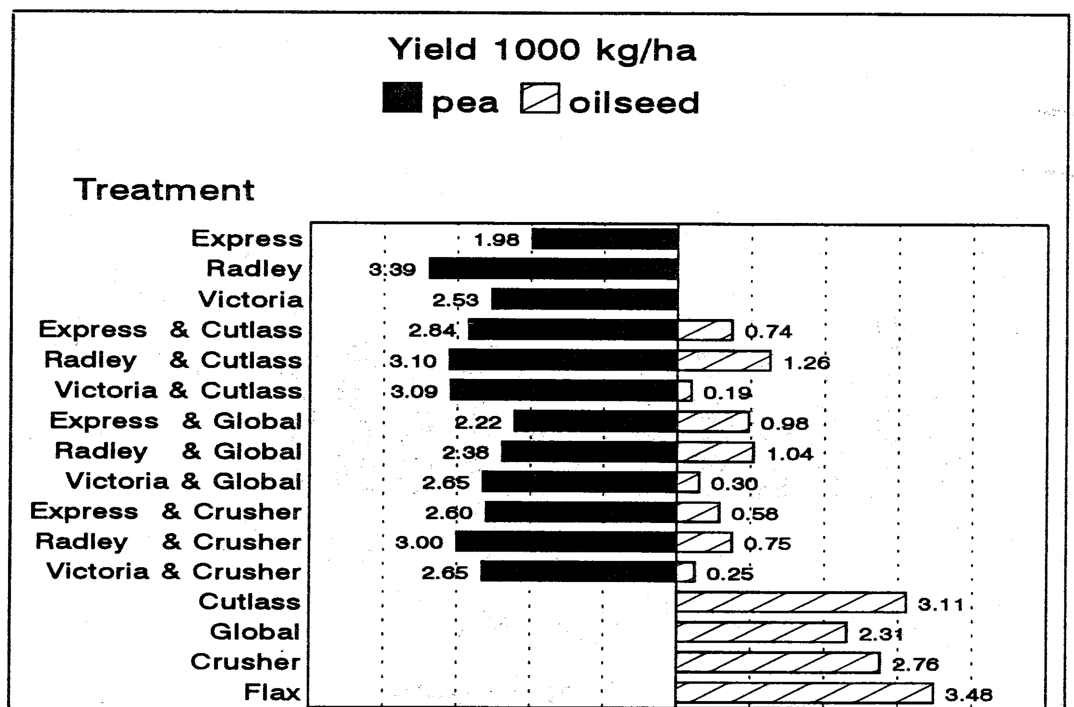


Figure 2. Intercropping pea and oilseed, 1992, Outlook

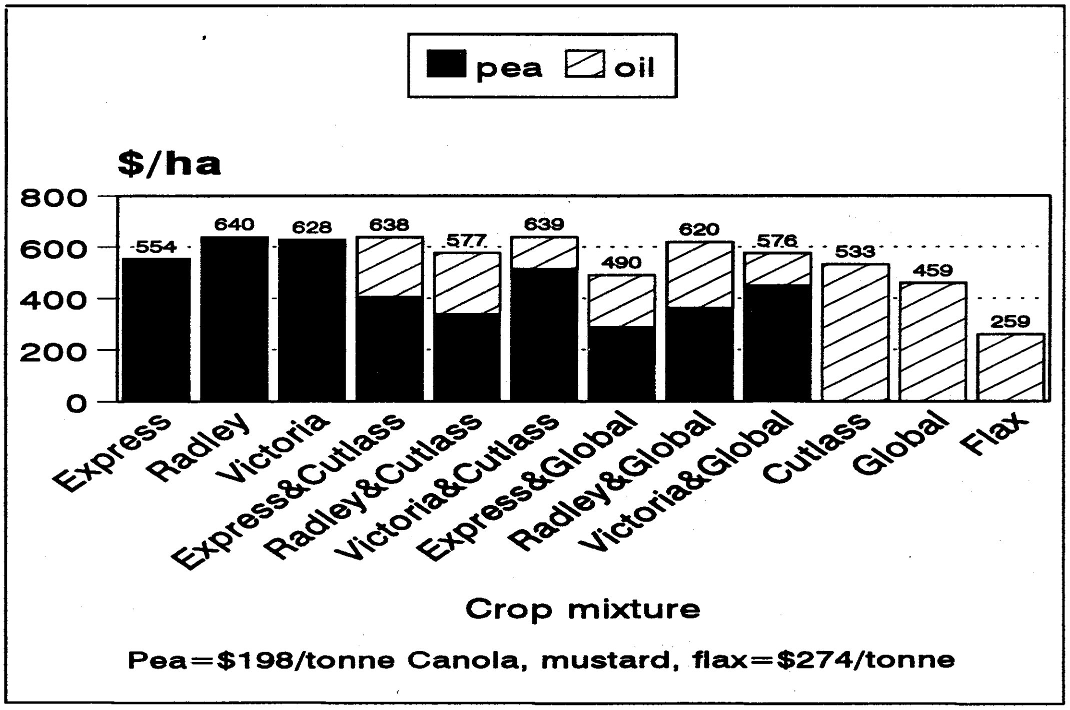


Figure 3. Returns from intercropping pea and oilseed, 1991, Outlook.

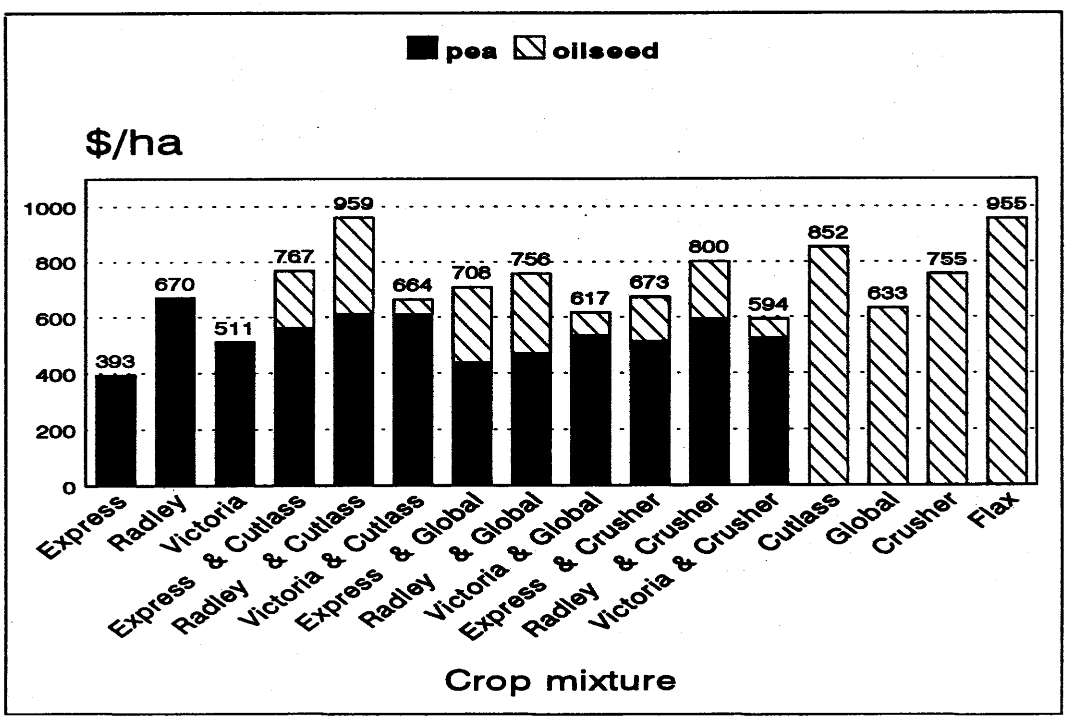


Figure 4. Returns from intercropping pea and oilseed, 1992, Outlook.

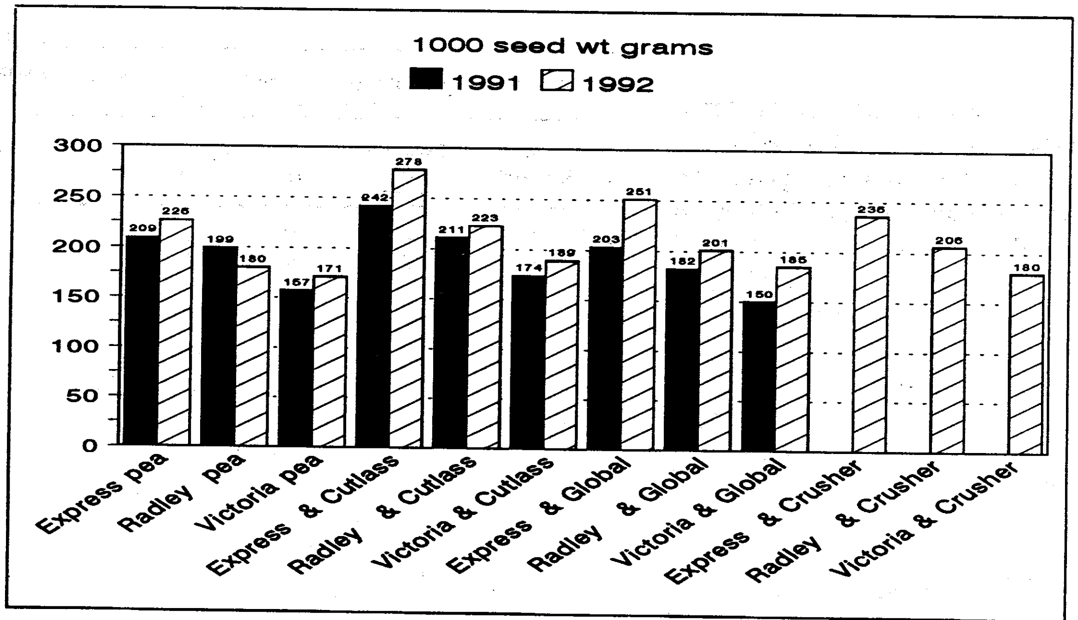


Figure 5. Seed weight of intercropped pea Outlook 1991 & 1992

Effect of Row Spacing and Seeding Rate on Canola Yields and Sclerotinia Infection

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Progress: Year two of three
Objective: To determine the effect of row spacing and seeding rate on the yields of *Brassica napus*.

The *B. napus* cultivar Global, was planted May 10, 1991 and May 5, 1992. A six replicate randomized complete block design was employed in 1991 and eight replicates in 1992. Plots were 3 m wide and 9.14 m long. The row spacings and seeding rates used are listed below:

Row spacing cm	Seeding rate kg/ha		
8	3	6	9
16	3	6	9
32	3		
48	3		
48(3@8cm)*	3		
64	3		

*3 rows with 8 cm between them separated by 48 cm row spacing.
The 3 kg/ha seeding rate was equivalent to 85 seeds/m^2.

Sclerotinia was rated on six samples of 10 plants per plot. Plant numbers were determined from six samples 0.25 m^2 in area from each plot. Height measurements were taken at the end of flowering by measuring the distance from the soil surface to the top of the plants. Estimates of lodging were made by using an ultrasonic distance measuring device to determine the height of the crop from the soil surface in three locations per plot. The surface area measured was approximately 0.5 m^2.

Yields in 1992 were 30-40% higher than in 1991 (Figure 1). As in 1991, yields at the 3 kg/ha seeding rate were not affected by row spacing even at 64 cm. In 1992, yields of the narrowest row spacing and highest seeding rate were significantly lower than all treatments. This was due in part to increased sclerotinia infection levels.

Lodging was increased as the seeding rate was increased (Table 1). The technique used to estimate lodging gives an objective number and indicates the degree to which the plants are compressed together. Lodging increases the potential for disease transfer by direct contact as well as restricting air movement. As lodging increased, sclerotinia infection levels also increased ($r^2=0.73$ df=8). Sclerotinia infected plants occurred in all plots but the level was quite low in plots where lodging was not severe. A combination of genetic resistance to lodging and lower seeding rates will reduce the severity of sclerotinia in canola.

Table 1. Row spacing and seeding rate effects on agronomic traits of Global canola.

Row spacing cm	Seeding rate kg/ha	Plants/m^2 1991	Plants/m^2 1992	Height cm	Lodging*
8	6	73	73	152	68.6
8	9	114	144	146	62.8
8	3	151	191	142	59.5
16	6	77	57	152	74.8
16	9	130	121	147	61.1
16	3	188	177	138	57.9
32	3	86	89	148	77.4
48	3	88	68	149	72.5
48(3@8cm)	3	93	84	152	72.0
64	3	64	84	147	80.3
CV		17.9	13.8	4.2	18.0
LSD		21.9	15.1	6.2	12.4

*Height to top of canopy

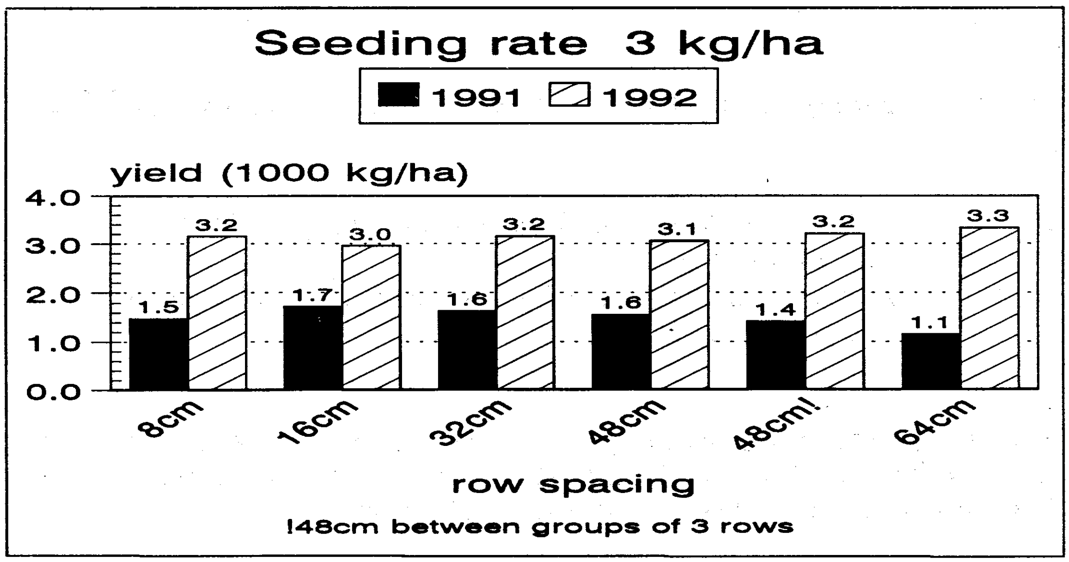


Figure 1. Row spacing on canola yields

Assessment of Genetic Resistance and Biological Control of Sclerotinia in Canola

Principal: D. McKenzie and P.R. Verma, Agriculture Canada Research Station Saskatoon, Saskatchewan
Location: Saskatchewan Irrigation Development Centre
Co-investigator: B. Irvine

Project 1

Progress: Year two of ongoing
Objective: To evaluate antagonistic bacteria and fungi as foliar applied biological control agents for control of sclerotinia stem rot in canola.

B. napus cv Global planted in a solid block was divided into four replicates of 2 m x 3 m plots. At midbloom, when petals had begun to senesce, the biological control agents were applied to the plots in a RCB design using a plot sprayer at a rate of 500 ml suspension/plot using 30 psi pressure. The concentration of the agents was 10^8 bacteria cells/ml, or 10^7 fungal spores or mycelial fragments/ml. One hundred plants in each plot were rated for disease severity at the mid pod stage.

Table 1. Effect of biological control agents on disease severity.

Agent	Disease Severity
Untreated Check	48.4 a
PF1	37.9 ab
Trichoderma sp	37.4 ab
Gliocladium sp	33.8 abc
LD 426a	27.6 bc
DB 2B-1	25.8 bc
Penicillium sp	22.3 bc
F 3-2	22.1 bc
DB 300	19.5 c
LSD	16.7

As shown in Table 1, three bacteria, LD426a, DB 2B-1 and DB 300, and two fungi, *Penicillium sp* and F 3-2, significantly reduced disease severity. Lack of uniform infection resulted in high variation within treatments.

Project 2

Progress: One year only

Objective: To compare the efficacy of foliar applied fungicides for control of sclerotinia stem rot of canola.

A solid block of *B. napus* cv Global was divided into four replicates of 2 m x 3 m plots. At 25% bloom using a RCB design the fungicides were applied using a R&D plot sprayer at 40 psi and 350 L solution/ha. At mid pod stage, 100 plants per plot were assessed for disease severity.

Only Benlate 50 DF at 500 g ai/ha significantly controlled the incidence and severity of sclerotinia stem rot (Table 2).

Table 2. Effect of fungicides on sclerotinia stem rot.

Fungicide	Rate (g ai/ha)	Disease Severity (%)	Disease Incidence (%)
Benlate 50 DF	500	2.0 c*	3.0 c
Fluazinam 500 F	500	46.7 ab	58.9 ab
Fluazinam 500 F	1000	37.2 b	52.3 b
Easout L 50 FW	500	39.1 b	53.5 b
Mertect 45 FL	500	59.8 a	74.0 a
Untreated check	---	51.6 ab	60.4 ab
Standard Error of Treatment Means		5.0	5.3

* Within a column, values followed by the same letter are not significantly different according to the Waller Duncan k-ratio t test, P=0.05.

Project 3

Progress: Year one of two

Objective: A dose response study of several fungicides for control of sclerotinia stem rot.

The range of rates of application, 150 to 450 g ai/ha, was within the suggested experimental rates for the five unregistered fungicides. Benlate which is registered for control of sclerotinia stem rot of canola was used as the standard. The test consisted of 3 m x 2 m plots arranged in a four-replicate split plot design in an area solid planted to *B. napus* cv Global. Fungicide was the main plot effect, and rate of fungicide was the subplot effect. The fungicides were applied at 25% bloom using a R&D plot sprayer at 40 psi and 350 L solution/ha. At mid pod stage, 100 plants in each plot were categorized for disease severity. Linear and quadratic (quad) orthogonal comparisons on rates for each fungicide were done using a SAS computer program.

Benlate, SAN 619, and Sportak showed significant linear reduction of disease severity with increasing dose (Table 3). Although SAN 619 and Sportak at 450 g ai/ha did not have an efficacy as good as Benlate, the significant linearity of the response indicate that dosage above 450 g ai/ha may result in further decrease in disease severity. Anvil, Folicur and Tilt displayed no efficacy against sclerotinia stem rot at the rates tested.

Table 3. Dose response values.

Fungicide	Rate (g ai/ha)	Disease Severity (%)	Orthogonal Comparison
Benlate 50 DF	0	47.4	linear: Pr>F = 0.0004
	150	20.7	quad: Pr>F = .38
	300	17.9	
	450	4.9	
SAN 619 100 SL	0	52.6	linear: Pr>F = 0.004
	150	34.2	quad: Pr>F = 0.29
	300	23.5	
	450	21.6	
Sportak 40 EC	0	52.9	linear: Pr>F = 0.02
(+ surfactant Enhance @	150	52.5	quad: Pr>F = 0.39
150 ml/ha)	300	41.9	
	450	28.3	
Anvil 5 SC	0	44.0	linear: Pr>F = 0.29
	150	43.3	quad: Pr>F = 0.64
	300	40.5	
	450	32.6	
Folicur 39 F	0	45.1	linear: Pr>F = 0.65
(+ surfactant Renex @	150	31.2	quad: Pr>F = 0.56
150 ml/ha)	300	41.4	
	450	36.4	
Tilt 250 EC	0	41.1	linear: Pr>F = 0.31
	150	44.1	quad: Pr>F = 0.85
	300	32.9	
	450	33.1	
Standard error of subplot means		7.7	

Forages

Alfalfa Cultivar Evaluation on Flood Irrigated Clay Soils in South Western Saskatchewan

Principal: P.G. Jefferson, Agriculture Canada Research Station
Swift Current, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-investigator: R.J. Rempel
Co-operators: R. Oldhaver and D. Bradley, Miry Creek; B. Dirkson and L. Dilworth, Rush Lake; V. and A. Perrault, Ponteix
Progress: Final year
Objectives:

a) to evaluate yield performance and forage quality of 11 alfalfa cultivars on heavy clay soils over a range of environmental conditions during a four-year period;
b) to determine the relative compatibility of alfalfa cultivars when grown with an associated grass (intermediate wheatgrass and smooth bromegrass) as compared to a monoculture stand.

The ANOVA indicates that when combined across all sites, the mixture treatment and site effects were statistically significant for mean total yield. However, the ranking of cultivars was not affected by mixture treatment. The ranking of cultivars was affected by the site. Miry Creek-1 and Ponteix-1 cultivar means were different from the other sites and the overall cultivar means.

Averaged over all five sites, Beaver alfalfa was the most productive cultivar with Anchor in second place and SCMf3713 last.

For first cut forage, the two mixtures yielded more than monoculture alfalfa at all five sites. At two sites, the intermediate wheatgrass (IWG) yielded more than bromegrass. For second cut forage, the alfalfa monoculture yielded more than the two mixtures.

Botanical composition (% alfalfa) in the mixture treatments varied by site and grass species. The highest proportion of alfalfa was found at Ponteix-1 and the lowest proportion at Swift Current-2. There was a higher proportion of alfalfa in mixture with intermediate wheatgrass than with bromegrass. The line SCMf3713 had the lowest proportion of alfalfa in either mixture.

At each of the five sites where yields could be harvested for two or three years, the forage quality was significantly affected by the mixture treatment. Fibre content of the mixtures was higher than that for the alfalfa monoculture at each site for both first and second cut forage. The protein and digestibility of the alfalfa monoculture was always superior to at least one of the two monocultures for first cut forage. For second cut forage, however, the digestibility of the mixtures were higher than for alfalfa monoculture. Differences in crude protein varied among sites with two sites exhibiting superior protein content for alfalfa monoculture, and three sites with at least one mixture treatment as good as the alfalfa monoculture.

Establishment and Seed Production of Turf and Forage Grasses

Principal:	Newfield Seeds Company Limited, Nipawin, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigator:	B. Irvine
Location:	SIDC, Outlook, Saskatchewan
Progress:	Final year
Objectives:	The project was designed to determine the effect of time of seeding and the use of a companion crop on the establishment and subsequent yields of turf and forage grasses.

In 1991, a six replicate test was planted as a split plot with the following varieties as sub-plots:

Dormie Kentucky Bluegrass	(turf)	Jaguar Tall Fescue	(turf)
Boreal Creeping Red Fescue	(turf)	Paddock Meadow Bromegrass	(forage)
Enjoy Chewings Fescue	(turf)	Climax Timothy	(forage)

The sub-plots above were seeded in the following main plots:

Early spring - no companion crop	Late spring - with wheat
Late spring - no companion crop	Mid summer - no companion crop

An establishment rating was taken in the spring of 1991, and seed yields, plant counts, and plant heights were taken in the summers of 1991 and 1992.

Companion cropping proved to be an unsuccessful method of establishing a grass due to prolonged and intense competition. Yields of grasses for 1991 and 1992 are listed in Table 1. There appeared to be a compensatory effect in 1992, as the late spring seeded plots yielded the best, which brought the total production to the same levels, independent of the date seeded.

From the yields obtained from the grasses, and current prices of pedigreed seed, irrigated grass seed production could be a very profitable crop option.

Table 1. Effect of seeding date on seed yield.

		Seed Yield (kg/ha)			
Variety	Year	Early Spring	Late Spring	Mid Summer	Average
Jaguar	1991	604	410	316	444
	1992	861	904	904	890
Dormie	1991	48	38	70	52
	1992	361	473	463	432
Enjoy	1991	63	44	73	60
	1992	428	634	258	440
Boreal	1991	401	148	272	273
	1992	542	544	557	549
Climax	1991	406	256	319	327
	1992	554	642	454	550
Paddock	1991	542	410	651	534
	1992	572	637	513	574

Hay Certification and Forage Market Access Project

Principal: Saskatchewan Forage Council
Funding: Irrigation Based Economic Development Agreement
Agriculture Development Fund
Co-investigators: Saskatchewan Feed Testing Laboratory,
University of Saskatchewan
Progress: Final year
Objectives:

a) to implement an objective method of classifying hay for sale, facilitating the transfer of hay from seller to buyer;
b) to foster greater awareness of the production and worth of quality hay as reflected by the demands of the marketplace;
c) to investigate and establish techniques to facilitate the marketing of forage products.

The Hay Certification and Forage Market Access Project, initiated in May 1990, is now in its final year. In the first year, a co-ordinator was hired to implement the project and develop a program to meet the objectives. The hay certification procedures and certificate were developed initially, describing the visual attributes and nutritional content of the forage. This certificate describes the hay to the buyer and can be used by the producer for promotion. To facilitate the certification and description of the hay, nineteen trained, independent inspectors across the province go to the various farms and inspect and describe the hay. This certification is done on a fee-for-service basis. Support by the program, in the form of advertising and promotion of inspector services, has been provided. To further facilitate the marketing of the certified forage, all of the certified hay lots are listed on a monthly basis in the Saskatchewan Agriculture and Food "Feed Grain and Forage Listing Service".

A major portion of the project has been promotion of the production and marketing of forage on the basis of quality. Brochures and news releases have been prepared for livestock producer newsletters and the media, as well as utilizing Saskatchewan Rural Service Centres for information distribution. Promotional activities have included forage days, attendance at producer meetings and participation in fairs and major shows, such as Agribition. The Hay Certification Program is particularly pleased with the initiation of a new Certified Hay class at Agribition, illustrating the respect and acceptability of the program to forage producers. The number of hay lots certified was slightly reduced from the previous year. It is thought that this slight reduction in the number of lots of hay certified is due to the shortage of high quality hay due to poor harvesting conditions, particularly for first-cut hay. The average lot size of hay certified was 90 tonnes, which, in total, represents over 10,500 tonnes of feed, with a value of approximately $600,000. The impact of a program such as this should not be measured only by the number of lots of hay certified, but also by its impact in terms of promotion and education of forage producers in the production of a higher quality forage. There has been a significant increase in the number of producers analyzing forage prior to its sale and using that analysis to help advertise their forage.

The Canadian Forage Council has continued to play a lead role in the formation of a National Hay Certification Program. The Saskatchewan Hay Certification Program has been adopted as a model for the national program. Manitoba has initiated a Hay Certification Program which has been modelled after that in Saskatchewan and is completing its first year of operation. It should be noted that the Saskatchewan program has endeavoured to share information and help the growth of programs provincially and nationally. This has, in turn, helped the Saskatchewan program grow and mature, enabling forage producers to recognize the value of adequately describing their product to increase its marketability.

Adaptation and Recommendation Testing of Forage Crop Varieties in Saskatchewan

Principal:	Saskatchewan Forage Council
Funding:	Irrigation Based Economic Development Agreement (20%); Agriculture Development Fund (80%)
Co-investigators:	B. Goplen, S.B.M. Wright, P. Jefferson, B. Gossen
Co-operators:	R. Scowan, G. Harbin, D. Bandford, S. Nahachewsky
Progress:	Final year
Objectives:	

a) to update and expand information available on recommended and registered forage variety performance across Saskatchewan;
b) to provide extension value to forage associations and other agencies by locating several research sites across the province;
c) to provide a larger data base for making variety recommendations to Saskatchewan forage producers.

In 1992, the seeding phase of this project was completed. Sites are located at Loon Lake, White Fox, Melfort, Saskatoon, Outlook, Indian Head, Swift Current (irrigation and dryland), Lashburn, Yorkton, Eastend and Estevan.

Yield and quality data was collected at Loon Lake, Melfort, White Fox, Saskatoon, Indian Head, Outlook and Swift Current (irrigation and dryland) in 1992.

A. Outlook

Trumpetor alfalfa, Paddock meadow bromegrass, Clarke intermediate wheatgrass, Arthur dahurian wild ryegrass and Swift russian wild ryegrass had the greatest first cut yields. Maxim alfalfa, Rebound smooth bromegrass, Orbit fall wheatgrass, James dahurian wild ryegrass and Eejay altai wild ryegrass obtained the greatest second cut yields. Greatest total yield was produced by Maxim alfalfa, Rebound smooth bromegrass, Clarke intermediate wheatgrass, James dahurian wild ryegrass and Eejay altai wild ryegrass.

Greatest first cut protein occurred in Peace alfalfa, Baylor smooth bromegrass and Summit crested wheatgrass. Barrier alfalfa, Signal smooth bromegrass and Summit crested wheatgrass had highest second cut protein content. First cut neutral detergent fibre (NDF) levels were lowest in Peace alfalfa and Clarke intermediate wheatgrass. Anik alfalfa, Baylor smooth bromegrass and Chief intermediate wheatgrass had lowest second cut NDF levels. Algonquin alfalfa and Fairway crested wheatgrass had greatest first cut acid detergent fibre (ADF), while Maxim alfalfa, Paddock meadow bromegrass and Parkway crested wheatgrass had the greatest second cut NDF levels.

B. Swift Current

Greatest first cut yield was obtained by Arrow alfalfa, Melrose sainfoin, Chief intermediate wheatgrass and Prairieland altai wild ryegrass. Greatest second cut yields were obtained with Sparta alfalfa, Florex red clover, Baylor smooth bromegrass, Adanac slender wheatgrass, Eejay altai wild ryegrass and Climax timothy. Greatest total yield was achieved by Arrow alfalfa, Florex red clover, Baylor smooth bromegrass and Prairieland altai wild ryegrass.

Greatest first cut protein content was observed in Carlton smooth bromegrass and Nordan crested wheatgrass. Rangelander alfalfa had the greatest second cut protein. Lowest first cut NDF content was in Carlton smooth bromegrass. Rangelander alfalfa, Carlton smooth bromegrass and Kirk crested wheatgrass had the lowest second cut NDF. Trumpetor alfalfa and Regar meadow bromegrass contained the lowest first cut ADF levels. Anchor alfalfa, Regar meadow bromegrass and Fairway crested wheatgrass had the greatest second cut ADF levels.

It should be noted that, in the above variety observations, greatest yields or quality may be co-dominant with other varieties.

Management of Forage Production under Irrigation

Principal:	B.P. Goplen Agriculture Canada Research Station Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	B.D. Gossen, J.J. Soroka, S.B.M. Wright, H. Ukrainetz
Location:	Saskatchewan Irrigation Development Centre
Progress:	Final year
Objectives:	

a) to examine the effect of row spacing, seed rate, fertilizer and cutting management on forage and seed yield of irrigated alfalfa;
b) to assess alfalfa lines and varieties for forage and seed production under irrigated conditions.

A. Seed Production Trials

Uniform Alfalfa Variety Tests - Leafcutter bee increase was fair to good in 1992. Cool, cloudy conditions promoted excess vegetative growth and a corresponding decrease in flower production and pollination activity. In spite of these unfavourable conditions, the average seed yield over all the Uniform Variety tests in 1992 was 335 kg/ha. It is of particular interest that a test seeded in 1987, which had previously been mechanically thinned, had the least forage growth, the best flowering, and produced an average seed yield of 469 kg/ha (Table 1), while a test established in 1990 produced an average seed yield of only 250 kg/ha (Table 2). Average dryland seed yields in Saskatchewan in 1992 are estimated to be as low as 50 kg/ha, which is well below average. A test of nondormant alfalfa varieties was established in 1992 to assess the seed production potential of alfalfa in the year of seeding. Weather conditions in 1992 resulted in only sparse and sporadic flowering in the fall and no mature seed was produced (data not shown).

B. Forage Production Trials

Uniform Alfalfa Variety Tests (forage) - The cool, cloudy conditions stimulated vegetative growth and forage yields of alfalfa were excellent, averaging 12.8 tonnes/ha from two cuttings (data not shown). Differences among lines were not consistent between tests, and another year of data is required before recommendations can be made.

Effect of seeding rate on alfalfa forage yields - The effect of seeding rates from 2 to 27 kg/ha on forage yields of alfalfa was examined over three years (1990-92). Although the 2 kg seeding rate was the only clearly inferior rate, there was an improvement in plant stand and forage yield (Table 3) as seeding rate was increased. Seeding rates of 9-11 kg/ha for alfalfa forage production are desirable for irrigated areas.

Table 1. Seed yields, 1987 Uniform Regional Alfalfa Test (irrigated) - Outlook, 1988-92.

Entry Name	Seed Yield (kg/ha)					Five Year Average	
	1988	1989	1990	1991*	1992	kg/ha	% Beaver
NAPB 32	910	650	447	429	544	596	117
Glory	810	565	436	425	603	568	111
OAC Minto	978	533	425	398	474	562	110
Primal	804	622	389	406	543	553	109
Anchor	760	654	365	439	478	539	106
Riel	747	570	429	372	547	533	105
Arrow	715	595	438	436	454	528	104
AP 40	962	615	355	329	370	526	103
Victoria	821	675	316	366	442	524	103
NAPB 31	747	571	381	395	516	522	103
Rambler	913	499	226	443	520	520	102
A 872	691	546	311	415	625	518	102
WL 222	858	516	251	459	464	510	100
Beaver	**801**	**526**	**285**	**400**	**535**	**509**	**100**
Apica	834	476	432	377	398	503	99
NK 83632	679	578	397	330	526	502	99
Barrier	695	488	404	361	486	487	96
Alouette	709	512	358	340	434	470	92
WL 316	621	591	355	265	486	464	91
Vernal VW-34-2	664	499	294	382	452	458	90
Maxim Oneida VR	673	440	366	330	454	452	89
Spredor II	625	472	335	345	448	445	87
80-16P	644	507	242	375	412	436	96
BLM 1019	766	379	282	302	400	425	84
Sitel	622	422	268	413	373	420	82
	793	295	203	265	288	269	72
	494	350	335	216	386	356	70
Mean	753	524	345	371	469	492	
F value	2.03**	1.49^{NS}	2.93**	1.93**	2.63**	3.60**	
LSD (0.05)	225	--	117	152	131	86	
CV (%)	21.2	32.3	24.0	23.2	19.8	13.9	

*harvested in the spring of 1992

Table 2. Seed yields, 1990 Uniform Regional Alfalfa Test (Irrigated) - Outlook.

Entry Name	Seed Yield (kg/ha)		Two Year Average	
	1991*	1992	kg/ha	% Beaver
GARST 633	662	301	482	148
PS 89-20	609	350	480.	147
IMPACT	658	294	476	146
AP 8820	654	268	461	141
PEACE	643	260	451	138
83CF042	619	281	450	138
SURE	578	316	447	137
AP 8822	640	236	438	134
APICA	603	269	436	134
VW-34-2	602	267	435	133
TRUMPETOR	598	260	429	131
P1859	578	276	427	131
SF8001	565	289	427	131
OAC MINTO	612	223	418	128
ANCHOR	568	247	408	125
B2186	547	246	397	122
RAMBLER	525	265	395	121
89-03-06	577	190	384	117
HEINRICHS	487	258	373	114
MULTILEAF 1	500	242	371	114
VERNAL	470	231	351	107
SPREDOR 2	404	253	328	101
BEAVER	**442**	**211**	**326**	**100**
RANGELANDER	481	157	319	98
1-88PF12	468	155	312	95
1-88PF11	470	148	309	95
Mean	560	250	405	
F value	2.02**	2.54**	3.23**	
LSD (0.05)	146	85	84	
CV (%)	20.7	27.1	23.6	

*harvested in the spring of 1992.

Table 3. Effect of seeding rate on forage dry matter yield of irrigated Beaver alfalfa, Outlook, 1990-92.

Seeding rate (lb/ac)	% Stand Spring 1992	Forage Dry Matter Yield (kg/ha)			
		1990	1991	1992	Mean
2	76	9100	9800	9400	9400
4	87	10300	11800	10300	10800
8	91	10000	11300	11300	10900
12	89	10700	12100	10700	11200
16	96	11000	11800	11700	11500
24	93	11200	12000	11200	11400
Mean	89	10400	11500	10800	10900
F value	4.74**	1.50ns	3.37*	4.77**	7.37**
CV (%)	8%	14%	9%	8%	10%
LSD (0.05)	9	--	1380	1070	790

*, ** = significant at $P \leq 0.05$, 0.01, respectively. ns = not significant.

Management of Alfalfa for Seed Production under Irrigation

Principal:	B.P. Goplen Agriculture Canada Research Station Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	B.D. Gossen, J.J. Soroka, S.B.M. Wright
Location:	Larson Farm, Saskatchewan Irrigation Development Centre
Progress:	Final year
Objectives:	To examine the response of new alfalfa lines for their potential in the irrigated areas of Saskatchewan.

<u>Eastern alfalfa seed trial</u> - The survival and seed production potential of thirty moderately-hardy alfalfa cultivars used in eastern Canada was assessed at SIDC from 1989-92. The plots, established in 1989, were not thinned (as is normal for seed production of hardy cultivars), because stand thinning due to winter killing was expected. However, increases in density due to growth of individual plants were as common as decreases due to plant losses during the winter (Fig. 1). During this same period, several forage production trials adjacent to the seed trial exhibited severe winter injury. This indicates that under the management system used for seed production, all of these varieties had sufficient hardiness to survive in most years in Saskatchewan.

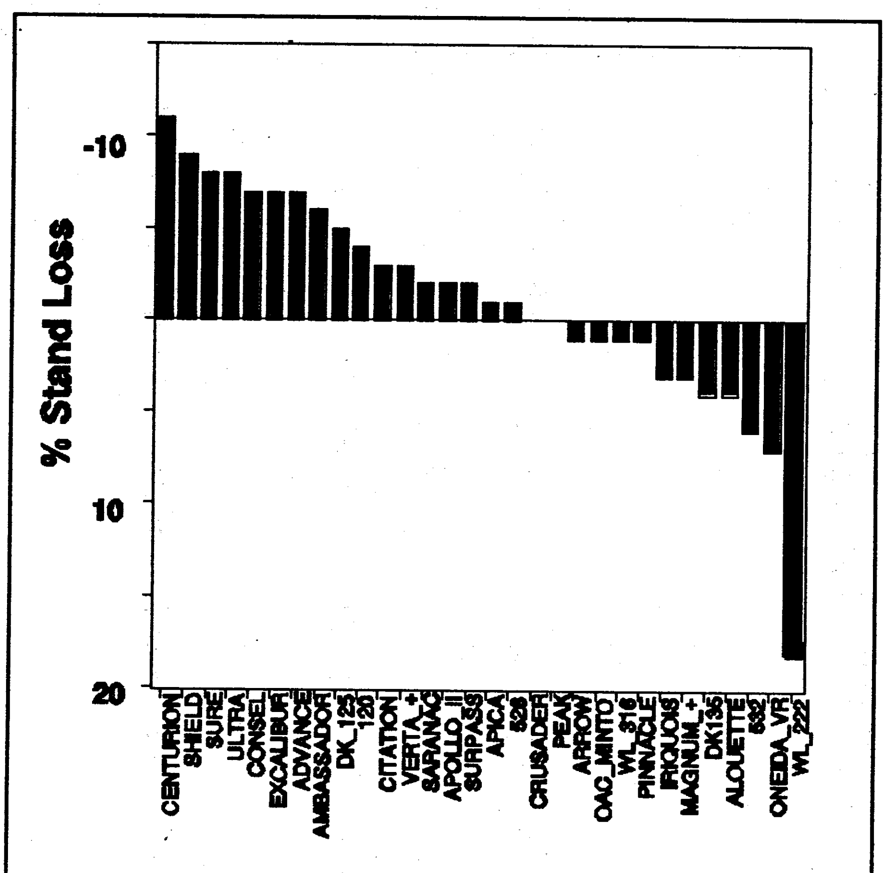


Fig. 1. Changes in stand density of eastern alfalfa cultivars at Outlook, Saskatchewan, from 1989 to 1992 (negative values for loss = increases in density during this period).

The leafcutter bees that pollinate alfalfa are most active under hot, dry conditions, and weather conditions during this study were generally cool and often wet. This resulted in delayed or reduced pollination each year. In 1990, excessive vegetative growth associated with heavy rain in June also reduced flower initiation, resulting in very low seed yields (mean of 185 kg/ha). In 1991, delays in pollination resulted in a late-maturing seed crop. An early snowfall (mid-October) occurred before harvest. The crop was left in the field and harvested in the spring of 1992. In spite of these problems, yields were excellent, averaging 684 kg/ha, and quality was good.

There were generally no statistical differences among the cultivars for survival (Fig. 1) or seed yield (Table 1). We noted that these moderately-hardy lines initiated flowering slightly later than hardy lines in adjacent trials, and also flowered longer into the fall. Seed production of moderately-hardy cultivars carries a higher risk than hardy cultivars, but this study clearly shows that their production is possible in the Outlook area.

Uniform alfalfa adaptation trials - Forage yields were excellent in 1992 (Table 2) and differences in yield among cultivars were significant in both 1991 and 1992. This data represents only two years of testing, and at least one additional year is required before reliable conclusions can be drawn from the results.

Table 1. Seed production of alfalfa cultivars recommended in eastern Canada, grown at Outlook, 1990-92.

Cultivar	Seed Yield (kg/ha)			
	1990	1991	1992	Mean
CRUSADER	213	732	571	506
SURE	186	831	488	502
WL 316	239	748	473	487
VERTA +	294	616	549	486
SARANAC	207	788	454	483
OAC MINTO	206	809	419	478
APICA	270	652	498	473
SHIELD	260	592	562	471
ULTRA	212	646	527	462
DK 125	288	610	476	458
EDGE	193	737	444	458
ONEIDA VR	182	759	424	455
ALOUETTE	210	730	407	449
IRIQUOIS	153	663	516	444
SURPASS	197	613	506	439
ADVANCE	124	643	541	436
MAGNUM +	180	587	529	432
CENTURION	197	686	392	425
AMBASSADOR	140	760	376	425
CITATION	178	704	388	424
CONSEL	198	642	430	423
PINNACLE	192	658	410	420
ARROW	128	742	388	419
120	180	602	446	410
DK 135	155	754	314	408
532	152	629	403	394
EXCALIBUR	166	594	400	387
526	130	602	411	381
APOLLO II	83	709	339	377
WL 222	117	671	344	377
PEAK	92	704	322	373
Mean	185	684	443	438
F value*	1.47	0.68	1.42	1.05
CV (%)	40	21	24	26

* No significant differences among cultivars at $P \leq 0.05$

Table 2. Forage yields, 1990 Regional Adaptation Alfalfa Test (Irrigated), Outlook, 1990-92.

Cultivar or Strain	Forage Dry Matter Yield (kg/ha)			% Beaver
	1991	1992	Mean	
EDGE	13000	15500	14200	120
MAXIM	12100	15900	14000	118
EXCALIBUR	13400	14500	13900	117
TRUMPETOR	12300	15100	13700	115
CITATION	12900	14000	13500	113
BARRIER	12500	14000	13300	112
89-03-06	12700	13200	12900	109
ANCHOR	13000	12700	12800	108
ARROW	11800	13600	12700	107
SPARTA	11800	13100	12400	105
APICA	11400	13400	12400	105
RAMBLER	12200	12600	12400	104
ALGONQUIN	11900	12700	12300	104
LSP	11200	13400	12300	103
OAC MINTO	11600	12800	12200	103
CHAMP	10700	13300	12000	101
VW-34-2	11300	12700	12000	101
VERNAL	11900	11900	11900	100
BEAVER	**11400**	**12400**	**11900**	**100**
RANGELANDER	11300	12500	11900	100
HSP	10200	13300	11800	99
PEACE	11600	12100	11700	99
HEINRICHS	11600	11200	11400	96
GRIMM	11600	11000	11300	95
ANIK	9100	7900	8500	72
Mean	11800	13000	12400	
F value	2.40**	7.26**	7.55**	
LSD (0.05)	1670	1080	1070	
CV (%)	11.3	6.7	9.8	

Grass Versus Alfalfa Production under Border Dyke Irrigation

Principal: D. Cameron, Normac AES Ltd.
Swift Current, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-operator: D. Harrigan, A. Lambert, D. Drever, K. Hope and B. Doonan
Location: Maple Creek
Progress: Final year
Objective: To compare the yield and nutritional value of various grass varieties to alfalfa on fine textured salt-affected border dyke irrigated soils in southwestern Saskatchewan.

Three grass-legume variety experimental plots were established in the Maple Creek irrigation flats. Replicated plots were originally established at the Doug Harrigan site in 1990 while smaller non-replicated plot areas were established at the Lambert/Drever and Ken Hope sites. In 1990 drought conditions existed and grass establishment was relatively poor. The 1990 grass establishment at the Doug Harrigan site was very poor and large scale replicated plots for comparison of crested wheatgrass, intermediate wheatgrass and brome were established in 1991. In 1992 the small non-replicated plots were re-established. The results showed an excellent catch of almost all the varieties of grass primarily because of the moist soil conditions that existed throughout June and July.

The grass varieties which appear to be the most suited for the Maple Creek area from the three years of observations include intermediate wheatgrass, bromegrass, meadow bromegrass, crested wheatgrass and Russian wild ryegrass. However, the brome-alfalfa mix also appeared to give reasonable results. In 1992 Dahurian wild ryegrass was tried and this grass also had a very good catch and establishment and holds promise for the future. Northern wheatgrass had a very poor establishment on the Lambert/Drever plot but showed some promise on the Ken Hope plot.

By far the best yield of forage was sweet clover, but unfortunately, as a biennial it only has a two-year life span. However, our results suggest that perhaps a mix of sweet clover and alfalfa might be one of the routes for forage establishment in the Maple Creek area. The sweet clover will provide an excellent yield, particularly during the second year, while the alfalfa has time to establish. If the alfalfa establishment is not as strong, the area can be directly re-seeded after sweet clover harvest or in the early spring of the following year to provide additional alfalfa plants.

Alfalfa Establishment and Fertility for Increased Yield and Stand Longevity on Border Dyke Irrigation

Principal:	Doug Cameron, Normac AES Ltd. Swift Current, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-operator:	R. Harrigan, D. Harrigan, D. Drever, A. Lambert, J. Brewitt, B. Doonan and R. Anderson
Location:	Maple Creek, Saskatchewan
Progress:	Final year
Objective:	To determine the best method of establishing alfalfa on the irrigated alluvium clay soils of the Maple Creek area.

The alfalfa establishment study was initially designed as a series of experiments looking at zero tillage versus conventional tillage for seeding alfalfa into standing stubble and mulches. There were no yield differences between the various treatments established in 1988. In 1989 the emphasis on the study was changed to look at the addition of organic matter, gypsum and fertilizer for improving alfalfa establishment. Three alfalfa establishment sites were set up in the fall of 1989-spring 1990 and monitored for the next three years. However, the results over the three years of monitoring did not support major yield improvements. Generally, there was a yield improvement of approximately 10% where the combination of gypsum and manure had been applied and in some cases where gypsum alone had been applied. However, in almost all cases where manure had been applied there was a slight decrease in yield and the reason for this is unknown. In the earlier experiments subplots of micronutrients, boron and high nitrogen rates were incorporated. However, none of these chemical additions showed a response and these subplots were not monitored after 1990.

However, during the initiation of all the various alfalfa establishment experiments two techniques seemed to provide some positive aspects for alfalfa establishment in the Maple Creek area. One technique was the use of sweet clover as a cover or companion crop for alfalfa establishment. Sweet clover is fairly productive on these heavy clay soils and provides excellent competition to weeds during the first two years of alfalfa establishment. It also allows time for the slower maturing alfalfa to become established and take over after the sweet clover. Another approach which appeared to enhance alfalfa establishment in the Maple Creek area was that of directly re-seeding poor establishment stands of alfalfa rather than reworking the stands and starting with a new seedbed. We found it more beneficial to conduct a light cultivation on the existing stand in order to kill any of the weeds but cause minimal damage to the alfalfa. The area was then re-seeded to alfalfa to increase the plant density.

Weed control has not been a technique widely practiced in the Maple Creek flats. However, we found that Treflan (trifluralin), a pre-emergent herbicide, provided fairly positive results for alfalfa production. It almost always reduced the weed counts by at least 50% or more and generally did not affect alfalfa seedling establishment. However, in some plots alfalfa plant numbers were reduced. This can be counteracted by heavier seeding rates.

Tile drainage would appear to have some good potential in the Maple Creek study areas. Analysis of the drainage waters in 1992 indicated that sodium, chloride and sulphate are being preferentially leached relative to calcium and magnesium. This is a positive indication as it will tend to decrease SAR in the soils and improve drainage which in turn will improve alfalfa production on these heavy clay soils.

Subsoiling directly into existing stands of alfalfa was tried in two locations on the Maple Creek plot area but the results are inconclusive. The use of a knife blade subsoiler was positive in that it caused minimal disturbance and left a channel open for water penetration. Further work is required on this technique.

In 1992 a small experiment was initiated for the control of foxtail barley in poorly established alfalfa by using a light rotovation to help kill the foxtail barley plants and then reseeding with alfalfa to increase the stand density. The seedling counts from the experiments indicate this approach has potential for reducing foxtail barley without destroying the existing alfalfa.

Alfalfa Varieties on Border Dyke Irrigation: Yield and Stand Longevity

Principal:	D. Cameron, Normac AES Ltd. Swift Current, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-operator:	R. Anderson, PFRA
Location:	Maple Creek (NW 8-11-26-W3)
Progress:	Final year
Objective:	To determine the alfalfa variety best suited to the heavy textured soils of the Maple Creek area. The most suitable variety would be one which is high yielding and has good stand longevity.

The alfalfa variety trials were established in 1988. A comparison of the yields from 1989 through to 1992 is shown in Figure 1. Over the four years of data collected, Roamer had the highest average yield (3.34 tonnes/ha) followed closely by Beaver (3.26 tonnes/ha) and Heinricks (3.28 tonnes/ha). Pioneer had the lowest average yield (2.97 tonnes/ha). The long term average yield over all varieties and through the four years was 3.2 tonnes/ha. During the four years of yield data collection and analyses there were no statistical differences between any of the varieties, although some of the varieties had higher average yields.

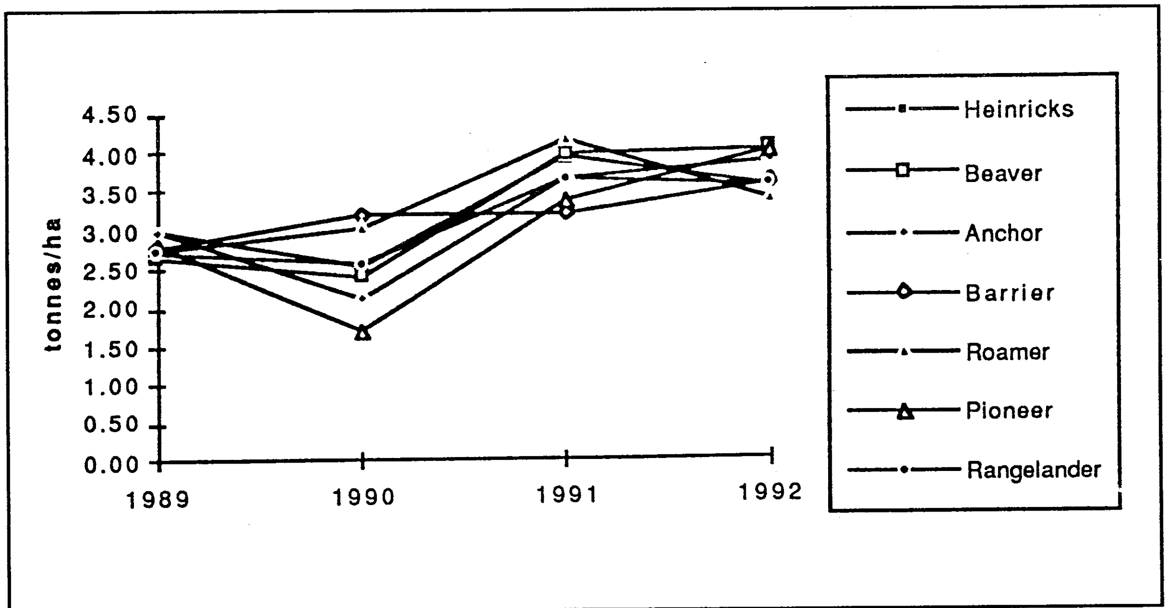


Figure 1. Comparison of alfalfa variety yields over the years 1989, 1990, 1991 and 1992 at Maple Creek.

In the four years that this project has progressed there has been a number of extremes in weather conditions. In 1988 when the project was initiated a relatively good seed catch was obtained primarily due to the fall rains which promoted growth. In 1989 only a partial irrigation was allowed in early July (prior to second cut) because of the dry year and lack of reservoir water supply. In 1990 there was sufficient spring moisture to provide one cut and no irrigation took place. With the drought there was insufficient growth to harvest a second cut. In 1991 the May-July conditions were excessively wet which, in turn, increased the first-cut yields but delayed harvest until mid-July. Yields were also good in 1992 with the late June-July rains. In wetter years, 1991 and 1992, the yields were approximately 1 tonne/ha higher than the drought years of 1989 and 1990.

Rudy Rosedale Community Pasture Irrigation Project

The Rudy Rosedale Irrigated Alfalfa Project was established to provide alfalfa hay for the PFRA community pasture program and to demonstrate irrigated alfalfa production. Production in 1992 was hampered by a cool growing season as well as wet weather during harvesting operations. There were a few agronomic demonstrations conducted at Rudy, the results of which are reported elsewhere in this report.

Operation

Three quarters were in alfalfa production in 1992. The fourth quarter (SW) was broken and Calibre oats (80 kg/ha) seeded on the alfalfa breaking May 4. The oats were harvested as greenfeed. Fertilizer was applied to all quarters according to soil test recommendations: The SE quarter had a large proportion of grass in the stand and for this reason received extra nitrogen to meet the nitrogen requirements of the grass.

Mole hills and wet conditions created harvest problems causing cutterbar plugging. A disc mower was demonstrated on a trial basis with good success. However, rapid wear on disc blades from mole hills and reduced drying of the windrows resulted in the baling operation being slowed considerably. More aggressive action will be required in the control of moles.

The quantity and quality of hay produced in 1992 is indicated in Tables 1 and 2. Yields were increased compared to 1991. The extra nitrogen on the SE quarter increased the first cut yields and should be considered again in 1993 as an alternative to breaking this quarter. Forage quality was good for the alfalfa. Where grass was a large portion of the stand, the protein content was lower for the first cut. Protein content of the oats was low.

Allocation of bales to the various pastures is as indicated in Table 3.

Table 1. Forage yields at Rudy Rosedale Irrigated Alfalfa Project.

	Alfalfa Hay (t/ha)					Greenfeed Oats (t/ha)	
Year	1st cut	2nd cut	3rd cut	Total	No. of bales	1st cut	No. of bales
1984	4.03	4.26		8.3	3400		
1985	4.30	4.70		9.0	3559		
1986	4.48	3.44		7.9	3215		
1987	4.70	2.47		7.2	2568	9.25	1050
1988	3.70	2.10	1.0	6.8	1480	7.50	1639
1989	4.60	3.50	1.8	9.9	2280	6.70	1482
1990	5.07	4.23	0	9.3	2209	7.76	1803
1991	3.33	3.91	0	7.2	2308	2.96	290
1992	5.56	3.32	0	8.9	3122	8.74	1060

Table 2. Forage quantity and quality at Rudy Rosedale Irrigated Alfalfa Project in 1992.

Location	Quantity of bales	Mean Weight (kg)	Protein (%)	TDN (%)	Nitrates (%)
NW 1st cut	523	481	17.20	59-61	Trace
NE 1st cut	597	452	19.93	57-59	Trace
SE 1st cut	822	467	14.63	52-54	Trace
SW oats	1060	452	8.83	51-53	0.72
NW 2nd cut	442	426	20.76	52-54	Trace
NE 2nd cut	432	454	16.60	34-41	Trace
SE 2nd cut	306	534	17.64	51-53	Trace

Table 3. 1992 bale allocation.

	Alfalfa	Oat
Mount Hope-Prairie Rose	30	---
Rudy-Rosedale	532	---
Ituna Bon Accord	270	180
Garry	150	60
Antelope Park	126	24
Maple Creek Bull Station	--	300
Fairview	150	---
Eagle Lake	120	---
Monet	180	60
Newcombe	270	120
Battle River - Cut Knife	120	---
Paynton	240	---
Auvergne - Wise Creek	---	180
Nashlyn	180	---
Oakdale	150	---
Bitter Lake	30	---
Shamrock	30	---
Big Stick	120	30
Masefield	30	---
Reno	60	---
Royal	90	---
Hillsburgh	84	36
Montrose	---	60
Wolverine	180	---
Kelvington	27	---
Total	3,169	1,050

Potassium Fertilization of Irrigated Alfalfa

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: L. Knapik (NE 01-29-08-W3); Spigott Brothers (NE 29-28-08-W3); J. Torrie (NE 11-22-07-W3); Rudy Rosedale (NE 01-31-07-W3)
Progress: Final year
Objective: To determine the response of irrigated alfalfa to potassium fertilization.

A demonstration project was established to determine the effect of potassium fertilization on irrigated alfalfa. Four sites with different soils and available potassium levels were selected (Table 1). Plots were established on three irrigated alfalfa fields in the spring of 1991 (Sites 1-3). Potassium treatments included 0, 50, 100 and 150 kg K_2O/ha surface broadcast as potassium chloride (0-0-60) and potassium sulfate (0-0-50). Potassium was applied again in the spring of 1992. A fourth site was established in 1990 on a field being established in alfalfa (Site 4). Treatments included both annual (50 and 100 kg K_2O/ha) and large once only (100, 200 and 400 kg K_2O/ha) applications of potassium chloride.

Initial soil analysis indicated a range in soil available potassium levels, however, all were considered sufficient by current soil test guidelines.

The total yield of alfalfa in 1992 was not significantly increased by the potassium applications (Table 2 and 3). As well, for Sites 1-3, the source of potassium had no significant effect on alfalfa yield. Plant analysis indicated that the potassium content of the alfalfa was increased by the potassium applications (Table 4).

Preliminary indications are that the current soil test guidelines correctly predict the potassium requirements of irrigated alfalfa.

Table 1. Irrigated alfalfa potassium fertilization demonstration site characteristics.

Site #	Legal Location	Soil Association	Surface Texture	Soil Available K (kg K_2O/ha)
1	NE 01-29-08-W3	Asquith	FSL	427
2	NE 29-28-08-W3	Asquith	SL	638
3	NE 11-22-07-W3	Fox Valley-Haverhill	L	690
4	NE 01-31-07-W3	Dune Sand	LS-S	241

Table 2. Total dry matter yield in 1992 for the irrigated alfalfa potassium fertilization demonstration (Sites 1-3).

Treatment (kg K_2O/ha)	Total Dry Matter Yield (kg/ha)					
	Site 1	CV %	Site 2	CV %	Site 3	CV %
0	7282	6.7	8981	9.8	9948	5.4
50 KCl	7259	9.9	9013	1.8	9743	6.7
50 K_2SO_4	7151	9.5	9121	4.5	9907	2.8
100 KCl	7260	8.2	8841	4.7	10405	4.7
100 K_2SO_4	7321	6.7	8896	4.6	10008	6.8
150 KCl	7339	9.3	8926	5.6	10025	6.8
150 K_2SO_4	7429	8.6	9197	5.0	9910	8.1
LSD (0.05)	NS		NS		NS	

NS - Not significant

Table 3. Total dry matter yield in 1992 for the irrigated alfalfa potassium fertilization demonstration (Site 4).

Treatment (kg K_2O/ha)	Total K_2O Applied (kg/ha)	Total Dry Matter Yield (kg/ha)	CV %
0	0	7425	7.6
50 Annual	150	7579	9.4
100 Annual	300	7392	5.1
100 Once	100	7572	7.6
200 Once	200	6638	8.4
400 Once	400	7983	18.7
LSD (0.05)		NS	

NS - Not significant

Table 4. Plant analysis for the first cut for the irrigated alfalfa potassium fertilization demonstration.

Treatment kg K_2O/ha	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
	%						ug/g				
Site 1											
0	3.57	0.31	2.42	0.30	1.80	0.45	5	89	42	16	31
50 KCl	3.53	0.34	2.79	0.34	2.05	0.51	5	82	50	19	31
50 K_2SO_4	3.56	0.30	2.58	0.31	1.84	0.44	5	58	42	17	30
100 KCl	3.73	0.30	2.70	0.28	1.67	0.40	5	57	41	17	32
100 K_2SO_4	3.46	0.28	2.57	0.30	1.74	0.43	5	84	42	16	31
150 KCl	3.54	0.30	2.80	0.30	1.77	0.42	5	61	46	14	30
150 K_2SO_4	3.53	0.31	2.81	0.32	1.81	0.43	5	63	44	24	34
Site 2											
0	3.14	0.26	2.89	0.28	1.52	0.33	6	48	22	13	28
50 KCl	3.20	0.27	3.26	0.29	1.57	0.34	6	51	24	17	27
50 K_2SO_4	3.28	0.27	2.81	0.29	1.56	0.33	6	53	23	13	27
100 KCl	3.17	0.28	3.04	0.27	1.51	0.31	5	48	24	13	23
100 K_2SO_4	3.20	0.26	2.98	0.29	1.53	0.32	6	74	22	13	28
150 KCL	3.12	0.26	3.38	--	1.49	0.32	6	50	25	14	31
150 K_2SO_4	3.16	0.25	3.17	0.29	1.51	0.32	6	73	24	14	27
Site 3											
0	4.29	0.35	2.86	0.36	1.93	0.45	5	71	46	21	30
50 KCl	4.14	0.33	3.21	0.35	1.98	0.45	5	79	47	23	32
50 K_2SO_4	4.13	0.33	3.24	0.36	1.90	0.45	5	76	42	25	34
100 KCl	4.16	0.34	2.68	0.35	1.88	0.43	5	--	46	23	34
100 K_2SO_4	4.24	0.33	3.15	0.36	2.01	0.45	6	--	55	40	32
150 KCl	4.09	0.34	3.19	0.36	1.78	0.43	5	82	46	22	30
150 K_2SO_4	4.25	0.35	3.86	0.39	1.88	0.44	5	84	46	22	27
Site 4											
0	3.44	0.40	2.35	0.39	1.60	0.35	5	62	35	22	28
50 Annual	3.53	0.38	2.47	0.35	1.64	0.35	3	62	41	21	28
100 Annual	3.39	0.35	2.80	0.34	1.48	0.30	2	66	32	32	26
100 Once	3.49	0.38	2.48	0.36	1.69	0.37	3	94	43	25	31
200 Once	3.55	0.37	2.79	0.35	1.58	0.35	2	56	36	22	29
400 Once	3.30	0.37	3.11	0.35	1.56	0.33	2	70	49	25	28

Response of Irrigated Alfalfa to Soil Incorporated Micronutrient Applications

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Irrigated Alfalfa Project (NW 01-31-07-W3)
Progress: Year two of ongoing
Objective: To determine the response of irrigated alfalfa to soil incorporated micronutrient applications.

A demonstration plot was established at the Rudy Rosedale Irrigated Alfalfa project in 1991 on an area where alfalfa was to be established. Soil analysis indicated marginal levels of copper according to current soil test guidelines. Two rates of copper and zinc (10 and 20 kg/ha) were surface broadcast and soil incorporated prior to seeding Beaver alfalfa.

There was no significant response in alfalfa yield to the residual soil incorporated copper and zinc in the year following alfalfa establishment (Table 1). Plant analysis indicated no differences in plant nutrient uptake due to the micronutrient applications (Table 2). The plant copper levels were low according to nutrient sufficiency ranges even where copper was applied. A more soluble form of copper may be required to elevate the plant copper levels into the range considered sufficient for optimum alfalfa production.

Table 1. The yield of alfalfa for the soil incorporated micronutrient demonstration plot.

Treatment (kg/ha)	Dry Matter Yield (kg/ha)					
	Cut 1 (June 22)	CV (%)	Cut 2 (Aug. 21)	CV (%)	Total	CV (%)
0	4540	17.2	4151	7.5	8691	12.6
10 Cu	4412	15.9	4126	35.0	8538	24.1
20 Cu	4307	19.8	3812	10.7	8119	15.1
10 Zn	4892	13.3	4317	11.1	9209	12.2
20 Zn	4576	4.5	4810	4.0	9387	2.9
LSD (0.05)	NS		NS		NS	

NS-Not significant

Table 2. Plant analysis for the alfalfa soil incorporated micronutrient demonstration plot.

Treatment (kg/ha)	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
	%						ug/g				
0	3.55	0.31	2.12	0.31	1.79	0.39	4	69	45	22	38
10 Cu	3.40	0.32	2.31	0.29	1.62	0.36	5	59	34	37	34
20 Cu	3.55	0.30	2.30	0.29	1.73	0.38	5	74	42	25	38
10 Zn	3.46	0.29	2.34	0.29	1.65	0.39	4	75	42	23	35
20 Zn	3.63	0.32	2.40	0.28	1.55	0.35	4	62	37	24	37

Response of Irrigated Greenfeed Oats to Nitrogen Fertilization on Alfalfa Breaking

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Irrigated Alfalfa Project (SW 01-31-07-W3)
Progress: One year only
Objective: To determine the nitrogen requirements of irrigated oats grown for greenfeed on alfalfa breaking.

In order to maintain high productivity at the Rudy Rosedale Irrigated Alfalfa Project the alfalfa must be rotated on a regular basis. Oats are generally grown for greenfeed during the rotational period. To produce maximum greenfeed yield adequate soil available nitrogen must be maintained. Previous research has indicated that the release of mineral nitrogen in the year of alfalfa breaking under irrigated conditions is generally sufficient to meet a large portion of cereal crop nitrogen requirements. Current soil test guidelines provide a nitrogen credit of 40 kg/ha for irrigated cereals on alfalfa breaking. A larger credit may be warranted. High levels of soil available nitrogen could lead to a high nitrate content of the greenfeed and/or leaching of nitrate to the water table.

A demonstration plot was established to determine the nitrogen response of irrigated oats grown for greenfeed on alfalfa breaking at Rudy Rosedale. Alfalfa was produced at this site for four years then broken in the fall of 1991. Soil analysis indicated a mean NO_3-N content of 103 kg/ha giving a nitrogen recommendation for irrigated cereal production of 45-65 kg N/ha under optimum irrigation (300-350 mm) and 0-20 kg N/ha under average irrigation (200-250 mm). Greenfeed yield showed a small but non-significant increase as the rate of nitrogen applied was increased (Table 1). Nitrogen content and uptake increased as the rate of nitrogen applied was increased.

These results indicate that the current soil test guidelines correctly predicted the nitrogen requirements for the production of greenfeed oats under average irrigation conditions on alfalfa breaking at Rudy Rosedale.

Table 1. Yield, nitrogen content and nitrogen uptake for the alfalfa breaking greenfeed oats nitrogen response experiment.

Nitrogen Application Rate (kg N/ha)	Dry Matter Yield (kg/ha)	CV %	N %	Nitrogen Uptake (kg/ha)
0	8029	8.5	1.58	127
28	8384	13.1	1.56	131
56	8766	10.3	1.76	154
112	8485	15.4	1.94	165
168	9298	4.8	1.89	176
LSD (0.05)	NS			

NS-Not significant.

Irrigated Grass-Alfalfa Mixtures for Forage Production

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Irrigated Alfalfa Project (NE 01-31-07-W3)
Progress: Third year of ongoing
Objective: To determine the yield and quality of grass-alfalfa mixtures.

A demonstration project was established in 1990 at the Rudy Rosedale Irrigated Alfalfa project to determine the yield and quality of irrigated grass-alfalfa mixtures. Yields in 1992, the second year of production after establishment, indicated that alfalfa produced a higher yield than the grass-alfalfa mixtures (Table 1). A lack of available nitrogen may have limited the yields of the grass-alfalfa mixtures. The slender wheatgrass-alfalfa mixture had a lower grass content than the other grass-alfalfa mixtures (Table 2). Quality of the grass-alfalfa mixtures was lower than that of pure alfalfa but should be adequate for maintaining breeding bulls over the winter period (Table 3).

Further monitoring of this plot is necessary to determine the long term viability of the different grass-alfalfa mixtures for irrigated forage production at the Rudy Rosedale Irrigated Alfalfa project.

Table 1. The first cut, second cut and total yearly dry matter yield for the grass-alfalfa demonstration plot.

Treatment	Dry Matter Yield (kg/ha)					
	Cut 1 June 22	CV (%)	Cut 2 Aug. 21	CV (%)	Total	CV (%)
Alfalfa	4491	6.5	4338	9.8	8830	6.7
Slender wheatgrass-alfalfa	4120	8.3	3805	17.9	7925	10.2
Intermediate wheatgrass-alfalfa	4838	8.9	3296	4.2	8134	5.8
Meadow bromegrass-alfalfa	4166	10.6	2733	14.9	6900	10.1
Bromegrass-alfalfa	5105	10.3	2084	13.3	7189	10.4
LSD (0.05)	586		574		889	

Table 2. Grass content of the grass-alfalfa treatments.

Treatment	% Grass			
	Cut 1 June 22	CV (%)	Cut 2 Aug. 21	CV (%)
Slender wheatgrass-alfalfa	38	41.5	22	9.8
Intermediate wheatgrass-alfalfa	70	21.2	30	19.9
Meadow bromegrass-alfalfa	79	11.4	39	23.3
Bromegrass-alfalfa	74	12.5	38	25.3
LSD (0.05)	18		11	

Cut	Treatment	Protein	TDN	Ca	P	NO_3	A.D. Fibre
		------------	------------	------------	%	------------	------------
1	Alfalfa	18.23	59-61	1.30	0.31	-	36.21
	Slender wheatgrass-alfalfa	17.44	59-61	1.07	0.32	-	36.42
	Intermediate wheatgrass-alfalfa	16.93	59-61	0.88	0.33	-	36.81
	Meadow bromegrass-alfalfa	13.72	54-57	0.87	0.26	-	41.01
	Bromegrass-alfalfa	12.19	51-53	0.56	0.27	-	43.77
2	Alfalfa	19.80	58-60	1.53	0.23	-	37.44
	Slender wheatgrass-alfalfa	19.38	57-59	1.34	0.27	-	38.80
	Intermediate wheatgrass-alfalfa	19.96	59-61	1.37	0.28		36.51
	Meadow bromegrass-alfalfa	17.14	57-59	1.37	0.24	-	39.13
	Bromegrass-alfalfa	17.52	60-62	1.33	0.26	-	36.00

Table 3. Forage analysis for the grass-alfalfa demonstration plot.

Improving Alfalfa Establishment under Irrigated Conditions (Year after Establishment)

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objective: To develop information which will enable producers to successfully establish alfalfa under centre pivot irrigation while obtaining maximum returns from the land base during establishment.

This test was established in 1989, 1990 and 1991 with the various cereal grain, pulse and oilseed companion crops. In 1990, two harvests of alfalfa were taken from four replicates of the test seeded in 1989, while in 1991, one harvest was taken from the test established in 1990. In 1992, two cuts of alfalfa were harvested from the test established in 1991. A second harvest could not be taken in 1991 as swathed hay remained on the plots for over three weeks creating uneven regrowth. Since the test was set up as two randomized complete block tests separate ANOVA's were run for the cereals and oilseed/pulse blocks.

Companion crops were established by planting with a hoedrill on 20 cm or 40 cm centres. Beaver alfalfa was planted at 9 kg/ha at right angles to the companion crop after the companion crop was planted.

Growing a cereal companion crop in the establishment year did not reduce first-year alfalfa yields in 1990 or 1992 but yields were reduced from 9-27% in 1991 (Table 1). Oilseed and pulse crops grown in the establishment year did not affect subsequent alfalfa yields except for the first cut in 1992. Alfalfa yields after canola were significantly lower than the control of other crops (Table 2).

Competition for light in the establishment year may not be a major yield limiting factor in subsequent crops providing moisture is adequate. It would appear that a companion crop seeded early in the season does not greatly reduce alfalfa yields the subsequent season when centre pivot irrigation is used. Therefore, the use of a companion crop must be based on the value of hay in the establishment year versus the value of the crop produced. It was found that alfalfa out competed Eston lentil grown for seed. Flax, canola, or cereal grain make satisfactory companion crops. The potential of fababean was not adequately determined by this test due to damage from blister beetles. Future work should examine date of planting of companion crops and the potential of pea, wide row canola and dwarf sunflowers as companion crops.

Table 1. Effect of cereal grain companion crops on subsequent yields of alfalfa.

Companion crop type	Treatment	Forage Yield (kg/ha dry matter) 1990 Cut 1	1990 Cut 2	1991 Cut 1	1992 Cut 1	1992 Cut 2
Durum	Sceptre 20 cm	4768	6675	3400	7652	5232
Durum	Sceptre 40 cm			3487	7428	5643
CPS	Biggar 20 cm	5307	6004	2944	7573	5529
CPS	Biggar 40 cm			3708	7324	6063
None	Beaver	5280	6971	4091	6887	5265
Soft wheat	Fielder 20 cm	4423	6042			
Barley	Winchester 20 cm	4768	6675			
CV		14.6	11.3	10.2	7.9	15.2
LSD		1024	1186	466	784	1131
Pr > F		0.32	0.52	0.01	0.31	0.54

Table 2. Effect of oilseed and pulse companion crops on subsequent alfalfa yields.

Companion crop	Treatment	Forage Yield (kg/ha dry matter) 1990 Cut 1	1990 Cut 2	1991 Cut 1	1992 Cut 1	1992 Cut 2
Fababean	Outlook 40 cm	6337	5546	4697	7432	5462
Canola	Parkland 20 cm	5568	5872	5092	6425	5290
Lentil	Eston 20 cm	6625	5578	4929	----	----
Lentil*	Indian Head 20 cm	----	----	----	7718	6052
Flax	McGregor 20 cm	6121	6247	4504	8223	5752
Alfalfa	Beaver solid	5458	5883	4816	7156	5659
CV		14.6	11.3	11.5	8.7	14.7
LSD		1353	1009	739	860	1068
Pr > F		0.32	0.58	0.53	0.006	0.63

* cut for forage, not grain

Double Cropping

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year three of four
Objective: To increase returns to irrigated land and increase the flexibility of the crop rotation by growing two crops on the same land base each season.

The yields of various crops following rye planting in the previous fall and harvested in mid June were determined over the period from 1988 to 1992. Crops varied between seasons.

Yields of rye forage were lower in 1991 than in other seasons but yields have averaged in excess of 5700 kg/ha (Table 1). The yields of sweetclover were approximately the same as rye and since sweetclover can fix its own nitrogen, this would be the preferred crop. The purpose of double cropping would be to meet the demand for hay in years of low rainfall. Sweetclover seed is low cost and thus sweetclover could be seeded with the previous season's canola crop and a hay cut taken only if prices are high. If hay prices are likely to be depressed due to abundant soil moisture in dryland hay fields, the sweetclover would be eliminated and a grain crop planted. Otherwise, the sweetclover hay crop would be followed by a lentil for forage or barley for forage or grain.

Barley can not be successfully grown after rye. The two attempts to produce barley by seeding into freshly harvested rye were unsuccessful as the barley plants did not develop any significant biomass despite the fact that barley planted in mid June yielded in excess of 12,000 kg/ha of dry matter when not planted on rye stubble.

Table 1. Rye and sweetclover dry matter yield and quality.

Crop and year	Dry matter kg/ha	SE	Protein %	TDN %
Rye 1988	5667	262	6.1	51
Rye 1990	6658	605	5.7	51
Rye 1991	4607	304		
Rye 1992	6056	367	11.8	50
Sweetclover 1991	4808	87		

Indian head lentil produced slightly greater than 2.5 t/ha of forage with a protein content of 15.5 % and a TDN of 62% in 1990 and approximately 2.0 t/ha in 1991 (Table 2).

Economically acceptable yields of lentil, canola or buckwheat have not been produced following fall rye (Table 2). I have been unable to sucessfully produce economically acceptable yields of lentil, canola or buckwheat after fall rye (Table 2). While barley grain can generally be produced by seeding after June 15, this is not an option after rye and must be demonstrated on sweetclover.

Table 2. Grain and forage yields of various crops after rye harvest in mid June for forage.

Crop type	Cultivar	Seeding method	1990 Yield kg/ha	1990 SE	1991 Yield kg/ha	1991 SE	1992 Yield kg/ha	1992 SE
Grain								
Lentil	Eston	Broadcast	574	408	---	---	---	---
Lentil	Eston	Drilled	654	231	849	92	0	---
Canola	Parkland	Broadcast	840	---	---	---	---	90
Canola	Parkland	Drilled	1425	40	1191	17	478	690
Forage								
Lentil	Indian Head	Drilled	5055	1153	4443	243	4939	1010
Turnip	Forage Star	Drilled	---				3742	787
Turnip	Rondo	Drilled	---				4187	

The return to rye/lentil double cropping of $678 ha ($271/ac) is not outstanding given the market assumptions given (Table 3). While these yields are not high, they would still provide good revenue in years of hay shortage and higher prices. Sweetclover underseeded with canola and harvested the following season (only if hay shortages are predicted) should provide excellent returns when double cropped with barley for silage or grain or lentil forage.

Table 3. Gross returns to various double cropping systems.

Crop type	Cultivar	$/ha for various double cropping systems					
		1990		1991		1992	
Grain		**Rye**	**Crop**	**Rye**	**Crop**	**Rye**	**Crop**
Lentil	Eston	366	316	253	466	333	0
Canola	Parkland	366	389	253	325	333	122
Forage							
Lentil	Indian Head	366	379	253	333	333	370

Rye forage $55/tonne, lentil forage $75/tonne, lentil grain $0.55/kg, canola $273/tonne

Seed Production of Kentucky Bluegrass

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Ongoing
Objective: To determine the effect of various management practices (burning, chemical thinning and nitrogen timing) on the yields of Kentucky bluegrass.

An excellent stand was obtained with the August 1989 seeding date. The fact that the grass had to be seeded twice in 1988 and twice in 1989 before an acceptable stand was obtained indicates that significant effort needs to be made to identify methods of improving establishment of this grass. After the stand was established, the field was divided into plots 3 m wide and 12 m long in a four replicate randomized complete block. The stand obtained by the August 1989 seeding produced very little seed in 1990 except in the tractor tracks which had created a firm seed bed and allowed the plants to develop more fully prior to winter.

Bluegrass yields in 1991 were 185 kg/ha.

In 1992, only the plots treated with Pursuit after harvest in 1991 had lower yields than the control plots. Since 1991 was the first seed production year, burning did not influence seed yields in 1992 (Table 1). The time of nitrogen application did not appear to have a major effect on seed yields. Further years of data will be required before firm recommendations can be made on fertilization. Establishment remains the major limitation in the production of this crop since there is no revenue generated during the establishment year. Companion crop type and management to provide revenue in the establishment year without reducing subsequent yields would aid in the acceptance of this crop.

Table 1. Effect of various management practices on seed yield of bluegrass.	
	Seed yield kg/ha
Treatment	1992
A Burn, 50N July, 50N Oct	438
B Burn, 50N Oct, 50N April	450
C Burn, 100N Oct	519
D Burn, 50N July, 50N Oct, 50N May	479
E Clip, 50N July, 50N Oct, 50N May	486
I Burn, 50N July, Pursuit 15g, 50N Oct	378
J Harvest alternate years 50N July, Oct, May	**
F Burn, 50N July, thin, 50N Oct, 50N May	418
Pr>F	0.059

**Not included in 1992 analysis as no yields taken. Cut for forage at the full head and allowed to regrow until late July when it was mowed and the field burned.

Non-cereal Annual Forages

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Progress: Ongoing
Objective: To determine the yields of broadleaf crops for annual forage production and complimentary grazing systems.

The yields of Indian Head lentil, Nitro annual alfalfa and Premier kale were evaluated. A randomized complete block with four replicates was used. Indian Head lentil was planted at 100 seeds/m^2 alone and at 50 seeds/m^2 with Nitro at 100 seeds/m^2. Nitro was also planted at 100 and 200 seeds/m^2 while Premier was sown at 150 seeds/m^2 alone. Kale was harvested on September 14 while all other crops were harvested August 6 and September 14.

The highest overall yield was obtained from Premier Kale (Figure 1). The TDN of this material was 65% with a protein content of 16.9% (Table 1). Kale has the potential of being stockpiled until September and grazed in a complimentary manner with dryland or irrigated perennial pastures.

The lowest yields were obtained from Indian Head lentil which in mixture with Nitro alfalfa produced the highest yields from cut 1. There was no regrowth from pure stands of Indian Head lentil. If weeds can be controlled, it should be possible to produce 7.8-9.0 t/ha of good quality alfalfa forage with alfalfa seeding rates of 200 seeds/m^2 or less. This would cost less than $24.71/ha and be similar to the cost of planting an annual grain crop. Lower seeding rates may be a possible means of improving the profitability of shorter crop rotations involving alfalfa.

Table 1. Feed quality of legumes and kale.

Crop	Harvested August 6 Protein %	T.D.N	Nitrate %	Harvested September 14 Protein %	T.D.N	Nitrate %
Premier kale				16.9	65	1.03
Nitro alfalfa 4 kg	21.5	60	.72	21.1	65	.48
Nitro alfalfa 6 kg	20.7	60	1.3	22.9	68	.76
Indian Head lentil 20 kg	21.4	63	trace	---	---	---
Indian Head lentil 10 kg	22.6	63	.68			
Nitro alfalfa 2 kg				20.5	68	trace

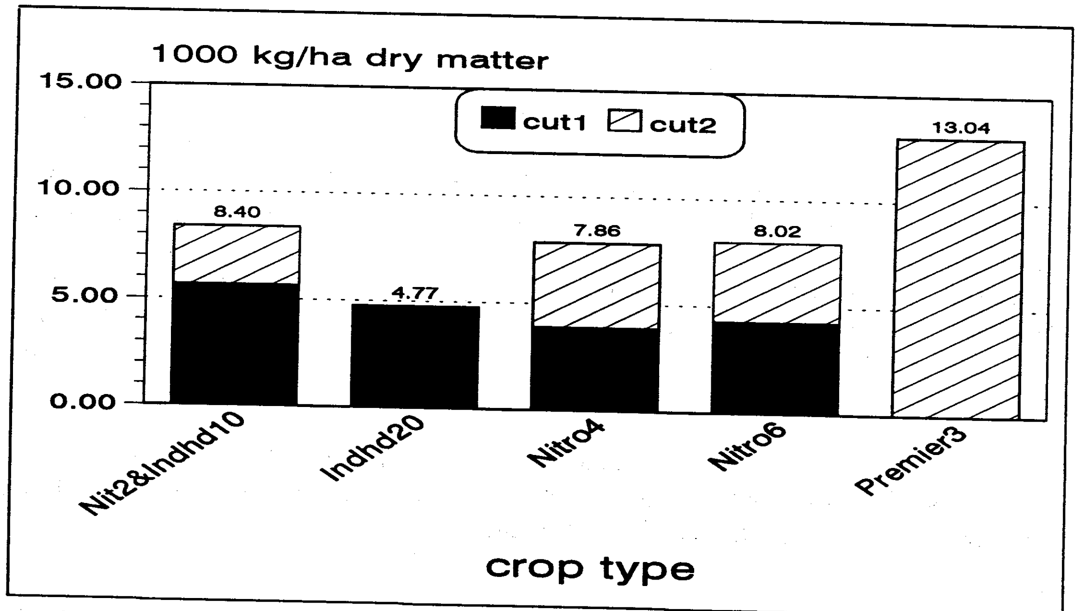


Figure 1. Annual crops for forage production Outlook 1992

Demonstration of Techniques for Producing Seed of Meadow Bromegrass

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operators: R. and M. Larson, Outlook (NW 22-29-8-W3)
Objectives:

a) To determine seed yield levels attainable with meadow bromegrass.
b) To determine the effect of time of nitrogen fertilization on seed aftermath and fall forage regrowth.
c) To determine yield and quality of hay produced on seed fields.

Meadow brome yields were lower in 1991 than in 1992 (421 vs 598 kg/ha). The reasons for this are unclear but insufficient plant numbers in year one due to the 60 cm row spacings might be responsible. The lack of a crop in the establishment year is a serious impedement to the development of the grass seed industry. Harvesting of an annual forage crop prior to planting grass or a non-competitive companion crop must be further evaluated. Meadow bromegrass produced slightly less than 8000 kg/ha of fair to good quality hay after harvest of the seed. This forage is worth approximately $370/ha. At current prices, annual returns, including the establishment year, in excess of $960/ha from the seed and $247/ha from the hay were obtained. While seed prices will likely decline, further work is warranted to improve the competitive position of irrigation seed production of this species.

1990

Prior to planting, 414 kg/ha of 11-51-0 was broadcast and incorporated. Paddock meadow brome was planted in rows 45 cm apart at 5.5 kg/ha on July 19, 1990. The field was given adequate water and broadleaf weeds were controlled with 2,4 D at 1.0 L/ha.

1991

Nitrogen had been applied in the fall of 1990 for the 1991 seed crop. Nitrogen was applied as 28-0-0 in two applications through the pivot at a rate of 112 kg/ha. Soil test results in the spring of 1991 indicated N 83, P 64, K 627 and S 105+ kg/ha. Nitrogen was applied May 14 and 15 via a center pivot irrigation system at 87 kg/ha. Nitrogen (28-0-0) was applied August 28 at 34 kg/ha. The grass seed was swathed July 19 and was ready to combine July 31. The seed was trucked to Nipawin for cleaning and a clean seed yield of 421 kg/ha was obtained. The seed was downgraded to common due to the presence of very thin wild oats which could not be removed. In addition to the seed, the aftermath yielded 3150 kg/ha of fair quality stems with limited leaf material, and 4940 kg/ha of good quality mostly leaf material.

The seed yields in the first season were somewhat lower than desirable due in part to thin stands in places. Further work on row spacing may be warranted since it may be cost effective to seed in narrower rows to increase the first year yields and then thin the stand.

1992

Nitrogen was applied at 93 kg/ha on April 21, 1992. No weed control was required. Soil moisture was monitored with tensiometers and was adequate to good during the development of the crop. The crop lodged to some extent in 1992. The crop was hauled directly to Nipawin and a clean seed yield of 598 kg/ha was obtained. Prices appear to be excellent again in 1992 with estimates as high as $3.00/kg. In addition to the seed, 7900 kg/ha of hay was obtained. The material which went through the combine was baled first and then the field cut at 5-7 cm and baled. Some of this hay has been sold at $50/tonne.

When converted to an area basis, total returns should be at least $1,235/ha for seed and $370/ha for hay. The price of meadow bromegrass seed will likely drop in the future due to increasing supplies but due to the short life span of the stand, seed prices should remain higher than smooth brome.

This stand will enter its third seed production season in 1993 and yields on dryland often decline after this time. It would be desirable to attempt to renovate the stands by mechanical or chemical means, as extending the productive life of irrigated stands by one to three years past dryland will give irrigated producers a competitive advantage. One potential method of renovation might be to apply Roundup at a sublethal dose to the entire field or in bands. This species is relatively resistant to Roundup and may regrow and regenerate. A second method of renovating stands may be to plant meadow bromegrass in rows 30 cm and after the first or second seed crop, undercut alternate rows forcing the crop to regenerate.

Fertilizing Grass Alfalfa Mixtures

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: E. Williams, Macrorie
Progress: Final year
Objective: To evaluate the yield and quality of smooth brome, meadow brome and intermediate wheatgrass grown for hay.

A demonstration project was established in 1991 to evaluate the yield and quality of grass-alfalfa mixtures for hay. Three grasses, Signal smooth bromegrass, Chief intermediate wheatgrass and Fleet meadow bromegrass were seeded (7 kg/ha) with two companion crops, Duke barley and Indian Head lentil (34 kg/ha). The companion crops were seeded on May 11, while the grasses were seeded on May 16. Seeding was delayed due to rainfall. Each grass strip was approximately 8 acres in size and ran the entire length of the field. The entire field received a pre-plant banded phosphorus application of 56 kg/ha. Nitrogen was banded at a rate of 112 kg/ha where the barley was to be seeded. Water was applied as required with a side roll irrigation system.

The barley companion crop was cut on July 13 while the Indian Head lentil was cut on July 20. Barley plus seedling alfalfa yielded 5.4 t/ha with a protein content of 14.3%. The lentil plus alfalfa mix had a yield of 4.5 t/ha with a protein content of 17.9%. A second cut yielding 1.1 t/ha was taken in late September.

In 1992, first cut from the grass strips was taken on June 23 and baled on June 27. After the first cut was baled, 146 kg/ha of P_2O_5, plus 32 kg/ha nitrogen was applied to the entire field. Half of each grass strip received an additional 84 kg/ha of nitrogen and 41 kg/ha of P_2O_5. Total yields for the year were less than 9 t/ha (Table 1). Even at first cut, grass was a small portion of the hay. The differences between the grasses were small and because of field variability, little confidence can be placed in this information.

Table 1. Grass-alfalfa yields.

	Yield t/ha	
	Cut 1	Cut 2
Meadow brome	5.4	3.5
Intermediate wheat	4.5	3.7
Smooth brome	4.3	4.2

Monitoring known gradients over time in this field might yield some interesting information verifying the competitive nature of these three grass species

Specialty Crops

Specialty Crop Development Program

Specialty Crop Demonstration Program

Other Specialty Crop Projects

Specialty Crop Development Program

Principal: J. Wahab
Saskatchewan Irrigation Development Centre

Introduction

The Specialty Crop Development Program in 1992 focussed on research mainly related to variety development and irrigated agronomic practices of dry bean, fababean, field pea, and lentil. Several minor crops such as canaryseed, coriander, lupin, fenugreek, and safflower were also studied. Relatively low temperatures during the 1992 growing season, particularly during the latter stages (refer to Meteorological Data section), delayed maturity of most of the crops. In turn, most were affected by the severe frost that occurred in August. This resulted in considerable yield reduction and even total losses for late maturing crops. The cool temperatures were, however, favourable for growth of field pea.

In general, experimental results were much more variable than those of previous years. This is largely due to the unfavourable weather conditions that promoted high incidence of disease in crops susceptible to Sclerotinia.

Agronomic Investigations

Dry Bean

Research on dry bean was designed to identify suitable genotypes from different market classes and develop agronomic practices for irrigated production and direct harvesting. The below average seasonal temperatures combined with excess precipitation resulted in a severe incidence of white mold (Sclerotinia) and other foliar diseases. Killing frosts in August caused further yield depressions. Consequently, very low yields were recorded in all dry bean tests. It is possible that the outcome of different treatments in the various tests may be confounded with the severity of diseases and frost injury. As in most northern dry bean production areas in North America, no reliable conclusions can be made with the 1992 data.

Cultivar Evaluation

SIDC continued to participate in the various Co-operative tests conducted across North America. Although yield was generally low in 1992, the early-maturing entries tended to produce higher yields than the late-maturing genotypes. Late-maturing genotypes were severely affected by the August frosts.

The Prairie Dry Bean Wide Row Co-op Test included 45 entries from seven market classes (Table 1). The pinto and pink market classes generally outperformed the other market classes tested. RNK 136, ISB 672, 88184, ISB 462, NW 63, and US 1140 were the highest yielding entries within the pinto, navy, black, pink, red Mexican, and great northern market classes, respectively. These entries tended to mature a few days earlier than the others in the respective market classes.

Table 1. Days to flower, days to mature, seed yield and average seed weight of dry bean genotypes under irrigated production - Prairie Wide-Row Co-op Test, Outlook, 1992.

Entry	Days to flower	Days to mature	Yield (kg/ha)	Seed weight (mg)
Navy				
88062	64	128	459	149
88112	64	128	1057	125
88113	64	134	867	120
88201	67	134	327	117
88206	63	134	750	119
GTS-0686	64	134	570	131
GTS-523	60	118	1146	139
HR16-818	66	134	642	137
HR40-128	63	134	682	156
ISB 565	62	128	1180	131
ISB 672	62	126	1089	141
ISB 721	62	122	1014	132
LR 91-1	63	128	802	179
RNK 103	64	134	394	126
RNK 377	65	134	703	137
Seaforth	63	132	529	133
Seaside	63	130	591	150
LS MEAN	**63**	**130**	**753**	**136**
Pinto				
Agate-II	63	134	942	228
Earliray	59	122	1412	281
ISB 82354	59	126	1141	247
ISB 84114	57	126	704	240
Othello	58	126	1091	234
RNK 101	62	128	994	222
RNK 136	55	126	1753	254
LS MEAN	**59**	**127**	**1148**	**244**
Pink				
ISB 462	57	130	1514	245
RNK 312	62	130	1095	209
Viva	57	120	1037	278
LS MEAN	**59**	**127**	**1215**	**210**
Red Mexican				
HR 42-820	61	132	551	154
NW 63	55	126	1254	247
LS MEAN	**58**	**129**	**902**	**200**
Great Northern				
RNK 523	63	134	854	196
US 1140	57	132	1147	209
LS MEAN	**60**	**133**	**1001**	**203**
Black				
88140	65	128	809	125
88184	57	118	1638	158
88190	64	130	850	114
HR 30-DC2	69	132	831	122
Loop	70	134	277	105
Panther	63	134	942	116
RNK 903	68	134	318	154
LS MEAN	**65**	**130**	**809**	**127**
Kidney				
Redkloud	57	128	1112	398
Significance	<0.01	<0.01	<0.01	<0.01
LS MEAN	61	129	899	173
C.V (%)	3.8	3.4	20.1	6.8

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: October 7, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

The Prairie Dry Bean Narrow Row Co-op Test was conducted with the objective of identifying genotypes adapted to solid seeding. Ten entries (five navy and five black) were seeded at 20 cm between row spacing compared to 60 cm conventional spacing. Sclerotinia infection combined with frost severely affected yield. All navy bean entries produced similar yields (Table 2). As in the Prairie Wide Row Co-op, the black bean 88184 outperformed all other entries in this market class under narrow-row seeding conditions.

Table 2. Days to flower, yield and average seed weight of dry bean genotypes under irrigated production - Prairie Narrow-Row Co-op Test, 1992.

Entry	Days to flower	Yield (kg/ha)	Seed weight (mg)
Navy			
HR 16-818	66	219	130
RNK 377	65	248	137
LRS 91-1	62	248	172
Seaforth	62	219	141
GTS-0686	64	255	124
Black			
Panther	62	485	118
88190	64	348	109
RNK 903	68	121	143
88184	56	691	148
88140	64	339	129
Significance	<0.01	<0.01	<0.01
LSD (5.0%)	3	138	163
C.V (%)	3.0	30.0	8.3

Plot size: 1.2 m x 3.6 m
Date of seeding: May 28, 1992
Date of harvesting: October 7, 1992
In season rainfall: 252 mm
Irrigation: 152 mm

The U.S. Dry Bean Nursery included 35 entries from different market classes (1 small white, 15 navy, 2 black, 7 pinto, 4 great northern, 2 pink, 2 dark red kidney, 2 cranberry). The pinto bean cv. Othello (Rust resistant) was the overall highest yielder (Table 3).

The U.S. Bean Modelling Nursery was grown once again at SIDC. Fleetwood (navy), UI 114 (pinto), Redkloud (Kidney), Viva (Pink), and UI 59 (great northern) beans were tested under irrigation in this project. Redkloud and UI 59 produced the highest and the lowest seed yields respectively (Table 4).

Excessive harvest loss associated with direct cut harvest systems is a major problem with pinto bean production in the Outlook irrigation district. Available commercial pinto bean cultivars have the first formed pods held closer to the ground. These pods are severed by the cutter bar during the direct harvesting operation. Over 700 dry bean genotypes of several market classes were tested at SIDC with the main objective of identifying genotypes suited for irrigated production and direct harvesting. Selections were made based on characteristics such as early maturity, erect plant architecture, and pods held relatively higher above ground level (data not presented). Several promising lines were identified and further work is being carried out at the Crop Development Centre, University of Saskatchewan.

Table 3. Days to flower, yield and average seed weight of dry bean genotypes under irrigated production - US Dry Bean Nursery, Outlook, 1992.

Entry	Days to flower	Yield (kg/ha)	Seed weight (mg)
Small White			
Aurora	62	616	113
Navy			
Fleetwood	69	521	125
ISB 486	55	599	131
ISB 565	64	855	127
ISB 672	63	900	136
ISB 721	61	876	144
Harowood	70	84	24
Centralia	57	690	206
Shetland	65	520	117
Gryphon	65	355	99
Cygnus	62	794	132
Vista	66	444	123
Crestwood	65	258	126
GTS 0786-2	64	365	137
1543	68	-	-
1551	65	370	89
Black			
Midnight	68	242	112
Harblack	68	588	131
Pinto			
UI114	58	617	230
Othello	55	632	228
Olathe	63	478	222
NW 1148	62	655	222
Othello (Rust Resist.)	55	1131	225
Arapaho	64	244	218
6315	61	628	236
Great Northern			
UI 59	62	660	199
Beryl	62	986	176
CO 1760	63	456	169
54028	62	537	197
Pink			
Viva	59	904	192
1572	55	1036	231
Dark Red Kidney			
Montcalm	61	871	409
UI 722	62	236	164
Cranberry			
Cardinal	58	494	449
Cran 09	61	943	314
Significance	<0.01	<0.01	<0.01
LSD (5.0%)	3	345	56
C.V. (%)	3.6	41.7	22.3

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: September 30, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Table 4. Days to flower, yield and average seed weight of dry bean genotypes under irrigated production - US Bean Modelling Nursery, Outlook, 1992.

Entry	Days to flower	Yield (kg/ha)	Seed weight (mg)
Fleetwood (Navy)	64	442	108
UI 114 (Pinto)	62	541	201
Redkloud (Kidney)	57	136	406
Viva (Pink)	59	714	155
UI 59 (Great Northern)	64	254	167
Significance	<0.01	<0.01	<0.01
LSD (5.0%)	4	120	22
C.V (%)	3.9	13.6	5.3

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: September 30, 1992
In season rainfall: 252 mm
Irrigation: 170 mm

Seed Source Evaluation

Growth and yield potential of Othello pinto bean from four seed sources was evaluated under irrigated conditions. Although statistically not significant, seed that originated under dryland conditions at Bounty produced the highest yield compared to seed raised under irrigation in Outlook, Fort Collins (Colorado), and the commercial source from Idaho (Table 5).

Bounty seed also appeared to produce slightly more vigorous plants than the other seed sources.

Table 5. Plant height, days to flowering, yield and average seed height of Othello pinto bean from four seed sources grown under irrigation - Test site, Outlook, 1992.

Seed Source	Plant height (cm)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
Idaho (irrigated*)	47	55	654	190
Fort Collins (irrig.)	47	56	673	190
SIDC (irrigated)	48	56	673	189
Bounty (dryland)	52	56	809	198
Significance	ns	ns	ns	ns
C.V. (%)	10.5	3.3	15.5	3.7

*Commercial seed lot
Plot size: 1.2 m x 3.6 m
Date of seeding: May 28, 1992
Date of harvesting: September 30, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Seeding Depth Study

Growth and yield characteristics of Othello pinto bean were studied for different seeding depths. Seeding at 2.5 and 5.0 cm produced significantly higher yields than 7.5 and 10 cm seeding depths (Table 6). The progressive yield reductions associated with increased depth of seeding was probably due to delayed development of plants that were seeded too deep. Seeding too deep (10 cm) resulted in a lower plant stand.

Table 6. Seeding depth effects on plant stand, days to flowering, yield and average seed weight of Othello pinto bean under irrigated production, Outlook, 1992.

Seeding depth (cm)	Plant stand (#/m^2)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
2.5	44	55	980	200
5.0	46	56	937	198
7.5	46	60	662	205
10.0	38	62	418	208
Significance	<0.05	<0.01	<0.01	ns
LSD (5.0%)	2	2	257	--
C.V. (T)	12.5	3.0	27.9	3.2

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: October 8, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Seed Priming

Seed priming is becoming a popular concept in the vegetable industry as a technique to enhance germination, produce uniform plant stands, and increase subsequent crop yields. As in 1991, Othello seed was subjected to 1, 2, and 3 cycles of alternate wetting and drying. Unlike 1991, no consistent trends were observed due to varying degrees of seed priming (Table 7). Severe disease infection followed by the frost likely masked any possible treatment effects.

Table 7. Seed priming effects on plant stand, days to flowering, yield and average seed weight of Othello pinto bean under irrigated production, Outlook, 1992.

Wetting and drying cycles	Plant stand (#/m^2)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
1	28	56	669	210
2	23	57	567	215
3	23	60	620	213
0	28	55	587	213
Significance	ns	<0.01	ns	ns
LSD (5.0%)	--	3	--	--
C.V. (T)	17.9	3.9	29.0	3.4

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: October 8, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Comparison of Different Dry Bean Rhizobium Inoculant Formulations

The effectiveness of granular and peat based inoculum were compared in this study. No significant yield differences were observed either between the different inoculum formulations or between the inoculated and the un-inoculated treatments (Table 8). It is possible that inoculation treatments were unable to express their efficacy, compared to the check treatment, due the severe frost and disease damage of the crop.

Seeding Bean into Standing Wheat Stubble

This study was conducted at SIDC under both irrigated and dryland conditions in order to study the growth and yield response of Othello bean due to (i) minimal tillage effects and (ii) the ability of the stubble to lift the pod retention height in the bean plant. The results of the irrigated and the dryland tests are summarized in Tables 9 and 10, respectively. The overall yield in the dryland test was higher than the irrigated trial as the dryland test was less affected by Sclerotinia and frost. In both studies, increase in seeding rate had a positive influence on yield which was associated with increased plant stands. Wider row spacing increased seed yield, but the differences were significant only in the irrigated study. This may be due to the fact that wider row spacing would enable better air circulation, thereby reducing the incidence of disease particularly under irrigated conditions. Seeding bean into standing stubble generally had no added yield advantage over the conventionally tilled treatment likely due to excessive trampling of stubble when using the FABRO seeder for seeding operations. This trial will be repeated using improved no-till seeding equipment.

Dry-down Study

Dry bean must be harvested at approximately 16-18% moisture in order to minimize harvest losses through shattering. As in 1991, the present study was designed to monitor the dry-down rates in the pods of Viva (pink), Beryl (great northern), Othello and Topaz (pinto) bean. The characteristic maturity stages could not be visually identified as most of the pods were affected by disease and frost. The moisture loss in the pods from all market classes studied decreased in a linear manner - Othello and Topaz (Figure 1); Beryl and Viva (Figure 2). The reduction in moisture content from 20% (slightly higher than optimum) to < 16% (less than optimum) occurred within three days for Viva and within two days for Beryl, Othello and Topaz. Due to the narrow window for optimum moisture content for bean harvesting, it is important that pod dry-down be monitored carefully to reduce harvest losses.

Fababean

Cultivar Evaluation

Eleven fababean entries were tested under irrigation in the fababean co-operative trial in 1992 (Table 11). Casper produced the lowest yield due to delayed maturity which resulted in appreciable frost damage. Casper was most resistant to lodging, whereas, Orion was most susceptible to lodging. There was no association between the degree of lodging and plant height among the different genotypes. Several entries produced considerably larger seeds compared to currently registered cultivars.

Table 8. Effect of rhizobial seed inoculum formulation on yield and average seed weight of Othello pinto bean under irrigated production, Outlook, 1992.

Inoculum formulation	Seed yield (kg/ha)	Seed weight (mg)
Granular	853	197
Peat based	721	192
No inoculum check	767	194
Significance	ns	ns
C.V. (%)	26.7	3.1

Plot size: 1.2 m x 3.6 m
Date of seeding: May 28, 1992
Date of harvesting: September 30, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Table 9. Stubble height, seeding rate, and row spacing effects on plant stand, plant height, yield and average seed weight of Othello pinto bean under irrigation, Outlook, 1992.

Treatment	Plant stand (per m row)	Plant height (cm)	Yield (kg/ ha)	Seed weight (mg)
Stubble height (cm)				
0	8.9	40	1418	229
15	9.0	39	1373	228
20	9.6	41	1025	209
25	9.8	40	1400	229
LSD (5.0%)	--	--	228	11
Row spacing (cm)				
20	8.4	40	1164	219
60	10.2	40	1445	229
LSD (5.0%)	--	--	171	--
Seeding rate (seeds/m)				
30	8.9	40	1180	229
40	9.5	40	1273	219
50	9.8	40	1460	225
LSD (5.0%)	0.7	--	109	--
Summary of ANOVA				
Factor				
Row spacing (S)	ns	ns	<0.01	ns
Stubble height (H)	ns	ns	<0.01	<0.02
Seeding rate (R)	<0.01	ns	<0.01	ns
S x R	<0.02	ns	ns	ns
S x H	ns	ns	ns	ns
H x R	ns	ns	ns	ns
S x H x R	ns	ns	ns	ns
C.V. (%)	22.0	6.6	20.5	2.9

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: October 9, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Table 10. Stubble height, seeding rate, and row spacing effects on plant stand, plant height, yield and average seed weight of Othello pinto bean on dryland, Outlook, 1992.

Treatment	Plant stand (per m row)	Plant height (cm)	Yield (kg/ha)	Seed weight (mg)
Stubble height (cm)				
0	9.3	38	1534	281
15	10.4	39	1547	281
20	10.9	37	1649	292
25	9.0	36	1545	283
LSD (5.0%)	1.3	2	--	--
Row spacing (cm)				
20	8.7	38	1467	282
60	11.1	37	1671	286
LSD (5.0%)	1.0	--	--	--
Seeding rate (seeds m^{-1})				
30	9.1	37	1418	283
40	10.0	38	1556	283
50	10.1	37	1732	286
LSD (5.0%)	1.1	--	161	--
Summary of ANOVA				
Factor				
Row spacing (S)	<0.01	ns	ns	ns
Stubble height (H)	<0.05	<0.05	ns	ns
Seeding rate (R)	<0.05	ns	<0.01	ns
S x R	ns	ns	ns	ns
S x H	ns	ns	ns	ns
H x R	ns	ns	ns	ns
S x H x R	ns	ns	ns	ns
C.V. (%)	22.0	6.6	20.5	2.9

Plot size: 1.2 m x 3.6 m
Date of seeding: May 27, 1992
Date of harvesting: September 23, 1992

In season rainfall: 252 mm
Irrigation: 0 mm

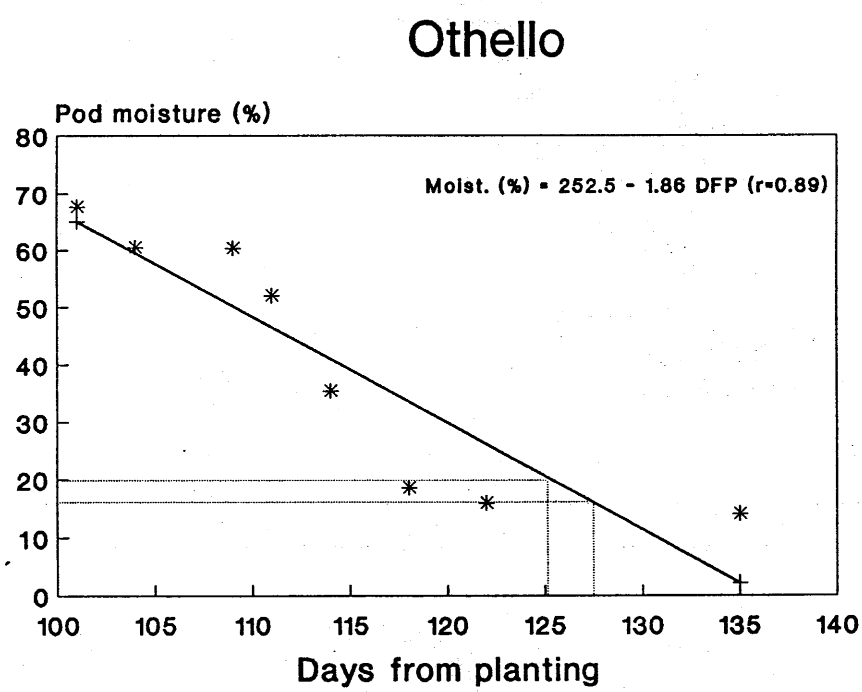
Table 11. Plant height, lodging, yield and average seed size of fababean genotypes under irrigated production - Co-op Test, Outlook, 1992.

Entry	Plant height (cm)	Lodging* (1-10)	Yield (kg/ha)	Seed weight (mg)
Aladin	155	4.3	4643	450
Outlook	147	2.3	5056	396
Pegasus	154	6.7	5630	415
Orion	133	9.7	5420	371
Casper	122	1.2	4464	493
SSNS-1 Bulk	156	2.8	5277	232
86LH08	130	7.5	5998	560
86LH10	148	4.0	5903	573
86LYL01	134	6.2	5979	587
86LYL07	139	6.7	5403	603
V88051	149	2.3	6101	365
Significance	<0.01	<0.01	ns	<0.01
LSD (5.0%)	14	2.7	1126	49
CV (%)	6.4	37.5	14.0	7.1

*Lodging rating: 1 - no lodging,
10 - 100% lodged
Plot size: 2.4 m x 3.6 m
Date of seeding: April 23, 1992

Date of harvesting: October 8, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Figure 1. Pod moisture content in Othello and Topaz beans during maturation.



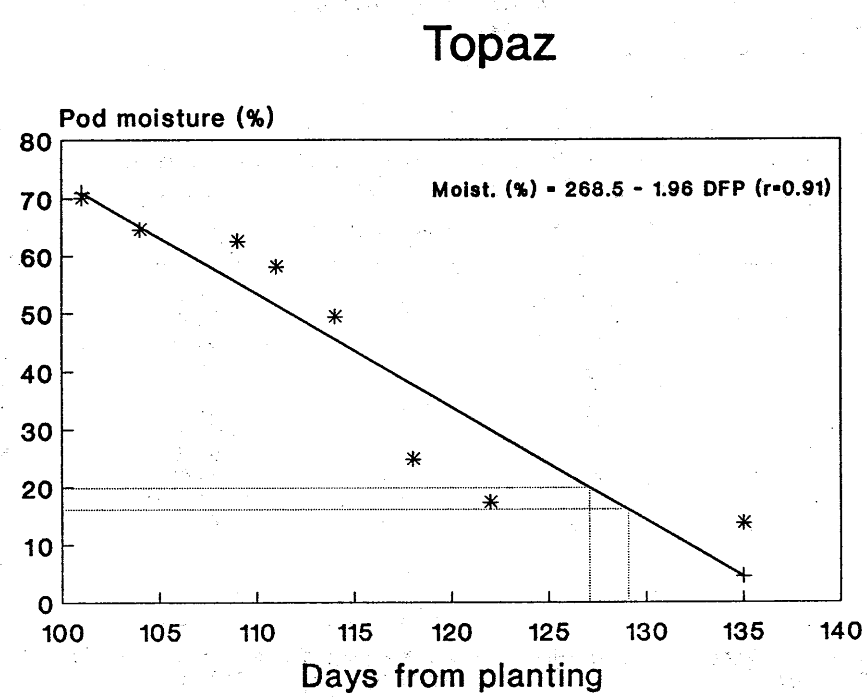
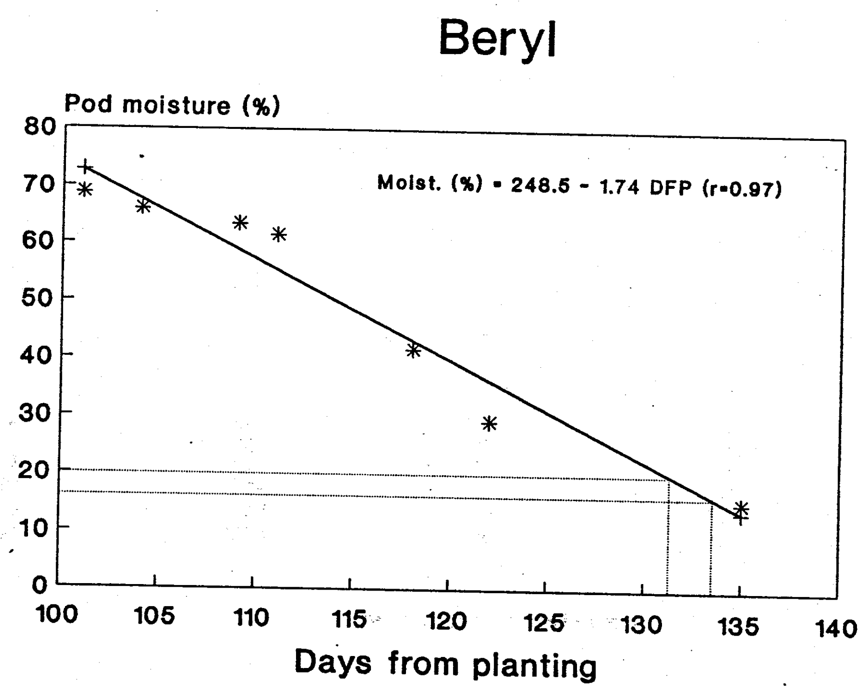
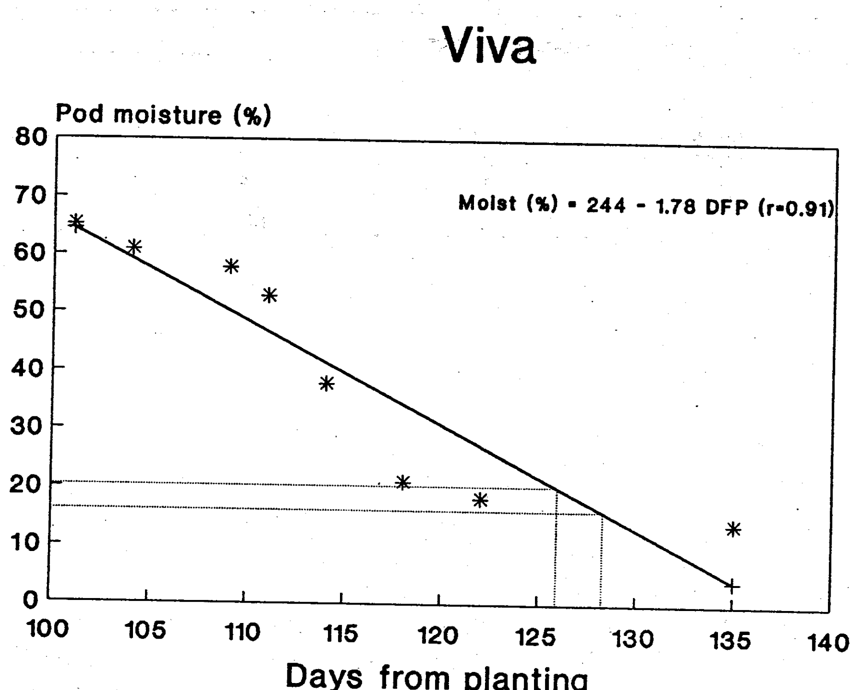


Figure 2. Pod moisture content in Beryl and Viva beans during maturation.





Irrigation Study

Growth and yield responses of six fababean entries were tested under varying moisture levels. Cultivar and irrigation main effects and their interaction were not significant for days to flowering, seed yield, and average seed weight (Table 12). Yield data were extremely variable in 1992. Increased moisture supply, however, produced taller plants.

Table 12. Effect of irrigation on plant height, days to flowering, yield and average seed weight of fababean genotypes - Outlook, 1992.

Treatment	Plant height (cm)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
		Mean effect of cultivar*		
Cultivar				
Outlook	172	61	4386	467
Chinese broadbean	156	51	3419	641
86LYL04	165	57	4832	531
86LYL08	160	55	5846	599
86SLT03	164	59	5032	474
86LH08	167	54	4392	586
LSD (5.0%)				
		Mean effect of irrigation**		
Irrigation (mm)				
30	154	57	4259	568
80	171	57	4431	520
127	157	55	4092	540
154	168	56	4361	559
179	169	55	6116	562
LSD (5.0%)	9	--	--	--
		Summary of ANOVA		
Factor				
Cultivar	<0.05	<0.01	ns	<0.01
Irrigation	<0.01	ns	ns	ns
Cultivar x Irrigation	ns	ns	ns	ns
C.V. (%)	9.6	5.6	64.1	12.7

Rainfall = 241 mm
*Average of irrigation treatments
**Average of cultivars
Plot size: 1.2 m x 3.6 m
Date of seeding: May 4, 1992
Date of harvesting: October 29, 1992
In season rainfall: 252 mm
Irrigation: as above

Starter Nitrogen Study

Fababean is seeded early in the season when soils are relatively cool. Nodule development may be relatively slow under cool soil conditions which may result in reduced nitrogen supply for early crop growth. This test was conducted to determine the influence of low level nitrogen application (15, 30 kg N/ha) at seeding on growth and yield of inoculated and uninoculated Orion seed. Neither nitrogen application nor inoculation had any significant effects on plant height, flowering date, shoot dry weight, and seed yield (Table 13). Although non-significant, application of nitrogen fertilizer and inoculation produced slightly higher seed yields compared to the control treatments.

Table 13. Effect of nitrogen applied at seeding on plant height, days to flowering, shoot dry weight, yield and average seed weight of inoculated and uninoculated Outlook fababean seed grown under irrigation - Outlook, 1992.

Treatment	Plant height (cm)	Days to flowering	Shoot dry weight/plant (g)	Yield (kg/ha)	Seed weight (mg)
Nitrogen (kg/ha)					
0	157	61	48.5	7939	339
15	159	62	50.0	9134	368
30	164	62	50.0	8897	361
Significance	ns	ns	ns	ns	0.05
LSD (5.0%)	--	--	--	--	29
Inoculation					
No	161	62	50.2	8515	353
Yes	159	62	48.1	8799	358
Significance	ns	ns	ns	ns	ns
Nitrogen x Inoculation	ns	ns	ns	ns	ns
CV (%)	9.0	2.7	22.5	16.5	6.9

Plot size 2.4 m x 3.6 m
Date of seeding: May 5, 1992
Date of harvesting: October 9, 1992

In season rainfall: 252 mm
Irrigation: 171 mm

Vegetable Broad Bean Evaluation

Seven broad bean cultivars were tested for vegetable pod production as well as seed yield. All entries produced good quality fresh bean. Greeny and Talia were the highest yielders compared to the other cultivars (Table 14). The August frost severely damaged the crop, resulting in relatively low seed yields. Further, the dry seeds were of very poor quality.

Table 14. Plant height, days to flowering, bean yield* (fresh and dry) of seven broadbean cultivars under irrigated production - Outlook, 1992.

Entry	Plant height (cm)	Days to flowering	Bean yield (kg/ha)* Fresh	Dry
Vroma	106	43	9051	3274
Danko	85	45	6306	4877
Greeny	120	53	22029	4546
Talia	114	46	15605	5420
Bianka	114	44	4977	4963
Canner	108	44	4495	3551
Major	116	43	10136	3937
Significance	<0.00	<0.00	<0.01	<0.00
LSD (5.0%)	11	2	9077	870
CV (%)	6.7	2.6	58.9	13.4

*Yield of shelled bean
Plot size: 1.2 m x 3.6 m
Date of seeding: May 12, 1992

Date of harvesting: October 29, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Field Pea

The favourable cool climatic conditions resulted in relatively high pea yields.

Cultivar Evaluation

Sixteen yellow peas and eight green peas were tested in the Prairie Field Pea Co-op Test. In the yellow category, SVE 36121, SVE 11116, SVC 61414, and CB 419 produced seed yields over 10,000 kg/ha (Table 15). Green pea entries HJA 51821, SVF 35121, and HJA 53750 also showed yield potentials in excess of 10,000 kg/ha. CB 419 (yellow) and HJA 51821 (green) are well suited for irrigated production as these entries are high yielding and relatively dwarf in plant architecture.

Table 15. Days to maturity, vine length, yield and average seed weight of field pea genotypes under irrigated production - Prairie Regional Co-op Test, Outlook, 1992.

Entry	Days to maturity	Vine length (cm)	Yield (kg/ha)	Seed weight (mg)
Yellow				
Express	118	96	9574	228
SVE 36121	114	97	10418	262
SVE 11116	115	99	10663	233
SVC 37133	112	103	8994	245
NSA 640	112	93	9568	279
4-9060	110	101	9238	291
SVC 61414	116	107	10034	326
CB 419	112	78	10175	297
SV 07323	115	110	9258	240
SVC 40143	116	135	9105	244
AC Tamor	115	76	6996	256
4-9088	111	92	9835	230
MP 1012	115	137	7108	246
L-2218	127	177	4536	204
MP-1011	115	117	6647	244
MP-1017	115	154	7126	250
Green				
Radley	114	93	9118	201
SVD 24041	119	95	8379	229
HJA 51821	115	79	10891	242
SVF 35121	112	90	10083	290
SVD 32129	115	82	9949	266
Trump	116	112	9426	252
LU-1-209	115	116	8935	280
HJA 53750	124	101	10175	256
Significance	<0.01	<0.01	<0.01	<0.01
LSD (5.0%)	3	14	1790	20
C.V. (%)	1.5	9.3	14.0	5.6

Plot size: 1.2 m x 3.6 m
Date of seeding: April 27, 1992
Date of harvesting: September 14, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Twenty-two entries were tested under irrigation in the Special Purpose Co-op Test. There were several promising early maturing relatively short, high yielding entries suited for irrigated production (Table 16).

Sixteen Austrian winter pea entries were evaluated under irrigation. Entry 4-69 was the highest yielding genotype that outperformed the highest yielding registered cultivar, Melrose, by 29% (Table 17). Line 4-69 recorded the largest seed weight.

Table 16. Days to mature, vine length and seed yield of field pea genotypes under irrigated production - Special Purpose Pea Co-op, Outlook, 1992.

Entry	Days to mature	Vine length (cm)	Seed yield (kg/ha)
Express	113	98	8306
Tara	113	147	6062
Radley	112	103	7764
TRXL22-20	124	161	5794
TAXTR-194	116	134	4904
TAXL22-27	118	144	5890
TRXL22-9	120	166	5054
BL-617	113	99	8020
PRO-8925	111	95	9861
ASCONA	111	78	8520
CEBECO-1218	112	92	8805
Impala	112	102	9701
Promar	111	93	8633
4-9061	108	86	8011
Montana	110	80	9133
SV-C-34111	109	83	6989
SV-D-32140	112	83	7493
SV-E-12226	113	104	7617
SV-C-61414	112	96	9529
Baroness	112	112	9678
BL-618	109	87	7913
Choque	116	122	9304
Significance	<0.01	<0.01	<.01
LSD (5.0%)	6	23	1267
C.V. (%)	8.9	15.1	11.4

Plot size: 1.2 m x 3.6 m
Date of seeding: April 29, 1992
Date of harvesting: August 31, 1992

In season rainfall: 252 mm
Irrigation: 171 mm

Table 17. Vine length, days to mature, yield and average seed weight of Austrian winter pea genotypes under irrigated production - Prairie Regional Co-op Test, Outlook, 1992.

Entry	Vine length (cm)	Days to mature	Yield (kg/ha)	Seed weight (mg)
Tara	131	133	4135	129
Melrose	124	133	5538	133
Common	135	124	4174	124
Glacier	137	130	2991	108
7-132	125	127	3834	136
7-94	141	130	3478	118
6-65	115	133	4802	134
6-101	112	133	5015	116
16-108	141	139	3559	127
6-09	102	130	5251	125
5-31	127	136	4019	137
5-57	104	136	5002	141
4-16	103	133	5997	142
4-94	117	133	5150	123
4-69	101	130	7155	148
6-15	127	133	4446	139
Significance	ns	ns	<0.05	ns
LSD (5.0%)	--	--	2125	--
C.V. (%)	27.8	6.0	32.4	16.9

Plot size: 1.2 m x 3.6 m
Date of seeding: April 27, 1992

Date of harvesting: September 21, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Seed Source Evaluation

Radley seed multiplied at Outlook (SIDC), Fort Collins, Colorado and a commercial seed lot were evaluated for growth and yield under irrigated conditions. The yields were relatively low due to severe Sclerotinia infection. The seed source from Outlook outperformed the other two sources, although the differences were not significant (Table 18).

Table 18. Effect of seed source on vine length, days to flowering, yield and average seed weight of Radley pea under irrigated production - Outlook, 1992.

Seed Source	Vine length (cm)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
Commercial	110	56	4513	183
Fort Collins	110	56	4085	185
SIDC (Outlook)	110	56	4677	186
Significance	ns	ns	ns	ns
CV (%)	4.5	0.9	11.6	6.0

Plot size: 1.2 m x 3.6 m
Date of seeding: May 3, 1992
Date of harvesting: September 21, 1992
In season rainfall: 252 mm
Irrigation: 152 mm

Seed Priming

Radley seed was subjected to 1, 2, and 3 cycles of alternate wetting and drying. There were no significant effects of the seed priming treatment on vine length, seed yield, or average seed weight (Table 19).

Table 19. Seed priming effects on vine length, yield and average seed weight of Radley pea under irrigated production - Outlook, 1992.

Soaking and drying cycles	Vine length (cm)	Yield (kg/ha)	Seed weight (mg)
1	135	3793	152
2	121	4135	153
3	127	4750	163
0 (control)	119	3780	168
Significance	ns	ns	ns
CV (%)	10.7	21.4	10.2

Plot size: 1.2 m x 3.6 m
Date of seeding: May 14, 1992
Date of harvesting: October 9, 1992
In season rainfall: 252 mm
Irrigation: 152 mm

Green Pea Mixture

Radley pea is more prone to lodging than the recently registered cv. Ricardo. It is believed that non-lodging pea is less affected by Sclerotinia. In this study Radley and Ricardo pea were seeded together in a mixture with the assumption Ricardo pea may prevent lodging of Radley. Seed from the two cultivars were mixed in varying proportions and were grown at two seeding rates. Ricardo in monoculture outperformed Radley in monoculture (Table 20). The yield of the seed mixtures failed to show evidence that Ricardo pea was capable of supporting Radley from lodging.

Starter Nitrogen Test

Radley pea was used in this study and the objectives were the same as for the fababean study. No significant effects were found among nitrogen treatments or between inoculation treatments (Table 21). However, increased nitrogen application caused a progressive delay in flowering.

Stand Establishment Study

As in 1991 a study was conducted to determine the effect of seeding date, seed size and fungicidal seed treatment on stand establishment and seed yield of small seeded (Express) and large seeded (Progreta) pea. The large and small seed classes were obtained by visually separating commercial seed lots from the respective cultivars. A summary of seed yield, stand establishment, and ANOVA are presented in Table 22. The non significant higher order interactions are not shown in this Table. Early seeding produced significantly higher yields despite a lower plant stand compared to late seeding dates that had a higher plant stand. Captan seed treatment did not affect seed yield of smaller seeded Express pea. However, Captan seed treatment significantly increased yields of larger seeded Progreta pea by improving plant stand compared to UBI2521-1 fungicide. For Express, large seeds produced higher yields than small seeds although the plant stands were similar in the two seed size categories. Both large and small seeds produced similar yields during early seeding(April 28). With delayed (May 11, May 25) seeding the larger seed tended to produce higher yields than the smaller seed.

Lentil

Cultivar Evaluation

Sixteen lentil genotypes were evaluated under irrigation. The yield levels were relatively low and variable (Table 23) due to severe incidence of Anthracnose and Sclerotinia.

Seed Source Study

Eston seed obtained from three sources (SIDC, Outlook; Fort Collins, Colorado; Commercial seed) were compared under irrigated conditions. There were no significant differences on growth and yield attributes among the different seed lots (Table 24).

Irrigation and Seeding Rate Effects on Lentil Genotypes

Eston, Laird, CDC Richlea, and 458-8-1 lentil were tested under several irrigation levels with increased seeding rates, i.e. 100 (commercial recommendation), 150, and 200 seed m^2 with the view of determining the influence of irrigation and seeding rate on disease incidence and yield. Higher level of moisture resulted in reduced seed yields (Table 25). Seeding rates had no significant effect on yield but results were extremely variable due to Sclerotinia infection.

Table 20. Effects of varying proportions of Radley and Ricardo field pea seed and seeding rate on yield and average seed weight - Outlook, 1992.

Treatment (% seed in mixture)			
Radley	Ricardo	Yield (kg/ha)	Seed weight (mg)
100	0	6302	184
75	25	6400	211
50	50	6968	226
25	75	6117	244
0	100	7025	308
Significance		<0.05	<0.01
LSD (5.0)		718	10
Seeding rate (seeds/m)			
80		6580	238
120		6544	230
Significance		ns	ns
C.V. (%)		10.7	9.8

Seeding rate x mixture interactions were not significant
Plot size: 2.4 m x 3.6 m
Date of seeding: April 29, 1992
Date of harvesting: August 31, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Table 21. Effect of nitrogen applied at seeding on plant height, days to flowering, shoot dry weight, yield and average seed weight of inoculated and uninoculated Radley peas under irrigated production - Outlook, 1992.

Treatment	Plant height (cm)	Days to flowering	Shoot dry weight/plant (g)	Yield (kg/ha)	Seed weight (mg)
Nitrogen (kg/ha)					
0	124	56	6.4	6515	212
15	129	58	8.2	5920	214
30	130	59	7.9	6527	214
Significance	ns	<0.01	ns	ns	ns
LSD (5.0%)	--	1	--	--	--
Inoculation					
No	130	58	7.5	6512	213
Yes	125	57	7.4	6130	214
Significance	ns	ns	ns	ns	ns
Nitrogen x Inoculation	ns	ns	ns	ns	ns
C.V. (%)	6.5	3.0	27.3	17.3	3.5

Plot size: 2.4 m x 3.6 m
Date of seeding: May 18, 1992
Date of harvesting: September 25, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Table 22. Seed size, seeding date, and seed treatment effects on plant stand and seed yield of Radley and Progreta pea under irrigated production - Outlook, 1992.

	Seed yield (kg/ha)			Plant stand (#/m)		
	Express	Progretta	Mean	Express	Progretta	Mean
Seed size						
Large	4759	4886	4823	14	12	13
Small	3985	4869	4427	13	12	13
Mean	4372	4878		14	12	
Fungicide						
UBI2521-1	4448	4676	4562	14	12	13
Captan	4145	5320	4732	14	14	14
Check	4524	4636	4580	13	11	12
Mean	4372	4878		14	12	
	Large seed	Small seed	Mean	Large seed	Small seed	Mean
Seeding date						
April 28	5943	6111	6027	12	13	12
May 11	5410	4402	4906	10	10	10
May 25	3115	2768	2942	16	15	16
Mean	4823	3327		13	12	

Summary of ANOVA

Factor	Significant	LSD (5.0%)	Significant	LSD (5.0%)
Seeding date (D)	<0.01	316	<0.01	0.9
Cultivar (C)	<0.01	258	<0.01	1.1
Seed size (S)	<0.01	258	ns	--
Fungicide (F)	ns	--	<0.01	0.9
D x C	ns	--	ns	--
D x S	<0.01	447	ns	--
D x F	ns	--	ns	--
C x S	<0.01	365	ns	--
C x F	<0.01	447	ns	--
CV (%)	16.9		20.7	

Plot size: 1.2 m x 3.6 m
Dates of seeding: as above
Dates of harvesting: September 14 and 25, 1992
In season rainfall: 252 mm
Irrigation: 171-178 mm

Table 23. Plant height, yield and average seed weight of lentil genotypes under irrigated production - Prairie Co-op Test, Outlook, 1992.

Entry	Plant height (cm)	Yield (kg/ha)	Seed weight (mg)
Eston	58	1460	31
Laird	66	1398	62
CDC Richlea	65	1503	46
VLT-15	70	593	40
ZT-4	62	659	36
Frech Green	62	1557	31
FVR-9-G	64	1353	42
89-LPR-122	69	865	29
C8-L32-AR-MM	58	1553	34
C8-L4-4R-MM	66	1045	37
PR-86-274	69	1608	56
C9-L8-AR-R	52	1377	29
C8-L27-AR-Y	63	764	45
89-73Y	63	1109	29
C8-L27-AR-R	64	1467	38
IC6002	54	1621	46
Significance	<0.01	<0.01	<0.01
LSD (5.0%)	6.1	474	4
C.V. (%)	7.2	26.7	7.1

Plot size: 1.2 m x 3.6 m
Date of seeding: May 13, 1992
Date of harvesting: September 18, 1992
In season rainfall: 252 mm
Irrigation: 76 mm

Table 24. Effect of seed source on plant height, yield and average seed weight of Eston lentil under irrigated production - Outlook, 1992.

Seed source	Plant height (cm)	Yield (kg/ha)	Seed weight (mg)
Commercial	62	2013	32
Fort Collins	62	1961	32
SIDC (Outlook)	61	1958	31
Significance	ns	ns	ns
C.V. (%)	4.3	21.2	2.6

Plot size: 1.2 m x 3.6 m
Date of seeding: May 13, 1992
Date of harvesting: September 18, 1992
In season rainfall: 252 mm
Irrigation: 102 mm

Table 25. Seeding rate and irrigation effects on days to flowering and yeild of lentil genotypes - Outlook, 1992.

Treatments	Days to flowering	Yield (kg/ha)
Cultivar		
Eston	54	802
Laird	55	796
CDC Richlea	60	650
458-8-1	61	476
LSD (5.0%)	2	127
Seed rate (seeds/m²)		
100	57	631
150	58	660
200	58	751
LSD (5.0%)	1	--
Moisture level (rainfall + irrigation)		
251	58	934
276	56	953
352	58	494
403	58	343
LSD (5.0%)	--	142
Summary of ANOVA		
Factor		
Cultivar	<0.01	<0.01
Seeding rate (R)	0.05	ns
Irrigation (I)	ns	<0.01
C x R	ns	ns
C x I	ns	ns
R x I	ns	ns
C x R x I	ns	ns
CV (%)	6.1	52.3

Plot size: 1.2 m x 3.6 m.
Date of seeding: May 13, 1992.
Date of harvesting: September 27, 1992.
In season rainfall: 252 mm.
Irrigation: as indicated above.

Seed Priming

Eston seed was subjected to 1, 2, and 3 cycles of alternate wetting and drying. The two and three cycle treatments produced superior yields, although, the differences between these treatments and the control were not significant (Table 26). The two and three cycle treatments outyielded the control treatment by approximately 15%. It is not clear why the one cycle treatment produced the lowest yield.

Starter Nitrogen Test

This test was conducted to determine the effect of low level nitrogen application at seeding in order to supply the plants with nitrogen during the early crop growth stages until the Rhizobia become fully functional. This is particularly important as lentil is seeded relatively early in the season into cool soils where the Rhizobial development may be slow. No significant effects were found on growth and yield characteristics with respect to nitrogen application and inoculation treatments (Table 27).

Table 26. Seed priming effects on plant stand, plant height, days to flowering, yield and average seed weight of Eston lentil under irrigated production - Outlook, 1992.

Wetting and drying cycles	Plant stand #/m	Plant height (cm)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
1	103	64	57	1444	29
2	89	63	57	2016	32
3	113	60	57	2065	31
0	113	61	57	1783	32
Significance	ns	ns	ns	<0.05	ns
LSD (5.0%)	--	--	--	473	--
C.V. (%)	18.6	8.9	*	16.2	6.9

Plot size: 1.2 m x 3.6 m
Date of seeding: May 13, 1992
Date of harvesting: September 18, 1992
In season rainfall: 252 mm
Irrigation: 102 mm

Table 27. Effect of nitrogen applied at seeding on plant height, days to flowering, shoot dry weight, yield and average seed weight of inoculated and uninoculated Eston lentil seed under irrigated production - Outlook, 1992.

Treatment	Plant height (cm)	Days to flowering	Shoot dry weight/plant (g)	Yield (kg/ha)	Seed weight (mg)
Nitrogen (kg/ha)					
0	68	57	9.1	772	27
15	68	57	11.7	802	28
30	68	57	12.4	755	28
Significance	ns	ns	ns	ns	ns
Inoculation					
No	68	57	11.1	752	28
Yes	68	57	11.1	800	28
Significance	ns	ns	ns	ns	ns
Nitrogen x Inoculation	ns	ns	ns	ns	ns
C.V. (%)	4.7	*	31.0	24.4	4.0

*Cannot be calculated since EMS was zero
Plot size: 2.4 m x 3.6 m
Date of seeding: May 18, 1992
Date of harvesting: September 16, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Seeding Date Study

Growth and yield attributes were studied for Eston and CDC Richlea lentil. Early seeding (April 27, May 11) produced significantly higher yields than late (May 25) seeding (Table 28). Cool temperatures during the growing season prolonged the vegetative period of the plant. Pod set was delayed. The marked yield losses in the May 25 seeding was due to frost damage of immature pods. The yield reduction was particularly severe in the relatively late maturing CDC Richlea compared to early maturing Eston.

Table 28. Seeding date effects on plant height, days to flower, yield and average seed weight of Eston and CDC Richlea lentil under irrigated production - Outlook, 1992.

Cultivar	Seeding date April 27	May 11	May 25	Mean
	Plant height (cm)			
Eston	54	52	51	53
CDC Richlea	56	63	49	56
Mean	55	57	50	
	Days to flower			
Eston	67	57	53	59
CDC Richlea	67	57	51	58
Mean	67	57	52	
	Yield (kg/ha)			
Eston	918	1082	491	831
CDC Richlea	1105	1073	262	814
Mean	1011	1078	377	
	Seed weight (mg)			
Eston	30	29	29	29
CDC Richlea	43	42	39	41
Mean	37	36	34	

Summary of ANOVA (level of significance)

Factor	Plant height	Days to flower	Yield	Seed weight
Cultivar	ns	ns	ns	ns
Seeding date	ns	ns	<0.01(159)	<0.01(2)
Cultivar x seeding date	ns	ns	<0.05(225)	ns
CV (%)	12.7	2.6	17.1	5.9

Values within parentheses are LSD at 0.05 level of significance
Plot size: 1.2 m x 3.6 m
Date of seeding: as indicated above
Date of harvesting: September 25, 1992
In season rainfall: 252 mm
Irrigation: 178 mm

Lathyrus

Cultivar Evaluation

Sixteen Lathyrus entries were tested under irrigated conditions. Cool weather and excess moisture resulted in severe disease incidence that in turn caused considerable yield reduction. Entry 850002 produced the highest seed yield (Table 29).

Irrigation Study

Yield potentials of four Lathyrus entries and Century and Tara pea were evaluated under three irrigation regimes. Increased water supply resulted in progressive decrease in seed yield and slight reduction in seed weight (Table 30). The two pea cultivars outperformed all Lathyrus lines at all irrigation levels.

Table 29. Yield of Lathyrus genotypes under irrigated production - Prairie Regional Co-op Test - Outlook, 1992.

Entry	Yield (kg/ha)
740026	699
850002	1065
850007	966
850022	856
850098	476
860296	984
860308	888
87006	962
87099	657
87064	682
87079	689
87083	809
87087	599
87089	757
87090	668
88003	596
Significance	<0.001
LSD (5.0%)	251
C.V. (%)	22.6

Plot size: 1.2 m x 3.6 m
Date of seeding: April 29, 1992
Date of harvesting: October 9, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Table 30. Irrigation effects on seed yield and average seed weight of field pea and Lathyrus genotypes - Outlook, 1992.

	Irrigation level (mm)			
Genotype	0	127	178	Mean
Seed yield (kg/ha)				
Century (pea)	2712	3105	2536	2784
Tara (pea)	3617	3835	2958	3470
X860125	677	367	273	438
L887117	1450	1260	639	1116
L887087	1071	881	285	746
LS740026	809	649	357	605
Mean	1723	1683	1174	
Seed weight (mg)				
Century - pea	135	140	158	145
Tara - pea	168	163	139	156
X860125	119	118	112	116
L887117	140	150	135	142
L887087	174	147	155	159
LS740026	126	129	136	131
Mean	143	141	139	

Summary of ANOVA

Factor	Yield	Seed weight
Irrigation	<0.01 (308)	ns
Genotype	<0.01 (435)	<0.01 (7)
Irrigation x genotype	ns	<0.05 (17)

Values within parentheses are LSD at <0.05 level of significance
Plot size: 1.2 m x 3.6 m
Date of seeding: May 14, 1992
Date of harvesting: October 9, 1992
In season rainfall: 252 mm
Irrigation: as indicated above

Coriander

Cultivar Evaluation

Coriander cultivars Autumn (late maturing) and Suzanne (early maturing) were evaluated under irrigation. The low temperatures affected overall yield. Delayed maturity of Autumn caused severe frost damage to developing capsules that resulted in total crop loss. Early maturing Suzanne produced a yield of only 400 kg/ha (Table 31).

Table 31. Plant height, days to flowering, yield and average seed weight of coriander genotypes under irrigated production - Outlook, 1992.

Entry	Plant height (cm)	Days to flowering	Yield (kg/ha)	Seed weight (mg)
Autumn	116	69	0	--
Suzanne	79	58	400	11
Significance	<0.00	*	<0.00	<0.00
LSD (5.0%)	22	*	86	1
CV (%)	33.9	*	65.3	28.2

*Denominator for F test is zero
Plot size: 1.2 m x 3.6 m
Date of seeding: April 27, 1992
Date of harvesting: September 23, 1992
In season rainfall: 252 mm
Irrigation: 171 mm

Date of Seeding Study

There was a progressive reduction in coriander (cvs. Autumn and Suzanne) yield with delay in seeding date (Table 32). May 25 seeding date produced no yield in the later maturing Autumn compared to early maturing Suzanne that produced an average yield of 1077 kg/ha. However, during early seedings, Autumn consistently outperformed Suzanne. Late seeding produced larger seeds of Suzanne but smaller seed of Autumn. As observed by plant height, delayed seeding produced vegetatively vigourous plants compared to plants for early seeding dates.

Lupin

Date of Seeding Study

Delayed planting of lupin (cvs. Progress and Ultra) progressively decreased seed yield and average seed size (Table 33). The marked yield reduction for May 25 seeding date was due to severe frost damage. Delayed seeding produced taller plants.

Safflower

Date of Seeding Study

Delayed seeding progressively decreased yield and seed size of AC Stirling and Saffire (Table 34). The yield potential of the crops seeded on May 11 and May 25 were considerably lower than that of April 27. Delayed seeding advanced the flowering date of both cultivars.

Canary Seed

Cultivar Evaluation

Six canary seed entries were tested under irrigation. There were no significant yield differences among the different genotypes (Table 35) but results were highly variable.

Table 32. Seeding date effects on plant height, days to flower, yield and average seed weight of Autumn and Suzanne Coriander under irrigated production - Outlook, 1992.

Cultivar	Seeding date: April 27	May 11	May 25	Mean
	Plant height (cm)			
Autumn	111	120	122	118
Suzanne	53	62	65	60
Mean	82	92	93	
	Days to flower			
Autumn	78	75	--	51
Suzanne	60	57	61	59
Mean	69	66	61	
	Yield (kg/ha)			
Autumn	2223	1565	--	1263
Suzanne	1576	1251	1077	1311
Mean	1899	1409	1077	
	Seed weight (mg)			
Autumn	10.3	8.0	--	6.1
Suzanne	10.8	13.6	13.1	12.5
Mean	10.6	10.8	13.1	

Summary of ANOVA (level of significance)

Factor	Plant height	Days to flower	Yield	Seed weight
Cultivar	0.00(5)	**	ns	0.00(1.8)
Seeding date	0.00(6)	**	0.00(701)	0.00(2.2)
Cultivar x seeding date	ns	ns	0.05(991)	0.00(3.1)
CV (%)	6.0	**	48.2	21.1

Values within parentheses are LSD at 0.05 level of significance
**Denominator for F test is zero
Plot size: 1.2 m x 3.6 m
Date of seeding: as indicated above
Date of harvesting: September 23, 25, and October 7, 1992
In season rainfall: 252 mm
Irrigation: 171-178 mm

Table 33. Seeding date effects on plant height, days to flower, yield and average seed weight of Progress and Ultra lupin under irrigated production - Outlook, 1992.

Cultivar	Seeding date April 27	May 11	May 25	Mean
Plant height (cm)				
Ultra	59	61	83	68
Progress	61	61	92	71
Mean	60	61	88	
Days to flower				
Ultra	59	57	64	60
Progress	59	53	57	56
Mean	59	55	61	
Yield (kg/ha)				
Ultra	1706	1536	343	1195
Progress	1557	1278	385	1073
Mean	1631	1407	364	
Seed weight (mg)				
Ultra	261	219	135	206
Progress	243	201	134	193
Mean	252	210	134	

Summary of ANOVA (level of significance)

Factor	Plant height	Days to flower	Yield	Seed weight
Cultivar	NS	<0.05(3)	ns	<0.01(7)
Seeding date	<0.01(6)	ns	<0.01(269)	<0.01(8)
Cultivar x seeding date	ns	ns	ns	ns
C.V. (%)	7.5	6.1	21.0	3.7

Plot size: 1.2 m x 3.6 m
Date of seeding: as indicated above
Date of harvesting: October 29, 1992
In season rainfall: 252 mm
Irrigation: 171-178 mm

Table 34. Seeding date effects on plant height, days to flower, yield and average seed weight of Saffire and AC Stirling safflower under irrigated production - Outlook, 1992.

Cultivar	Seeding date: April 27	May 11	May 25	Mean
	Plant height (cm)			
Saffire	86	82	89	86
AC Stirling	88	84	88	86
Mean	87	83	88	
	Days to flower			
Saffire	101	95	85	94
AC Stirling	103	98	85	95
Mean	102	96	85	
	Yield (kg/ha)			
Saffire	1018	506	112	546
AC Stirling	1376	447	22	615
Mean	1197	477	68	
	Seed weight (mg)			
Saffire	22	16	13	17
AC Stirling	24	17	11	17
Mean	23	16	12	

Summary of ANOVA (level of significance)

Factor	Plant height	Days to flower	Yield	Seed weight
Cultivar	ns	<0.00(0.6)	ns	ns
Seeding date	ns	<0.00(0.7)	<0.00(269)	<0.00(1.6)
Cultivar x seeding date	ns	<0.00(1.0)	ns	<0.05(2.1)
CV (%)	16.8	2.2	40.9	8.1

Values within parentheses are LSD at 0.05 level of significance
Plot size: 1.2 m x 3.6 m
Date of seeding: as indicated above

Date of harvesting: October 19, 1992
In season rainfall: 252 mm
Irrigation: 171-178 mm

Table 35. Yield of canary seed genotypes under irrigated production - Outlook, 1992.

Genotype	Seed yield (kg/ha)
NC123-2	1728
NC123-3	1723
NC123-5	1702
NC123-8	1437
NC123-9	1565
NC123-10	1217
Significance	ns
CV (%)	17.7

Plot size: 1.2 m x 3.6 m
Date of seeding: May 1992
Date of harvesting: October 19, 1992

In season rainfall: 252 mm
Irrigation: 170 mm

Specialty Crop Demonstration Program

Principals: A. Kapiniak, J. Wahab
Saskatchewan Irrigation Development Centre

Irrigated Pinto Bean Seed Source Comparison: Idaho vs. Saskatchewan (dryland)

Co-operators: M. Purcell, K. Carlson, A. Hamer
Locations: Pike Lake, Broderick, Central Butte
Objective: To evaluate the performance of pinto bean seed produced under dryland conditions in south-central Saskatchewan, compared to seed imported from Idaho.

Currently, seed for pinto bean production in Saskatchewan is imported from the USA (mainly Idaho). Importing seed is risky in terms of introducing new weeds and diseases. It is also costly. These risks and costs could be reduced if pinto bean seed was produced in the arid environment of south-central Saskatchewan.

A demonstration project was designed to compare the agronomic performance of pinto bean seed produced in Saskatchewan, under dryland conditions, to pinto bean seed imported from Idaho. Comparisons were made in the brown and dark brown soil climatic zones at three irrigated fields.

Cooler than normal temperatures throughout the growing season retarded plant development. Thus, most of the seeds were immature when the first frost occurred. Frost damage was severe enough at two of the demonstration fields that crop insurance adjusters declared the crop a 100% loss. These fields were not harvested. Results from the field near Central Butte are summarized in Table 1.

In addition to slow plant development due to cool temperatures, the very low average potential yield is due to extreme competition from volunteer wheat and weeds. Most of the dockage was wheat and weed seeds. Seed weight was considerably smaller than the 350 g/1000 seeds average from the three previous growing seasons.

Due to the problems previously mentioned, results are inconclusive. Further field scale testing is necessary to determine the agronomic performance of pinto bean seed produced under dryland conditions in south-central Saskatchewan.

Table 1. Seed source, average yield, dockage, and seed weight of irrigated pinto bean produced near Central Butte in 1992.

Seed source	Average yield		Dockage	Seed weight
	Potential (kg/ha)	Net (kg/ha)	(%)	(g/1000)
Saskatchewan	339	150	49.6	186
Idaho	383	194	52.5	183

Irrigated Pinto Bean Seeding Equipment Comparison

Co-operators: B. Davison and M. Kasper
Locations: Outlook and Broderick
Objective: To evaluate the effect of seeding equipment on the agronomic performance of irrigated pinto bean in south-central Saskatchewan.

For the past several years, grain drills have been used to seed irrigated pinto bean in Saskatchewan. In some cases, seeds are not metered uniformly, leaving gaps within rows where weeds can grow without competition. Also, the plants that are bunched together compete for light, nutrients, and water. Plants that are spaced more uniformly within rows may utilize resources more efficiently. In many dry bean production areas, corn planters are adapted for seeding beans. If corn planters meter bean seeds more uniformly than grain drills, pinto bean producers in Saskatchewan may be at a disadvantage. A one year field scale demonstration comparing a John Deere Flexi-71 corn planter and John Deere 9000 series grain drill, was conducted on two irrigated fields in 1992.

Stand counts were very similar for the two types of seeders at both sites (Table 1). Based on visual observations, seeding uniformity within rows was not different in strips seeded with the grain drill compared to strips seeded with the Flexi-71 planter. Overall yields were extremely low due to much cooler than normal temperatures throughout the growing season. Frost ocurred in late August. At one site, sclerotinia reduced yield potential. Statistically, yield differences between strips seeded with a grain drill and strips seeded with the Flexi-71 planter were not significant.

Grain drills with metering systems capable of handling large seeds appear to be comparable to corn planters for seeding pinto bean crops, provided the rate of travel does not exceed 6.4 km/h (4 mph). Any future evaluations of this kind should use a precision seeder to maximize potential treatment effects.

Table 1. Average yield, stand count, and seed size of irrigated pinto bean seeded with two types of seeding equipment at Outlook and Broderick, Saskatchewan in 1992.

Site	Seeder	Average yield: Potential (kg/ha)	Average yield: Net (kg/ha)	Stand count (plants/m^2)	Seed weight (g/1000)
Outlook	Grain drill	473	214	25	203
	Flexi-71	416	157	22	197
Broderick	Grain drill	1187	280	22	234
	Flexi-71	1118	211	23	229

Irrigated Pinto Bean Agronomy: N Application Timing

Co-operator: J. Konst
Location: Outlook
Objective: To evaluate the effect of N application timing on irrigated pinto bean in south-central Saskatchewan.

Field scale demonstration results have shown that irrigated pinto bean respond positively to additional nitrogen fertilizer in fields testing low in available N. Many of the irrigated fields in south-central Saskatchewan have sandy loam soils in which nitrogen may readily be leached out of the crop root zone. Applied N fertilizer may be more efficiently utilized by irrigated pinto bean if applied during the vegetative stage.

A one year field scale demonstration was conducted in 1992 to determine the optimum growth stage of irrigated pinto bean for applying N fertilizer to obtain the most efficient use of applied N. This demonstration involved four treatments (see Table 1).

Cool weather caused soil temperatures to remain cold in the spring which affected the germination of pinto bean seeds. The targeted stand count of 25 to 30 plants/m^2 was not achieved. Overall potential yield was low due to cool weather throughout the growing season and an earlier than normal frost on August 25. Seed size was considerably smaller than the average of 350 g/1000 seeds.

Strips of irrigated pinto bean that received split applications of N fertilizer (treatment 3) produced the highest yield, but were not significantly higher than the other treatment strips. These results are inconclusive.

Table 1. Results from a field scale demonstration that evaluated the effect of nitrogen application timing on yield of irrigated pinto bean at Outlook, Saskatchewan in 1992.

Treatment	Nitrogen rate (kg/ha)	Average yield		Stand count (plants/m^2)	Seed weight (g/1000)
		Potential (kg/ha)	Net (kg/ha)		
1. Preseeding	45	542	165	12	224
2. Vegetative	45	514	137	15	235
3. Preseeding & Vegetative	45	590	213	17	232
4. None	0	539	162	13	223

Irrigated Fababean Agronomy: Row Spacing Evaluation

Co-operators: L. Lee, R. Pederson, and L. Ward
Locations: Macrorie, Outlook, and Birsay
Objective: To evaluate the effect of row spacing on the agronomic performance of irrigated fababean in south-central Saskatchewan.

By seeding irrigated fababean at wide row spacings, the crop canopy will close later in the season. This may delay disease development. Higher yields may result. Research results at SIDC showed no significant difference in yield of irrigated fababean when row spacings were increased from 20 cm to 30 or 40 cm.

Wide row spacing was evaluated in a field scale demonstration involving three irrigated fields in south-central Saskatchewan. Plant characteristic data were averaged from all three sites (Table 1). Statistical analysis revealed that except for plant height, plant characteristic differences due to row spacing treatments were not significant (Table 2).

Due to unfavourable harvest weather, only one of the three sites was harvested. Test swaths remaining in the field at the remaining sites may be harvested in the spring. Yield results at the Lee site were 3233, 3023, and 3067 kg/ha for row spacings of 15, 30, and 45 cm respectively. Statistically, the differences among yields are not significant. Results are incomplete. Therefore, no conclusions can be drawn regarding row spacing effects for irrigated fababean under commercial production conditions.

Table 1. Average population and physical characteristics of irrigated fababean plants seeded at three different row spacings in 1992.

Row* spacing (cm)	Stand count (plants/m^2)	Plant height (cm)	Height to first pod (cm)	Number of podded nodes per plant	Number of pods per plant
15-18	27	154	39	17	32
30-36	26	155	41	17	32
45-53	24	154	39	18	35

*Range over three sites. All plant measurements are mean of three sites.

Table 2. Average population and physical characteristics of fababean plants from three irrigated fields in south-central Saskatchewan.

Site	Stand count (plants/m^2)	Plant height (cm)	Height to first pod (cm)	Number of podded nodes per plant	Number of pods per plant
Lee	25	160	40	17	34
Pederson	23	156	41	20	35
Ward	28	146 a	37	15	30

Irrigated Fababean Agronomy: Seeding Rate Evaluation

Co-operators: K. Carlson and J. Kasper
Locations: North of Broderick and East of Broderick
Objective: To evaluate the effect of seeding rate on the agronomic performance of irrigated fababean in south-central Saskatchewan.

Research results over three years at SIDC showed that seeding rates for irrigated fababean may be reduced up to 50% of the currently recommended 40 seeds/m² without significantly reducing yield. Reduced seeding rate may be a method of reducing the cost of fababean production under irrigation. A demonstration designed to test seeding rates on a field scale was conducted near Broderick, Saskatchewan in 1992.

Fababean was seeded into three four hectare strips, one for each of the targeted plant populations of 20, 30, and 40 plants/m². Two irrigated fields were involved. Targeted plant populations were not achieved on all strips (Table 1). Two possible reasons for the lower than targeted plant populations are: calibration problems with the seeding equipment, and seeds rotting in cold soil before germination.

Plant characteristic differences among seeding rate treatments (Table 1) were not significant. Fababean plants at the Carlson site were 10 cm taller, with seven more podded nodes, and 15 more pods per plant than plants at the Kasper site. Compensation among yield components was evident from the increase in number of podded nodes and pods per plant at the site with the lower plant population density. These differences are statistically significant. The effect that the plant characteristic differences may have had on yield are not known. Yield data could not be collected because cool wet weather plagued the 1992 harvest season. Swaths did not dry sufficiently for combining before the snow covered them. It may be possible to harvest test swaths in the spring for yield data.

Based on numerous inquires about results from this demonstration, it should be repeated in a year with more co-operative weather.

Table 1. Stand counts and physical characteristics of irrigated fababean plants from two fields near Broderick, Saskatchewan.

Site	Target stand (plants/m²)	Actual stand (plants/m²)	Plant height (cm)	Height to 1st pod (cm)	Number of podded nodes per plant	Number of pods per plant
Carlson	20	11	146	22	25	45
	30	14	148	21	25	48
	40	18	149	23	23	43
Kasper	20	18	136	27	16	27
	30	30	138	23	19	36
	40	26	138	27	17	29

Irrigated Field Pea Agronomy: Inoculant Comparison

Co-operators: L. Bagshaw, R. Duncan, G. McNeill, L. Sjovold
Locations: Birsay, Outlook, Broderick, Outlook
Objective: To evaluate the performance of a new strain of rhizobium for field pea, on a commercial field scale, under irrigated conditions in Saskatchewan.

Field pea can benefit from atmospheric nitrogen, provided Rhizobia infect the plant roots and form nodules. To ensure that the correct strain of Rhizobium is available in adequate concentrations, pea seeds are inoculated with Rhizobia prior to seeding. A new strain of Rhizobium for pea was identified by Dr. Chris van Kessel at the University of Saskatchewan. According to van Kessel, the new strain appears to be superior to commercially available strains, but all testing was done on small plots.

The new strain (C-1) was compared to a commercial strain (C), on a field scale demonstration in 1992. Control strips that received uninoculated seed were also compared. Four irrigated fields, two for Express pea and two for Radley pea, were involved.

Results from the individual fields are summarized in Tables 1 and 2. Analysis of yield data, combined from the four sites, indicates a trend. Based on yields, treatments ranked from highest to lowest as follows: C, C-1, and control. However, the yield differences were not statistically significant.

Further analysis of the combined data shows that inoculated seed outyielded uninoculated seed by 915 kg/ha (814 lb/ac). Even though this difference is not statistically significant, it is economically significant. Assuming $183/tonne ($5/bu), gross returns would be increased by $167.45/ha ($67.79/ac) due to inoculating the seed. Inoculation costs of $4.95 to $7.40/ha ($2 to $3/ac) would be recovered by a yield increase of only 67 kg/ha (1 bu/ac). Values may not be this dramatic on every field or every year, but in most situations, inoculating pea seed will result in additional returns.

Based on results from this demonstration, the strain of Rhizobium (C or C-1) used is not as important as ensuring that seeds are inoculated.

Table 1. Results from a field scale demonstration comparing two types of inoculant on Express pea under irrigation in Saskatchewan.

Site	Inoculant treatment	Average yield: Potential (kg/ha)	Average yield: Net (kg/ha)	Seed weight (g/1000)	Indigenous rhizobia (#/g soil)
Bagshaw	C	5905	5486	213	10
	C-1	5742	5323	209	
	Control	4020*	2075*	256*	
Duncan	C	4496	3874	207	0
	C-1	4462	3840	216	
	Control	4176	3554	217	

*Significantly different at P=0.05 level.

Table 2. Results from a field scale demonstration comparing two types of inoculant on Radley pea under irrigation in Saskatchewan.

Site	Inoculant treatment	Average yield: Potential (kg/ha)	Average yield: Net (kg/ha)	Seed weight (g/1000)	Indigenous rhizobia (#/g soil)
McNeill	C	5030	4602	199	2.8×10^4
	C-1	4604	4176	187	
	Control	4567	4141	196	
Sjovold	C	3796	3604	157	1.0×10^3
	C-1	3806	3614	159	
	Control	4021	3829	157	

Vegetable Cultivar Testing Program

Principal: D.R. Waterer, Department of Horticulture Science
Funding: Agriculture Development Fund
Location: Cudworth, Saskatoon and Saskatchewan Irrigation Development Centre, Outlook
Progress: 1992 trials completed
Objective: Vegetable cultivar trials were conducted by the Department of Horticulture Science to supply information regarding cultivar performance under local growing conditions. The cultivars tested are ones which performed well in previous trials, ones recommended by other provinces, and ones recommended by seed companies as suitable to our area. The results are distributed as an aid to commercial and hobby growers in selecting improved vegetable cultivars. Each year, several crops are tested.

The 1992 trials were supported by the Agriculture Development Fund of Saskatchewan Agriculture and Food.

Growing conditions during the 1992 crop season were generally cool and cloudy, with late spring and early fall frosts. Averaged over the growing season, the mean daily temperature was 1°C cooler than normal, while sunshine hours were 20% below normal. Mid-season rainfall was sparse which reduced yields at the rainfed Cudworth site.

Crop production and pest control measures generally followed recommended practices. Soil fertility levels were adjusted according to the recommendations outlined in the Horticulture Science Publication: "Vegetable Crop Fertility Schedules" (ERDA Publications No. 88-3). All crops received a mid-season application of nitrogen either through the irrigation system or via side-dressing. Overhead or drip irrigation was used to maintain adequate soil moisture levels throughout the growing season at both the Outlook and Saskatoon sites. The Cudworth site was largely rainfed, although some supplemental irrigation was applied to aid in establishment of the cucumbers and melons.

All but the vine crops were planted in twin rows using recommended in and between row spacings. Rows were 9 m in length and data was collected from the centre of each plot. The vine crops were grown as single, 10 m long rows. The cabbage, lettuce, corn, carrots and onions were direct seeded, using a Planet Jr. type seeder. The carrots were sown as twin rows on raised beds. The cucumbers were seeded by hand. Transplants were used to produce the storage cabbage, melons, watermelon and pumpkins.

The watermelons and cucumbers were grown on black plastic soil mulch. The watermelons were protected by clear polyethylene tunnels in the spring and Agryl P-17 field covers through the summer and fall. The muskmelons and watermelons were grown on clear soil mulch and covered with Agryl P-17 or P-30 field covers for the majority of the growing season.

Cool growing conditions and low insect pest levels resulted in good yields and quality of the cool season crops such as cabbage, lettuce, carrots and onions. At the rainfed Cudworth site, the lower than average rainfall combined with weed pressure reduced yields of several of the cool season crops. The cool weather caused uneven germination, slow growth, poor fruit set and low quality in most of the warm season crops tested.

Late spring and early fall frosts cut short the growing season at Cudworth and Outlook, while the Saskatoon site had an average number of frost free days. Fall harvest conditions were good.

Summary and Cultivar Recommendations

Direct Seeded Cabbage

Cool growing conditions and low insect numbers combined to produce excellent cabbage crops at all test sites, although the early fall frost reduced yields of some late maturing varieties. For the early market (less than 110 days) Balbro (Stokes), Copenhagen Market (Alberta Nurseries) and Polar Green (Stokes) are recommended for their high yields, uniform maturity and quality. For mid-season use, (110-130 days) Multikeeper (Stokes) was outstanding. For growers interested in a variety with more variability in size and maturity date, Titanic is recommended. For late season and storage use, (> 130 days) a number of high yielding, high density cultivars are available i.e. Bartolo (Seedway), Masada (Bejo Zaden) and Lennox (Seedway).

Transplanted Storage Cabbage

Using transplants increased yields by 30-50% but only shortened time to maturity by 5-10 days relative to direct seeding the same varieties. The transplanted crop was considerably more uniform in size and maturity than the seeded crop. All varieties tested as transplants performed well, with Lennox (Seedway) and Masada (Bejo Zaden) producing excellent yields of high quality heads.

Carrots

Conditions for establishment and growth of carrots were generally favourable during 1992, although weeds reduced yields at the Saskatoon site. Narova (Stokes) was outstanding as a high yielding, good tasting Nantes type. Of the Imperator types tested, FMX 350 (Ferrymorse) and A-Plus (Liberty) performed well. For Danvers type carrots, Danvers 126 (Agway) and Karaman (Seedway) are recommended.

Bibb Lettuce

Although conditions were generally favourable for lettuce in 1992, the varieties tested performed quite differently at the various test sites and planting dates. Mantilla (Peto Seeds) combined earliness with good yields, while Summer Bibb (Abbot & Cobb) produced a high quality, slow maturing crop. Sangria (Stokes) featured an attractive red exterior and green interior.

Onion

The onion test plot at Cudworth was lost due to combined weed pressure and drought. Weed pressure also slowed maturity and reduced yields in Outlook. For the third year running Yula (Stokes) ranked as the best variety, with a combination of early maturity, high yields and good bulb quality. Unfortunately, Yula did not store well in the 1991-1992 trial (see next section). Daytona (Peto Seeds), Norstar (Stokes) and Spartan Banner (William Dam Seeds) also performed well. Tango (Abbott and Cobb) was the best red onion tested.

Onion Storage Trial

In this trial, the onion cultivars grown in 1991 were tested for weight loss, scale adherence, color retention and sprouting over eight months cold storage. A number of varieties, including Benchmark (Asgrow), Bingo (Stokes), Sweet Sandwich (Stokes) and Tauris (Asgrow) came through extended storage in very good condition. Yula, which was the highest yielding variety in both 1991 and 1992, did not store well.

Direct Seeded Cucumber

The short, cool growing season resulted in poor yields and high percentages of misshapen fruit for all varieties tested. Jazzer (Stokes) and Seedway (Stokes) were the best slicing types tested while Fancipak (Asgrow) was the best pickling type.

Sweet Corn

The 1992 growing season was disastrous for corn. Less than 20% of the varieties tested matured before fall frost and the quality of the harvested crop was poor. Of the regular types (Su), Quickie produced good yields. Two new sugar enhanced (Se) lines from Seneca Hybrids (Seneca RXY6703 + RXY6402) produced good yields of high quality cobs. Northern Supersweet was the only supersweet type to mature prior to frost.

Muskmelon

Yields and quality of melons were generally poor due to the short, cool growing season. None of the melons planted at Outlook and Cudworth matured prior to frost. Earligold (Seedway) continues as the variety of choice, producing good yields of high quality fruit despite the season. Sweet Granite (Johnny's) is recommended as a very early type. Passport (Johnny's) is a high yielding, early, green flesh type. None of the other Crenshaw or Honeydew types tested could be recommended

Pumpkin

Despite the growing season, maturity, yields and quality of the pumpkins tested were generally good. Of the carving types, Spirit Hybrid (Alberta Nursery) was easily the best, combining very high yields with uniform size and shape. Autumn Gold (Liberty) was an attractive orange throughout the season. Both pie types tested, Baby Bear (Johnny's) and Small Sugar (Alberta Nursery) produced well.

Watermelon

By using clear polyethylene tunnels early in the season and field covers later in the year, a good crop of mature watermelons was produced, despite the poor growing season. Sweet Favorite (Dominion) was the best red fleshed type, producing high yields of large, sweet fruit. Gold Baby (Alberta Nurseries) was the best yellow fleshed type, although the fruit tended to split if handled roughly.

Soil Moisture Monitoring of Sprinkler Irrigated Fababean and Dry Bean

Principal:	T. Hogg and J. Wahab, Saskatchewan Irrigation Development Centre
Location:	Saskatchewan Irrigation Development Centre (SW15-29-08-W3)
Progress:	Final year
Objective:	To determine the soil moisture change, total water use and water uptake from different soil depths for sprinkler irrigated fababean and dry bean.

Soil moisture change, total water use and water uptake from different soil depths were monitored in an irrigation response experiment established by the Specialty Crops Program at SIDC in 1990, 1991 and 1992. Moisture gradients ranging from dry to full irrigation were established under a linear sprinkler irrigation system. Soil moisture monitoring was conducted at approximately two week intervals throughout the growing season with a neutron moisture meter.

The total water use of sprinkler irrigated fababean (Table 1) and dry bean (Table 2) increased with increasing water application in all three years. Total water use was greater in 1991 than in either 1990 or 1992. Excess precipitation in June of 1991 possibly caused leaching losses below the zone of measurement resulting in an over estimation of water uptake. Fababean had a greater water use than dry bean.

Water uptake decreased with increasing depth in the soil for both fababean (Table 3) and dry bean (Table 4). Water uptake from the 0-30 cm depth was significantly greater than from the other depths for both fababean and dry bean. As well, water uptake from the 30-60 cm depth was significantly greater than from the two lower depths. For fababean, water uptake from the 0-30 cm depth was generally greater for the wetter treatments (Table 3). However, there was no significant effect of irrigation treatment or treatment by depth interaction on water uptake. The wetter treatments maintained a higher soil moisture content in the 0-30 cm depth interval and thus a larger percentage water uptake occurred from this depth.

Table 1. Moisture budget for the sprinkler irrigated fababean irrigation response experiment conducted in 1990, 1991 and 1992.

Year	Water Treatment	Rainfall	Irrigation	Growing Season Soil Moisture Change	Total Water Use
		(mm)			
1990	Dry	231	0	60	291
	P1	231	28	74	333
	P2	231	78	61	370
	P3	231	123	49	403
	Full	231	167	34	432
	LSD(0.05)			NS	29
1991	Dry	297	0	137	434
	P1	297	25	140	462
	P2	297	76	141	516
	P3	297	102	122	523
	Full	297	140	99	538
	LSD(0.05)			19	21
1992	Dry	241	30	71	342
	P1	241	80	34	355
	P2	241	127	19	387
	P3	241	154	12	407
	Full	241	179	15	434
	LSD(0.05)			NS	41

NS-Not significant

Table 2. Moisture budget for the sprinkler irrigated dry bean irrigation response experiment conducted in 1990, 1991 and 1992.

Year	Water Treatment	Rainfall	Irrigation	Growing Season Soil Moisture Change	Total Water Use
		(mm)			
1990	Dry	202	0	73	275
	P1	202	22	64	288
	P2	202	61	50	313
	P3	202	108	38	348
	Full	202	160	24	386
	LSD(0.05)			11	23
1991	Dry	242	0	74	316
	P1	242	25	61	328
	P2	242	51	63	356
	P3	242	76	64	382
	Full	242	102	54	398
	LSD(0.05)			11	11
1992	Dry	201	22	12	235
	P1	201	66	10	277
	P2	201	126	2	329
	P3	201	126	5	332
	Full	201	151	1	353
	LSD(0.05)			NS	21

NS-Not significant

Table 3. Water uptake from different depths for the sprinkler irrigated fababean irrigatioon reponse experiments conducted in 1990, 1991 and 1992.

Year	Water Treatment	% Water Uptake			
		0-30 cm	30-60 cm	60-90 cm	90-120 cm
1990	Dry	57	26	12	5
	P1	64	24	7	5
	P2	63	21	9	7
	P3	68	17	7	8
	Full	71	14	7	8
1991	Dry	43	27	20	10
	P1	41	29	22	8
	P2	41	30	19	10
	P3	47	27	18	8
	Full	53	27	14	6
1992	Dry	50	24	17	9
	P1	58	20	13	9
	P2	62	16	13	9
	P3	61	16	11	12
	Full	60	13	15	12
Mean	LSD.05 = 7	56	22	14	8

Table 4. Water uptake from different depths for the sprinkler irrigated dry bean irrigation response experiments conducted in 1990, 1991 and 1992.

Year	Water Treatment	% Water Uptake			
		0-30 cm	30-60 cm	60-90 cm	90-120 cm
1990	Dry	57	27	10	6
	P1	55	27	10	8
	P2	54	29	11	6
	P3	57	24	11	8
	Full	54	21	12	13
1991	Dry	48	24	14	14
	P1	46	23	12	19
	P2	46	19	18	17
	P3	43	21	20	16
	Full	43	15	21	21
1992	Dry	45	24	13	18
	P1	37	18	20	25
	P2	43	19	16	22
	P3	48	25	15	12
	Full	47	20	20	13
Mean	LSD.05 = 5	48	22	15	15

An Evaluation of Combine Modifications for Reducing Dry Bean Harvesting Losses

Principal:	L. Zyla, Department of Agricultural and Bioresource Engineering University of Saskatchewan, Saskatoon, Saskatchewan
Funding:	Saskatchewan Irrigation Development Centre
Co-investigator:	A. Kapiniak, Saskatchewan Irrigation Development Centre
Locations:	Langham, Nokomis, Broderick (2), Star City and Balcarres
Progress:	One year only
Objective:	To evaluate combine header modifications for reducing dry bean harvesting losses. Improvement in reduction of harvest losses in dry beans has been identified by SIDC as critical to the development of a dry bean industry. Funding was provided by SIDC to Ag Engineering to assist in the development of a suitable harvest technology.

The concept of air jet guards for reducing dry bean harvest losses was evaluated in the fall of 1992. An IH 93 combine with a 3.1 m direct cut, rigid header had air guards placed on one half of the header. The other half of the header was left unmodified and was used as a standard check against the air jet guards. The air jet nozzles were positioned 25 cm in front of the cutter bar on 23 cm centers and provided a fairly uniform flood of air over the cutter bar. The IH 93 was also fitted with a Hume pickup reel which was modified slightly. On the air guard side of the header, the standard finger of the reel was replaced with nylon bristles. The nylon bristles were an attempt to increase the amount of contact of the reel with the bean plant.

Three equipment configurations on the modified side were evaluated at each site. These were:

1. The air jet guards as described above.
2. The air jet guards with crop lifters positioned between the air jet guard nozzles.
3. The air jet guards with crop lifters positioned between the air jet guard nozzles, but with the air supply shut off.

The average reduction in loss for the air only option varied from 0% to 40% and averaged 24%. For the lifter air option, losses varied from 0% to 35% and average 29%. For the lifter only option, losses varied from a 17% increase to an 18% reduction and averaged a 4% reduction. A paired t-test performed on the data showed the air only combination to be significantly different at the 1% level. The lifter air combination was significantly different at the 0.1% level and the lifter only combination showed no significant difference.

Although the results were encouraging, the overall reduction in loss was not reduced to the commercially acceptable loss level of 10%. Average losses were 38% (460 kg/ha) for the air only option, 39% for the lifter air option and 49% for the lifter only option. Even though the lifter air combination showed the largest reduction in loss, the crop lifters plugged often when heavy crop or weed conditions were encountered.

General comments on these preliminary results are:

1. The air jet guards did an excellent job of keeping the cutter bar of the combine clean.
2. The air jet guards did not lift pods above the cutter bar as anticipated.
3. The crop lifters were moderately successful in reducing harvest losses.

Soil/Fertilizer/Water

Nutrient Requirements of Irrigated Crops

Principal: J.L. Henry, Department of Soil Science
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objectives:

a) to improve the estimation of available nutrient levels in irrigated fields by designing soil sampling systems which recognize the variability within fields that have received large fertilizer doses;
b) to evaluate current soil test benchmarks for irrigated crops in light of recent Alberta research, and to modify soil test benchmarks if required;
c) to evaluate new fertilizer materials or methods and times of application that may have specific relevance to irrigated crops.

The 1992 work involved two series of field experiments; the first series was a detailed set of experiments to evaluate Biggar wheat response to phosphorus fertilization under a wide range of soil test conditions, and the second was a series of field experiments designed to evaluate the copper response of Fielder and Biggar wheat.

Seven phosphorus experiments were laid down on soils with soil tests ranging from less than 10 to nearly 40 kg P/ha in the 0-15 cm depth. Phosphorus was applied at rates of 0, 11, 22, 34, 45 and 90 kg P_2O_5/ha as seed placed monoammonium phosphate. The individual plot size was 1.2 X 6 m and the experiment was replicated 10 times and the test crop was Biggar wheat.

The yield data (Table 1) show yield increases up to 2000 kg of grain/ha for irrigated conditions with the lowest phosphorus soil test. At the highest soil test, only very minimal phosphate response was noted and only significant at the 0.1 level.

At harvest time, soil samples were taken from directly over the row and the interrow position of the 0-15 cm depth for the 0, 45 and 90 kg P_2O_5/ha rates. The soil analyses data (Table 2) shows very clearly the effect of soil sample position on phosphorus soil test value where row applications of phosphorus have been made. This data serves to illustrate the reasons for unexplained variation in soil test values where soil samples are taken after row applications.

The 1992 data confirm that the phosphorus soil test, as now utilized, does serve to adequately separate responsive from non-responsive situations.

Two experiments with Biggar wheat and one experiment with Fielder wheat were conducted with copper. Rates of 0 and 40 kg Cu/ha were surface broadcast and incorporated in a 10 times replicated experiment. All soils were Asquith fine sandy loam and the copper soil test was in the marginal range. Response to copper fertilization (Table 3) was obtained for the Fielder wheat but not for Biggar. At this time, it is not known whether the Fielder response is related to genetics or whether the response is related to that specific site.

Table 1. Yield data for the P experiments (Biggar wheat).

Site	Soil P Spring (ppm-0-15cm)	P_2O_5 seed placed (kg/ha)	Grain yield (bu/acre)	----Yield----- (kg/ha)		$LSD_{0.10}$ (kg/ha)		Harvest Index
				Grain	Straw	Grain	Straw	
Hauberg Dryland Summerfallow	3.2	0	34	2262	2375			0.49
		11	44	2972	2941			0.50
		22	50	3358	3224			0.51
		34	55	3694	3440			0.52
		45	60	4059	3695			0.52
		90	65	4372	4058	249	236	0.52
Hauberg Irrigated Summerfallow	3.6	0	68	4586	4564			0.50
		11	79	5309	5641			0.48
		22	88	5884	6260			0.48
		34	92	6175	6664			0.48
		45	98	6565	6938			0.49
		90	98	6576	6930	344	439	0.49
Hauberg Dryland Stubble	4.4	0	31	2098	2128			0.50
		11	36	2445	2497			0.49
		22	41	2772	2783			0.50
		34	45	3034	3037			0.50
		45	48	3239	3100			0.51
		90	51	3455	3406	228	242	0.50
SIDC	5.0	0	44	2928	4904			0.37
		11	52	3470	5523			0.39
		22	59	3979	6220			0.39
		34	59	3956	6500			0.38
		45	64	4305	6538			0.40
		90	72	4848	6715	494	346	0.42
Kent	5.8	0	60	4005	4896			0.45
		11	60	4044	4884			0.45
		22	63	4261	5368			0.44
		34	65	4370	5375			0.45
		45	66	4434	5535			0.44
		90	70	4671	5863	316	410	0.44
Riley	11.8	0	59	3979	6519			0.38
		11	67	4493	6595			0.41
		22	65	4363	6825			0.39
		34	67	4506	7035			0.39
		45	72	4826	6935			0.41
		90	75	5060	7304	614	398	0.41
Tullis	18.6	0	74	4960	5735			0.46
		11	72	4832	5811			0.45
		22	72	4864	6012			0.45
		34	77	5148	6231			0.45
		45	78	5270	6403			0.45
		90	77	5197	6409	261	394	0.45

Table 2. Soil analysis in the phosphorus experiments from row and inter-row samples of three selected treatments (kg P_2O_5/ha seed placed) - sampled on harvest date.

Site	Soil P Spring (ppm-0	-----Row----- 0	45	90	-----Inter-row----- 0	45	90	$LSD_{0.01}$ (ppm - 0-15 cm)
		--Fall soil phosphorus (ppm - 0-15 cm)--						
Hauberg Dryland Summerfallow	3	3	11	20	2	3	3	7.5
Hauberg Irrigated Summerfallow	4	3	7	23	3	5	6	4.7
Hauberg Dryland Stubble	4	3	13	28	3	3	4	6.1
SIDC	5	6	8	16	6	6	6	4.8
Kent	6	5	15	30	7	6	8	5.1
Riley	12	10	14	21	11	12	13	3.9
Tullis	19	14	24	33	17	20	22	8.6

Table 3. Yield data for the copper field experiments - 1992.

Site	Cultivar	Treatment (kg Cu/ha)	Grain* (bu/ac)	±Std. error	Grain* (kg/ha)	Straw (kg/ha)	Harvest index	Sig. diff.
Riley	Fielder	0	64	±4	4328	7786	0.36	**
Riley	Fielder	40	76	±6	5087	8345	0.38	**
Carlson	Biggar	0	76	±6	5119	7731	0.40	N.S.
Carlson	Biggar	40	74	±4	4942	7669	0.39	N.S.
Weiterman	Biggar	0	82	±5	5512	7325	0.43	N.S.
Weiterman	Biggar	40	83	±4	5604	7125	0.44	N.S.

*All yields based on a two square meter sampling size for each treatment.
**Means are significantly different at $P<0.025$
N.S. = no significant difference between means

The Design and Field Testing of a Vertical Mulcher for Irrigated Soils

Principals: T.S. Tollefson and T.L. Tollefson
Paragon Consultants Ltd.
Mossbank, Saskatchewan
Co-operator: T. Hogg, Saskatchewan Irrigation Development Centre, Outlook
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objectives:

a) to design, construct and test a field scale vertical mulcher on irrigated soils;
b) to measure the effect of the vertical mulch treatment on water infiltration and fall to spring moisture storage efficiency as a result of vertical mulching followed by post harvest irrigation;
c) measure treatment influence on subsequent crop yield:
d) assess the duration of the vertical mulch effect.

The emphasis in the concluding year of this project was to quantify the effects of various tillage treatments and fall irrigation on subsequent soil moisture regime and crop growth. A replicated plot was established which consisted of three tillage treatments (vertical mulch, subsoil, control) replicated three times at each of three rates of fall applied water (0, 5, 10 cm). A plot site was established immediately after harvest in September 1991. The three tillage and three fall water treatments were then applied. Each water treatment was flood irrigated individually using a rectangular 3 m x 3 m wooden frame as a dyke. The entire plot area was direct seeded to durum var. Sceptre on May 25, 1992. Neutron access tubes were installed in duplicate in each treatment May 26. Soil moisture was monitored monthly and final grain yield measured.

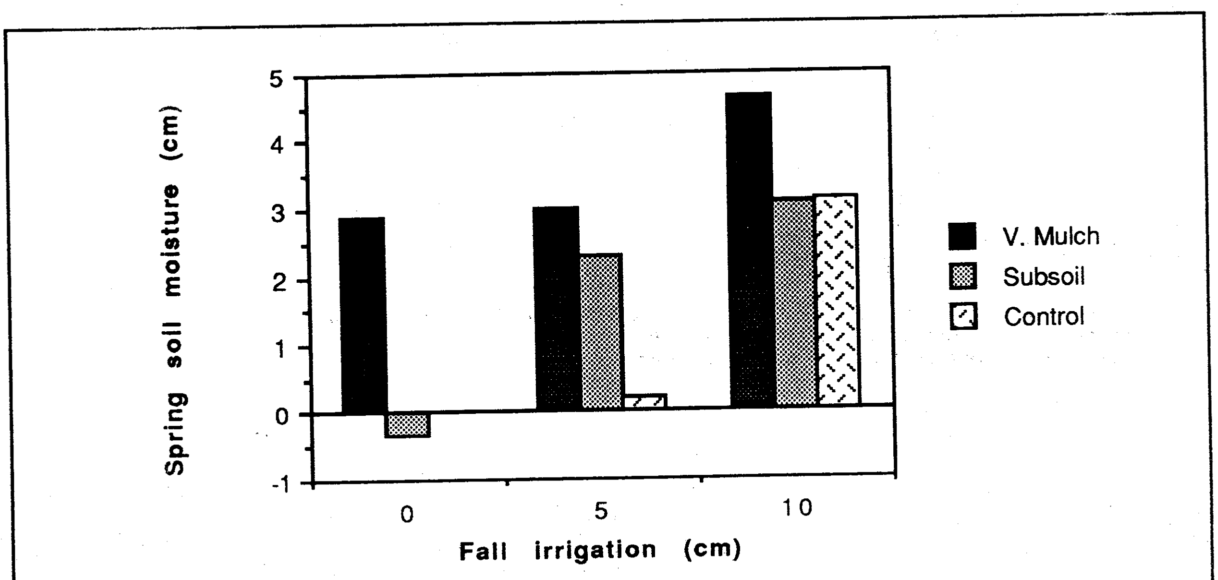


Figure 1. The influence of several tillage treatments and fall water application rates on spring soil moisture values as compared to the control (no tillage, no fall water).

Specific observations and conclusions from 1992 data.

1. Only a small percentage of fall applied water was measured the following spring in any of the tillage treatments (Figure 1). The loss was most severe at the 5 cm rate of fall applied water and was proportionally less at 10 cm. The 5 cm treatment stored most of the water near the surface and was subject to major evaporative losses. At the 10 cm application rate a greater proportion of fall applied water was stored in the subsurface and therefore less susceptible to evaporative loss.
2. Vertical Mulch (VM) tillage treatment had the largest total overwinter moisture storage. It was most effective as a means of enhancing storage of snow melt but less effective as a method of enhancing storage of fall applied irrigation water.
3. The VM treatment, receiving 10 cm of fall water, stored 4.6 cm more water in spring than the control treatment (no tillage, no fall water). Of that amount, 60% could be attributed to snowmelt infiltration and 40% fall irrigation.
4. A similar comparison of the VM treatment receiving 5 cm of fall water as compared to a control showed an extra 3 cm of water available in spring. Of that 3 cm, 95% could be attributed to snowmelt and only 5% to fall infiltration.

General observations and conclusions:

1. VM tillage increases soil water infiltration and storage. Maximum infiltration is experienced when free water is present on the soil surface producing flow directly into the vertical mulch channel and deep infiltration. These conditions seem to exist during spring snowmelt, and is most apparent if the melt is rapid.
2. Typical sprinkler systems do not apply water at a sufficient rate to produce substantial free water on the soil surface and therefore these sprinkler systems do not benefit from the enhanced infiltration capability offered by the VM treatment.
3. The data from this investigation does not support the contention that fall irrigation is a practice which will supply substantial quantities of stored moisture for use in the following crop year. A large percentage of the water which was applied in late September in this study could not be accounted for in spring. This low moisture carryover is likely due to the fact that in the South Saskatchewan Irrigation District #1 water is unavailable after October 1. Therefore, farmers are not able to apply water in late fall when evaporative potential is low. These losses were made more severe at low application rates because the bulk of the water was stored at or near the soil surface where it is most susceptible to evaporative loss.
4. VM tillage is capable of providing enhanced soil water infiltration and storage for several years so long as the surface continuity of the vertical mulch is not destroyed. Subsequent tillage destroys this surface continuity and substantially reduced VM effectiveness.
5. VM tillage buries a large percentage of loose crop residue. Direct seeding is therefore possible following VM tillage.
6. No incentives exist presently for improvement of water application efficiency under irrigation, primarily because of low commodity prices and relatively low cost of water to producers. When commodity prices and water costs increase and if the VM tillage effect could be used in a rotation where its effect is exerted over several crop years by using it prior to the establishment of a perennial crop or in a zero till annual production system, VM tillage could then be viewed as a realistic production practice.

Esso Chemical Canada 1992 Field Trials with Alfalfa

Principal: R.K. Hynes, Esso Ag. Biologicals
Location: Saskatchewan Irrigation Development Centre
Co-investigator: B. Irvine
Progress: Site 1: Second year of three
Site 2: First year of three
Objective: To test naturally occurring soil microorganisms known as plant growth promoting rhizobacteria (PGPR) on alfalfa. The PGPR co-inoculated with Rhizobium have promoted growth of root and shoot, crop vigour and root nodule number and mass of soybean, bean and lentils. The purpose of these experiments was to screen strains for yield increases of alfalfa.

The design of the experiments was a six-replicate RCBD with statistical analysis using the LSD at the 95% confidence level (MSTAT C). Alfalfa cv Beaver was treated with a strain of PGPR and Rhizobium, Rhizobium alone or untreated. At Site One, all microorganisms were formulated in Nitragin Gold (Lipha Tech, Milwaukee), and at Site Two, microorganisms were formulated in a peat or the Nitragin Gold.

Observations made from these experiments are as follows:

Site One: This was the second year of this study and dry matter yields were compared between treatments from the two cuts taken this year. After two years and four cuts, one strain of PGPR has consistently (three of four cuts) demonstrated a yield increase of alfalfa over the Rhizobium alone treatment and untreated seed.

Site Two: We did not take any cuts from these plots last year because of poor growth of the alfalfa.

Esso Chemical Canada 1992 Field Trials with Pinto Beans

Principal: R.K. Hynes, Esso Ag. Biologicals
Location: Saskatchewan Irrigation Development Centre
Co-investigator: J. Wahab
Progress: One year
Objective: Captan is the most common fungicide used to treat bean seed against root rot pathogens. Nodulation and nitrogen fixation by Rhizobium of bean treated with captan is significantly reduced, diminishing the crops potential to fix its own nitrogen. This study was undertaken to find a strain of Rhizobium that could nodulate and fix nitrogen in the presence of captan.

The design of this experiment was a six-replicate RCBD with statistical analysis using the LSD at the 95% confidence level (MSTAT C). Pinto bean cv Othello, captan-treated seed (Rangen Inc., Id.) and untreated seed was inoculated with a strain of *Rhizobium leguminosarum* bv *phaseoli*. that had been screened for captan tolerance in the greenhouse.

Observations made from this experiment: 1) nitrogen fixation (acetylene reduction assay), 2) nodule rating, and 3) final yield. No reliable data was collected due to severe frost damage and sclerotinia infection.

Hay and Protein Productivity of Single or Intercropped Alfalfa and Bromegrass under Zero Nitrogen Fertilization

Principal: G.O. Tomm, EMBRAPA, Passo Fundo, RS, Brazil, Ph.D., student at the Department of Crop Science and Plant Ecology, University of Saskatchewan

Co-investigators: C. van Kessel and A.E. Slinkard, University of Saskatchewan

Progress: Final year

Objectives: To verify the level of herbage and crude protein productivity of single and intercropped forages attainable under zero N-fertilization.

Nitrogen (N) fertilizer enhances the growth of grass in grass-legume associations and frequently inhibits N_2 fixation by the legume-Rhizobium symbiosis. The cost of N fertilizer and environmental concerns related to contamination of groundwater are making the use of N fertilizers a less attractive alternative. The herbage and crude protein production of single or intercropped alfalfa (*Medicago sativa* cv. Beaver) and meadow bromegrass (*Bromus riparius Rhem.* cv. Fleet) grown under irrigation, without N-fertilization, were evaluated near Outlook, at SIDC, from 1990 to 1992. Hay yield of alfalfa increased from 4.5 t/ha in the first year to 10.6 t/ha in the third year following seeding (Table 1). The hay yield of bromegrass decreased from 5.3 t/ha in the second year to 1.2 t/ha in the following year due to limited availability of N for plant growth. Alfalfa+bromegrass hay yield increased from 4.1 t/ha in the first year to 10.5 t/ha in the third year. Crude protein yields of single alfalfa or alfalfa+bromegrass were above 750 kg/ha/year in the first year and increased to 1700 kg/ha/year in the third year whereas the crude protein yield of bromegrass declined from 300 kg/ha in the first year to 80 kg/ha in the third year. Crude protein yield of bromegrass seeded in alternate rows with alfalfa was up to 125% higher than that of single bromegrass (not sharing resources). The amount of nitrogen fixation (kg/ha) on intercropped alfalfa in the third year was as high as that of alfalfa not sharing space with bromegrass.

Table 1. Nitrogen fixation on alfalfa swards, hay and crude protein yield of alfalfa or meadow bromegrass grown under irrigation and zero N-fertilization near Outlook, Saskatchewan (Tomm, van Kessel and Slinkard, 1993).

Treatments	Year 1	Year 2	Year 3	Total
		Herbage yield (kg/ha)		
Alfalfa, single	4535	9318	10592	24445
Bromegrass, single	1853	5253	1185	8291
Bromegrass, intercropped	810	3062	1796	5668
Alfalfa, intercropped	3262	6438	8693	18393
Intercropped total	4072	9500	10489	24061
Mean	2615	6018	5566	
Standard Error	171	572	327	
		Crude protein (kg/ha)		
Alfalfa, single	949	1603	1720	4272
Bromegrass, single	302	323	80	705
Bromegrass, intercropped	133	282	180	595
Alfalfa, intercropped	623	1068	1522	3213
Intercropped total	756	1350	1702	3808
Mean	502	819	876	
Standard Error	29	58	68	
		Nitrogen fixed (kg/ha)		
Alfalfa, single	59	193	133	385
Alfalfa, intercropped	33	118	141	292

Nitrogen Response of Irrigated Soft Wheat on Soil with High Residual Nitrogen at Depth

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Saskatchewan Irrigation Development Centre (SW 15-29-08-W3)
Progress: One year only
Objective: To determine if irrigated soft wheat will respond to additional nitrogen applications on soil with large residual nitrogen levels at depth in the soil profile.

Soil test nitrogen recommendations based on the top 60 cm of the soil profile do not take into account the distribution of available nitrogen throughout the profile. Large residual levels of nitrogen in the lower sampling depth may indicate sufficient available nitrogen levels are present. However, additional nitrogen may be required during early plant growth prior to root extension into the lower depths.

A demonstration plot was established at SIDC on a site with large residual nitrogen at depth (Table 1). Irrigated Fielder soft wheat showed no significant response to additional nitrogen applications (Table 2). Nitrogen content of the grain and straw was elevated at the higher nitrogen applications, however, there was no trend of increasing nitrogen uptake with increasing nitrogen application (Table 3). High nitrogen levels caused protein content of the grain (% N at 13.5% moisture x 5.7) in excess of what is considered desirable for soft wheat.

Table 1. Spring soil analysis for the soft wheat nitrogen response experiment.

Depth (cm)	pH	1:1 EC (dS/m)	NO_3-N	P	K	SO_4-S
			(kg/ha)			
0-15	8.4	0.2	18	67+	504	22
15-30	8.6	0.2	18			41
30-60	8.4	0.2	130			96+

The results from this work indicate that the current soil test guidelines based on the total available nitrogen in the top 60 cm of the soil profile correctly predicts the nitrogen requirements of irrigated softwheat.

Excess nitrogen either present in the soil or applied as fertilizer can cause protein levels in excess of what is considered desirable for soft wheat. Thus, nitrogen management of irrigated soft wheat is extremely critical.

Table 2. The effect of nitrogen fertilization on the yield, harvest index and seed weight of irrigated soft wheat grown on soil with high initial NO_3-N content.

Nitrogen rate (kg/ha)	Grain yield (14%) (kg/ha)	CV (%)	Straw yield (kg/ha)	CV (%)	Harvest index	CV (%)	1000 Seed weight (g)	CV (%)
0	5714	19	6705	16	0.77	14	44	5
25	6051	12	7042	5	0.78	8	40	4
50	5319	24	7246	21	0.66	10	39	8
75	5561	16	7026	16	0.71	6	38	6
100	5455	18	7051	12	0.69	14	42	2
150	4986	24	6885	11	0.67	35	37	13
LSD (0.05)	NS		NS		NS		NS	

NS-not significant.

Table 3. Nitrogen content and nitrogen uptake of irrigated soft wheat grown on soil with high initial NO_3-N content.

Nitrogen rate (kg/ha)	Grain % N	Straw % N	Nitrogen uptake (kg/ha)		
			Grain	Straw	Total
0	2.17	0.57	109	38	147
25	1.88	0.52	100	37	137
50	1.79	0.55	84	40	124
75	2.23	0.55	109	39	148
100	2.12	0.71	101	50	151
150	2.18	0.73	95	50	145

Nitrogen Response of Irrigated Cereals on Annual Legume Stubble

Principal: T. Hogg, Saskatchewan Irrigation Development Centre;
J.L. Henry, Department of Soil Science, University of Saskatchewan, Saskatoon, Saskatchewan

Funding: Irrigation Based Economic Development Agreement

Progress: One year only (This work was part of a larger project entitled Nutrient Requirements of Irrigated Crops undertaken by J.L. Henry)

Objective: To provide further field information to assist in the verification or modification of the current nitrogen credits for annual legumes in the rotation under irrigation conditions.

In Saskatchewan, nitrogen recommendation adjustments for annual legumes in the rotation for irrigated crop production are based on a limited amount of previous research conducted in the Outlook irrigation district. With the recent increase in acreage of annual legumes in the irrigation districts around Lake Diefenbaker in Saskatchewan, there is a renewed interest in the nitrogen contribution to succeeding cereals from annual legume stubble.

A project was initiated to determine the nitrogen response of irrigated Biggar CPS wheat grown on annual legume stubble. Sites were selected at four locations with two on lentil stubble and two on fababean stubble (Table 1). Current soil test nitrogen credits for irrigated cereals following annual legumes are 0.8 and 1.8 kg N/ha per 112 kg seed yield for lentil and fababean, respectively. Soil test nitrogen recommendations for the selected sites were lowered more for the fababean sites than for the lentil sites (Table 2).

Yield response to nitrogen applications occurred at three of the four sites (Table 3). Nitrogen response occurred at higher nitrogen application rates for the one lentil site than either of the two fababean sites. Thus, the lentil stubble would appear to be contributing less nitrogen than the fababean stubble and would require a larger nitrogen application than the fababean stubble. These results would indicate that the nitrogen credit for lentil stubble should be less than that for fababean stubble. The current soil testing guidelines provide a larger credit for fababean stubble than lentil stubble which agrees with the results observed in the present work. Nitrogen recommendations without a nitrogen credit would appear to be high, further indicating that a nitrogen credit should be used when the previous crop is an annual legume.

Table 1. Selected sites for the annual legume stubble nitrogen response experiment.			
Farmer Co-operator	Legal Location	Soil Type	Previous Crop
Eliason	SW 01-30-06-W3	Tuxford cl-c	lentil
Carlson	SW 15-31-07-W3	Asquith sl-fl	lentil
Carlson	SE 28-30-07-W3	Bradwell vl-l	fababean
Weiterman	SW 16-31-07-W3	Bradwell vl Asquith sl-fl	fababean

Table 2. Soil test nitrogen recommendations for irrigated CPS wheat grown on annual legume stubble.

Site	Legume Yield kg/ha	NO_3-N 60 cm kg/ha	N Credit kg/ha	N Recommendation (kg/ha)			
				With N Credit		Without N Credit	
				Optimum	Average	Optimum	Average
Eliason lentil	1600	65	11	112-134	67-90	134-157	90-112
Carlson lentil	2200	78	16	90-112	45-67	112-134	67-90
Carlson fababean	3900	41	59	90-112	45-67	157-179	112-134
Weiterman fababean	2800	65	43	90-112	45-67	134-157	90-112

Table 3. Yield data for the nitrogen response of irrigated CPS wheat grown on annual legume stubble.

Site	N Rate kg/ha	Grain Yield kg/ha	CV %	Straw Yield kg/ha	CV %	Harvest Index	CV %	1000 Seed wt.(g)
Eliason lentil	0	4508	14	6075	18	0.43	7	34.35
	28	5103	13	7059	19	0.42	7	32.73
	56	5544	4	8188	17	0.40	10	31.78
	112	6187	10	8963	19	0.41	7	31.43
	168	6111	8	9563	22	0.39	11	32.88
LSD(0.05)		602		947		NS		
Carlson lentil	0	6729	11	8228	13	0.45	4	43.08
	28	6879	14	8444	19	0.45	6	40.15
	56	6311	13	8854	18	0.42	10	40.55
	112	6342	12	8081	14	0.44	7	35.63
	168	6705	12	9305	16	0.42	6	34.63
LSD(0.05)		NS		NS		NS		
Carlson fababean	0	4539	21	7164	27	0.39	6	36.03
	28	4461	20	7475	25	0.37	7	36.33
	56	5100	12	8684	17	0.37	10	35.43
	112	5354	16	9110	11	0.37	7	35.35
	168	5619	7	9579	15	0.37	6	33.25
LSD(0.05)		899		1464		NS		
Weiterman fababean	0	4207	16	5079	26	0.45	7	42.08
	28	5261	12	6561	14	0.45	6	39.98
	56	5450	9	7281	13	0.43	5	39.73
	112	5593	9	7966	17	0.41	9	36.95
	168	5800	6	9405	13	0.38	3	35.20
LSD(0.05)		674		1447		0.03		

The Response of Irrigated Cereals to Chloride Fertilization

Principal: T. Hogg and B. Irvine, Saskatchewan Irrigation Development Centre
Location: Saskatchewan Irrigation Development Centre (SW 15-29-08-W3)
Progress: One year only
Objective: To determine the response of irrigated cereals to chloride fertilization.

The most frequently reported beneficial effect of chloride fertilization on cereal production is disease suppression. Under irrigated conditions, diseases of cereals can be a problem especially where disease pressure is high due to the extended use of cereals in the crop rotation. Therefore, a project was initiated to determine the response of irrigated cereals to chloride fertilization.

One site was selected at SIDC in the spring of 1992. The disease potential for cereals at this site was high due to the fact that barley had been seeded for the previous four years. As well, this site was leached the previous fall with 300 mm of water resulting in a chloride content below that considered sufficient (>34 kg Cl/ha for the 0-60 cm depth) by current soil test guidelines (Table 1).

The yields of Fielder soft wheat, Sceptre durum wheat, Biggar CPS wheat and Duke barley were not significantly increased by seed placed potassium chloride fertilizer (Table 2). As well, there was no significant effect of the potassium chloride treatments on the degree of root stunting.

These results suggest that the potassium chloride treatments were not effective in reducing the root diseases present at this site. Further evaluation of disease suppression by chloride fertilization is necessary before definite conclusions can be made.

Table 1. Spring soil analysis for the irrigated cereal chloride fertilization experiment.

Rep	Depth (cm)	pH	1:1 E.C. (dS/m)	NO_3-N	P	K	SO_4-S	Cl (0-60 cm)
				(kg/ha)				
1-3	0-15	8.6	0.2	27	43	672+	22	31
	15-30	8.8	0.3	19			44	
	30-60	9.0	0.3	39			108+	
4-6	0-15	8.9	0.2	21	67+	672+	27	27
	15-30	9.0	0.2	13			30	
	30-60	9.1	0.2	16			75	

Table 2. Stand counts, grain yield and seed weight for the irrigated cereal chloride fertilization experiment.

Crop	KCl Rate (kg/ha)	Plant Counts ($\#/m^2$)		Grain Yield @ 14% H_2O (kg/ha)		1000 Seed Weight (g)	
		Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
Fielder Soft Wheat	0	176	13.6	6054	8.7	41	11.9
	27	173	2.9	6568	13.5	40	2.4
	54	170	13.3	6094	12.5	42	9.8
LSD(0.05)		NS		NS		NS	
Sceptre Durum	0	145	7.9	6410	10.4	48	5.6
	27	144	8.2	6035	11.7	47	1.3
	54	144	15.5	5833	7.8	47	4.2
LSD(0.05)		NS		NS		NS	
Biggar CPS Wheat	0	162	16.1	6034	17.8	41	12.3
	27	170	10.9	6200	13.7	40	4.1
	54	173	12.9	6108	9.3	40	3.3
LSD(0.05)		NS		NS		NS	
Duke Barley	0	142	20.1	6909	9.8	40	3.9
	27	128	21.3	6791	9.0	40	9.8
	54	122	15.0	6441	12.9	39	4.8
LSD(0.05)		NS		NS		NS	

NS-Not significant.

The Response of Irrigated Pea to Rate and Placement of Phosphorus and Potassium Fertilization

Principal: T. Hogg and J. Wahab, Saskatchewan Irrigation Development Centre
Location: G. McNeill (SE 03-31-07-W3)
Progress: One year only
Objective: To determine the effect of rate and placement of phosphorus and potassium fertilization on irrigated pea production.

It is generally recommended that irrigated pea be seeded early to obtain maximum yield. Early seeding usually coincides with cooler soil temperatures resulting in slower root development and metabolism. Restricted movement of both phosphorus and potassium under conditions of low soil temperature may reduce the available supply of these two nutrients for plant uptake. Therefore, a project was initiated to determine the effect of rate and placement of phosphorus and potassium fertilization on irrigated pea production.

A site was selected on the farm of G. McNeill, Outlook, Sask. (SE 03-31-07-W3) where pea was to be seeded in 1992. Soil analysis indicated available phosphorus was low for irrigated pea production while available potassium was high and considered sufficient according to current soil test guidelines (Table 1).

Irrigated pea seed yield increased with phosphorus applications up to 44 kg P_2O_5/ha on a soil testing medium in available phosphorus (Figure 1). A similar response to potassium was not obtained indicating that the initial available potassium level in the soil was adequate as indicated by current soil testing guidelines. Furthermore, the application of potassium with the seed resulted in a significant reduction in pea seed yield (Figure 2) even though stand counts were not significantly reduced. The amount of potassium fertilizer placed in direct contact with the seed must be limited.

Table 1. Soil analysis for the irrigated pea phosphorus and potassium fertilization rate x placement experiment.

Sample	Depth (cm)	pH	1:1 E.C. (dS/m)	NO_3-N	P	K	SO_4-S
				(kg/ha)			
1	0-15	7.7	0.1	17	26	672+	34
	15-30	8.2	0.2	13			19
	30-60	8.6	0.2	13			27
2	0-15	8.0	0.2	15	21	672+	29
	15-30	8.3	0.1	10			10
	30-60	8.6	0.3	12			18

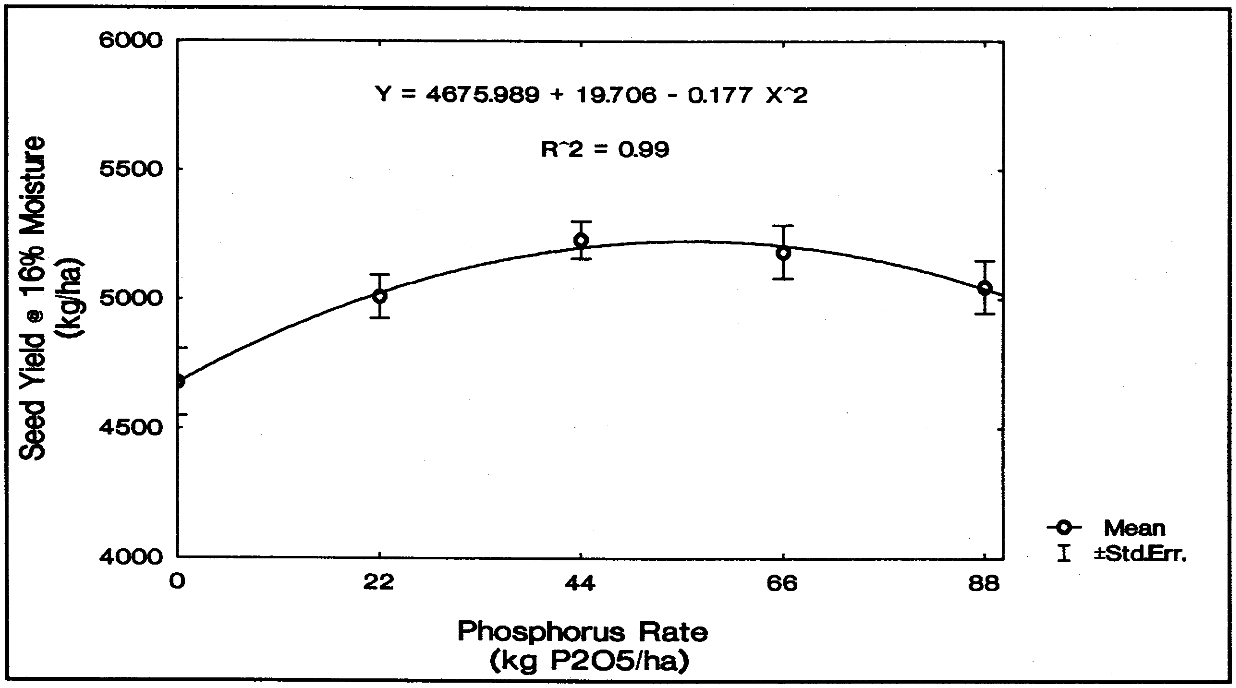


Figure 1. The effect of phosphorus rate on irrigated pea seed yield.

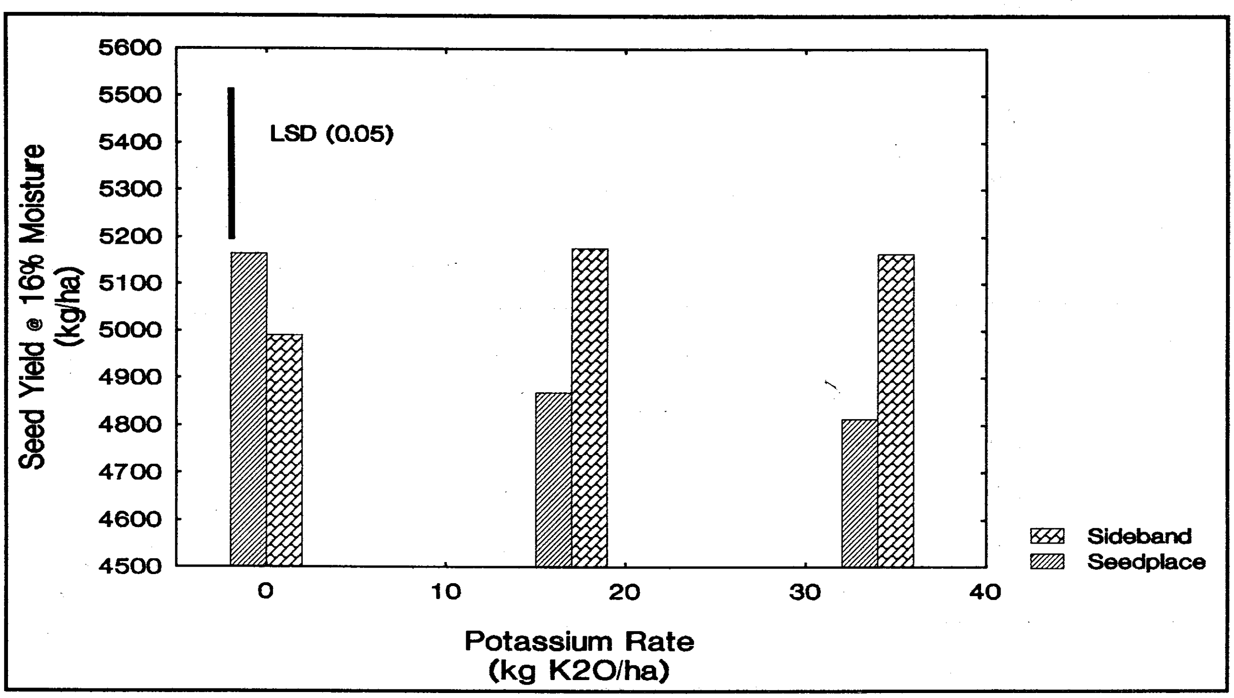


Figure 2. The effect of potassium rate and placement on irrigated pea seed yield.

Preferential Transport of Herbicides and Plant Nutrients Applied to Conventionally Tilled and Untilled Soil under Fall Leaching Using Low Pressure Sprinkler Irrigation

Principal: A.J. Cessna, Agriculture Canada Research Station
Regina, Saskatchewan
Funding: Parkland Agricultural Research Initiative
Site: Saskatchewan Irrigation Development Centre
Co-investigators: W. Nicholaichuk, J. Elliott, K. Best
Progress: First year of two
Objectives:

a) to confirm that preferential transport of herbicides/nutrients occurs in the unsaturated zone by monitoring tile drain water relative to water from lysimeters;
b) to determine what portions of the herbicide and fertilizer applications may move by preferential routes to ground water by estimating losses via the tile drain water;
c) to determine whether reduced tillage increases preferential transport of herbicides and nutrients.

The study was conducted on Field 11 at SIDC. The field is irrigated by a linear sprinkler and is tile drained. The site is divided into north and south sections by a shallow ditch. Both the north and south sections drain independently into a manhole located in the southwest corner of the site. The north side was chosen as the untilled portion and was left as standing stubble. The south side was used for the tilled component and was spiked on September 17.

Fertilizer was applied to both sections of the study site as a blend of ammonium nitrate and ammonium phosphate to give 100 kg N/ha and 22 kg P/ha. The fertilizer was incorporated along with the herbicides, trifluralin and triallate, on the south side only. The herbicides, MCPA, 2,4-D, dicamba, diclofop, bromoxynil and mecoprop were applied to the whole field and were not incorporated. Between September 25 and October 7, 222 mm of irrigation water were applied to the site in the fall leaching program.

Analysis of tile drain water samples has shown that preferential flow of the surface-applied herbicides occurred on both sides of the field. There was no evidence of preferential flow of the incorporated herbicides. Nitrogen and phosphorus were present in all tile drain water samples. Phosphorus levels were within water quality guidelines but nitrate levels which were consistently around 15 mg/L on the north side and 18 mg/L on the south side exceeded the Canadian Drinking Water Quality Guideline of 10 mg/L. The fall leaching program was used to give a "worse case scenario" for nutrient and herbicide leaching and therefore these results do not necessarily reflect leaching losses under normal conditions.

Monitoring Water and Salt Movement During a Leaching Irrigation Using Time Domain Reflectometry

Principal:	W. Nicholaichuk, National Hydrology Research Institute Saskatoon, Saskatchewan
Funding:	Parkland Agricultural Research Initiative
Site:	Saskatchewan Irrigation Development Centre
Co-investigators:	J. Elliott, K. Best, A. Cessna
Progress:	First year of two

Time domain reflectometry (TDR) is an accepted method for measuring soil moisture content and recent laboratory studies have suggested that TDR may also be used to measure electrical conductivity. The objective of this study is to evaluate TDR as a method of measuring electrical conductivity in field conditions. The study is being conducted on Field 11 at SIDC. Over the last 10 years salts have been removed from the soil by leaching irrigations in the fall. Time domain reflectometry (TDR) waveguides were paired with suction lysimeters which sampled at 30, 60, 90, 150 and 180 cm at four locations in the field. Measurements of electrical conductivity made by TDR were compared to electrical conductivities measured on water samples taken from the lysimeters on six occasions during the summer and fall of 1992. In the summer soil conditions were comparatively dry and in the fall as leaching progressed the soils became increasingly wet. These measurements were used to calibrate the TDR for electrical conductivity.

TDR was successfully used to estimate bulk soil electrical conductivity in field conditions and measurements provided useful data on changes in water content and electrical conductivity during fall leaching. There were some limitations to the utility of the method. Firstly, with present technology, TDR cannot be used to measure electrical conductivities greater than six dS/m because attenuation of the signal is so great that the reflected signal cannot be measured. Moisture content measurements are also difficult to obtain under these conditions. The second limitation is that electrical conductivity measured by TDR has to be calibrated for moisture content and it is not known if the same calibration will be applicable for all soils. Further research into the interaction between the water content of soil and electrical conductivity in the attenuation of the TDR signal in the waveguides is required.

Marketing and Economics

Irrigation Marketing Research

Principal: Harvey Clark
Market Analyst

Objective: To evaluate irrigated marketing opportunities and help focus the research and demonstration activity.

The importance of marketing has more recently been recognized. A market analyst position was staffed at SIDC to examine market trends, price expectations and opportunities for irrigated crop production. This information will assist us to more knowledgeably take a market-driven approach to irrigated research and demonstration. A wide array of opportunities have and are being evaluated for irrigated crop production. Particular emphasis has been placed on specialty and horticultural crops with development potential under irrigated conditions. These crops often have smaller, specialized and less developed markets.

A summary report of this activity is being developed. Its intent is to provide direction for our irrigated research and demonstration program, stimulate economic development opportunities and ultimately enhance rural development.