Research and Demonstration Highlights 1990

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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. This report summarizes the work conducted, funded or facilitated by the Centre in 1990. I trust you will find this report informative and useful.

The success of the Centre is dependent upon its ability to increase the number of viable cropping options available to irrigation farmers along with its ability to increase irrigated crop productivity on a sustainable basis. These efforts contribute to the ultimate goal of increased irrigation farm profitability.

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.

Year's Highlights

Many highlights occurred at the Centre in 1990. 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, 84 research applications have been received for funding and 33 have been approved. In addition, 126 demonstration applications have been received with 78 being approved. Additional detail is provided in this report.

2. Twenty-four tours were hosted by SIDC in 1990. The average size of the group was 12. In total over 1,500 guests visited the Centre. Particular highlights included our annual field day, a summer evening tour, a forage field day and our annual winter report session.

3. Papers and/or poster sessions were presented at: Soils & Crops Workshop, Pulse Growers Association meeting, Soil Conservation meetings, Irrigation Research and Demonstration in the 1990's Conference (Lethbridge), Alberta Bean Growers Association, Organic Producers Workshop, Spices and Herbs Workshop. In addition, a SIDC booth was staffed at the Crop Production Show and the Western Wheat Growers Association annual meeting.

4. Conducted a review of the field and specialty crops research and demonstration program.

5. Created and staffed agronomist position (T.J. Hogg).

6. Completed a chemical handling and storage facility.

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 at 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 co-ordinated, 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. This group co-ordinates and implements the general program and objectives of the Saskatchewan Irrigation Development Centre.

2. The Research Advisory Committee includes representatives from the University of Saskatchewan, Agriculture Canada and provincial governments and industry. This committee identified, reviewed and suggested proposals for irrigation research work to be conducted,

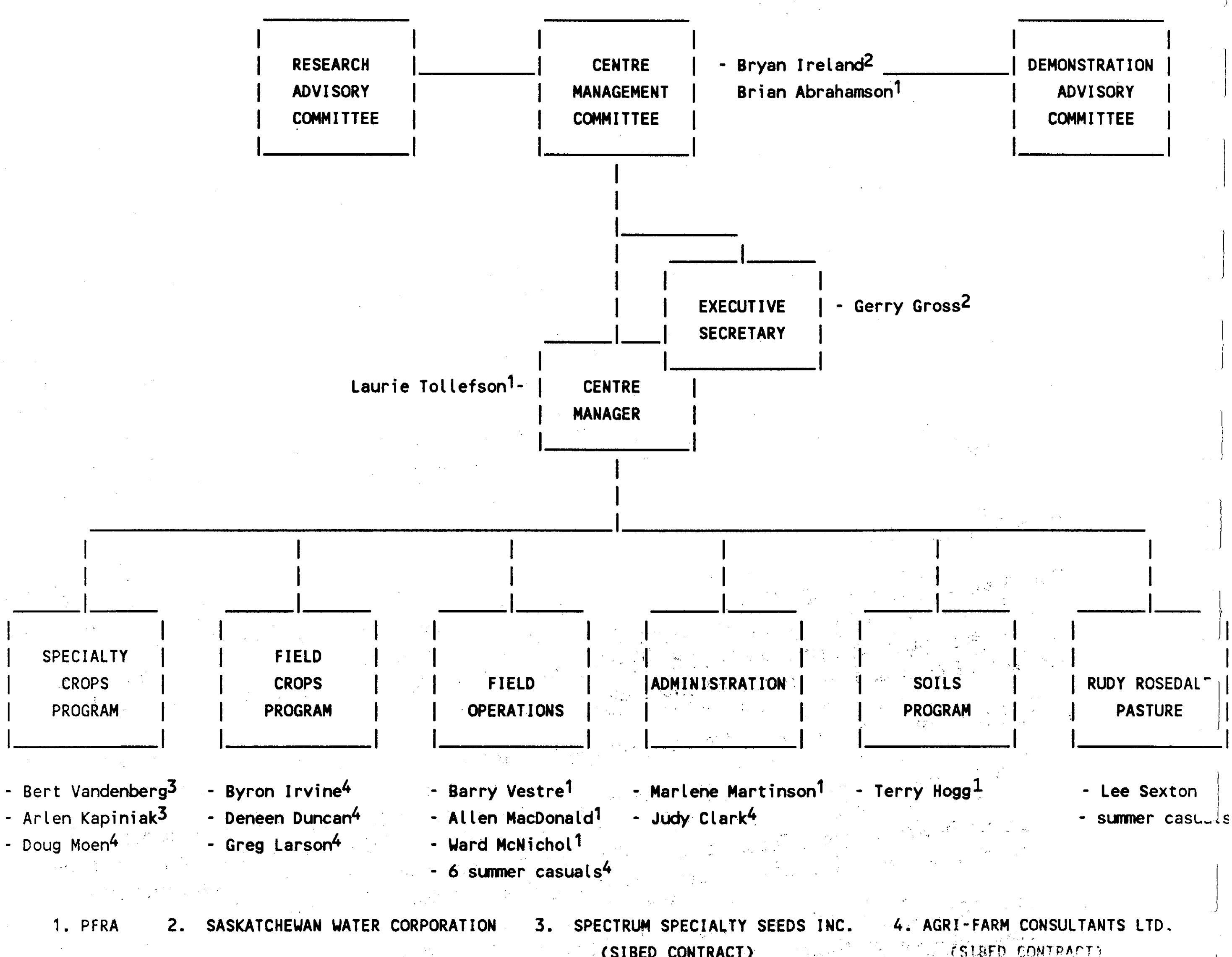
prioritized and recommended proposals to the Centre Management Committee, and advised the Centre Management Committee on all matters related to irrigation research and extension. They also reviewed and assessed research work at the request of the Centre Management Committee.

3. The Demonstration Advisory Committee, comprised of mainly irrigation farmers, reviewed and suggested proposals for the type of irrigation demonstration work to be conducted. It also recommended and prioritized proposals to the Centre Management Committee and advised the Centre Management Committee on all matters related to irrigation demonstration and extension. This committee also reviewed irrigation research proposals.

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, implementation of an SIDC extension program.

Figure 1. Organizational Chart



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), and the Agriculture Development Fund (ADF).

	(Ag Canada) PFRA	ADF	SIBED	Sask Water
Salaries	273,000	22,138	323,160	48,760
Operating	121,755	15,069	138,161	1,071
Capital	165,900	---	---	
Research			659,485	
Demonstration			223,740	
Total	560,655	37,207	1,344,546	49,831

Total expenditures for the year were $1,992,239.00.

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. A total of 33 irrigated research and 78 demonstration projects have been funded. These are included in the SIDC list of projects.

SIDC
List of Projects

Irrigation Based Economic Development Fund (IBED):

IBED Research Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1990 EXPENDITURES	TOTAL $
Soil Salinity Investigation at the SSRID #1 Principal: L. Henry, U of S	One year Completed 1987	$0.00	$100,000.00
Methods of Improving Alfalfa Establishment under Irrigated Conditions Principal: B. Irvine, SIDC	Four years	$66.18	$4,700.00
Seed Production of Kentucky Bluegrass Principal: B. Irvine, SIDC	Four years	$161.51	$660.00
Irrigation Scheduling Information Principal: R. Lawford, NHRI	Two years Completed 1990	$6,500.00	$30,000.00
Determination of Soil Intake Rates under Centre Pivot Irrigation Systems Principal: D. Norum, U of S	Two years Completed 1990	$3,480.00	$35,282.00
N Fertilization and Water Use Efficiency of Irrigated Crops Principal: C. van Kessel, U of S	Three years Completed 1990	$55,227.28	$134,500.00
The Design and Field Testing of a Vertical Mulcher for Irrigated Conditions Principal: Paragon Consultants Ltd., T. Tollefson	Four years	$8,000.00	$73,750.00
Alfalfa Cultivar Evaluation on Flood Irrigated Clay Soils in South West Saskatchewan Principal: P. Jefferson, Ag Canada, Swift Current	Four years	$26,300.00	$210,000.00
Irrigation Scheduling Tools for Farm Use Principal: B. Irvine, SIDC	Three years Completed 1990	$781.89	$30,753.97
Evaluation of Conventional Height Semi-Dwarf Cultivars for Irrigated Production in Saskatchewan Principal: P. Hucl, Sask Wheat Pool	Three years Completed 1990	$7,676.00	$14,033.00
Sodicity Hazard of Sodium and Bicarbonate Principal: F. Selles; Contractor: Normac AES Ltd.	Four years	$163,968.67	$349,200.00
Denitrification in Irrigation Cropping Systems and its Significance for Crop Production Principal: C. van Kessel, U of S	Two years Completed 1990	$27,495.70	$43,000.00
Influence of Seed Piece Spacing, Fertility and Irrigation on Yields of Whole Seed Potatoes in Saskatchewan Principal: D. Waterer, U of S	Two years Completed 1990	$30,118.60	$40,346.00
Diseases of Irrigated Wheat to Evaluate Fungicide Sprays for Foliar Disease Control Principal: L. Duczek, Ag Canada, Saskatoon	Three years	$10,235.35	$41,700.00

IBED Research Projects (cont.):

PROJECT NAME AND CO-OPERATOR	TERM	1990 EXPENDITURES	TOTAL $
Management of Alfalfa for Seed Production under Irrigation Principal: B. Goplen, Ag Canada, Saskatoon	Three years	$14,357.00	$38,440.00
Irrigated Production of Hybrid Canola Seed Principal: D. Hutcheson, Ag Canada, Saskatoon	Three years	$2,508.00	$91,161.00
Herbicide, Pesticide and Nutrient Loss Using Low Pressure (High Volume) Irrigation Systems Principal: W. Nicholaichuk, NHRI	Three years	$58,000.00	$98,200.00
Grass Species for Irrigated Pastures Principal: B. Goplen, Ag Canada, Saskatoon	Three years	$36,237.00	$170,007.00
Management of Forage Production under Irrigation Principal: B. Goplen, Ag Canada, Saskatoon	Three years	$46,342.45	$192,400.00
Barley Silage as a Source of Available Energy and Nonstructural Carbohydrate for Lactating Dairy Cows Principal: D.A. Christensen, U of S	Two years	$14,375.34	$60,100.00
Evaluation of High-yielding, Disease-resistant Durum Wheat Breeding Lines for Irrigated Production Principal: J.M. Clarke, Swift Current Research Station	Three years	$30,000.00	$168,300.00
Nutrient Requirements of Irrigated Crops Principal: L. Henry, U of S	Three years	$53,106.04	$233,950.00
Barley Development and Evaluation for Irrigation in Saskatchewan Principal: B. Rossnagel, U of S	Three years	$32,608.51	$191,376.00
Screening for Phytopath Resistance in Cereal and Pulse Crops for Saskatchewan Principal: B. Rossnagel, U of S	Three years	$21,584.63	$74,990.00
Establishment and Seed Production of Turf and Forage Grasses under Irrigation Principal: Newfield Seeds Limited	Three years	$5,120.00	$27,200.00

IBED Demonstration Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1990 EXPENDITURES	TOTAL $
Irrigated Canola Varieties Demonstration Co-operator: M. Larson	Two years Completed 1988	$0.00	$2,000.00
Irrigated Production of Texas Kochia Co-operator: R. Derdall	One year Completed 1987	$0.00	$1,558.25
Fertigation Feasibility on Fine Sandy Loam Co-operators: R. & R. Bond	Three years Completed 1989	$0.00	$7,695.35
Oilseed/Pulse Crop Sequence Co-operator: B. Irvine, SIDC	Three years Completed 1989	$0.00	$1,181.09
Agronomics of Pinto Beans Using Conventional Farm Equipment Co-operator: K. Carlson, Keg Farms Ltd.	Three years Completed 1988	$0.00	$7,000.00
Comparison of Leduc and Virden Barley for Silage Production under Irrigation Co-operator: B. Irvine, SIDC	Two years Completed 1988	$0.00	$575.00
Infrared Crop Photography of Irrigated Production Co-operator: J. Linsley, SWC	One year Completed 1987	$0.00	$5,968.20
Irrigated Production of Texas Kochia on Saline Soil Co-operator: R. Derdall	Two years Completed 1989	$0.00	$3,090.65
Irrigated Field Pea Early Seeding Demonstration Co-operator: J. Konst	Three years Completed 1990	$3,422.96	$11,909.36
Ripping Solonetzic Soils Co-operator: M. Grevers	Three years Completed 1990	$13,170.34	$27,253.00
Alfalfa Varieties on Border Dyke Irrigation - Yield and Stand Longevity Contractor: Normac AES Ltd.	Five years	$2,485.00	$12,050.00
Alfalfa Establishment and Fertility for Increased Yield Contractor: Normac AES Ltd.	Five years	$13,330.71	$49,883.00
Maximum Economic Yield Co-operator: Outlook Irrigation Production Club	Four years	$17,802.61	$77,900.00
Finishing & Marketing Options for Lambs Raised on Irrigated Pasture Co-operator: D. Kelman	One year Completed 1988	$0.00	$3,500.00

IBED Demonstration Projects (cont.)

PROJECT NAME AND CO-OPERATOR	TERM	1990 EXPENDITURES	TOTAL $
Creep Feeding Lambs Raised on Irrigated Pasture Co-operator: R.D.H. Cohen	One year Completed 1988	$0.00	$12,360.00
Drainage & Subsoiling to Improve the Yield of Alfalfa on Border Dyke Irrigation Contractor: Normac AES Ltd.	Four years	$2,127.00	$14,748.00
Use of Spring Seeding Winter Annual Cereal Grains for Grazing (Large Animal Trial) Co-operator: Vestre Farms	Two years Completed 1989	$0.00	$5,425.06
Irrigated Fababean Agronomy Demonstration of Benefits of Early Seeding Co-operator: M. Miller	Three years Completed 1990	$2,360.34	$8,715.59
Canola Variety Demonstration, Site 2 Co-operator: D. Duncan, SIDC Site: C. Bagshaw	Three years	$979.61	$2,637.84
Evaluation of a Reservoir Tillage System to Reduce Runoff at High Water Application Rates Co-operator: D. Duncan, SIDC Site: J. Eliason	One year Completed 1988	$0.00	$2,086.35
Using Chemical Desiccants to Speed Curing of Alfalfa Forage Co-operator: L. Knapik	Two years Completed 1990	$836.00	$1,672.00
Irrigated Field Pea Agronomy Co-operator: G. Follick	One year Completed 1988	$3,198.35	$3,198.35
Irrigated Alfalfa Seed Production Co-operator: M. Millar	Three years	$5,000.00	$15,500.00
Semi-dwarf vs. Traditional Barley Varieties Grown under Irrigation Co-operator: J. Senger	One year Completed 1989	$0.00	$1,945.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: J. Eliason	One year Completed 1989	$0.00	$2,975.00
Increasing Returns from Irrigated Grass Pastures Grazed by Sheep Co-operator: Riverside Sheep Co.	One year Completed 1989	$387.00	$1,753.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: Derdall Irrigation	Three years	$3,548.84	$17,715.00

IBED Demonstration Projects (cont.)

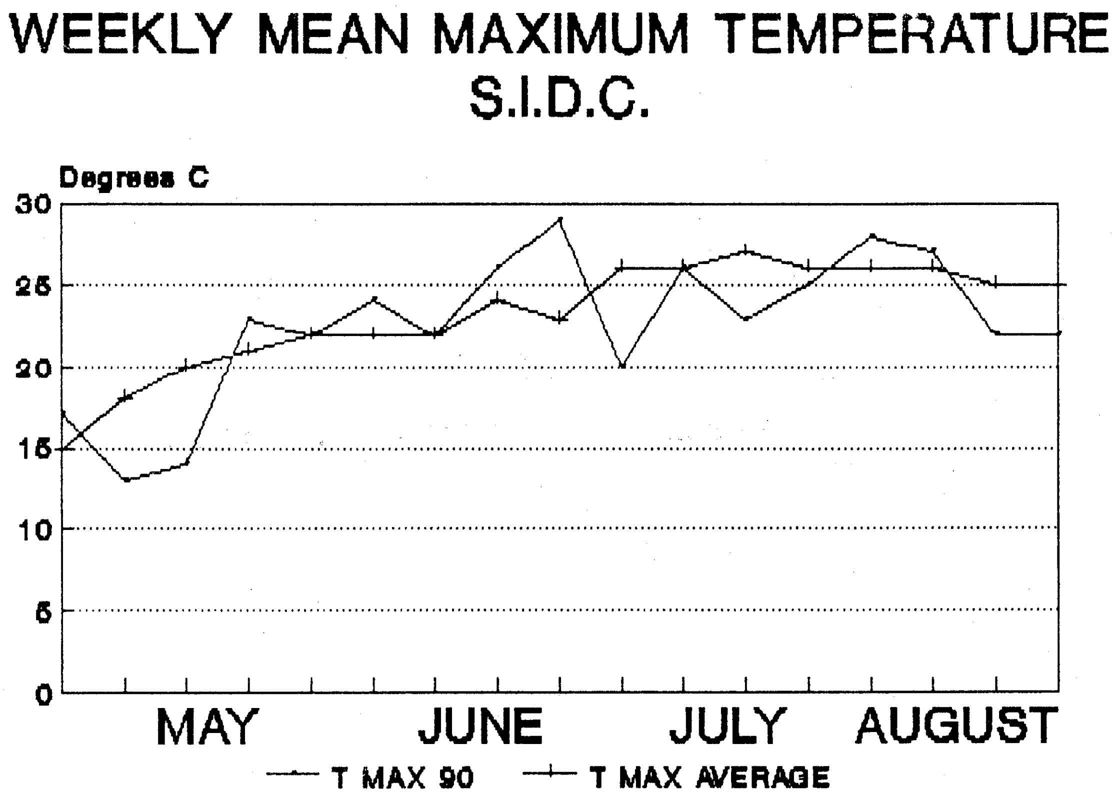
PROJECT NAME AND CO-OPERATOR	TERM	1990 EXPENDITURES	TOTAL $
Irrigated Safflower Agronomy: Evaluation of Nitrogen Response in Safflower Productivity Co-operator: J. Massey	Three years	$1,780.88	$8,007.00
Irrigated Great Northern Bean: Evaluation of Disease Control Technology Co-operator: J. Konst	Three years	$2,022.98	$5,190.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: Lakeview Ranch	Three years	$5,148.25	$17,715.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: K. Carlson	Three years	$5,705.00	$17,715.00
Skid Boom Sprayer Evaluation for Sclerotinia Control in Irrigated Pinto Bean Co-operator: J. Konst	One year Completed 1989	$1,376.57	$4,420.93
Timothy Production under Irrigation Co-operator: P. & S. Verwimp	Three years	$3,224.00	$10,000.00
Irrigated Field Pea Agronomy: Early Seeding Date Co-operator: G. Ostie	Two years Completed 1990	$1,979.93	$5,026.05
Demonstration of Alfalfa Seed Production Under Irrigation Co-operator: M. & R. Larson	Three years	$5,000.00	$15,500.00
Timothy Production under Irrigation Co-operator: K. Bagshaw	Three years	$2,430.30	$6,400.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: D. Walberg	Three years	$2,709.00	$12,525.00
Irrigated Field Pea Agronomy: Early Seeding Demo Co-operator: M. Purcell	Two years	$4,182.86	$9,148.00
Canola Productivity Centre Pilot Project Co-operator: Canola Council of Canada & Sask Canola Growers Association	One year Completed 1990	$10,402.54	$10,402.54
Grasses for Irrigated Pastures Co-operator: N. MacLeod	Three years	$2,144.10	$7,200.00
Hay Certification and Forage Market Access Project Co-operator: V. Racz, U of S	Three years	$33,018.00	$147,500.00

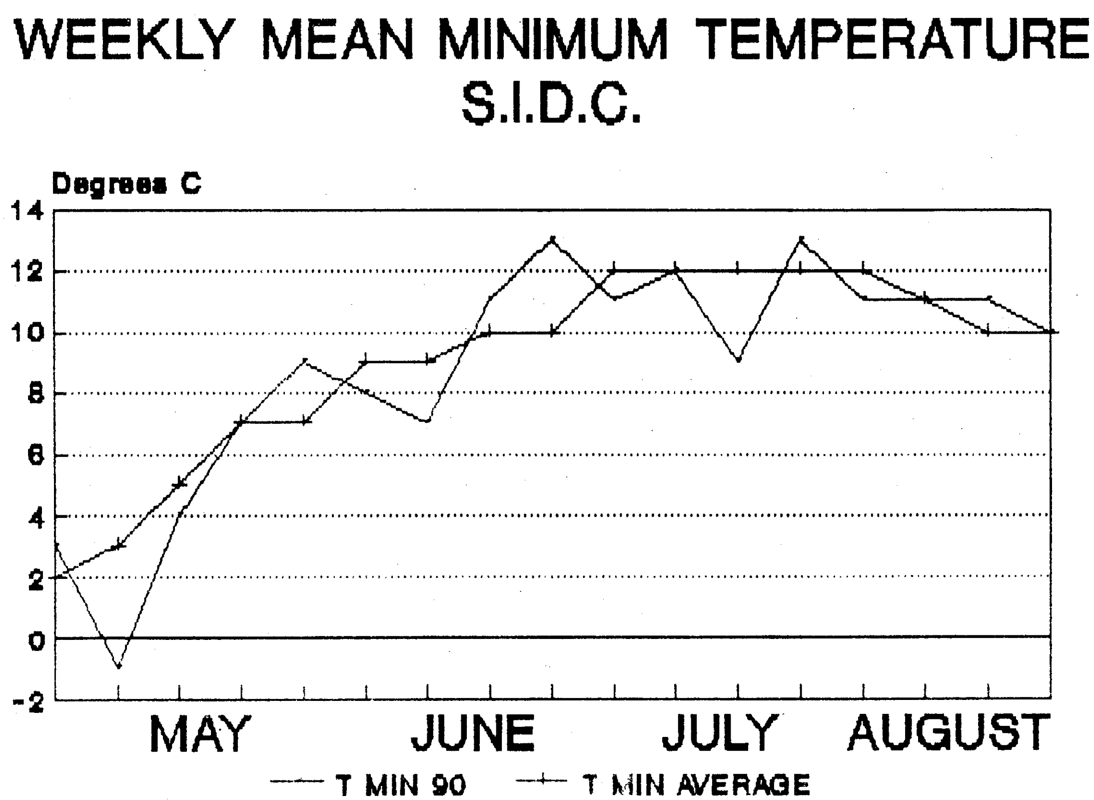
IBED Demonstration Projects (cont.)

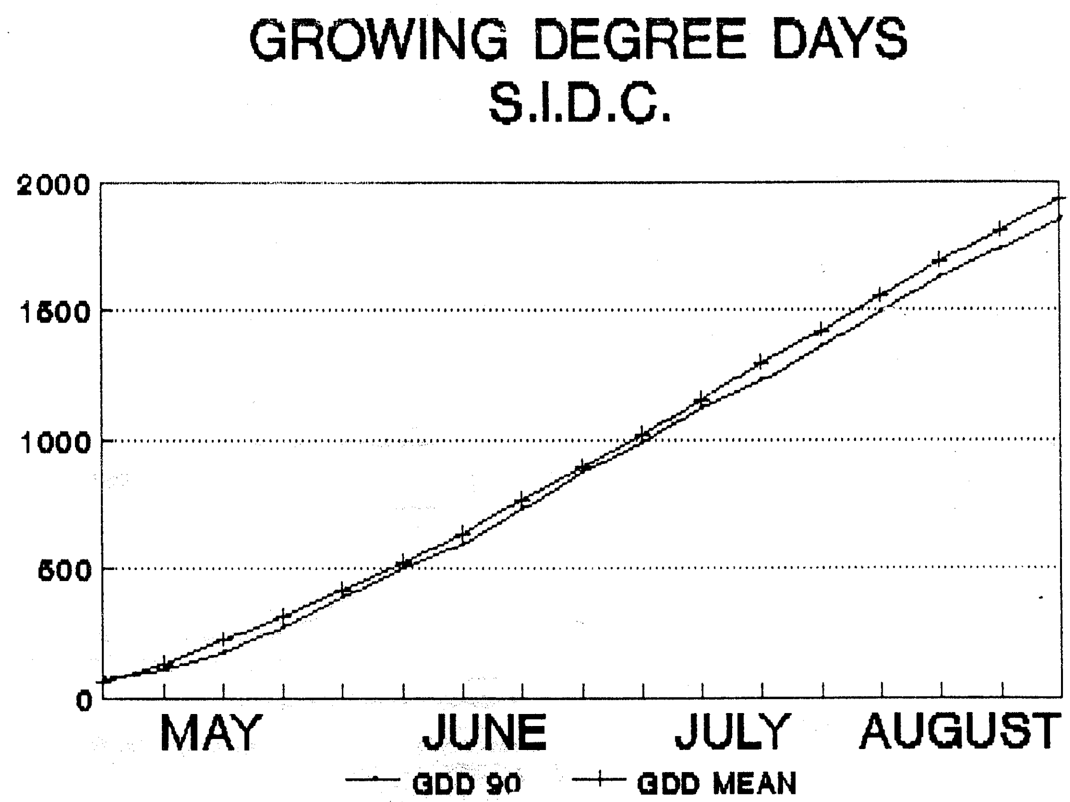
PROJECT NAME AND CO-OPERATOR	TERM	1990 EXPENDITURES	TOTAL $
Grasses vs. Alfalfa Production and Nutritional Value on Border Dyke Irrigation in SW Saskatchewan Contractor: Normac AES Ltd.	Three years	$4,304.65	$17,750.00
Irrigated Pinto Bean Agronomy: Evaluation of Airseeders for Pinto Bean Production Co-operator: B. Whenham	One year Completed 1990	$3,500.00	$3,500.00
Irrigated Pinto Bean Agronomy: Evaluation of Airseeders for Pinto Bean Production Co-operator: W. Jones	One year Completed 1990	$2,727.81	$2,727.81
Irrigated Pinto Bean Agronomy: Evaluation of Nitrogen Response in Pinto Bean Production Co-operator: C. Millar	Two years	$2,097.02	$6,000.00
Irrigated Pinto Bean Agronomy: Evaluation of Nitrogen Response in Pinto Bean Production Co-operator: J. Massey	Two years	$2,677.30	$7,000.00
Irrigated Pinto Bean Agronomy: Evaluation of Airseeders for Pinto Bean Production Co-operator: B. Tullis	One year Completed 1990	$3,156.06	$3,156.06
Irrigated Pinto Bean Agronomy: Harvestability Evaluation Co-operator: B. Davison	One year Completed 1990	$3,103.11	$3,103.11
Testing Grain Crop Varieties under Irrigation Co-operator: B. Harvey	Three years	$21,121.42	$179,050.00
Adaptation and Recommendation Testing of Forage Crop Varieties in Saskatchewan Co-operator: Sask Forage Council/Newfield Seeds	Three years	$24,075.00	$85,185.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: M. Larson	Two years	$3,500.00	$7,000.00
Demonstration of Techniques for the Seed Production of Meadow Bromegrass Co-operator: R., M. & R. Larson	Three years	$3,500.00	$10,500.00

SIDC
Meteorological and Irrigation Data

1990 Meteorological Data (Growing Season)







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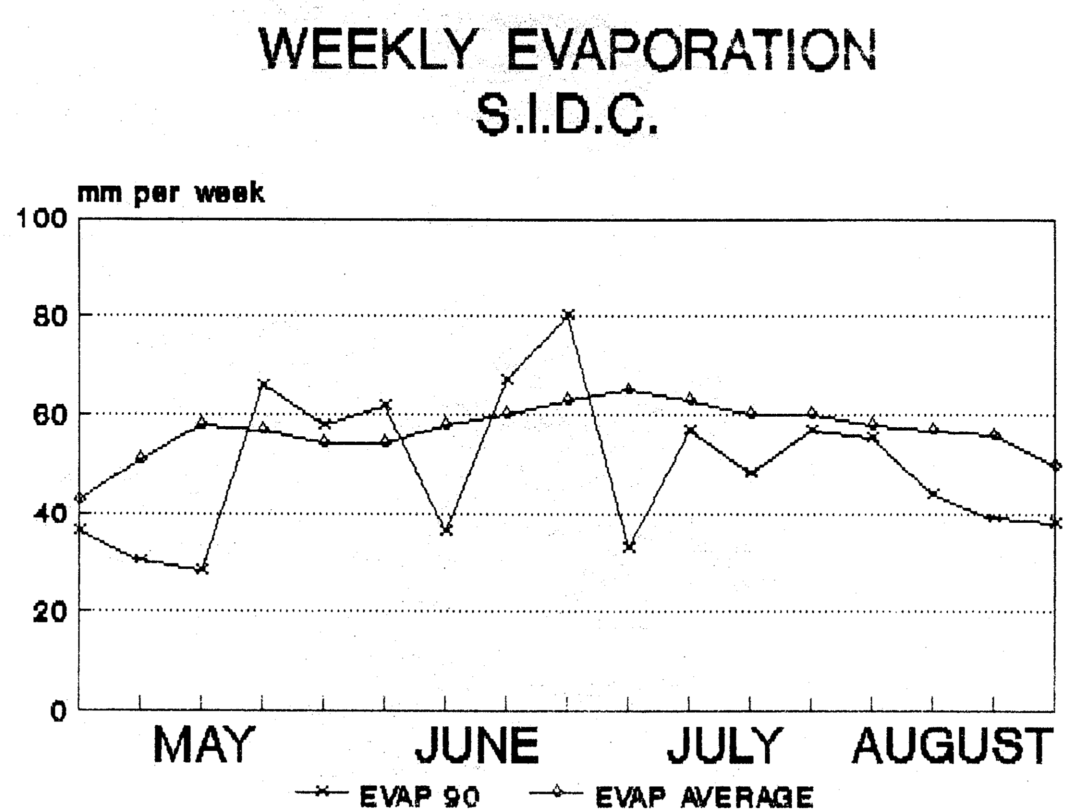

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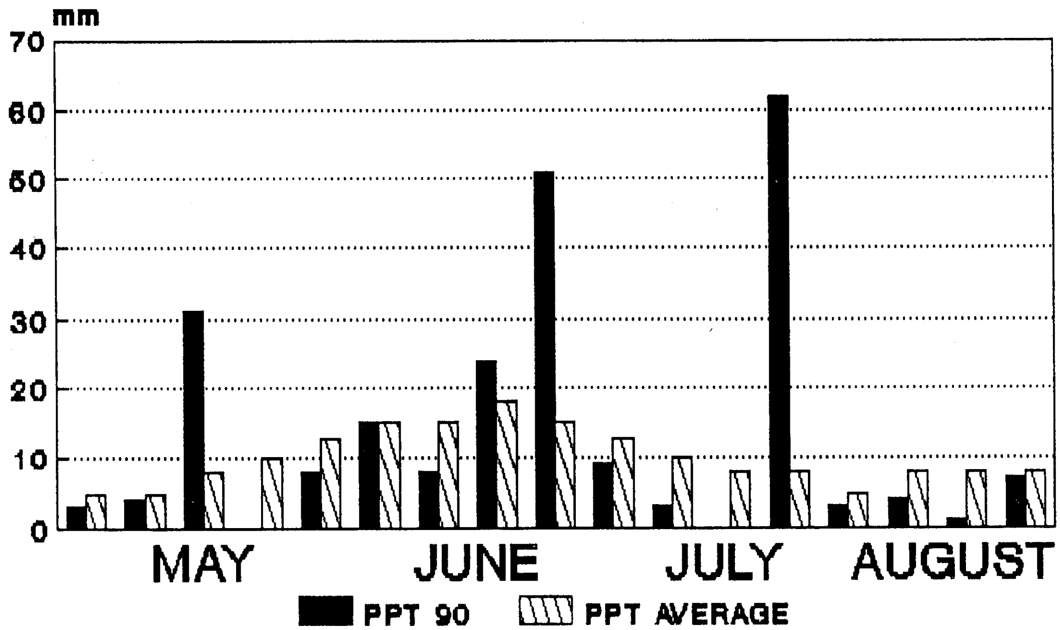


1990 Irrigation Data (mm) (application records at SIDC for various plots)

CROP	PLOT	MAY	JUNE	JULY	AUGUST	SEPTEMBER	Total through Growing Season	Fall Irrigation	Total Irrigation
Barley (Duke)	1	0.0	111.5	84.0	0.0	0.0	195.5	75.0	270.5
Sunflower Co-op	1	0.0	86.0	84.0	108.5	0.0	278.5	0.0	278.5
Corn	1	0.0	86.0	84.0	86.0	0.0	256.0	22.0	278.0
Alfalfa	2B	0.0	Two floods	Two floods	0.0	0.0		0.0	
Soft Wheat (Fielder)	3	0.0	35.0	103.0	0.0	0.0	138.0	0.0	138.0
Barley (Winchester)	4	0.0	84.5	93.5	0.0	0.0	178.0	50.0	228.0
Barley (Duke)	5	0.0	84.5	101.5	0.0	0.0	186.0	100.0	286.0
Wheat (Laura)	7	0.0	0.0	101.0	0.0	0.0	101.0	0.0	101.0
Soft Wheat (Fielder)	8	0.0	94.0	104.0	52.5	0.0	250.5	75.0	325.5
Grass Seed Trials	8	0.0	78.5	48.0	65.0	26.0	217.5	0.0	217.5
Wheat (Laura)	9	0.0	118.5	148.0	49.0	0.0	315.5	75.0	390.5
Semi-dwarf Barley	9	0.0	111.0	127.0	35.0	0.0	273.0	75.0	348.0
Durum	9	0.0	113.0	133.5	63.5	0.0	310.0	75.0	385.0
Soft Wheat Co-op	9	0.0	113.0	133.5	65.0	0.0	311.5	75.0	386.5
Canola	9	0.0	113.0	133.5	65.0	0.0	311.5	75.0	386.5
Durum (Sceptre)	10	0.0	89.2	149.5	46.5	0.0	285.2	75.0	360.2
Cereal Disease Study	10	0.0	109.0	139.5	45.0	0.0	293.5	75.0	368.5
Durum	10	0.0	76.0	127.5	68.5	0.0	272.0	75.0	347.0
Barley (Duke)*	11	0.0	63.0	72.0	0.0	0.0	135.0	270.0	405.0
Soft Wheat (Fielder)	12	0.0	103.5	82.5	22.5	0.0	208.5	75.0	283.5
Wheat (Laura)	12	0.0	135.5	69.0	0.0	0.0	204.5	50.0	254.5
Malt Collaborative	12	0.0	137.5	91.0	0.0	0.0	228.5	50.0	278.5
Faba Beans	12	0.0	103.5	82.5	22.5	0.0	208.5	0.0	208.5
Durum (Sceptre)	1L	0.0	76.0	131.0	47.0	0.0	254.0	75.0	329.0
Oilseed Demos	2L	0.0	101.5	100.0	54.0	0.0	255.5	50.0	305.5
Cereal Demos	3L	0.0	110.0	101.0	53.0	0.0	264.0	50.0	314.0

* Fall irrigation applied for leaching on drainage field.

Cereals

Regional Spring Grain Variety Trial

Principal: Sue McColl, Crop Development Centre
University of Saskatchewan
Saskatoon, Saskatchewan

Funding: Agriculture Development Fund

The Regional Spring Grain Variety Trial is a cooperative program of the University of Saskatchewan, Crop Development Centre, Saskatchewan Rural Development and participating farmers. The Agriculture Development Fund provides funding for this program. One of the testing sites is under irrigation at SIDC in Outlook. In 1990, these plots focused on varieties of flax, canola, durum and Canada Prairie Spring wheat. The yield data from these trials are presented in the tables below.

Table 1. Yield as a % of Westar and Tobin.

Canola	85	86	87	88	89	90	Ave.
B. napus							
Westar		100	100	100	100	100	100
Regent		77	98	102	91	106	95
Tribute		55	68	56	64	80	65
Profit				107	116	107	110
Alto				107	90	107	101
Legend				103	117	112	111
Celebra					114	112	113
Vanguard					118	119	119
Delta					121	124	123
Hyola 40					108	123	116
Bounty						125	125
B. campestris							
Tobin	100	100	100	100	100	100	100
Horizon				101	123	92	105
Colt				91	98	94	94
Parkland				109	97	89	98

Table 2. Yield as a % of Norlin.

Flax	85	86	87	88	89	90	Ave.
Norlin	100	100	100	100	100	100	100
McGregor	90	108	98	114	101	104	103
Norman	95	109	86	115	102	108	103
Vimy		97	75	123	90	71	91
Andro	100	92	78	94	93	98	93
Somme					114	98	106
Flanders					108	109	109

Table 3. Yield as a % of Kyle.

Durum	87	88	89	90	Ave.
Kyle	100	100	100	100	100
Medora	97	86	148	94	106
Sceptre	91	92	143	101	107
Wakooma	96	71	94	100	90
Plenty			142	100	121
DT 242			165		165
DT 462			159		159

Table 4. Yield as a % of Genesis (87-90)

High Yield Wheat	87	88	89	90	Ave.
Neepawa	71	70	95	62	75
HY320	72	86			79
Genesis	100	100	100	100	100
HY380*		109	108	93	103

*Note HY380 was recommended for registration February 1991

Testing Grain Crop Varieties under Irrigation

Principal: B.L. Harvey, Department of Crop Science
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: First year of three
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 will provide information to producers to allow them to make informed choices of varieties under irrigation.

In 1990, selected varieties of each of the major grain crops and specialty crops grown in Saskatchewan were evaluated in replicated yield trials at three irrigated locations: Aberdeen, Birsay, and Broderick. Sites were chosen in consultation with SIDC personnel. In 1991, Outlook will be included as a fourth irrigated location. In total, sixty-seven varieties and advanced lines were seeded at each site. For a list of these entries see Table 1. Seeding and establishment of plots was completed by May 30. Preliminary data only is available at this time. For more detail contact the principal investigator.

Table 1. SIDC variety list and treatment numbers.

HARD RED	SIX ROW	CANOLA
SPRING WHEAT	BARLEY	B. napus
1 Roblin	1 Duke	1 Westar
2 Laura	2 Samson	2 Legend
3 CDC Makwa	3 Heartland	3 Profit
4 BW 616	4 Brier	4 Alto
5 Katepwa	5 Argyle	
	6 Tankard	B. campestris
CANADA PRAIRIE		1 Tobin
SPRING WHEAT	TWO ROW	2 Parkland
1 Biggar	BARLEY	3 Colt
2 HY355	1 Harrington	4 Horizon
3 Oslo	2 Ellice	
	3 TR 226	FLAX
DURUM WHEAT	4 Manley	1 McGregor
1 Medora	5 TR544	2 Norlin
2 Sceptre	6 Deuce	3 Somme
3 Arcola		4 Flanders
4 Plenty	OAT	5 Andro
5 Kyle	1 Calibre	
	2 Derby	FIELD PEA
SOFT WHITE	3 Waldern	1 Express
WHEAT	4 Jasper	2 Titan
1 Fielder	5 Robert	3 Radley
2 Owens	6 OT257	4 Bellevue
3 SWS52		
	FABABEAN	LENTIL
TRITICALE	1 Outlook	1 Laird
1 Wapiti	2 Encore	2 Eston
2 Frank	3 Aladin	3 Rose
3 T72	4 Pegasus	4 LA179310-8
PINTO BEAN	CANARY SEED	SAFFLOWER
Fiesta	Keet	Saffire
Topaz	Elias	

Soft White Spring Wheat Co-operative Trial

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

Twenty-five soft white spring wheat cultivars were evaluated in a four-replicate test at the Saskatchewan Irrigation Development Centre at Outlook. This test formed part of the official testing program of Soft White Spring wheats in Western Canada. The test was also grown under irrigation at Saskatoon and at four locations in 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. Results from this test will be used to identify improved lines for further testing in the Co-operative Trial.

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: Saskatchewan Irrigation Development Centre
L. Hamoline, Aberdeen, Saskatchewan
Progress: First year of three
Locations: Saskatoon, Aberdeen 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 first year of this project, more than 400 advanced Crop Development Centre barley breeding lines and selections, as well as introductions from the United States, Scandanavia and Europe, were evaluated under irrigation from one to three locations. Test locations included Saskatoon, Aberdeen 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).

Based on 1990/91 data, several lines appear to have promising combinations of straw strength, yield potential and maturity. These will be tested again in 1991/92. Of most interest was the performance of several Scandinavian and European two-row genotypes which 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.

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 2-row and 6-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
Co-operators:	Saskatchewan Irrigation Development Centre L. Hamoline, Aberdeen, Saskatchewan
Progress:	First year of three
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 of 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. However, once this is achieved, using a specialized 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.

Some 60,000 early generation individuals and 10,000 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. *tritici*). 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 1750 Winter Wheat breeding lines. Over 1300 wheat lines were tested for better tolerance to various races of *Septoria* sp. and some 1200 wheat genotypes were scored for resistance to Black Point, Bunt and Loose Smut. Finally, in excess of 500 lentil selections 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. This verification normally requires 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.J. 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:	First year of three
Objective:	To evaluate the efficacy of registered fungicides and to evaluate the effect of timing on application of fungicides.

Foliar disease levels in Katepwa and Fielder wheat were significantly reduced in small plot field trials at Outlook in 1990 by applications of Tilt and Dithane fungicides. Symptoms on penultimate leaves were reduced from 29% to as low as 6%. Tilt reduced disease slightly more than Dithane and one spray of Tilt was just as effective as two sprays. Yield was also significantly improved by the Tilt sprays with a yield increase of 11% over the unsprayed plots. In the Tilt study on timing of application, disease levels were reduced by a single application of Tilt anytime between tillering and early milk growth stages but the best control occurred when spraying was done from booting to the emergence of inflorescence growth stages. Yield did not show a significant difference from the control for any treatment, although all treatments had greater yields than the control. The highest yields were 6% and 4% greater than the control when spraying was done at booting and emergence of inflorescence, respectively. *Septoria* leaf spot caused over 90% of the leaf spots with *Septoria nodorum* being the dominant pathogen while *S. avenae* f. sp. *triticea*, leaf rust and powdery mildew being less common.

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

Principal:	J.M. Clarke
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	G. McLeod, M. Fernandez, R. Knox, R. DePauw, B. Irvine
Location:	Swift Current and Outlook
Progress:	Year one of three
Objective:	To determine agronomic and disease resistance required for irrigated durum.

A two-replicate yield trial, comprising 200 lines (F_6 and F_8 breeding lines, introduced lines, and standard durum and bread wheat check cultivars), was grown under dryland and irrigation at Swift Current, and under irrigation at Outlook. Breeding lines that performed well at all three locations have been selected, and are being increased in California for further testing in 1991.

Some of the semidwarf breeding lines yielded more grain than the registered cultivars under irrigation (Table 1), but it still must be determined whether their quality is acceptable. Grades were reduced due to discoloration, mildew, and smudge. None of the registered cultivars were downgraded. There was considerable blackpoint on the grain from Outlook. The cultivars that were downgraded tended to have more blackpoint. Resistance to other diseases, such as tan spot/pink smudge is being tested in greenhouse and field experiments.

Table 1. Crop height, days to maturity, lodging, and grain yield, grain protein, and commercial grades of registered durum cultivars, advanced lines and introductions, and bread wheat checks grown under irrigation at Swift Current (SC) and at Outlook (Ou) in 1990.

Cultivar	Ht	Mat	Lod	Yield		Protein		Grade			
	Ou	Ou	Ou	SC	Ou	SC	Ou	SC	Ou	SC	Ou
	-cm-	-days-		--% of Kyle--		-%-					
Kyle	134	97	4[2]	6160[3]	7210[3]	12.3	12.4	1	CWAD	1	CWAD
Arcola	120	96	5	100.7	103.4	14.8	13.0	1	CWAD	1	CWAD
Medora	119	98	2	100.3	99.4	15.1	13.3	1	CWAD		-
Plenty	133	103	3	108.3	110.9	14.4	13.7	1	CWAD	1	CWAD
Sceptre	115	99	2	97.8	110.4	14.0	11.6	1	CWAD	1	CWAD
Wakooma	139	101	7	103.2	103.8	14.3	12.2	1	CWAD	1	CWAD
Cidall[1]	104	100	5	98.2	82.3	15.0	11.5	1	CWAD	2	CWAD
DT 367	125	102	4	114.5	107.8	13.0	11.0	1	CWAD	2	CWAD
DT 3691	107	100	4	115.2	115.0	13.9	11.1	1	CWAD	2	CWAD
8662-DL1B[1]	98	104	1	85.6	100.9	13.9	11.3	2	CWAD	2	CWAD
8663-CE2A[1]	107	103	1	118.1	124.1	12.9	11.2	1	CWAD	1	CWAD
8667-*I198C	115	100	2	100.9	107.0	14.8	12.6	1	CWAD	2	CWAD
8678-*I023C[1]	109	103	3	123.1	99.2	13.6	9.9	1	CWAD	1	CWAD
8678-*I048A[1]	107	108	2	120.4	116.4	12.8	11.0	1	CWAD	2	CWAD
Westbred 881[1]	97	104	3	87.5	100.3	13.2	11.9		-		-
Biggar[1]	96	104	3	110.4	105.1	10.4	9.4	1	CPSR	1	CPSR
Genesis	124	101	5	125.0	81.2	10.7	9.4		-	1	CPSW
Katepwa	103	95	4	90.6	81.1	14.5	12.6	1	CWRS	1	CWRS
Laura	113	99	3	89.4	87.9	14.8	12.8	1	CWRS	1	CWRS
Fielder[1]	105	103	5	108.8	93.3	10.0	9.3	1	CWSWS	1	CWSWS

1 semidwarf; 2 scale 1 to 9 (1=upright, 9=flat); 3 kg/ha.

Maximum Economic Yield

Principal: Outlook Irrigation Production Club
Funding: Irrigation Based Economic Development Agreement
Progress: Third year of four
Objectives:

a) to demonstrate the use and value of detailed field monitoring of irrigated crops;
b) to compare High Input Crop Management techniques to standard agronomic practices in an attempt to reach maximum economic yields;
c) to monitor crop growth and development to better understand crop growth stages and to improve the timing of application of agronomic inputs;
d) to improve the participants' knowledge of the effects of disease, lodging, irrigation scheduling, and agronomic practices on crop returns under irrigation.

The Club continued with the same nine members in 1990. 1989 results were presented to the public at the Irrigation Conference in March. Five informational and planning meetings were held during the year. The fields in the study were toured on July 25th.

Field demonstrations or trials were conducted on six of the nine fields. This included one field of Terpal C evaluations, two fields were treated with the fungicide Polyram DF and five fields received additional fertilizer. The first year of a two-year tiller investigation was carried out on a field of Canada Prairie Spring Wheat.

Moisture status, growth stage, disease incidence, lodging and field conditions were monitored and recorded weekly by the Crop Club's fieldman. Harvest data was collected in August. The data recorded was tabulated and summarized in the form of a report during January and February, 1991.

The results for 1990 were encouraging and informative. Many of the pre-harvest indicators and yield components such as seed emergence, plants per square meter, tillers per plant, heads per square meter, improved for all varieties in 1990 compared to 1988 and 1989.

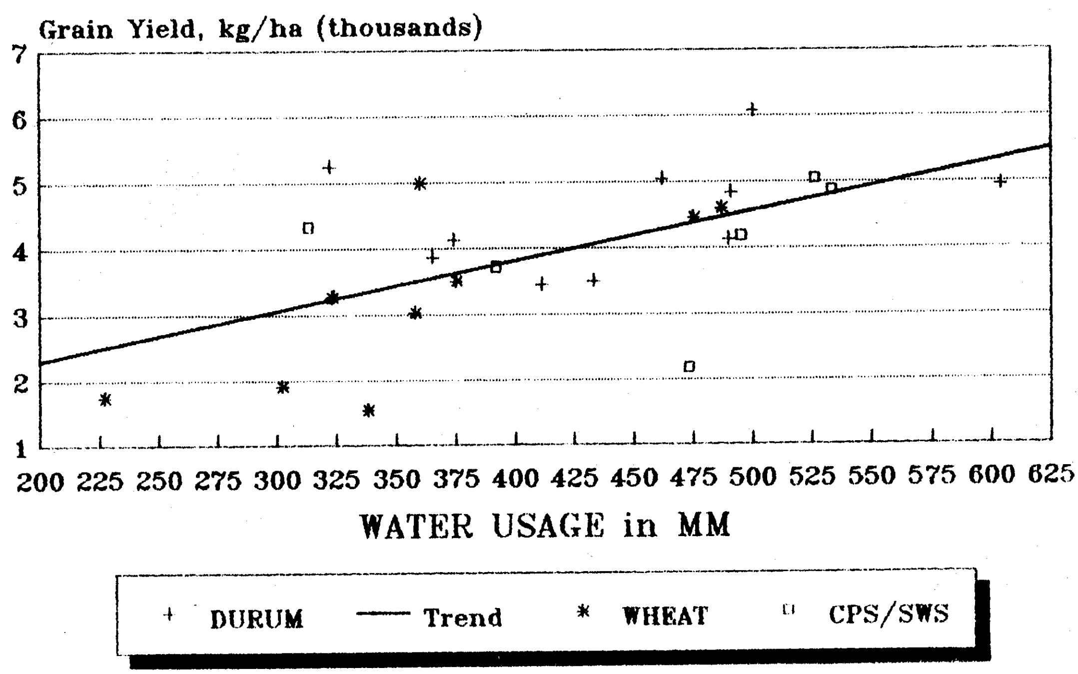
Once again, the additional fertilizer did not result in improved yield. It appears from three years of data that 150 kilograms per hectare of Nitrogen is adequate under irrigated conditions with current cereal varieties being grown.

Leaf disease and root diseases were much more prevalent in 1990. Economic losses from tanspot and common root rot occurred in four of the nine fields. Leaf diseases developed early in June on two fields and they were treated with Polyram DF. There was a positive economic return to the fungicide treatment. There was an approximate nine bushel per acre increase on ten square meter samples.

The application of high input package [PGR (Terpal C) and high fertility] resulted in a net loss of $26.00 per acre. The lodging incidence was very low in this field as it was for all the fields in the project in 1990. Results from three years of trials suggest that plant growth regulator is worthwhile only when lodging pressure is moderate to severe. The members of the club feel ease of harvest is a very important and economical benefit when growth regulators are used.

Water use efficiency (kilograms per millimetre) has steadily improved each year of the project. Average water use efficiency has been 8.6, 9.3, 11.4 for 1988, 1989 and 1990 respectively. (Figure 1) It appears that 375 millimetres of total water may be adequate for hard wheat but durum and Canada Prairie Spring/Soft White Spring will continue to respond to more water if it is available. The average yield for durum was 69 bushels per acre. Hard Red Spring wheat yielded 56 bushels per acre and Canada Prairie Spring soft white wheat yielded 70 bushels per acre.

FIGURE 1 CROP RESPONSE vs. WATER 1988,1989,1990



Irrigated Soft Wheat Production Package

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operators: L. and E. Ward, SIDC
Location: Birsay (W 1/2-16-24-8-3), Outlook (NW-26-29-8-3)
Progress: Year two of four
Objective: To develop a production package for irrigated soft wheat that will consistently produce economically high yields with acceptable seed quality.

The soft wheat production package was designed to demonstrate the effects of different nitrogen levels, row spacing, and fungicide applications on the yield of Fielder soft white spring wheat. Three nitrogen rates of 165 kg/ha, 140 kg/ha, and 112 kg/ha were used in conjunction with 8 cm and 16 cm row widths. A single seeding rate of 400 viable seeds/m^2 was used for the soft wheat demonstration which was based on the maximum economic yield recommendation from Alberta. A full rate of Tilt was applied at the recommended necessary stages and compared to a check area to evaluate the effect and economics of the fungicide application.

To date, there has been no yield advantage associated with the application of nitrogen in excess of 112 kg/ha to Fielder soft wheat. These results are of obvious economic importance to the producer. The main reason for this response is related to lodging. The highest level of applied nitrogen increased the lodging rate of the soft wheat which in turn resulted in a reduced seed weight of the harvested crop and ultimately a lower yield. Also, the increased nitrogen rates caused an increase in seed protein which is not acceptable for soft wheat production. A reduction in row spacing provided a similar response contrary to other studies. Reducing the spacing from 16 cm to 8 cm increased lodging rates in the plots by 20-25%. The increased lodging appeared to be responsible for the reduced seed weights and yield of the soft wheat.

In both of the first two years of the demonstration, the application of Tilt to the soft wheat significantly increased yield through an increase in seed weight. On average, the 1989 fungicide application produced an additional 636 kg/ha of soft wheat. In 1990, the fungicide application produced an additional 502 kg/ha of soft wheat. In both years, the yield increase was more than enough to pay for the cost of the Tilt.

Table 1. Effect of Tilt on the yield and economics of Fielder soft white spring wheat in 1989 and 1990 at Outlook, Saskatchewan.

Year	Yield (kg/ha) (Tilt)	(No Tilt)	Increased Return† ($/ha)	Cost of Tilt ($/ha)	Net Return‡ ($/ha)	($/ac)
1989	6735	6099	85	38	47	19
1990	5096	4594	59	38	21	8

† Based on an initial price for #1CW SWS of $133/tonne for 1989 and $117/tonne for 1990.

‡ The net return must also cover the cost of aerial or ground application of the product, and/or the cost of cropping reductions caused by tramlines (if used).

The average yield for 1990 was 19% lower than the soft wheat yield in 1989. The difference between the two years appeared to be in the number of heads produced per unit area. The same seeding rate resulted in an additional 40-60 heads per m^2 in 1989. The difference in yield between the two years may be as simple as seed lot, but may also be much more complex and unpredictable.

It should be noted that the objectives of the soft wheat production package will remain the same over the next two years. Additional emphasis will be placed on reducing the lodging potential of the irrigated crop. Seeding rates will be combined with existing row spacing treatments to evaluate their effect on lodging. Due to the positive response of Tilt, a fungicide application will remain as part of the package. Nitrogen levels in excess of 112 kg/ha will no longer be applied to the soft wheat because of their negative or no response effect on yield as well as increasing the level of lodging.

Irrigated Durum Production Package

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operators: L. and E. Ward, SIDC
Location: Birsay (W 1/2-16-24-8-3), Outlook (NW-26-29-8-3)
Progress: Year two of four
Objective: To develop a production package for irrigated durum that will consistently produce economically high yields with acceptable seed quality.

The irrigated durum production package was designed to demonstrate the effect of various combinations of nitrogen rate, seeding rate, and row spacing on the yield of Sceptre durum. A combination of three seeding rates (215, 320, and 430 seeds/m^2) and four row spacing (solid seeded, 8 cm, 16 cm, and 20 cm) were tested under two nitrogen application regimes of 112 kg/ha and 150 kg/ha. A single treatment combination consisting of solid seeded rows and 320 seeds/m^2 was tested under an additional two nitrogen regimes of 45 kg/ha and 80 kg/ha. The purpose was to ensure that adequate ranges of nitrogen were being used in the production package demonstration.

Nitrogen levels in excess of 112 kg/ha did not have a positive effect on yield of the Sceptre durum. The Outlook site did not see a response to nitrogen above the 45 kg/ha rate most likely due to the initial soil nitrate levels of 70 kg/ha. In fact, the highest level of nitrogen significantly reduced durum yield. Even with spring soil nitrate levels at Birsay being 20 kg/ha, there was no response to a nitrogen application greater than 112 kg/ha. Increasing the seeding rate from 215 to 430 seeds/m^2 also had a negative effect on yield. The number of heads produced per square meter was larger at the highest seeding rate, but lodging rate and severity was also increased which resulted in a reduced seed weight of the harvested crop and ultimately a lower yield.

Table 1. Effect of seeding rate on lodging rate, seed weight, and yield of Sceptre durum grown at Outlook and Birsay in 1990.

Seeding Rate (seeds/m^2)	[1](bu/ac)	Lodging Rate (%) OUTLOOK	Lodging Rate (%) BIRSAY	Seed Weight (g/1000) OUTLOOK	Seed Weight (g/1000) BIRSAY	Yield (kg/ha) OUTLOOK	Yield (kg/ha) BIRSAY
215	1.5	22	7	38.5	37.0	6350	5365
320	2	52	15	36.9	35.8	6028	5399
430	3	72	23	35.4	34.1	5747	5142

[1] These are approximate figures and are based on an estimated average seed weight of Sceptre durum of 45 g/1000.

Contrary to the results obtained from research in northern Saskatchewan, reducing the row spacing in the irrigated durum production package from 20 cm to 8 cm and solid seeded conditions did not increase wheat yield. These results are also supported by the lack of a yield response to narrow rows in the irrigated soft wheat and canola production packages.

The 1990 yield of the Sceptre durum displayed an overall average yield of 5,302 kg/ha at Birsay and 6,058 kg/ha at Outlook.

Relative Yields of Cereal Cultivars

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

Plots were 4.2 m wide and 9.1 m long with a row of winter wheat on each side of the plot. The plots at all sites were seeded at 300 seeds/m^2 in rows 20 cm apart. The entire plot was harvested and subsamples taken to determine moisture and dockage. Seeding dates and nutrient levels are given below:

Table 1. Seeding dates and nutrient levels for cereal variety test 1990.

		Soil test nutrient (kg/ha)				Fertilizer (kg/ha)	
Test	Seeding date	N	P	K	S	N	P_2O_5
E1989	May 12, 1989	40	22	320	105+	122	44
L1989	May 28, 1989	40	22	320	105+	122	44
E1990	May 4, 1990	45	22	300	80	132	55
L1990	May 28, 1990	45	22	300	80	132	55
B1990	May 23, 1990					122	55

E1989=Early 1989 Outlook, L1989=Late 1989 Outlook,
E1990=Early 1990 Outlook, L1990=Late 1990 Outlook, B1990=Birsay

Grain yields are reported at 14% moisture. Grade, protein and seed size were determined on a cleaned composite sample. Yields of all grains are expressed as (%HRS). The check cultivars for hard red spring (%HRS) are Katepwa and Roblin.

The most commonly grown barley cultivar, Harrington, yielded only slightly more than the mean of the hard red spring wheat checks (Table 2). This appears to be due to its high level of lodging and susceptibility to net blotch. The malting cultivar TR930, a two-row malt, also lodged badly but still produced 14% more grain than Harrington. The semi-dwarf barley cultivar Duke outyielded TR930 by 15% presumably due to superior lodging tolerance. Although Duke is a semidwarf cultivar it was only 10 cm or less shorter than the two-row types tested.

The hard red spring wheat cultivar Laura appears to be poorly adapted to production under center pivot irrigation yielding 18% less than the mean of the hard spring checks (Table 2). It was the lowest yielding hard red spring wheat in all five tests. HY368 (Biggar) out performed HY355 (Genesis) in all tests presumably due to its superior lodging resistance.

In both seasons, yields were lower and lodging was higher with late seeding (Table 2). It is premature to speculate whether late seeding increases lodging or if this is a chance event but all cultivars responded in the same way.

The late seeded test had lower grades than the early Outlook or Birsay tests (Table 3). This may be due in part to greater lodging. Protein contents of hard red spring and durum wheats were lower at Birsay than at Outlook. Protein content of all barley lines was higher than desireable for malting. Protein content of soft wheat was low enough to meet quality standards but the late seeded test was graded feed. Sceptre durum tended to have slightly lower protein than durum cultivars but still graded as well as other cultivars.

Table 2. Yield of cereal varieties of sites and years.

Cultivar	E1990 KG/HA	E1990 %HRS	L1990 KG/HA	L1990 %HRS	B1990 KG/HA	B1990 %HRS	E1989 KG/HA	E1989 %HRS	L1989 KG/HA	L1989 %HRS	OVERALL KG/HA	OVERALL % HRS
DUKE	6946	138	5954	130	6394	140	5953	110	6006	139	6250	131
HARRINGTON	5722	113	4264	93	4661	102	4806	88	4883	113	4867	102
TR490	6227	123	4593	101	4739	104	4967	91	4927	114	5091	107
TR930	6676	132	4928	108	5353	117	5887	108	4889	113	5547	116
HY355	5309	105	4558	100	4918	108	5394	99	4316	100	4899	102
HY368	6109	121	5077	111	5747	126	6629	122	4905	113	5693	119
ARCOLA	5008	99	4226	92	4284	94	5624	103	4466	103	4722	98
DT369	5590	111	4731	104	5207	114					5176	109
MEDORA	5166	102	4036	88	4518	99	5555	102	4171	96	4689	98
SCEPTRE	5628	111	4382	96	4715	103	6222	114	4397	101	5069	105
BW606	5359	106	4286	94	4401	96					4682	99
KATEPWA	5249	104	4769	104	4514	99	5455	100	4233	98	4844	101
LAURA	4274	85	3283	72	3467	76	5183	95	3543	82	3950	82
ROBLIN	4846	96	4369	96	4618	101	5416	100	4437	102	4737	99
FIELDER	5700	113	4678	102	5163	113	6234	115	4868	112	5329	111
SWS-52	4529	90	4272	93	4480	98					4427	94
BARLEY	6489	129	4935	108	5287	116	5403	99	5176	119	5458	114
CPS	5709	113	4817	105	5332	117	6011	111	4578	106	5289	110
DURUM	5371	106	4344	95	4681	103	5800	107	4349	100	4909	102
HRS	4938	98	4177	91	4250	93	5351	98	4071	94	4557	95
SWS	5115	101	4475	98	4822	106	6234	115	4868	112	5103	106
CV%	7.8		10.9		9.4		7.2		9.6			
LSD	610		702		648		582		566			

Table 3. Grade and protein of cereal cultivars 1990.

Cultivar	E1990 Grade	E1990 Prot	L1990 Grade	L1990 Prot	B1990† Grade	B1990† Prot
DUKE	1 CW	13.4	1 CW	14.2	1 CW	14.3
HARRINGTON	1 CW	14.3	1 CW	14.3	1 CW	13.0
TR490	1 CW	14.4	1 CW	14.9	1 CW	13 6
TR930	1 CW	13.4	1 CW	12.1	1 CW	13.9
HY355	1 CW	12.2	FEED	12.4	--	--
HY368	1 CPS	11.9	2 CPS	11.4	1 CPS	11.1
ARCOLA	3 CW	13.9	4 CW	13.8	1 CW	13.5
DT369	3 CW	13.4	3 CW	12.5	5 CW	11.5
MEDORA	2 CW	13.6	3 CW	12.6	2 CW	12.9
SCEPTRE	2 CW	13.4	3 CW	13.8	1 CW	11.1
BW606	2 CW	14.5	3 CW	14.9	2 CW	12.9
KATEPWA	2 CW	14.6	FEED	14.2	2 CW	12.3
LAURA	2 CW	14.4	FEED	14.6	3 CW	14.2
ROBLIN	2 CW	14.6	2 CW	14.9	2 CW	14.2
FIELDER	1 CW	11.3	FEED	11.8	2 CW	9.8
SWS-52	2 CW	11.3	FEED	10.5	1 CW	11.1

†Barley on 0% moisture basis

Cereal Recropping on Oilseed and Pulse Crop Stubble

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year three of four
Objective: To determine the yields of durum, soft wheat and malt barley grown on areas which had previously grown canola, pea, fababean, flax, peaola, N fertilized peaola and Canada Prairie Spring wheat.

As in previous years the test was a 4 replicate split block. Fielder soft wheat, Sceptre durum wheat and Harrington barley were planted May 5 at right angles to the plots on which the previous crop was grown. Plots were 11 rows wide with a seeding rate of 300 seeds/m^2. Plots were 5.18 m long but were trimmed to 2.2 m prior to harvest to remove end effects. Likewise the outside 2 rows of each plot were removed prior to harvest to reduce edge effects from adjacent plots. Mono-ammonium phosphate (11-52-0)) was sidebanded at 110 kg/ha and supplied 12 kg/ha N plus 57 kg/ha P_2O_5. Soil tests were taken in the fall of 1989 and additional nitrogen was added at 12, 52, 92 and 132 kg/ha. Soil test nutrient levels are listed below (kg/ha):

Table 1. Soil tests on nutrient levels on various crop residues.

Previous crop	N	P	K	S
	--------kg/ha------			
Canola	48	25	396	81
Wheat	35	34	484	68
Pea	57	30	385	73
Flax	29			
Fababean	32			

Samples were dried and weighed and subsamples were taken from each plot and composited by subplot prior to determination of protein and grade.

Analysis of variance indicated there were significant interactions between previous crops, current crop and nitrogen rate. The major differences were due to the lowest nitrogen rate and growing wheat on wheat residue.

Grain yield for Harrington in 1990 was almost 2,000 kg/ha less than in 1989. The yield of Fielder in 1989 was 6,842 kg/ha when well supplied with nitrogen while the 1990 yield was 5,447. The yield of Sceptre did not change appreciably (5561 vs 5367). Yield of Harrington was significantly lower than that of Fielder or Sceptre at all nitrogen rates (Table 2). At higher nitrogen rates Harrington yields declined (Fig 1) while other crop yields remained stable from 52 to 132 kg/ha of added nitrogen (Fig 2, Fig 3). Yield of cereal grains grown on flax or canola stubble were similar to yields grown on pulse stubble even at the 12 and 52 kg/ha of added N rates. While no estimates of nitrogen supplying power are available it appears that sufficient nitrogen was released from canola and flax residue to meet crop needs with as little as 52 kg/ha of added nitrogen fertilizer. Since the yield of Fielder and Sceptre on wheat stubble was 15-20% lower than on land which had grown other crops it would seem that crop rotational factors rather than nitrogen could be involved. Further evidence is that the flag leaf tissue nitrogen content of Sceptre durum increased from 2.73% with 12 kg/ha N to 4.39% with 52 kg/ha of added N, this value is the same as those taken from plots which had received higher levels of N.

Protein content of Sceptre durum was higher after pea and peaola mixtures than other crops including fababean (Table 3). Nitrogen application of 52 kg/ha was sufficient to attain protein contents of at least 12% on all crops except Sceptre on wheat residue.

Table 2. Effect of previous crop and nitrogen rate on the yields and lodging of Fielder, Sceptre and Harrington.

NRATE kg/ha	PREVIOUS CROP	GRAIN KG/HA	LODGING 1-9	GRAIN SE	LODGING SE
	CPS	4474	1.6	106	0.2
	Fababean	5213	2.3	94	0.3
	Canola	5225	2.4	91	0.3
	Flax	5136	2.2	104	0.3
	Pea	4993	2.8	103	0.3
	Peaola	4926	3.0	96	0.3
	Peaola50	5016	3.1	130	0.3
12		4912	1.5	80	0.1
52		5045	2.3	79	0.2
92		5030	3.0	81	0.2
132		5026	3.2	89	0.2
12	CPS	4171	1.0	315	0.0
12	Fababean	5061	1.1	139	0.1
12	Canola	5284	1.5	174	0.3
12	Flax	4675	1.0	159	0.0
12	Pea	4778	2.0	192	0.4
12	Peaola	5148	1.8	166	0.4
12	Peaola50	5127	2.3	217	0.5
52	CPS	4345	1.3	155	0.2
52	Fababean	5240	2.1	179	0.5
52	Canola	5176	2.1	147	0.5
52	Flax	5120	2.6	179	0.6
52	Pea	5104	2.6	208	0.4
52	Peaola	4981	3.2	224	0.5
52	Peaola50	5288	2.4	261	0.6
92	CPS	4743	2.4	162	0.5
92	Fababean	5242	2.9	219	0.6
92	Canola	5306	2.9	194	0.5
92	Flax	5530	2.8	217	0.7
92	Pea	4923	3.3	180	0.6
92	Peaola	4761	2.9	200	0.4
92	Peaola50	4693	3.5	231	0.6
132	CPS	4583	1.9	208	0.4
132	Fababean	5307	3.0	222	0.6
132	Canola	5136	3.2	227	0.6
132	Flax	5212	2.5	213	0.5
132	Pea	5166	3.3	245	0.6
132	Peaola	4816	4.0	176	0.6
132	Peaola50	4931	4.3	314	0.7

Fig 1 Effect of nitrogen rate and previous crop on yield of Harrington

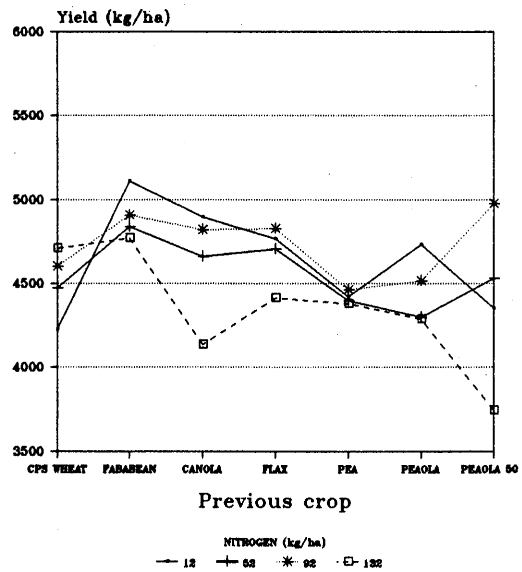


Fig 2 Effect of nitrogen rate and previous crop on yield of Fielder

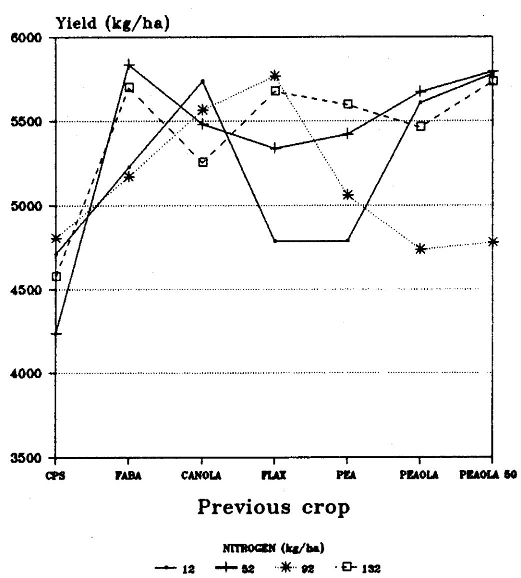


Fig 3 Effect of nitrogen rate and previous crop on yield of Sceptre

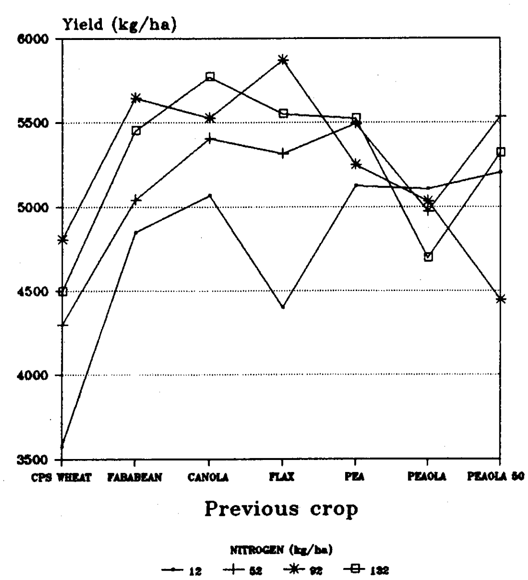


Table 3. Grade and protein of durum and soft wheat grown with differing levels of N on seven previous crop residues.

Previous crop	Nitrogen rate	Sceptre durum		Fielder soft wheat	
		Grade	Protein %	Grade	Protein %
	(kg/ha)				
CPS	12	3	9.57	1	9.40
	52	3	9.55	1	10.27
	92	1	10.95	1	10.30
	132	2	11.67	1	10.43
Fababean	12	3	9.77	1	9.71
	52	2	12.21	1	10.93
	92	2	12.45	1	11.25
	132	2	13.65	1	10.67
Canola	12	2	10.08	1	9.54
	52	2	11.83	2	10.58
	92	2	12.18	2	11.06
	132	2	12.78	1	11.49
Flax	12	3	9.76	1	9.71
	52	-	11.83	2	10.14
	92	2	12.17	2	10.55
	132	1	12.57	2	11.14
Pea	12	2	11.16	1	10.01
	52	2	12.62	2	10.98
	92	1	13.52	2	11.63
	132	2	14.00	2	11.68
Peaola	12	1	11.96	1	10.37
	52	2	13.01	1	11.47
	92	-	13.84	1	11.56
	132	3	14.73	1	12.10
Peaola50	12	2	12.17	1	11.56
	52	-	12.60	1	11.49
	92	-	14.57	1	11.56
	132	3	14.03	1	12.10

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: Year One of three
Objective: To determine the effect of plowing, discing and spiking combined with removal or retention of crop residues on the yields of subsquently grown wheat and barley crops.

Biggar CPS wheat and Harrington barley were seeded across plots established in 1989. Both crops were planted May 4 in plots 9.1 m wide with a 20 cm row spacing. Biggar was planted at 145 kg/ha and Harrington at 120 kg/ha. The lower seeding rate for barley was intended to reduce lodging. Nitrogen was sidebanded at 144 kg/ha, while P_2O_5 was applied at 55 kg/ha in the same band as the nitrogen.

At harvest a 2.01 m wide segment was harvested from the center of each plot. Samples were dried and weighed and subsamples were taken from each plot and composited by treatment prior to determination of protein and grade.

Analysis of variance was performed separately on each crop and comparisons between treatments were made using linear contrasts where feasible.

Plowing reduced the number of Biggar plants which emerged (Table 1). While a similar trend occurred in barley the effect was not significant (Table 2). This may have been due to a less compact seedbed and therefore deeper seeding. Accurate spike counts were impossible to obtain on barley due to the high level of lodging but in wheat there were no significant differences in head (spike) number. There was very little effect of tillage treatment, previous crop or residue removal on protein or grade.

Table 1. Effect of previous crop, tillage and residue management on plant number, head number and grain yield of Biggar CPS wheat.

Previous Crop	Residue Mgt	Tillage	Treat #	Plants $\#/m^2$	Heads $\#/m^2$	Grain kg/ha	Grade	Protein %
Durum	removed	disced	1	185	401	5977	1CPS	11.89
Flax	removed	disced	2	211	372	6224	1CPS	11.48
Canola	retained	disced	3	203	417	6549	1CPS	11.97
Durum	retained	disced	4	200	388	6044	1CPS	11.57
Durum	removed	plowed	5	169	385	6196	1CPS	11.97
Flax	removed	plowed	6	195	384	6131	1CPS	11.97
Canola	retained	plowed	7	176	377	5825	1CPS	12.33
Durum	retained	plowed	8	178	388	5675	1CPS	12.19
Flax	retained	plowed	9	185	370	6038	1CPS	12.20
Durum	removed	spiked	10	197	390	6119	1CPS	11.84
Flax	removed	spiked	11	184	372	6351	1CPS	11.87
Canola	retained	spiked	12	183	420	6478	1CPS	12.06
Durum	retained	spiked	13	187	388	6143	1CPS	11.62
CV%				7.1	10.3	5.0		
LSD				19.2	57.2	439		

Single degree of freedom comparisons indicated that removal or retention of durum crop residue did not affect grain yields of wheat or barley. Likewise, plowing did not affect yield relative to spiking or discing. There was a significant increase in wheat yield and a significant decrease in barley yield on flax and canola residue relative to durum residue. However, the size of difference was less than 1% and of little economic significance.

Table 2. Effect of previous crop, tillage and residue management on plant number and grain yield of Harrington barley.

Previous Crop	Residue Mgt	Tillage	Treat #	Plants #/m²	Grain kg/ha	Grade	Protein%†
Durum	removed	disced	1	173	4928	1 CW	14.10
Flax	removed	disced	2	185	4945	1 CW	13.72
Canola	retained	disced	3	170	4779	1 CW	13.92
Durum	retained	disced	4	172	4784	1 CW	13.93
Durum	removed	plowed	5	159	5057	1 CW	14.12
Flax	removed	plowed	6	163	4891	1 CW	14.25
Canola	retained	plowed	7	152	5064	1 CW	13.96
Durum	retained	plowed	8	158	5340	1 CW	13.83
Flax	retained	plowed	9	160	5196	1 CW	13.47
Durum	removed	spiked	10	168	5212	1 CW	13.83
Flax	removed	spiked	11	172	4711	1 CW	14.00
Canola	retained	spiked	12	172	4930	1 CW	14.81
Durum	retained	spiked	13	162	5154	1 CW	13.86
CV%				7.7	4.5		
LSD				18.4	324		

† barley on dry basis

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

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year two of three
Objective: To determine the effect of plowing, discing and spiking combined with removal or retention of crop residues on the yield of subsequent crops. (Cycle 2, Year 1, production of residues)

The test was a four replicate RCBD with plots 4.57 m wide and 33 m long with 0.6 m between adjacent plots to facilitate seeding and harvesting operations. The plots were trimmed to 30 m prior to harvesting. Plots which were to be planted to canola and flax were treated with Treflan (trifluralin) at 1.7 l/ha in the fall of 1989. Plots were seeded May 5 with a hoe type drill with a 20 cm row spacing. Soil test nutrient levels (kg/ha) were: N 40, P 24, K 495 and S 98. Nitrogen and phosphorous (P_2O_5) were sidebanded at 145 kg/ha and 66 kg/ha respectively. Global canola was seeded at 9 kg/ha, McGregor flax at 45 kg/ha and Sceptre durum wheat at 130 kg/ha.

Flax was desiccated and then straight cut harvested. Durum was also straight cut harvested. The canola was swathed but yields were not accurate since a strong wind blew some of the swaths around resulting in shattering and removal of material from the plot area. The plots where crop residues were retained were mowed with a rotary mower to reduce the length of the crop residue. The tillage treatments were imposed in late September. The discing treatment was to a depth of only 5-6 cm rather than 10 cm as in the previous season.

Canola yields were significantly lower than flax yields which were lower than durum yields (Table 1). The low yields of canola were the result of wind damage and possibly disease and lodging. Flax yields were lowered due to uneven plant stands likely resulting from seeding into cold soils treated with trifluralin. Rotary mowing or flail shredding of straw could be a very effective method of managing crop residues.

Table 1. Yields of crops grown to provide residue.

		Grain			Straw	
Crop	Cultivar	kg/ha	SD	Grade	kg/ha	SD
Canola	Global	1205	264	1		
Flax	McGregor	2073	164	1	1724	577
Durum	Sceptre	4977	421	2	1764	546

Dwarf Oat Trial 1990

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objective: To determine the yield, quality and lodging potential of semi-dwarf and conventional height oat cultivars.

The test was a six replicate randomized complete block using 11 row plots 7.8 m long with a 20 cm row spacing. Seeding rate was 250 seeds/m^2. Plots were seeded May 14 using a hoedrill which sidebanded P_2O_5 at 55 kg/ha. All rows were harvested for grain. Nitrogen was broadcast at 55 kg/ha. Soil test nutrient levels (kg/ha) were: N 130, P 24, K 224, and S 108+.

Table 1. Yield and agronomic traits of oat cultivars.

	Yield (kg/ha)				Lodging		Height cm	
Cultivar	1988	1989	1990	%Calibre	1989	1990	1989	1990
Calibre	4356	7117	5918	100	6.2	6.5	120	123
Robert	4577	7085	5831	100	6.0	5.8	116	112
OT255		6624	5751	100	7.8	7.2	123	121
OT257	4405	7392	6458	105	1.0	1.0	94	81
W86012	4692	7586		107	4.3		104	
W86693		6176			6.3		117	
Biggar			4159			1.0		89
CV%		15.6	10.3		40.9	26.3	6.4	4.3
LSD		1312	694		2.6	1.3	8.6	5.4

As in previous seasons the oat line OT257 combined high yield, short plant stature and no lodging (Table 1). This line would be well adapted to irrigation but it is late maturing and may not be registered for this reason.

Oilseeds

Irrigated Canola Production Package

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

The canola production package was designed to demonstrate the effect of row spacing (seeding methodologies) on canola yield and to evaluate a *Sclerotinia* forecasting procedure along with the efficiency of a fungicide application for disease control. Five row spacing treatments of 8 cm, 16 cm, 20 cm, solid seeded, and broadcast and incorporated were compared at a constant seeding rate of 215 seeds/m^2. The broadcast and incorporated method was designed to imitate seeding canola with a Valmar applicator mounted on a cultivator. The solid seeded method was created by attaching deflector plates to the underside of the cultivator shovels from an air drill. An Amazone narrow row spacing drill with hoe type openers was used to generate the 8 and 16 cm row spacing and an air drill, also with hoe type openers was used to generate the 20 cm spacing. The *Sclerotinia* forecasting procedure used was the canola petal test developed by Robin Morrall at the University of Saskatchewan. The petal test was designed to forecast *Sclerotinia* infection levels with the intention of aiding the producer in fungicide application decisions. Three levels of fungicide (check, medium rate, and a high rate) were applied to the canola to evaluate the results of the petal test.

Two years of information on the irrigated canola production package produced some interesting observations. Contrary to the results of research work located in areas of northern Alberta and Saskatchewan, a reduction in row spacing below 20 cm had no significant effect on the irrigated canola yield in the Lake Diefenbaker region of Saskatchewan. It should also be noted that row spacing did not have any effect on the rate or severity of lodging of the canola plants. The average yield of the Global canola for 1989-90, over the range of row spacing treatments, was 2,491 kg/ha. To date, the application of a fungicide to the canola production package has shown neither an economic or yield advantage. The petal testing procedure has proved to be a good forecasting tool for *Sclerotinia* infection. Unfortunately, the results of the test were available too late to be of value to the producer.

Table 1. Effect of fungicide on *Sclerotinia* infection and yield of Global canola grown in the Lake Diefenbaker area in 1989 and 1990.

	Sclerotinia Infection (%)			Yield (kg/ha)		
Fungicide Rate (Rovral Flo)	OUTLOOK (1989)	OUTLOOK (1990)	RIVERHURST (1990)	OUTLOOK (1989)	OUTLOOK (1990)	RIVERHURST (1990)
0 L/ha	28.7	29.8	11.9	2609	2446	2527
2 L/ha	19.6	26.7	11.2	2618	2485	2506
3 L/ha	15.1	27.3	11.9	2512	2558	2385

A significant harvestability and production limitation of canola can be lodging. The stage during the growing season at which the plants begin to lodge and the rate and severity of lodging are important to disease progression through plant contact. Proper varietal selection can help reduce the lodging potential in the field. Global was selected for that reason. Global will lodge, but the lodging generally occurred late enough during the season that any disease transfer and subsequent infection were too late to cause any yield reduction. In addition, the rate and severity of the lodging that occurred did not restrict air movement within the canopy. Based on results from the canola variety demonstration, Topaz is a strong strawed, high yielding variety that responds as well or even better than Global under irrigated conditions.

It should be noted that over the next few years the emphasis of the canola production package will be to determine a seeding method (seeding rate and row spacing combinations) for canola that will consistently reduce the lodging potential of the irrigated crop. Attempting to reduce or eliminate the lodging potential of the canola crop may be more effective in controlling disease transfer than a fungicide, and more economical for the producer.

Irrigated Canola Variety Demonstration Update (1986-1990)

Principal: D. Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Locations: Outlook, Birsay, and Riverhurst
Progress: Fifth 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 in 1986. Project location is intended to remain within the irrigation districts surrounding Lake Diefenbaker to obtain varietal information for these climatic conditions.

Four new varieties (Celebra, Vanguard, Profit, and Parkland) were introduced in 1990 into the irrigated variety comparison. Westar was removed. Under irrigated conditions in the regions used for this demonstration, Westar exhibited high levels of lodging, disease incidence, seed chlorophyll content, and ultimately lower yields. Profit replaced Westar because it has similar seed quality characteristics and maturity, but the Regional test showed more resistance to lodging and blackleg infection. Celebra and Vanguard are classified as high yielding varieties with acceptable seed quality that are five-seven days earlier maturing than Global and Topaz. A new Polish variety, Parkland, was introduced into the variety demonstration because of its yield potential (8-12%) higher than other Polish varieties. The previously tested varieties were Global, Topaz, Pivot, Legend, and Delta.

Table 1. Main characteristics of the varieties grown in the irrigated canola variety demonstration in the Lake Diefenbaker region of Saskatchewan (1986-1990).

Variety	Site Years	Average Yield[1] (% of Global)	Days to Swathing	Resistance to Lodging	Blackleg Infection (%)	Seed Chlorophyll (ppm)	Oil (%)	Protein (%)
Celebra	1	88	100	Fair	7.2	10.4	47.4	42.1
Delta	3	80	99	Poor	15.7	5.6	44.8	41.7
Global	8	100	105	Good	10.0	12.9	45.0	41.5
Legend	3	79	96	Poor	12.5	9.4	46.3	43.6
Pivot	7	85	101	Fair	15.6	14.4	46.0	44.6
Profit	1	70	100	Poor	10.0	10.7	48.4	41.9
Topaz	7	103	105	Excellent	7.8	11.4	46.5	44.5
Vanguard	1	74	98	Poor	12.4	9.7	45.8	43.7
Parkland	1	76	82	Poor	18.3	0.5	45.3	42.0

[1] The average yield of Global is 2300 kg/ha, with a range among the years of 1,890 kg/ha to 3,175 kg/ha.

Global and Topaz remain the highest yielding canola varieties and will continue to be the recommended varieties under irrigated conditions in areas where a longer growing season is not a concern. These varieties exhibit better straw strength and reduced amounts of lodging. This makes swathing easier and helps reduce the transfer of disease through plant contact. This is especially noticeable with *Sclerotinia* infection. The varieties that lodged most have generally exhibited the highest levels of *Sclerotinia* infection. Blackleg infection appears to be consistent among varieties with the stronger strawed cultivars showing the least susceptibility over time.

The seed quality characteristics of the different varieties were excellent for the 1990 growing season in comparison with the provincial average of 41.6% and 38.6% for oil and protein content, respectively.

Although Parkland is considered to be higher yielding than its Polish counterparts, it is still much lower yielding than the best Argentine varieties under irrigation. However, Parkland does provide an alternative in situations where a very short season crop is required or straight combining is the preferred method of harvest.

Irrigated Production of Hybrid Canola Seed

Principal: D.S. Hutcheson, Agriculture Canada Research Station
Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: Second year of four
Objective: To examine both traditional and unconventional hybrid seed production techniques to foster the development of a Saskatchewan based hybrid canola seed production industry.

Two years of seed production experiments have indicated the feasibility of a novel technique for the production of hybrid canola seed. Field trials conducted at three locations in 1990 provide evidence that hybrid seed produced using the novel technique performs essentially as well as seed produced using more expensive conventional procedures. The hybrid used in this study has completed the first of three years of pre-registration testing and will be eligible for registration in early 1993.

Table 1. Yield of hybrid seed lots admixed with various levels of the male parent (Rf) in Saskatchewan, 1990 as a percent of cv. Westar and compared to Hyola 40.

	Yield % of cv. Westar			
Hybrid Seed Lot (%F1 : %Rf)	Saskatoon (dryland)	Scott (dryland)	Outlook (irrigated)	Mean
100 : 0	127.3	132.6	156.3	138.7
95 : 5	120.0	125.6	174.9	140.2
90 : 10	116.4	125.3	135.4	125.7
85 : 15	119.9	138.5	141.3	133.2
80 : 20	120.6	140.9	142.8	134.8
75 : 25	124.4	128.6	143.0	132.0
70 : 30	113.3	124.5	157.9	131.9
65 : 35	122.8	141.1	117.4	127.1
60 : 40	126.9	130.1	120.1	125.7
Hyola 40	105.1	109.8	130.6	115.2

Canola Productivity Centre Pilot Project

Principal: Canola Council of Canada
Funding: Irrigation Based Economic Development Agreement
Co-investigator: J. Bessel, Canola Council agronomist for Saskatchewan
Co-operator: G. and B. Kent
Location: Riverhurst, Saskatchewan
Progress: One year only
Objective:

To demonstrate practical canola production technology by:

a) testing three different seeding rates for their production capabilities and, thus, to determine the most satisfactory seeding rate;
b) observing new *B. campestris* varieties, Parkland and Horizon, and to determine the yield and quality factors in comparison to Tobin;
c) comparing nitrogen nutrient levels at below, above and meeting soil test recommendations, and also comparing yield and quality factors;
d) comparing new harvesting techniques of straight combining versus swathing of *B. campestris* canola.

The following tables represent one year's data collected in 1990.

Table 1. Yield and quality data - seeding rate trial (Tobin) - Riverhurst Canola Production Center.

	Low 3.4 lbs/ac†	Medium 6.7 lbs/ac	High 10.9 lbs/ac
Yield (bu/ac)	25.9 - 99%	26.2 - 100%‡	25.1 - 96%
Oil %	44.7	44.8	45.1
Protein %	22.6	22.6	22.3
Chll -ppm	1.6	2.0	1.1
Plants/sq. meter§	77.0	85.0	94.0

†lbs/ac raw seed only.
‡Percentage using the medium seeding rate as a base (100%).
§Plant counts taken at 3-4 leaf stage of plant development.

Table 2. Yield and quality data - Variety Comparison Trial - *B. campestris* Varieties - Riverhurst Canola Production Center.

	Tobin	Parkland	Horizon
Yield (bu/ac)	25.6 - 100%†	25.8 - 97%	23.0 - 90%
Oil %	44.7	45.1	45.3
Protein %	21.9	21.8	21.6
Chll -ppm	0.3	0.0	0.0
Plants/sq. meter	77.0	85.0	94.0

†Indicates yield as a percentage using the variety Tobin as a base (100%).

Table 3. Yield results - Nitrogen Fertility Trial - Tobin Riverhurst Canola Production Center.

	Yield (bu/ac)	Chll - ppm	Oil %	Protein
Low nitrogen (124.0 lb/ac)	25.1 (90%)	0.7	44.9	22.3
Medium nitrogen (140.0 lb/ac)	27.8 (100%)	1.2	43.8	22.8
High nitrogen (170 lbs/ac)	29.3 (107%)	0.7	44.4	23.0
High post emergent nitrogen (176.0 lb/ac)	27.9 (100%)	1.5	43.1	23.6

Table 4. Yield and quality results - Straight Combining vs. Swathing Trial Tobin - Riverhurst Canola Production Center.

	Swathed	Swathed Combined
Yield (bu/ac)	28.4	35.5
Yield %	100%	120%
Oil %	44.5	44.3
Protein %	22.3	22.4
Chll -ppm	0.5	0.3

1990 Regional Canola Test

Principal: R.K. Downey, Agriculture Canada Research Station
Saskatoon, Saskatchewan
Co-operator: Saskatchewan Irrigation Development Centre

The test was seeded at 32 locations, 20 in Saskatchewan, two in Alberta and ten in the Northern States. The complete test was lost at Shellbrook, Fox Valley, Girvin, Canora, Prosser, and Lethbridge Dryland. Also lost was the *B. campestris* portion of the test at Codette, Riverhurst and Langdon. The *B. napus* portion of the test at Moscow, Cando and Minot, as well as the *B. campestris* portion at Moscow, Cando and Prosper, had a CV greater than 25% and were not used in the averages. The *B. napus* strains ACS-N1, ACS-N4 and AU154 were named Excel, Tristar and Bounty. The *B. campestris* strain 83-51243N was named Eclipse.

The design of the test was a randomized complete block with three or four replicates. Oil content was determined at the Saskatoon Research Station using a Newport Mark III.A NMR spectrometer. The test was co-ordinated by the Saskatoon Research Station, only the Outlook results are reported here.

	Yield of seed (00's kg/ha)		Oil content in percent of dry weight		Resistance to lodging (1-Good, 5-Poor)	Days from seeding to maturity
	Outlook ADF	Outlook Irrigated	Outlook ADF	Outlook Irrigated	Outlook Irrigated	Outlook Irrigated
B. napus strains:						
Westar	20.0	15.2	44.6	41.2	2.8	92
Regent	21.2	17.6	45.0	40.6	2.0	95
Tribute	15.9	10.1	39.2	36.8	4.5	94
Profit	21.4	17.0	45.0	41.4	2.0	96
Excel	17.1	22.5	45.8	42.8	1.2	95
Stallion	18.1	18.6	42.2	38.0	1.0	96
Tristar	17.1	10.7	42.4	38.8	3.2	91
Legend	22.4	21.8	44.2	41.0	1.5	96
Celebra	22.4	21.5	45.8	41.0	1.0	96
Vanguard	23.7	20.3	43.3	40.8	1.5	96
Alto	21.4	18.1	43.0	39.4	3.2	91
Delta	24.7	22.2	43.4	41.0	1.0	96
Hyola 40	24.5	22.5	43.2	40.2	1.2	96
Bounty	24.9	23.2	42.7	40.8	1.2	96
Average	21.1	18.7	43.6	40.3	2.0	95
CV	11.7	10.7	1.9	2.4		
L.S.D. 5%	3.5	2.8	1.8	2.0		
B. campestris strains:						
Tobin	21.0	13.7	42.8	40.5	2.2	77
Horizon	19.4	14.5	44.0	41.2	2.0	78
Colt	19.7	12.7	44.2	41.8	2.0	78
Parkland	18.7	11.7	44.0	40.8	2.5	78
Eclipse	19.1	12.1	44.8	40.7	2.2	78
Average	19.6	13.0	43.9	41.0	2.2	78
CV	9.5	11.2	0.5	2.4		
L.S.D. 5%	N.S.	2.2	0.6	N.S.		

Canola/Rapeseed Co-operative Trials at Outlook

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

The test was grown at 28 locations in western Canada, 11 in the mid-season zone, seven in the short season zone, eight in the long season zone and two in the irrigation zone. The complete tests were lost due to hail at Altona and poor germination at Aylsham. The *Napus* portion of the test was lost due to flooding at Winnipeg and poor germination at Sexsmith. Both the *Napus* and *Campestris* at Lethbridge dryland, the *Napus* at Sexsmith and High Level; the *Campestris* portion of the test at Thornhill had a CV greater than 25%. Yield data from these sites was not included in the averages. All locations either cut or straight combined strains according to maturity.

Saskatoon *B. napus* strains ACS-N1 and triazine-resistant strain ACS-N4 were licensed and named Excel and Tristar. Also licensed were triazine-resistant strains SV8525953, Stallion (Svalof), *Napus* strain AU154, Bounty (Allelix) and *Campestris* strain 83-51243N Eclipse (U of A).

All 38 strains were seeded at all locations. The 30 *B. napus* entries were arranged in a 5 X 6 rectangular lattice and the eight *B. campestris* entries in a randomized complete block. All entries were replicated four times at each location.

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

The irrigation zone results are reported in Tables 1, 2, 3 and 4.

Mustard Co-operative Trials at Outlook

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

The test was grown at 12 locations, three in Alberta, five in Saskatchewan, one in Manitoba and two in North Dakota. With the exception of *Sinapis alba* portion of the test at Lethbridge, all sites had acceptable data with a number of locations having a CV of less than 10%.

Oil content was determined at Saskatoon using a Newport Mark III.A NMR spectrometer. Glucosinolate analyses were done by gas chromatography of the Trimethylsilyl glucosinolates using benzyl glucosinolate as an internal standard. All quality analyses were done in duplicate for each strain.

The Outlook results are reported in Table 5.

Table 1. ***Brassica napus*** and ***B. Campestris*** 1990 - Co-op A test yield of seed (00's kg/ha) irrigation zone.

Strains	Outlook	Lethbridge	Average	% of Westar Check	Rank
B. napus					
Westar	13.2	25.8	19.5	100.0	27
Regent	17.8	20.8	19.3	100.0	27
XE1516	21.1	23.2	22.2	113.8	22
S85-1426	17.7	18.3	18.0	92.3	29
Sv02406	27.2	23.7	25.5	130.8	11
CS005	24.1	29.3	26.7	136.9	4
Pald 21-88	22.7	23.9	23.3	119.5	20
K4-87	15.5	27.5	21.5	110.3	23
ACS-N8	23.6	28.0	25.8	132.3	9
CS017	24.3	24.6	24.5	125.6	14
A0337	21.9	30.8	26.4	135.4	5
Stellar	16.5	16.7	16.6	85.1	30
Pald 10-88	24.5	29.8	27.2	139.5	1
Legend	24.1	28.2	26.2	134.4	8
CS010	23.3	24.2	23.8	122.0	18
AU093	21.0	26.9	24.0	123.1	16
CS011	25.0	27.7	26.4	135.4	5
K36-87	19.3	28.9	24.1	123.6	15
BSI-87	25.2	26.4	25.8	132.3	9
AU138	24.0	26.2	25.1	128.7	12
K255-88	16.6	28.4	22.5	115.4	21
BS3-87	24.4	23.0	23.7	121.5	19
A0327	24.2	25.5	24.9	127.7	13
Hero	19.2	20.7	20.0	102.6	26
CS016	23.5	29.2	26.4	135.4	5
Profit	20.2	21.3	20.8	106.7	25
K10-87	24.1	29.4	26.8	137.4	3
Delta	25.5	28.6	27.1	139.0	2
S84-2208	19.6	22.1	20.9	107.2	24
Hyola 40	23.4	24.2	23.8	122.1	17
Average	21.8	25.4	23.6		
CV%	12.7	14.1			
LSD 5%	4.0	6.1			
B. campestris				% of Tobin Check	
Tobin	14.5	25.4	20.0	100.0	1
Parkland	13.9	24.1	19.0	95.0	6
Horizon	14.8	23.4	19.1	95.5	4
DL6272	14.5	22.9	18.7	93.5	7
Sv03616	14.3	23.9	19.1	95.5	4
S83-5009W	14.1	24.9	19.5	97.5	2
AK88998	13.6	25.3	19.5	97.5	2
84-56552N	13.3	22.8	18.1	90.5	8
Average	14.1	24.1	19.1		
CV%	11.6	10.6			
LSD 5%	N.S.	N.S.			

Table 2. *Brassica napus* and *B. campestris* Test 1990 - Co-op A test oil content in percent of dry weight irrigation zone.

Strains	Outlook	Lethbridge	Average	Rank
B. napus				
Westar	40.0	43.0	41.5	28
Regent	42.2	44.8	43.5	12
XE1516	39.8	42.9	41.4	29
S85-1426	42.5	44.6	43.6	11
Sv02406	44.0	45.8	44.9	4
CS005	42.2	44.8	43.5	12
Pald 21-88	43.8	46.9	45.4	2
K4-87	40.8	45.9	43.4	14
ACS-N8	42.8	45.2	44.0	9
CS017	43.3	45.1	44.2	8
A0337	41.6	44.2	42.9	17
Stellar	40.0	41.8	40.9	30
Pald 10-88	42.4	46.2	44.3	7
Legend	40.9	44.2	42.6	20
CS010	41.7	43.6	42.6	20
AU093	41.6	43.8	42.7	19
CS011	42.0	43.6	42.8	18
K36-87	40.4	44.6	42.5	24
BSI-87	43.8	46.4	45.1	3
AU138	42.1	43.8	43.0	16
K255-88	41.0	44.3	42.6	20
BS3-87	41.4	43.8	42.6	20
A0327	42.0	44.6	43.3	15
Hero	43.7	45.8	44.8	5
CS016	40.8	42.5	42.0	27
Profit	42.7	46.0	44.4	6
K10-87	42.4	45.2	43.8	10
Delta	41.2	43.8	42.5	24
S84-2208	44.6	46.4	45.5	1
Hyola 40	41.4	43.0	42.2	26
Average	42.0	44.5	43.3	
CV%	1.8	2.0		
LSD 5%	1.6	1.9		
B. campestris				
Tobin	40.5	43.4	42.0	6
Parkland	41.2	45.3	43.2	3
Horizon	41.4	45.0	43.2	3
DL6272	40.4	43.8	42.1	5
Sv03616	39.2	43.6	41.4	7
S83-5009W	42.8	45.6	44.2	1
AK88998	39.3	41.7	40.5	8
84-56552N	42.0	44.6	43.3	2
Average	40.8	44.1	42.5	
CV%	1.5	1.7		
LSD 5%	1.4	1.8		

Table 3. Irrigated *Brassica napus* and *B. campestris* 1990 - Co-op A test days from seeding to maturity.

Strains	Outlook	Lethbridge
B. napus		
Westar	88	97
Regent	92	100
XE1516	92	99
S85-1426	90	100
Sv02406	96	104
CS005	94	102
Pald 21-88	94	104
K4-87	92	98
ACS-N8	91	99
CS017	91	100
A0337	94	100
Stellar	93	104
Pald 10-88	92	98
Legend	93	98
CS010	92	100
AU093	91	96
CS011	88	98
K36-87	88	98
BSI-87	96	103
AU138	92	99
K255-88	92	99
BS3-87	96	104
A0327	92	100
Hero	88	96
CS016	89	99
Profit	92	99
K10-87	91	100
Delta	92	100
S84-2208	90	96
Hyola 40	92	98
Average	92	100
B. campestris		
Tobin	74	87
Parkland	75	87
Horizon	75	88
DL627	75	86
Sv03616	76	88
S83-5009W	75	88
AK88998	75	87
84-56552N	75	86
Average	75	87

Table 4. Irrigated *Brassica napus* and *B. campestris* 1990 - Co-op A test resistance to lodging (1 Good-5 Poor).

Strains	Outlook	Lethbridge
B. napus		
Westar	4.5	3.8
Regent	2.5	3.2
XE1516	3.2	3.2
S85-1426	2.8	3.8
Sv02406	1.0	1.0
CS005	1.5	1.8
Pald 21-88	1.0	1.2
K4-87	2.5	2.5
ACS-N8	2.2	3.8
CS017	2.2	2.2
A0337	1.8	1.2
Stellar	4.5	5.0
Pald 10-88	1.8	1.8
Legend	2.8	1.5
CS010	2.5	1.2
AU093	2.0	2.2
CS011	2.2	2.2
K36-87	3.0	2.2
BSI-87	1.0	1.5
AU138	1.8	2.8
K255-88	2.2	2.2
BS3-87	1.0	1.5
A0327	1.2	1.8
Hero	1.8	3.2
CS016	2.2	2.5
Profit	3.2	3.0
K10-87	1.8	2.5
Delta	2.5	2.5
S84-2208	2.0	2.2
Hyola 40	2.2	2.0
Average	2.2	2.4
B. campestris		
Tobin	3.0	3.0
Parkland	2.8	2.5
Horizon	2.0	3.0
DL627	1.8	2.5
Sv03616	2.2	3.0
S83-5009W	2.8	3.2
AK88998	2.8	3.0
84-56552N	2.2	3.0
Average	2.4	2.9

Table 5. Mustard Co-operative Trial, 1990, Outlook, Saskatchewan.

Strain & Species	Yield (kg/ha)	Oil Content %	Days from seeding to maturity	Resistance to Lodging 1-Good;5-Poor	Allyl Isothiocyanate content (mg/gm)	Hydroxybenzyl glucosinolate (micromole/gm)
B. juncea						
Cutlass	2890	38.2	92	2.5	18.6	
Leth. 22A	2436	37.0	94	1.8	15.0	
Blaze	2698	34.2	93	2.8	15.2	
Comm. Brown	2475	33.8	94	2.2	14.9	
Forge	3140	35.4	92	3.0	20.3	
CBWR	2160	32.4	93	2.0	17.3	
Average	2633	35.2	93	2.4	16.9	
CV%	14.6	1.4				
L.S.D. 5%	575	1.3				
S. alba						
Gisilba	2727	27.7	93	2.0		193.6
Ochre	2299	30.6	90	1.8		205.0
Tilney	2255	28.8	92	1.0		185.2
CW/89/TY	2672	28.1	96	1.0		195.4
Average	2488	28.8	92	1.4		194.8
CV%	14.8	2.0				
L.S.D. 5%	N.S.	1.8				

Last year's Research and Demonstration Highlights presented the 1989 data in a similar table to allow comparison with the current year's figures.

Pea/Canola and Mustard Intercropping

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year one of three
Objective: To determine the yield and economic performance of intercropping canola or mustard with peas.

Victoria pea was seeded at a depth of 5 cm prior to the oilseeds. The oilseeds were planted at a depth of 1.5 cm in a second operation. Victoria pea was planted at 50 seeds/m^2 when planted with canola and 80 seeds/m^2 when seeded alone. Canola and mustard were planted at 112 seeds/m^2 when planted with pea and 224 seeds/m^2 when seeded alone. Plots consisted of 11 rows 9.14 m long with a 20 cm row spacing. When the two crops were seeded together, canola was planted between the pea rows in a second operation. Cutlass oriental mustard, Delta and Global *Brassica napus* and Parkland *B. campestris* canola were seeded to obtain a range of oilseed maturities. Soil test nutrient levels (kg/ha) were: N 34, P 26, K 440, S 90. Prior to planting, nitrogen was applied as ammonium nitrate at 35 kg/ha to plots where pea or pea and canola were to be seeded and 120 kg/ha where canola or mustard were to be planted. The test was planted May 29 in a randomized complete block design with six replicates. Separate ANOVA's were run for the pea and canola components as well as the total yield.

Oilseed yields were low when grown in mixture with Victoria pea but given average long term prices, the mixtures were often more profitable (Table 1). Pea grown with Cutlass oriental mustard and Delta

B. napus canola appeared to produce more seed than Victoria pea alone but this was not a significant difference. Parkland *B. campestris* canola alone or Victoria pea alone gave the lowest gross returns. It is premature to attach any significance to one site year of work.

Table 1. Yields of pea/canola or pea/mustard mixtures.

Treatment	Pea kg/ha	Canola kg/ha	% Canola /mustard	Total kg/ha	$/ac†
Cutlass & Victoria	3289	353	10	3641	287
Cutlass	0	2279	100	2279	258
Delta	0	1881	100	1881	213
Delta & Victoria	3483	310	8	3793	297
Global	0	2233	100	2233	253
Global & Victoria	2681	396	13	3078	246
Parkland & Victoria	2965	187	6	3152	244
Parkland	0	1808	100	1808	205
Victoria	2827	0	0	2827	213
CV%	16.6	25.3		16.2	
LSD	638	365		583	

†pea $186/tonne, canola $280/tonne, mustard $280/tonne
(prices vary widely)

Yield of Pulse and Oilseed Crops under Irrigation

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objective: To determine the yield of pulse and oilseed crops under irrigation and to determine the effect of these crops on subsequent yields of cereal grains.

The crops were planted and managed at the best level possible. The test was a four-replicate randomized complete block with plots 4.57 m wide and 36 m long with 0.6 m between adjacent plots to facilitate seeding and harvesting operations. Unless otherwise stated the row spacing was 20 cm. Seeding details are outlined in Table 1.

The lack of stubble to anchor the pea and canola crops resulted in severe wind damage to the windrows. As in 1989 fababeans in wide rows had similar yields to those in narrow rows (Table 2). Flax yields were good despite a less than optimum stand. The yield of HY355 (Genesis) was low due to severe lodging. The flax residue was mowed with a rotary mower prior to fall working. This appears to be a satisfactory method of residue management.

Preliminary data indicates that lower seeding rates for canola may reduce *Sclerotinia* infection (Table 2). Since yield data are unreliable due to wind damage it is not possible to determine if this would alter yield. Further work will be done to determine the usefulness of lower seeding rates or wider row spacings to reduce lodging and disease.

At the price assumptions used (Table 3) fababean returns were greater than flax or canola. Canola yields were low in three of four years due to seeding problems or wind damage. Yields from other tests in the same field suggest that canola yields of 2400-2700 kg/ha are reasonable. Pea yields can be improved with proper rotation and using shorter semi-leafless varieties. Fababean is much less affected by *Sclerotinia* than pea.

Table 1. Planting information for the various crops.

Crop	Cultivar	Seeding date	Seeding rate kg/ha	Nitrogen kg/ha
Canola	Global	May 10	3	133
Canola	Global	May 10	6	133
Canola	Global	May 10	9	133
Pea	Victoria	May 5	150	13
Fababean 20 cm	Outlook	May 5	180	13
Fababean 40 cm	Outlook	May 5	90	13
Peaola	Victoria	May 10	100	13
	Global	May 10	4	--
Peaola +50N	Victoria	May 10	100	13
	Global	May 10	4	flowering 50
Flax	McGregor	May 5	50	133
CPS wheat	HY355(Genesis)	May 5	130	133

Soil test nutrient levels (kg/ha) were: N 45, P 22, K 450 and S 89. All plots received 60 kg/ha of P_2O_5 banded 5 cm below and 2 cm beside the row.

Table 2. Yield and quality of oilseed and pulse crops 1990.

Crop	Cultivar	% Plants *Sclerotinia*	Grain yield kg/ha	SE
Fababean 20 cm	Outlook		3897	155
Fababean 40 cm	Outlook		4001	74
Canola 3 kg/ha	Global	34	1416	119
Canola 6 kg/ha	Global	45	1379	117
Canola 9 kg/ha	Global	52	1336	62
Pea	Victoria		---	---
Peaola	Vic&Global		1995	142
Peaola +50N	Vic&Global		2219	3
CPS wheat	HY355		4240	181
SE		4.1		

Table 3. Returns to crops based on annual yields and average prices.

Crop	$/tonne	Gross $/acre 1987	1988	1989	1990
Fababean	184	272	320	297	293
Pea	186	211	232	147	---
Canola	280	---	280	145†	158‡
Adjacent canola				292	277
Flax	276		278	280	285
CPS wheat	125			270	214

†poor stand
‡wind damage yields of an adjacent stand

Flax Co-operative Test 1990

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year four of ongoing
Objective: To determine the yield and agronomic characteristics of potential new flax cultivars.

The test was seeded May 24 in a randomized complete block design with four replicates. Plots were six rows, 3.6 m long with a 20 cm row spacing. Plots received 110 kg/ha of nitrogen and 55 kg/ha of P_2O_5. Soil test nutrient levels (kg/ha) were: N 45, P 22, K 450 and S 89.

There was a strong negative effect of lodging on yield. For example, Vimy which had a high lodging rating (9.0) yielded less than 50% of McGregor, which had a low lodging rating (1.5). Where Vimy did not lodge, yields were similar to McGregor and Norlin. McGregor had a low yield, whereas Norlin and Andro had the highest overall yield (Table 1). This agrees with the comments on yield from the Manitoba field crop variety recommendations. It was noted that McGregor in the seeding rate and method test seeded in an adjacent area on May 10 was approximately 20 cm shorter. This difference may have been due to the season, but if earlier seeding produces shorter straw, this would be a definite production advantage.

Table 1. Yield and agronomic characteristics of flax cultivars Outlook 1990.

Cultivar	Days to mature	Height (cm)	Lodging 1-9	Grain (kg/ha)
Andro	97	69	3.3	2223
Flanders	96	78	2.3	2125
McGregor	100	82	1.5	1694
Noralta	91	80	8.5	1002
Norlin	95	69	3.5	2396
Somme	91	75	8.3	1604
Vimy	91	70	9.0	980
FP862	91	71	7.3	2082
FP884	99	83	1.0	2040
FP897	98	81	1.5	1583
FP899	99	84	1.0	2186
FP900	99	83	1.0	2185
FP904	93	74	8.3	1219
FP905	101	80	3.8	1555
FP907	100	84	1.3	2009
FP911	97	79	4.8	1436
FP921	101	85	2.0	1609
FP923	98	80	5.3	1646
FP924	96	79	7.8	1174
FP926	94	75	4.5	1453
CV%	2.3	3.7	38.7	17.0
LSD	3.1	4.1	2.3	417

Effect of Seeding Rate and Seeding Method on Flax Yield

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year one of three
Objective: To determine the effect of seeding method and seeding rate on the yield of flax.

McGregor flax was seeded May 9 and 10 in a randomized complete block design with six replicates. Individual plots were 13 m long and 2.25 m wide. The plots received 140 kg/ha of nitrogen and 60 kg/ha of P_2O_5 deep banded prior to seeding at right angles to the direction of seeding. Soil test nutrient levels (kg/ha) were: N 45, P 22, K 450 and S 89.

There was a significant negative effect of seeding rate on seed yield. Highest seed yields were obtained with a 30 kg/ha seeding rate regardless of the seeding equipment (Table 1). With the exception of the highest seeding rate, seeding with the hoedrill produced greater yields than broadcast seeding. This may have been due to slightly deeper incorporation since the broadcast crop was incorporated using sweeps rather than harrowing. There was no yield advantage to narrow row spacing when the Amazone drill was used. Plant numbers were within or above the recommended levels. In this test the plants seeded with the hoe drill were shorter than other seeding methods.

Table 1. Yield and agronomic traits of flax seeded at different rates with different seeding methods.

Seeding method	Rate kg/ha	Plants /m^2	Height cm	Yield kg/ha
Amazone 8 cm	50	580	68	2695
Amazone 16 cm	50	425	69	2804
Broadcast	30	302	71	2664
Broadcast	50	457	69	2340
Broadcast	70	554	69	2194
Hoedrill 20cm	30	467	61	2889
Hoedrill 20cm	50	525	62	2606
Hoedrill 20cm	70	675	61	2138
CV%		21	4	11
LSD		126	3.2	336

Forages

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: First year of three
Objectives:

a) to examine the effect of agronomic practices (row spacing, seeding rate, fertilizer, cutting management) on forage and seed yields of irrigated alfalfa;
b) to assess alfalfa lines and varieties for forage and seed production under irrigated conditions;
c) to assess forage grass species and grass/alfalfa mixtures for forage production under irrigation;
d) to determine the importance of insect and disease pests to alfalfa seed production.

A. **Seed production trials** - Four new alfalfa seed tests were seeded in 1990. They were a 1990 Uniform Regional Alfalfa Seed Test [Registration] with 26 varieties and strains, a 1990 Saskatchewan Alfalfa Seed Test [Adaptation] with 25 varieties, and two tests to examine the effect of fertilization on alfalfa seed yield. These tests were seeded in late May and very good stands were obtained. The first seed harvest will be taken in 1991.

Conditions for pollination were poor for much of the early season because of cloudy, wet weather, which promoted vegetative growth and inhibited flowering. A fairly dry, sunny August and a long period before the first frost resulted in good bee activity in the latter part of the summer and seed setting extending beyond the normal period. Bee increase is estimated at somewhat under two times the number set out.

Uniform Alfalfa Variety Tests (Seed) - Seed harvests were taken from a 1987 Uniform Alfalfa Test with 27 varieties (mean seed yield = 345 kg/ha), and a 1989 Uniform Alfalfa Test with 19 varieties (600 kg/ha). The major observation is that almost all entries produced very good seed yields.

Effect of Soil Fertility on Alfalfa Seed Production - No irrigation was applied at the site at Saskatoon because of timely rains in June. The average yield in the trial was 327 kg/ha. There was no significant response to the fertilizer treatments.

Renovation of bluegrass seed stands - Two replicated trials were set out in the fall of 1990 in each of two commercial fields to examine 1) the effect of timing and rate of N fertilization and 2) timing of post-harvest burning on seed production of Kentucky bluegrass under irrigation. The trials will be rated for plant vigor, number of seed heads and total yield in 1991.

B. **Forage trials** - Two new alfalfa forage tests were seeded in 1990 with the establishment of a 1990 Uniform Regional Alfalfa Forage Test [Registration] with 26 varieties and strains, and a 1990 Saskatchewan Alfalfa Forage Test [Adaptation] with 25 entries. A trial to assess winter hardiness and yield of timothy varieties under irrigated conditions was established this spring. Establishment was excellent. Also, a trial to assess brome-alfalfa mixtures was established. This project will investigate the competitive interactions of bromegrass-alfalfa types and provide information on desirable cultivar types for irrigated mixtures.

Uniform Alfalfa Variety Tests (Forage) - The 1987 and 1989 Uniform alfalfa tests were severely damaged by low-temperature injury and were plowed down. Data from the 1989 test are recorded in Table 1. Note the general superiority of varieties recommended for Saskatchewan.

Effect of rate of seeding on alfalfa forage yields - Rates of seeding of 2 and 4 kg/ha produced stands which were significantly thinner than the stands obtained with rates of seeding of 12-24 kg/ha, but there was no significant difference in yield among seeding rates. More years of data are required before definitive conclusions can be made.

Date of fall cutting - Survival and vigor were significantly lower for the three-cut treatments, irrespective of the date they were taken, than where only two cuts were taken.

Grass species trials - In the 1987 Grass Species Trial, winter injury was observed in the orchardgrass and meadow fescue lines in the spring of 1990 (Table 2) and there was little recovery. Large differences in species performance over years shows that environmental factors have an important impact on the performance of the different species, even under irrigation. Meadow bromegrass yields were higher than smooth bromegrass in this trial. The winter injury in orchardgrass and meadow fescue was reflected in their poor yield performance and the yield of bluegrass lines has been low. Timothy has performed well in this trial, but has not done as well in the 1988 trial. Orchardgrass and tall fescue lines in the 1988 trial showed significant winter injury, but recovery was excellent.

Table 1. 1989 Uniform Alfalfa Forage Test - SIDC, Outlook
1990 data on spring stand and spring vigor

Cultivar	Spring stand (%)	Spring vigor (1-9, 1-best)
Beaver	100	4
SC 3801	100	5
OAC Minto	99	5
I 88PF11	98	4
I 88PF12	97	4
SCL38403	97	5
Rambler	96	3
Vernal	96	5
AP-41 (Envy)	87	5
AP8820	82	3
AP8821	81	3
Garst 636	78	4
Impact	75	3
Anchor	74	3
Sparta	68	3
VS 623	55	2
Champ	54	3
Barrier	51	2
VS 872	46	3
Comsel	42	2
VW 34-2	42	3
Mean	77	4
C.V. %	27.5	45.4
F Value	4.91	1.96
LSD	26.7	2

Table 2. Survival (rated spring 1990) and dry matter forage yields 1988-90, Grass Species Test, SIDC, Outlook, seeded in 1987.

Species & cultivar	% spring stand	Forage Yield (kg/ha) 1st cut	2nd cut	3rd cut	Total	% of Carlton
Meadow bromegrass						
Fleet	99	5.2	2.8	3.9	11.9	110
Regar	99	4.6	3.1	3.4	11.1	103
Reed Canarygrass						
UM80-06	75	3.0	4.3	3.6	10.9	101
Smooth bromegrass						
Carlton	96	4.2	3.5	3.1	10.8	100
Timothy						
Champ	100	2.8	3.1	3.3	9.1	84
Orchardgrass						
Kay	31	2.3	2.2	3.5	7.9	73
Kentucky bluegrass						
Dormie	100	3.7	2.8	2.4	8.9	82
S-7766	100	2.9	2.6	2.5	7.9	73
Troy	98	3.2	2.1	2.4	7.6	70
S-8607	85	3.1	2.5	1.9	7.4	69
Delta	100	3.2	1.7	2.5	7.4	69
Meadow fescue						
Ensign	58	2.0	2.2	3.1	7.3	67
Mean	87	3.3	2.7	3.0	9.0	
C.V. (%)	19	30	24	23	17	
LSD	24	0.8	0.5	0.5	1.2	
F value	***	***	***	***	***	

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: Saskatchewan Irrigation Development Centre
Progress: Second year of four
Objectives:

a) to examine the response of new alfalfa lines for their potential in the irrigated areas of Saskatchewan;
b) to examine the effects of plant stand density on seed production in medium to large-scale plots;
c) to investigate the response of meadow bromegrass seed yields to row width.

A. **Alfalfa seed production trials** - The cool, wet conditions in July were excellent for alfalfa vegetative growth, but were very poor for flowering, pollinator activity and seed set. Bee activity was generally low throughout the summer. Bee reproduction was good, especially given the poor conditions for bee activity early in the season.

Effect of row spacing and seeding rate on alfalfa seed yields - This test was designed to test seed production from row spacings (1, 2, 3, 4 ft.) and seeding rates (1 and 2 lb/ac). Seed yields were extremely low. Even the plots with a 1 lb/ac seeding rate and 4 ft. row spacing provided a solid cover of growth, equivalent to the plots with 1 ft. row spacing. Severe thinning of the stand (minimum of 50%) by cultivation is planned.

Eastern variety trial - A test of alfalfa varieties recommended for eastern Canada was established at SIDC in 1989. Most of the lines came through the winter in good to excellent condition. These lines are not as cold-tolerant as lines recommended for Saskatchewan, yet they showed less injury than Beaver alfalfa in an adjacent forage trial which had been cut three times the previous fall. Yields (84 - 297 kg/ha) were very low relative to another test of the same age (598 kg/ha) at the same site.

Stand density study - In this trial, we have used the co-operator's (Larson's) management practices, but have altered the stand density. Treatments consisted of 1) Larson's management practice (3-ft row spacing, 2 kg/ha seeding rate), 2) treatment #1 plus a right angle cultivation in October 1989, 3) cultivation at right angles and one diagonal, and 4) cultivation at right angles and both diagonals. In May, the plots which had been cultivated the previous fall had thinner stands and shorter plants with fewer leaves than plants in the uncultivated check plots. However, at harvest, the differences in stand density among treatments were not readily apparent. Plant growth in all plots had been luxurious and chiefly vegetative. The uncultivated (thickest) plots had significantly lower yields than plots which had been cultivated. Yields from plots cultivated one, two, or three times were similar.

B. **Meadow bromegrass seed production (cv Fleet)** - This study examined the effect of row spacings on meadow bromegrass seed yield. Uncleaned seed yields approaching 1000 kg/ha. Much of the seed was not adequately filled, so cleaning losses were high. Lack of irrigation in July probably resulted in mild drought stress prior to ripening, and uneven and incomplete seed filling. Yields of cleaned seed averaged 451 kg/ha with 30 cm row spacing, 393 at 60 cm and 283 at 120 cm. However, more years of data are necessary to assess the effects of wider row spacings.

C. **Pest monitoring** - Populations of Lygus bugs reached the economic threshold in early July and the farmer co-operator initiated insecticide application for their control. Their populations remained low for the rest of the summer. Head smut was noted in the meadow bromegrass seed production trial. This was the first report of smut on Fleet meadow bromegrass.

Improving Alfalfa Establishment under Irrigated Conditions (establishment year)

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progess: Year two of four
Objective: To develop information which will enable producers to successfully establish alfalfa under center pivot irrigation while obtaining maximum returns from the land base during establishment.

The plots were seeded on May 9 using the companion crop information listed in Table 1. The test was replicated five times. Each block (cereals and oilseed/pulse) contained a treatment where alfalfa was seeded without a companion crop. Beaver alfalfa was seeded at a rate of 9 kg/ha in 8 cm row spacings at right angles to the companion crops in a second operation.

Fababean yields were not taken since yields were once again greatly reduced due to blister beetle feeding. Canola stands were low on several plots due to wind damage; only two replicates were harvested and these yields were low. Weed control in the seeded alfalfa was not adequate and, therefore, yields were not taken. Yields of cereal grains were 25-40% lower than in 1989 (Table 2). Yields were likely reduced due to no irrigation or rainfall from August 6 to September 10. The 40 cm and 20 cm rows produced the same amount of grain but these yields were too low to be economic. Flax yields were good and canola yields were higher than in 1989. Although the yield of lentil was higher in 1990, they are not economic. Harvesting of lentil is very difficult since the alfalfa grows higher than the lentil and the alfalfa leaves tend to be difficult to separate. Delaying seeding of alfalfa or planting Indian head lentil with the alfalfa and harvesting it for forage could be alternatives.

Table 1. Seeding information for companion crop test.

Crop type	Variety	Seeding rate (kg/ha)	Row spacing (cm)
Durum	Sceptre	60	20
Durum	Sceptre	60	40
CPS	Biggar	60	20
CPS	Biggar	60	40
Fababean	Outlook	90	40
Canola	Parkland	4	20
Lentil	Eston	30	20
Flax	McGregor	45	20

Table 2. Yield of crops in 1989 and 1990.

		Row spacing	1989		1990	
Crop	Cultivar	(cm)	Yield	SE	Yield	SE
Durum	Sceptre	20	4195	359	3287	462
Durum	Sceptre	40	--	--	3293	277
CPS	Biggar	20	4233	306	2499	208
CPS	Biggar	40	--	--	2993	355
Fababean	Outlook	40	513	186	--	--
Canola	Parkland	20	452	28	1461	363
Lentil	Eston	20	115	31	826	220
Flax	McGregor	20	782	104	1964	197
Alfalfa	Beaver	solid	8354	469	--	--

Improving Alfalfa Establishment under Irrigated Conditions (year after establishment)

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

This test was established in 1989 with various companion crops as outlined above. Two harvests of alfalfa were taken from four replicates. Since the test was set up as two randomized complete block tests separate ANOVA's were run for the cereals and oilseed/pulse blocks.

There were no detectable differences in yields due to the presence of a cereal companion crop and where no crop was grown (Table 1). This was also true for the oilseed and pulse crops (Table 2). There was no detectable negative effect of growing a companion crop on the subsequent yield of alfalfa. One of the problems of growing a companion crop is that weed control options may be reduced. Clear seeding with the use of Indian Head lentil may provide an alternative to the current recommendation of seeding a crop of barley or oats and cutting it for green feed. Though the yields of cereal forage are higher than lentil, this material is difficult to market due to its low protein and digestibility. Variability was high enough that biologically significant differences might have been missed. Several seasons of data will be required before firm conclusions can be drawn but it may be that under center pivot irrigation water is applied frequently enough to allow development of adequate plant stands with a companion crop. Competition for light in the establishment year may not be a major yield limiting factor in subsequent crops providing moisture is adequate.

Table 1. Alfalfa yields in the year after establishment with various cereal grain companion crops.

		Yield (kg/ha of dry matter)		
Companion crop	Variety	Cut 1	Cut 2	Total
Durum	Sceptre	4768	6675	11174
CPS	HY320	5307	6004	11312
Barley	Winchester	4768	6675	11174
Soft wheat	Fielder	4423	6042	10465
None		5280	6971	12251
CV%		14.7	12.9	7.0
Prob > F		.38	.52	.17

Table 2. Alfalfa yields in the year after establishment with various oilseed/pulse companion crops.

		Yield (kg/ha of dry matter)		
Companion crop	Variety	Cut 1	Cut 2	Total
Canola	Parkland	5568	5872	11440
Fababean	Outlook	6337	5546	11883
Lentil	Eston	6625	5578	12203
Flax	McGregor	6121	6247	12368
None		5458	5883	12368
CV%		14.6	11.3	10.2
Prob > F		.32	.58	.68

Effect of Cutting Height and Variety on Alfalfa Yield

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progess: Year two of four
Objective: To determine the effect of cutting height and date of third harvest on the yield and winter survival of five alfalfa varieties differing in winter hardiness.

A four-replicate test with five alfalfa cultivars of differing winter hardiness was established in 1988. The plots 7.3 m wide and 100 m long. The cutting height study was initiated in 1989 by cutting at right angles to the direction of seeding. The design is a split block for cutting height. Each cutting height plot was split into four blocks differing in the time of the third harvest. Third harvest dates were to be: September 1, September 15, October 15 and not cut. The first harvest was made June 21 and the second harvest on August 8. Third harvest dates were on September 20 and October 17.

Table 1. Effect of cultivar and cutting height on alfalfa forage yields.

Cultivar	Cutting height	Harvest 1 kg/ha	Harvest 1 TDN%	Harvest 1 Prot%	Harvest 2 kg/ha	Harvest 2 TDN%	Harvest 2 Prot%	Total kg/ha
Algonquin	5cm	6008	58	19.4	4280	62	20.6	10289
Anchor	5cm	6093	57	17.5	4562	61	21.9	10655
Beaver	5cm	6356	61	21.2	4775	64	23.2	11130
Pioneer 526	5cm	6069	62	22.6	4632	62	21.3	10701
Roamer	5cm	5918	61	24.0	4527	61	20.7	10445
Mean	5cm	6089	60	20.9	4555	62	21.5	10644
Algonquin	10cm	5739	62	22.6	4646	61	20.8	10385
Anchor	10cm	5554	63	22.0	4299	64	23.1	9853
Beaver	10cm	5445	63	23.8	4357	65	25.2	9802
Pioneer 526	10cm	5221	60	19.1	4421	62	22.4	9643
Roamer	10cm	5190	65	25.8	4089	62	23.8	9279
Mean	10cm	5430	64	22.7	4362	63	23.1	9792

Yields did not differ significantly due to cultivar, cutting height or their interaction at either harvest date or in total yield. The mean yield of the first harvest 10 cm cutting height plot was 11% less than the 5 cm cutting height and the second cut was 4% lower (Table 1). However, due to the split block design limiting the degrees of freedom these means are not significantly different. It appears that both protein and TDN are slightly increased by taller cutting heights. The interaction between cutting height, final harvest date and genetic winter hardiness on winter survival can not be determined from this test since insufficient water was applied to allow sufficient regrowth to allow a harvestable third cut (yields < 1,000 kg/ha).

Effect of Potassium Fertilization on Alfalfa Yield and Winter Survival

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progess: Year one of four
Objective: To evaluate the effect of potassium rate and source on alfalfa yields and winter survival.

This test was established as a split plot design with four replicates. Main plots were the alfalfa cultivars Anchor and Beaver which had been planted in 1988 and sub plots were the various nutrient levels. Soil test nutrient levels (kg/ha) were: N 20, P 26, K 270, S 108+. Phosphorous was broadcast over the entire area at 50 kg/ha P_2O_5.

Potassium was applied at 0, 60, 120 and 180 kg/ha using potassium chloride as the source of K and at 120 kg/ha using potassium carbonate. Calcium chloride was also applied, to equal 120 kg/ha KCl, and evaluate if there was a chloride effect. Product was hand broadcast on plots 7.3 m by 3 m prior to the initiation of spring growth and an area 6.7 m x 1.52 m harvested June 21 and August 8 from the center of the plot.

There were no significant yield differences due to cultivar, fertilizer treatment or their interaction. The coefficient of variability was high for first cut yields. Forage yields were high and there was no trend towards improved yield at higher K fertility rates (Table 1). Soil test recommendations were that this site had sufficient potassium for optimum yield. The effects of K fertilization on winter survival has not been determined at this time.

Table 1. Effect of potassium fertilization on alfalfa forage yields.

			Dry matter kg/ha					
		Level	Anchor			Beaver		
Product	Nutrient	kg/ha	Cut 1	Cut 2	Total	Cut 1	Cut 2	Total
KCL	K	0	6720	5946	12666	7084	5365	12449
KCL	K	60	6756	5685	12440	6986	6090	13076
KCL	K	120	8299	6547	14846	7544	6000	13544
KCL	K	180	7254	5437	14846	6517	5499	12016
K_2CO_3	K	120	6522	6302	12823	7102	5453	12555
$CaCl_2$	Cl	120	7278	6244	13522	6376	6537	12913

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

Principal: D. Cameron, Normac AES Ltd.
Swift Current, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-operator: R. Harrigan
Location: Maple Creek, Saskatchewan
Progress: Third year of five
Objective: To determine the best method of establishing alfalfa on the irrigated alluvial clay soils of the Maple Creek area.

In the fall of 1989, the project emphasis on alfalfa establishment experiments was extended from zero till and cover crops to the use of soil amendments such as gypsum and manure, fertilizers and weed control to improve alfalfa germination and emergence. Three new plot areas were established on lands owned by Doug Harrigan, Archie Lambert and Ken Hope. There was ideal seedbed moisture when the plots were seeded, however, the succeeding drought with no irrigation (due to water shortages) severely reduced germination and emergence, particularly on the Harrigan and Lambert plots. The effects of the soil treatments were difficult to measure. Applications of gypsum up to 22 tonnes/ha did not appear to affect the emergence of alfalfa in the dry conditions of 1990. A manure application (49 tonnes/ha) appeared to provide a slightly lusher growth of weeds but did not appear to affect the establishment of alfalfa. No differences were observed in alfalfa or weed growth where high nitrogen rates (112 kg of actual N/ha) were applied. Similarly, no differences were observed where various applications of boron and micronutrients were made across parts of the plot area. However, the weed control treatment using pre-emergent trifluralin provided excellent weed control. In all the plot areas, alfalfa growth was better on the weed control plot than on plots where no trifluralin had been applied. Unfortunately, however, the alfalfa catch was so thin that the success of this experiment remains debatable. It is believed that under more normal irrigation conditions, the use of trifluralin may be very beneficial for alfalfa establishment. The zero till cover crop experiments initiated in 1988 on the Roy Harrigan plot were observed in 1990. The streaky growth pattern that was noted and monitored in 1989 was also present in 1990. First-cut yields on this plot area were approximately 2.44 tonnes/ha. Portions of this plot may be utilized in 1991 to see if subsoiling can be used to improve the growth of the short alfalfa patches.

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)
Progress:	Third year of five
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.

In 1988, seven varieties of alfalfa including Heinrichs, Beaver, Anchor, Barrier, Roamer, Pioneer and Rangelander were seeded in three replicate blocks on Ross Anderson's border dyke plot in the Maple Creek Irrigation Project. Because of drought conditions in 1989, there was no first irrigation, however, a second irrigation was possible. With the continued drought in 1990, there was no water available for irrigation. First-cut average yields in 1990 ranged from 1.70 tonnes/ha for Pioneer to a high of 3.20 tonnes/ha for Barrier. No second-cut was taken because of dry conditions and poor regrowth. However, an analysis of variance of the yield results showed no significant differences between varieties. Potassium was applied to one strip across the plot area and the results showed that there was no significant increase in yield from potassium. Correlation coefficients between yield and EM38 readings showed that there was a negative correlation between yield and salinity levels. Block effects were significant because of increasing salinity levels from Block 1 to Block 3.

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 and K. Hope
Location:	Maple Creek
Progress:	First year of five
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. Larger scale replicated plots were set up at the Doug Harrigan site while smaller non-replicated plot areas were established at the Archie Lambert and Ken Hope sites. Comparisons included alfalfa, sweet clover, sanfoin, bromegrass, meadow bromegrass, crested wheatgrass, western wheatgrass, northern wheatgrass, creeping foxtail, Russian wild rye, intermediate wheatgrass, slender wheatgrass and meadow foxtail. Although spring moisture seeding conditions were optimum, the pursuing drought greatly reduced seed germination and growth resulting in poor grass catches (with the exception of the Ken Hope plot where the soils were less saline and not as heavier textured as the other two plots). Germination tests on the grass seed showed that slender wheatgrass, western wheatgrass and northern wheatgrass had less than 20% germination. Once the plots were seeded, the test sites were examined periodically throughout the growing season. The Doug Harrigan plot did very poorly, the Archie Lambert plot had a poor to fair response, and at the Ken Hope site, establishment was relatively good. The best rating for first-year stand establishment was obtained by sweet clover followed by intermediate wheatgrass, brome-alfalfa mix and alfalfa. Meadow bromegrass, Russian wild rye, crested wheatgrass, bromegrass and sanfoin had moderate stands, although, somewhat thin. Very poor results were obtained for western wheatgrass, northern wheatgrass, slender wheatgrass, creeping foxtail and meadow foxtail. This may be related directly back to poor germinating quality of the seed obtained for these varieties. The results for 1990 represent survival conditions for a drought year where no irrigation was applied. Real differences in grass development are better assessed in the second year. Intermediate wheatgrass gave the best grass stand in 1990. Russian wild ryegrass, meadow bromegrass and bromegrass gave reasonable stands. Sweet clover appeared to be an excellent crop having the ability to establish very well under the 1990 conditions.

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. Birkson and L. Dilworth, Rush Lake; V. and A. Perrault, Ponteix
Progress: Second year of four
Objectives:

a) to determine the validity of alfalfa variety recommendations and to estimate the number of yield test sites that would be necessary to make reliable recommendations;
b) to determine the relative compatibility of alfalfa cultivars with smooth bromegrass and intermediate wheatgrass for irrigated forage production.

This project is only 50% complete but some valuable results have been obtained. The forage establishment data indicates that the greater competition ability of bromegrass with alfalfa compared to that of intermediate wheatgrass with alfalfa is present during the seeding year. While the mixture produced the highest hay yields, the proportion of alfalfa in the hay was significantly less than for the intermediate wheatgrass-alfalfa mixture. Both seedling year yield and stand establishment were affected by site factors such as soil salinity, fertility and soil type as well as weather factors. There were no differences among alfalfa cultivars in those two sites where seeding failed due to soil salinity. Thus, the suggestion that creeping-rooted alfalfa like Roamer and Heinrichs are more saline tolerant than tap rooted varieties, cannot be supported. Continued monitoring will establish if variety differences are evident for two and three years after establishment. Forage quality data will also be collected.

Double Cropping

Principal: B. Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progess: Year one 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.

Rye was planted September 12, 1989, at 120 kg/ha in rows spaced 20 cm apart. Eston lentil and Parkland canola were broadcast into the standing rye crop on June 4, 1990 and the entire area received 7-8 mm of water every day for the following week. The rye was harvested June 15 and

Eston lentil, Indian Head lentil, Parkland canola and Harrington barley were planted June 20, 1990 using a zero-tillage hoe drill.

Soil moisture was monitored using tensiometers, but in early July, a combination of irrigation and heavy rain appeared to cause significant water damage such that, in some plots, lentil plants rotted.

Malathion was sprayed five times to control flea beetles on canola, but despite this program, some damage occurred.

Rye forage yields of 6,658 (SE=605) kg/ha were obtained. The rye forage had 5.7% protein and a TDN of 51%. These yields and quality are lower than acceptable. Rye forage yields of 5,667 (SE=262) kg/ha were obtained in 1988. The 1988 rye had similar protein and TDN levels (6.1 and 51%, respectively). The low quality of this material makes it difficult to market and alternatives such as sweet clover should be considered. The goal of double cropping would be to take advantage of market opportunities resulting from poor forage yields on dryland. This would also be a superior crop rotation which is less dependent on selling via the quota system. A dwarf form of sweetclover which is not as stemmy exists but has not been marketed.

Indian head lentil produced slightly over 2.5 t/ha forage with a protein content of 15.5 % and a TDN of 62% (Table 1). These yields are similar to those produced in 1988. There was considerable variability in yield due to uneven stands and yield could be significantly higher. Barley forage yield was extremely poor and must be attributed to the phytotoxic effects of the rye crop.

Table 1. Yields of crops grown after a rye forage crop.

Crop	Seeding method	Yield kg/ha	SE
Grain			
Eston lentil	broadcast June 4	574	408
Eston lentil	drilled June 20	654	231
Parkland canola	broadcast June 4	840	---
Parkland canola	drilled June 20	1425	40
Forage			
Indian head lentil	drilled June 20	5055	1153
Harrington barley	drilled June 20	3465	408

Previous work indicated that barley silage yield in excess of 12,000 kg/ha is possible when seeding occurs in mid June. Broadcast canola and lentil stands were uneven and many of these plots were not harvested. It would appear that more uniform broadcasting of the seed and higher seeding rates may be required for broadcast seeding to be viable. Canola yields appear to have been reduced by a flea beetle infestation.

Seed Production of Kentucky Bluegrass

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progess: Year two of four
Objective: To determine the effect of various management practices (burning, chemical thinning and nitrogen timing) on the seed yields of Kentucky bluegrass.

An adequate stand was obtained by seeding in August of 1989. No seed was produced except for plants that emerged more rapidly in the wheel tracks.

In 1991, ten treatments with four replicates will be applied on established 1990 bluegrass plots. The treatments will apply the various management practices (burning, chemical thinning, and nitrogen timing) on Kentucky bluegrass. The data to be collected in 1991 will be seed yield and seed size. In addition, observation will be made on the area from which the seed is produced in year 1 and year 2.

Establishment and Seed Production of Turf and Forage Grasses

Principal: Newfield Seeds Limited, Nipawin, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: First year of three
Objectives:

a) to determine the effect on establishment and seed yield of seeding date and the use of companion crops;
b) to determine the seed yield potential of a selection of forage and turf type grasses.

Four main plots were sown with six selected species. The four plots represented establishment treatments of:

1) Early spring seeding - no companion crop
2) Late spring seeding - no companion crop
3) Late spring seeding - with durum wheat
4) Mid-summer seeding - with no companion crop

Three sub-plots of intermediate wheatgrass, reed canarygrass, creeping foxtail, Russian wild rye and smooth bromegrass were sown on July 23 to test their potential seed yield.

Results of establishment testing were as follows:

Meadow bromegrass and turf type tall fescue - stands established under all treatments except with a companion crop.

Creeping red fescue - stands established only when sown in mid-summer.

Chewings fescue, Timothy and Kentucky bluegrass - stands established only in plots sown mid-summer without a companion.

Barley Silage as a Source of Available Energy and Nonstructural Carbohydrate for Lactating Dairy Cows

Principal: D.A. Christensen, University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-operator: B. Rossnagel, Crop Development Centre
Progress: First year of two
Objective: To determine the nutritive characteristics of varieties of barley grown for silage on irrigation for use with high performance ruminants.

During the summer of 1990, a summer student was hired to sample and analyze four barley plots being grown for experimental silage production. Laboratory analyses of these samples is now underway.

In August of 1990, barley silage from Harrington, Duke, Virden and Heartland was harvested at the milk and the mid-dough stage. This silage is being used in voluntary intake and digestibility trials with growing steers. A dairy cow production trial is in progress in which one of the silages will be evaluated at the early and later maturity stages.

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, R. Horton
Co-operators : R. Scowen (White Fox); G. Harbin (Lashburn)
Progress: First year of three
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.

Twelve sites will be established under this project. Sites will be located at Lashburn, Loon Lake, White Fox, Yorkton, Melfort, Saskatoon, Estevan, Indian Head, Eastend and Swift Current. Irrigated sites will be located at Swift Current and Outlook.

Test sites were seeded at Lashburn, Loon Lake and White Fox and the alfalfa portion of the test was established at Outlook, Saskatoon and Swift Current (dryland and irrigated).

Since the project is in the establishment phase, no reliable forage yield data has been collected. However, research site establishment is proceeding on schedule.

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: First year of three
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, covers a three-year term. A coordinator was hired to implement the project and to develop a program to meet the objectives.

A hay certification procedure and certificate was developed, describing the visual attributes and nutrient content of the forage. The certificate adequately describes the hay to the buyer and can be used by the producer for promotion. Ten inspectors have been trained in hay certification procedures. These inspectors, from various areas of the province are available to certify hay for producers, on a fee-for-service basis. Support, in the form of advertising and promotion of inspector services, has been provided. Approximately 95 lots of hay have been certified under the program.

The certified hays have been listed in the Feed and Forage Listing Service of Saskatchewan Agriculture and Food.

A major portion of the project involved promotion of production and marketing hay on the basis of quality. Brochures and news releases have been prepared for livestock producer newsletters, radio, television and press, as well as utilizing Saskatchewan Rural Service Centres for information distribution. Promotional activities have included a forage day at Outlook, attendance at producer meetings, and participation in fairs and major shows, such as Agribition.

Program development has occupied much of this initial year. To date, the response has been good and the project aims to increase promotion of hay certification to forage producers and consumers. Greater effort can now be expended on promoting the production and marketing of hay on the basis of quality.

Grass Species of Irrigated Pastures

Principal:	S. Wright Agriculture Canada Research Station, Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	B. Goplen, Agriculture Canada; R. Cohen amd M. Howard, University of Saskatchewan
Co-operator:	N. McLeod
Location:	Outlook
Progress:	First year of three
Objectives:	To provide information to producers on the suitability of seven grass species for irrigated pasture use.

The 35 acres of land for this study was broken and worked in May and June. Seeding of the eight test grasses was completed on July 2, following the seeding of an oat cover crop on June 16 and 17. Early establishment was good in all grass species with an estimated rate of seeding establishment ranging from 65% for reed canary grass, to 90% for slender wheatgrass. Summer growth on all species was good, however, grazing by sandhill cranes, and accidental grazing by sheep has raised some concern over the winter-survival of the less hardy species. Winter survival will be determined early in 1991 and any necessary reseeding will be done immediately. High intensity, low duration grazing cycles will be implemented in 1991 to maximize the potential for seedling survival.

The pasture received 920 mm of water over the growing season, with almost 80% coming from irrigation. Fertilizer was applied several times in small increments, for a total of 242 kg N/ha and 62 kg P/ha.

Soil samples taken on August 18 indicated adequate phosphorus levels and available nitrogen levels of 55 kg/ha. The cover crop of oats was harvested in September with a total of 2,350 kg/ha (29 tons/ac) being harvested as hay.

Rudy Rosedale Community Pasture Irrigation Project

Rudy Rosedale Community Pasture Irrigated Alfalfa Project provided large tonnages of high quality feed. It's main objective is to increase and stabilize hay production for the PFRA community pasture program and to demonstrate the production of irrigated alfalfa to farmers in the area. In addition, a number of agronomic demonstrations have been initiated to help increase the yield and quality of forage produced. Results from these demonstrations are reported in this report.

A forage equipment demonstration day was held on June 28, 1990. A wide range of hay harvesting equipment was demonstrated to a large group of irrigated hay producers. It was a most successful day.

<u>Operation</u>

The rotation of cereals upon breaking of alfalfa was completed. Calibre oats (80 kg/ha) were planted in the alfalfa breaking (NW quarter) using a press drill. The oats were harvested as green feed. Beaver alfalfa (8 kg/ha) plus Calibre oats (38 kg/ha) as a companion crop were planted on the northeast quarter. The oats were planted using a press drill and the alfalfa with a valmar air system followed by a double harrowing operation. Fertilizer was applied according to soil test recommendations.

The alfalfa and greenfeed oats produced large quantities of good quality feed. Tables 1 and 2 indicate the yield and quality of feed at Rudy Rosedale Pasture. Table 3 indicates where the bales were allocated.

Table 1. Forage yields at Rudy Rosedale Community Pasture

	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

Table 2. Forage quantity and quality at Rudy Rosedale Community Pasture in 1990.

Location	Quantity (no.)	Protein (%)	TDN (%)	Nitrates (%)	Ave. weight (lbs)
SW 1st cut	616	19.47	59-61	Trace	958
SE 1st cut	608	19.23	59-61	Trace	1031
SW 2nd cut	485	21.06	60-62	Trace	1010
SE 2nd cut	500	19.34	59-61	Trace	1054
NE oats	821	10.89	54-57	.61	1043
NW oats	982	9.99	54-57	1.00	1021

Table 3. 1990 bale allocation

	Alfalfa	Oat
McCraney	--	60
Mount Hope-Prairie Rose	180	120
Rudy-Rosedale	179	53
Usborne	30	90
Wolverine	30	60
Ituna Bon Accord	120	90
Garry	--	60
Antelope Park	140	100
Maple Creek Bull Station	390	300
Kindersley - Elma	150	60
Fairview	30	30
Eagle Lake	90	30
Mantario	60	30
Monet	180	60
Newcombe	60	120
Battle River - Cut Knife	120	120
Mariposa	60	30
Paynton	120	120
Progress	--	30
Auvergne - Wise Creek	30	60
Beaver Valley	30	--
Kelvington	--	60
Nashlyn	90	30
Webb	--	30
Wreford	60	--
Oakdale	60	60
Total	2,209	1,803

Response of Established Irrigated Alfalfa to Nitrogen Fertilization

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Community Pasture (SW-01-31-07-W3)
Progress: One year only
Objectives: To determine the response of established irrigated alfalfa to nitrogen fertilization.

A demonstration plot was established at the Rudy Rosedale Community Pasture Irrigated Alfalfa Project on the SW-01-31-07-W3 to determine the response of established irrigated alfalfa to nitrogen fertilization. Nitrogen treatments consisted of two rates (25 and 50 kg N /ha) applied at two times (spring and 1st cut) as a surface broadcast application of ammonium nitrate (34-0-0).

Alfalfa yield (Table 1) and quality (Table 2) were not significantly affected by the time or rate of nitrogen fertilization. The nitrogen requirements of this stand of irrigated alfalfa appear to be adequately met through nitrogen fixation.

Table 1. Total dry matter yield for the alfalfa nitrogen demonstration plot.

Treatment	Yield (kg/ha) 1st Cut		2nd Cut	
(kgN/ha)	Mean	CV%	Mean	CV%
0	4746	10.4	4570	8.7
25 spring	5239	8.2	4976	3.3
50 spring	4445	8.4	4543	9.5
25 1st cut	4808	5.9	4597	2.8
50 1st cut	4577	7.6	4567	7.4
LSD (0.05)	NS†		NS	

†NS-not significant

Table 2. Plant analyses for the alfalfa nitrogen demonstration plot.

Cut #	Treatment (kgN/ha)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu (ug/g)	Fe (ug/g)	Mn (ug/g)	Zn (ug/g)	B (ug/g)
1	0	3.52	0.37	2.54	0.34	1.97	0.36	10	178	46	28	61
	25 spring	3.57	0.36	2.47	0.34	1.93	0.35	4	163	40	22	54
	50 spring	3.32	0.42	2.61	0.33	1.76	0.37	4	152	37	22	51
	25 1st cut	3.38	0.39	2.69	0.33	1.82	0.36	4	146	41	23	53
	50 1st cut	3.15	0.41	2.42	0.32	1.72	0.36	4	227	40	30	50
2	0	3.68	0.36	2.54	0.37	1.89	0.36	4	151	41	25	60
	25 spring	3.61	0.35	2.59	0.37	2.06	0.33	9	155	41	19	61
	50 spring	3.52	0.36	2.69	0.38	1.99	0.35	5	161	42	25	63
	25 1st cut	3.59	0.38	2.71	0.39	2.10	0.37	4	153	43	33	63
	50 1st cut	3.64	0.33	2.65	0.36	1.96	0.34	5	140	37	26	61

Irrigated Grass-Alfalfa Mixtures for Forage Production

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Community Pasture (NE-01-31-07-W3)
Progress: First year of four
Objectives: To determine the yield and quality of irrigated grass-alfalfa mixtures.

A demonstration plot was set-up at the Rudy Rosedale Community Pasture Irrigated Alfalfa Project to determine the yield and quality of irrigated grass-alfalfa mixtures. Seven grass varieties were seeded in a mixture with Beaver alfalfa (Table 1). Depending on the establishment obtained, yields will be monitored in subsequent years.

Table 1. Grass varieties and seeding rates used for the grass-alfalfa demonstration plot.

Grass Variety	Seeding Rate (kg/ha)
Revenue slender wheatgrass	6
Chief intermediate wheatgrass	10
Fleet meadow bromegrass	12
Magna bromegrass	7
Climax timothy	1
Garrison creeping foxtail	2
Vantage reed canarygrass	2

Response of Established Irrigated Alfalfa to Micronutrient Fertilization Applications

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Community Pasture (SW-01-31-07-W3)
Progress: First year of four
Objectives: To determine the effect of micronutrient fertilization on established irrigated alfalfa.

A demonstration plot was established at the Rudy Rosedale Community Pasture Irrigated Alfalfa Project to determine the effect of micronutrient fertilization on established irrigated alfalfa. Soil analyses indicated deficient levels of copper and marginal levels of zinc according to current soil test benchmarks (Table 1). Two rates of copper (11 and 22 kg/ha) and zinc (15 and 30 kg/ha) were surface broadcast in the Spring of 1990.

The yield of alfalfa was not significantly affected by the copper or zinc applications (Table 2). Application of these micronutrients did not increase the yield of the alfalfa for either the 1st or 2nd cut.

Plant analyses of bulked samples indicated no difference between treatments within a cut (Table 3). The 2nd cut alfalfa had a higher copper and zinc content than the 1st cut a trend that was similar for some of the other nutrients.

Response of the irrigated alfalfa to the residual applied micronutrients will be monitored in subsequent years.

Table 1. Spring soil analyses for the alfalfa micronutrient demonstration plot.

Depth (cm)	pH	1:1 E.C (dS/m)	NO_3-N	P	K	SO_4-S	Cu	Fe	Zn	Mn
			(kg/ha)†							
0-15	7.4	0.3	4	17	225	18	0.7	24.0	0.8	17.0
15-30	7.4	0.3	9			16				
30-60	7.4	0.4	20			43				

†kg/ha = ppm x 2 for 15 cm depth and ppm x 4 for 30 cm depth

Table 2. Total dry matter yield for the alfalfa micronutrient demonstration plot.

Treatment (kg/ha)	Yield (kg/ha) 1st Cut Mean	1st Cut CV%	2nd Cut Mean	2nd Cut CV%
0	5010	4.3	4512	10.0
11 Cu	4444	3.1	4432	11.0
22 Cu	4724	13.0	4647	10.9
15 Zn	5001	3.3	4862	5.6
30 Zn	4504	11.1	4295	8.7
LSD (0.05)	NS†		NS	

†NS-not significant

Table 3. Plant analyses for the alfalfa micronutrient demonstration plot.

Cut #	Treatment (kg/ha)	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
		%						(ug/g)				
1	0	3.45	0.31	2.56	0.31	1.70	0.36	4	130	31	20	49
	11 Cu	3.51	0.31	2.67	0.32	1.74	0.35	5	140	30	22	54
	22 Cu	3.55	0.30	2.65	0.32	1.76	0.35	5	143	31	23	52
	15 Zn	3.41	0.28	2.59	0.31	1.77	0.34	5	131	29	25	52
	30 Zn	3.38	0.32	2.59	0.30	1.66	0.34	4	160	29	20	49
2	0	3.73	0.32	2.83	0.38	1.87	0.35	7	146	32	23	65
	11 Cu	3.51	0.28	2.85	0.36	1.84	0.34	8	125	28	27	63
	22 Cu	3.59	0.29	2.73	0.37	1.86	0.32	8	123	31	31	61
	15 Zn	3.44	0.29	2.67	0.35	1.86	0.32	6	135	30	30	62
	30 Zn	3.85	0.32	2.87	0.39	1.92	0.36	8	136	33	28	66

Potassium Requirements of Irrigated Alfalfa

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Community Pasture (NE-01-31-07-W3)
Progress: First year of four
Objectives: To determine the response of irrigated alfalfa to potassium fertlization.

A demonstration plot was established at the Rudy Rosedale Community Pasture Irrigated Alfalfa Project on the NE-01-31-07-W3 to determine the response of irrigated alfalfa to potassium. Soil analyses indicated a low level of potassium for establishing irrigated alfalfa (Table 1). Potassium treatments consisted of both annual (50 and 100 kg K/ha) and once only (100, 200 and 400 kg K/ha) surface broadcast applications of potassium chloride (0-0-60).

Table 1. Spring soil analyses for the alfalfa potassium demonstration plot.

Depth (cm)	pH	1:1 E.C (dS/m)	NO_3-N	P	K	SO_4-S
			---------	(kg/ha)†		---------
0-15	6.7	0.3	14	23	215	13
15-30	7.1	0.2	14			21
30-60	7.2	0.2	25			30

†kg/ha = ppm x 2 for 15 cm depth and ppm x 4 for 30 cm depth

Table 2. Oat greenfeed total dry matter yield for the alfalfa potassium demonstration plot.

Potassium Rate (kg/ha)	Yield (kg/ha) Mean	CV%
0	9158	8.0
50 annual	9113	4.3
100 annual	8615	8.2
100 once	9058	4.1
200 once	8823	3.5
400 once	9024	11.7
LSD(0.05)	NS†	

†NS-not significant

Beaver alfalfa was seeded with an oat companion crop. The companion crop was cut as greenfeed in the establishment year. The yield of greenfeed oats showed no significant response to the potassium applications (Table 2).

Soil samples collected from selected treatments indicated that soil available potassium levels were adequate according to current soil test benchmarks where potassium had been applied.

Response of the irrigated alfalfa to potassium fertilizer applications will be monitored in subsequent years.

Growth Stage of Oats for Greenfeed Production

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Rudy Rosedale Community Pasture (NE-01-31-07-W3 and NW-01-31-07-W3)
Progress: One year only
Objectives: To determine the yield and quality of oats cut for greenfeed at different growth stages.

Rotation of alfalfa with cereals is an ongoing project at the Rudy Rosedale Community Pasture Irrigation Project. Oats is generally the cereal rotated and is cut at the soft dough stage. Under irrigated conditions cutting the oats at the soft dough stage can result in rank growth and a large tonnage of dry matter that is difficult to cure and bale. Cutting the oats at an earlier growth stage and taking a second cut may make the haying operation more manageable.

Two demonstration plots were established on the NE-01-31-07-W3 and NW-01-31-07-W3 to determine the difference in yield and quality of oats cut for greenfeed at the soft dough stage compared to heading plus regrowth. The total yield of oat greenfeed was significantly greater at the soft dough stage compared to heading plus regrowth for both sites (Table 1). The yield of regrowth was low and under field scale conditions it may be difficult to work with this small quantity.

Quality of the greenfeed was improved when cut at heading and regrowth compared to the soft dough stage (Table 2). Oats cut at the earlier growth stages had higher nutrient levels, increased energy content (% TDN) and lower fibre content. However, when cut at the earlier growth stages the oats also had a higher nitrate content which is undesirable for livestock. Where the regrowth was mainly alfalfa nitrate levels were low.

Total protein yield was similar for greenfeed cut at the soft dough and heading plus regrowth even though the total dry matter yield was almost double at the soft dough stage (Table 3). This was due to the higher protein content of the greenfeed when cut at the earlier growth stages. The very high protein content of the regrowth on the NE-01-31-07-W3 reflects the fact that this was mainly alfalfa.

It is concluded that during rotation of alfalfa with oats, the oats should be cut at the soft dough stage to avoid problems of high nitrate levels and low yield.

Table 1. Yield of oats greenfeed at different growth stages.

	Yield (kg/ha)			
	NE		NW	
Growth Stage	Mean	CV%	Mean	CV%
Soft Dough	10325	8.9	10951	9.9
Heading	4408	8.6	4470	8.7
Regrowth	1429	24.0	1234	31.0
t value (Soft Dough vs Heading + Regrowth)	12.3 †		12.9 †	

† significant at P = 0.01

Table 2. Forage analyses of oats greenfeed at different growth stages.

Site	Growth Stage	Protein	T.D.N.	Ca	P	Nitrate	A.D. Fibre
		%					
NE	Soft Dough	9.85	55-57	0.33	0.19	0.60	32.26
	Heading	16.27	54-56	0.43	0.30	1.51	34.74
	Regrowth	21.65	59-61	1.03	0.33	0.52	26.91
NW	Soft Dough	10.09	50-52	0.32	0.24	1.19	38.39
	Heading	18.00	55-57	0.43	0.44	2.35	34.88
	Regrowth	18.26	56-58	0.44	0.33	1.50	31.61

Table 3. Total protein yield of oats greenfeed at different growth stages.

Site	Growth Stage	Yield (kg/ha)	Protein %	Total Protein Yield (kg/ha)
NE	Soft Dough	10325	9.85	1017
	Heading	4408	16.27	717
	Regrowth	1429	21.65	309
NW	Soft Dough	10951	10.09	1105
	Heading	4470	18.00	805
	Regrowth	1234	18.26	225

Specialty Crops

Specialty Crop Development Program

Principal: A. Vandenberg
Saskatchewan Irrigation Development Centre

Introduction

The specialty crops development program is focused on three irrigated pulse crops - dry bean, fababean and field pea. Research is conducted on numerous other minor or potentially new crops that may be of interest for irrigated production. Many of the experiments are established under a linear irrigation system. Irrigation can be controlled on a crop specific basis. Table 1 shows the water application regimes in 1990 for four blocks of experiments under the linear irrigation system. Reference will be made to this table for individual experiments in the following discussion of results.

Table 1. Rainfall and irrigation application for specialty crop experiments established under the linear irrigation system at SIDC in 1990.

		Irrigation and total water by crop production block					
		A		B		C	
Level of irrigation	Rainfall	Irrigation	Total	Irrigation	Total	Irrigation	Total
	mm						
Dryland	231	7	238	4	235	14	245
Partial 1	231	28	259	30	261	22	253
Partial 2	231	78	309	89	320	61	292
Partial 3	231	123	354	132	363	108	339
Full	231	167	398	153	384	160	391

Block A - fababean
Block B - pea, safflower, lupin, fenugreek, coriander, grass pea
Block C - dry bean
Rainfall - precipitation from May 1, 1990 to August 31, 1990.

Dry Bean Research

General

Research on irrigated dry bean agronomy and variety development continued in 1990. The growing season was relatively cool and wet in May and June, while late August and September were relatively warm and dry. Environmental conditions were favourable for development of *Sclerotinia* (white mold) on dry bean crops in mid to late July. As a result, some experiments were inconclusive due to variability caused by the infection. Some entries in variety evaluations were infected with seed-borne bacterial blight. These were eliminated when detected. Adjacent plots were affected, but variability was within acceptable limits.

Variety Evaluations

The U.S. Dry Bean Cooperative Nursery was grown for the fifth consecutive year (Table 2). All entries were direct combined at maturity. Sierra, a more upright pinto line from Michigan, showed noticeably lower *Sclerotinia* infection. Three pinto lines were earlier than Viva pink, the maturity check variety in dry bean trials at SIDC. Most entries in this nursery are too late maturing for Saskatchewan.

The Prairie Dry Bean Wide Row Cooperative Test was grown for the third year (Table 3). This test is grown across Western Canada as the base for cultivar registration recommendation. The cultivar Othello was recommended for registration in 1991.

In 1990, the Prairie Dry Bean Narrow Cooperative Test was grown for the first time (Table 4). The purpose of this trial is to evaluate potential new cultivars at narrow row spacing and higher plant populations to determine suitability for the direct harvest system.

A Preliminary Dry Bean Test (three replications, 23 entries) originating from Agriculture Canada in Lethbridge was grown at an off station location in 1990. Shipment of seed was delayed, therefore the test was not established until June 6. There was poor stand establishment and most entries were affected by late season frost.

A seed increase of some of the 1990 entries for the Prairie Dry Bean Cooperative Tests was attempted to develop a seed source for 1991 tests. An observational increase of twenty lines originating from Chile was also grown. These were grown under dryland conditions. Some entries were affected by foliar diseases, making the seed unsuitable for test purposes. Most white-seeded types were also affected by zinc deficiency because they were grown on a field that had been levelled several years ago. Exposure of subsoil can lead to zinc nutritional imbalance in dry bean crops, particularly for white-seeded bush cultivars.

A dryland pinto bean test was established at Bounty in cooperation with the Crop Development Centre. Thirty-three entries were included. Results indicated that under dryland conditions, the cultivar Othello was superior to both Topaz and Fiesta. Therefore, dryland production of Othello can be used to assure a disease-free seed supply for irrigated production.

Irrigation Response Study

An irrigation response study for dry bean was established under the linear irrigation system. Topaz pinto and Viva pink were used. Figure 1 shows that yield of dry bean can be reduced by almost half as irrigation is applied under environmental conditions conducive to *Sclerotinia* infection. Conversely, under favourable disease development conditions, the level of *Sclerotinia* infection can reach 100% in response to increasing irrigation of dry bean cultivars that have a vine growth habit (Figure 2).

Airseeding Study

This experiment was initiated in 1989 and repeated in 1990 with some treatment modifications (Table 5). Figures 3, 4 and 5 highlight the agronomically important treatment interactions. Demonstration projects based on 1989 research results were conducted at three sites in 1990. It was successfully shown that airseeders can be used to establish dry bean crops without loss of stand or yield if seed moisture is raised to the 16-18% level. The 1990 experimental results suggest that it may also be possible to airseed at even lower seed moisture levels if double impact distributor manifolds are avoided.

Table 2. Mean yield, seed weight, days to flower, days to maturity, plant height and *Sclerotinia* infection level for entries in the 1990 USDA Cooperative Dry Bean Nursery grown at Outlook, Saskatchewan.

Market class	Entry	Yield	Seed weight	Days to flower	Days to maturity	Plant height	*Sclerotinia* infection
		kg/ha	mg			cm	%
Pinto	Sierra	3355	301	58	109	60	40
	Olathe	2343	297	57	109	28	91
	ISB82-354	2341	333	46	105	33	83
	6315	2207	380	56	105	43	56
	UI114	2099	339	57	106	29	86
	Mean	2469					
Pink	Viva	2406	242	49	107	40	84
	Yolano	2340	292	53	106	36	88
	55037	2298	308	53	105	42	83
	Mean	2348					
Navy or small white	HR18-675	3001	167	54	111	46	31
	6137	2784	166	53	106	39	38
	Mayflower	2585	165	51	114	56	26
	Centralia	2487	175	56	111	42	35
	Fleetwood	2487	175	56	111	42	35
	H4 -17-827	2333	167	58	115	44	20
	Aurora	2313	139	54	111	40	44
	ISB85-672	1780	170	53	111	41	23
	Gryphon	1444	169	55	110	41	25
	Mean	2357					
Kidney	Sacramento	1998	518	41	108	33	10
	Redkloud	1977	542	42	115	44	13
	ISB82-772	1776	635	44	109	39	15
	Montcalm	1728	534	51	116	42	8
	37-16	1682	596	41	108	38	13
	ISB82-865	1473	492	45	112	38	13
	CELRK	1424	595	42	109	30	18
	29-21	1373	500	41	111	35	15
	40-23	1299	558	41	109	37	15
	31-19	1272	577	44	111	34	10
	CDRK82	1135	530	56	97	40	10
	Mean	1558					
Great northern or large white	GN-WM-85-43	2821	375	53	108	50	54
	GN-WM-85-55	2762	313	57	117	27	77
	UI59	1920	288	58	115	32	81
	Harris	1610	321	56	116	31	85
	Mean	2278					
Black	UI906	2291	162	55	104	40	24
	Midnight	2203	172	59	114	45	26
	Blackhawk	1980	181	59	113	48	26
	Mean	2158					
Overall mean		2068					
CV %		17					
LSD (0.05)		460					

Plot size: 1.2 m x 3.7 m, 2 rows at 60 cm spacing
Seeding rate: 35 seeds/m^2 (intended)
Planting date: May 26, 1990
Harvest: Direct combined at maturity, September 24, 1990
Rainfall: 231 mm Irrigation: 75 mm

Table 3. Mean yield, seed weight, days to flower, days to maturity, stand, *Sclerotinia* infection, and canopy height for entries in the Prairie Dry Bean Cooperative Test grown at Outlook, Saskatchewan, 1990.

Market class	Entry	Yield	Seed weight	Days to flower	Days to maturity	Stand	*Sclerotinia* infection	Canopy height
		kg/ha	mg			plants/m^2	%	cm
Pinto	D81127B	2839	336	54	106	48	38	43
	NW590	2570	295	53	106	43	79	30
	UI 111	2526	345	55	109	38	78	33
	ISB82354	2304	339	46	104	51	80	33
	UI 126	2302	322	53	110	50	61	34
	Othello	2292	314	43	108	44	74	34
	D81122	2257	324	52	107	53	81	31
	NW410	2173	279	58	111	52	78	36
	ISB84114	2169	359	51	108	45	81	30
	6315	2161	349	53	105	48	39	44
	Mean	2359						
Great northern or large white	Beryl	2748	273	50	107	40	74	34
	GNWM-85-43	2488	358	52	110	53	50	46
	83B352	2439	284	51	108	49	63	36
	GN1140	2110	295	49	105	45	80	28
	83B342	1925	364	47	109	50	74	30
	Mean	2342						
Pink	Yolano	2680	287	48	106	48	79	36
	D80192	2376	281	52	105	43	86	30
	Viva	2365	242	49	107	43	80	35
	ISB473	2281	260	44	106	44	78	36
	Mean	2426						
Small red	Garnet	2396	283	46	107	54	83	34
	NW63	2311	295	48	110	46	75	32
	ISB480	2205	261	51	106	52	89	25
	D79144	1949	301	46	105	52	70	33
	Mean	2215						
Black	UI906	2281	155	43	105	44	26	37
	NAG20	2260	210	55	106	47	14	43
	94041	2187	167	55	107	38	71	35
	Loop	2187	178	58	110	51	35	46
	X3160-5	2016	132	52	106	54	70	20
	Mean	2186						
Small white or navy	K0107	2697	158	54	110	56	50	42
	6137	2624	161	51	106	49	29	38
	UI158	2516	157	54	106	54	40	35
	Seaforth	1889	184	53	107	38	15	37
	B2W83-3	1816	174	49	107	38	36	40
	D84071	1788	163	52	108	51	13	37
	GTS0284-2	1737	187	51	106	46	25	41
	Sprint	1656	184	48	108	50	58	34
	ISB85657	1577	172	53	110	52	21	38
	Mean	2033						
Kidney	Redkloud	2275	508	42	110	43	10	42
	ISB82865	2027	542	31	108	51	34	34
	Montcalm	1594	545	53	111	53	10	50
	ISB82772	1135	565	45	109	24	9	33
	Mean	1758						
Overall mean		2195						
CV %		14						
LSD (0.05)		448						

Plot size: 1.2 m x 3.7 m - row spacing 60 cm
Planting rate: 40 seeds/m^2 (intended)
Planting date: May 26, 1990
Harvest: Direct combined at maturity, September 14, 1990
Rainfall: 231 mm Irrigation: 75 mm

Table 4. Mean yield, seed weight, days to flower, days to maturity, stand and *Sclerotinia* infection for entries in the 1990 Narrow Row Prairie Dry Bean Cooperative Test grown at Outlook, Saskatchewan, 1990

Market class	Entry	Yield	Seed weight	Days to flower	Days to maturity	Stand	*Sclerotinia* infection
		kg/ha	mg			plants/m^2	%
Navy or small white	K0107	3207	162	54	109	50	74
	L9322	3036	179	57	109	43	48
	D84071	2520	169	53	109	38	49
	HR55	2409	176	55	107	46	83
	ISB85657	1947	179	55	110	50	59
	ISB85672	1829	168	52	108	49	68
	Seaforth	1686	185	54	108	31	61
Pinto	Sierra	3250	327	57	110	40	59
	Topaz	3128	347	53	106	48	76
	D81127B	2764	330	53	106	48	78
Black	UI 906	2446	158	53	107	47	38
Kidney	ISB82865	2079	575	42	108	47	41
	Mean	2525					
	CV %	11					
	LSD (0.05)	407					

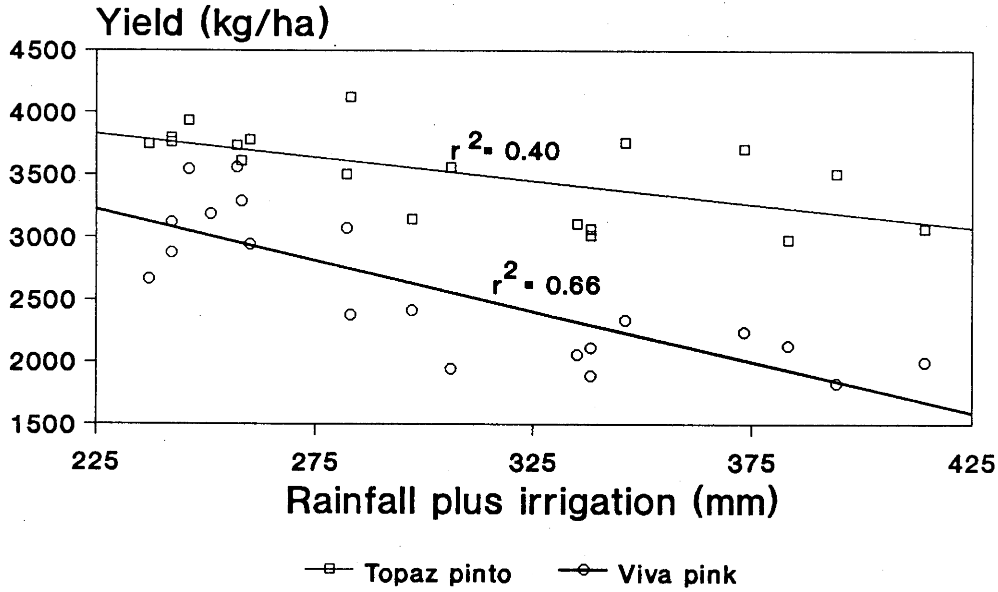
Plot size: 1.2 m x 3.7 m - 6 rows at 20 cm spacing
Planting rate: 50 seeds/m^2 (intended)
Planting date: May 26, 1990
Harvest: Direct combined at maturity, September 21, 1990
Rainfall: 231 mm Irrigation: 75 mm

Table 5. Treatment combinations used in the airseeding experiment in 1990 at Outlook, Saskatchewan.

Cultivar and seed weight	Seed moisture level: Ambient	Seed moisture level: Elevated	Airseeder: Number	Airseeder: Type of distributor
Beryl - 320 mg	10.2 %	16-18 %	1	Single impact (padded)
Topaz - 260 mg	9.4 %	16-18 %	2	Direct delivery
			3	Single impact (unpadded)
			4	Double impact
			5	Control

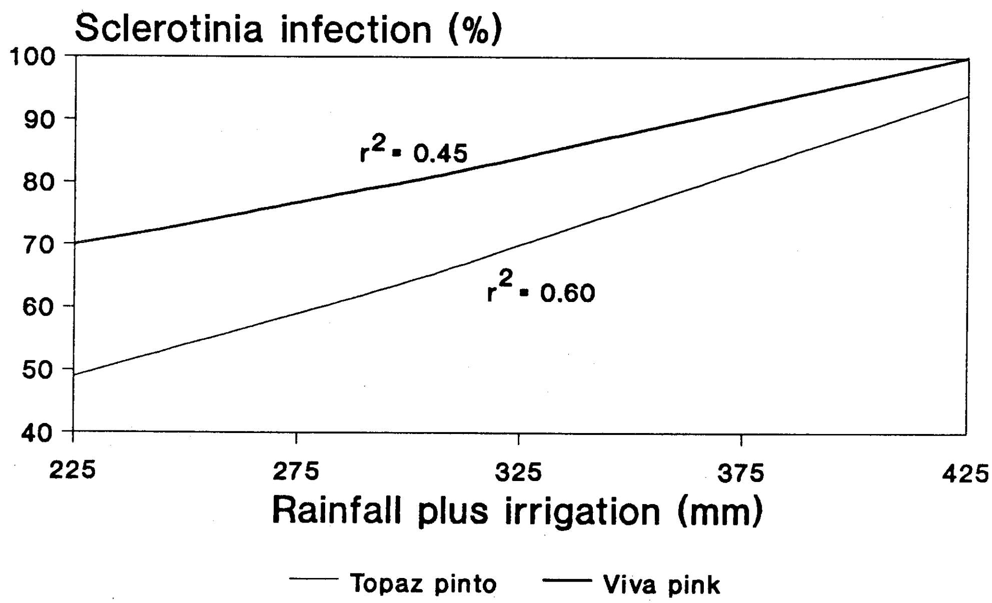
Rainfall: 231 mm Irrigation: 75 mm

Figure 1. Regression of yield on water application for dry bean



1990 at SIDC, Outlook, Saskatchewan

Figure 2. Regression of % Sclerotinia infection on water application



1990 at SIDC, Outlook, Saskatchewan

Figure 3. Effect of seed moisture and airseeder on Topaz dry bean seed 1990

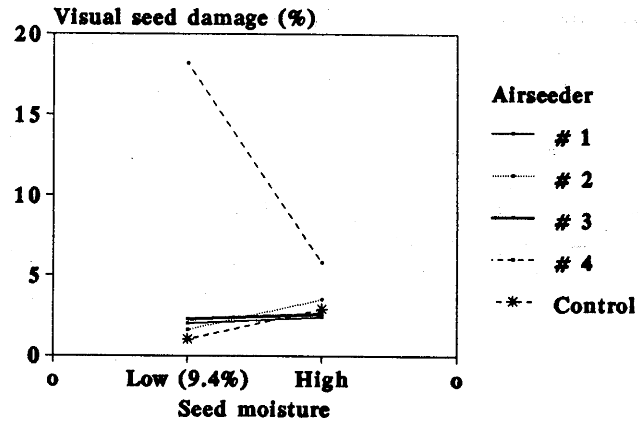
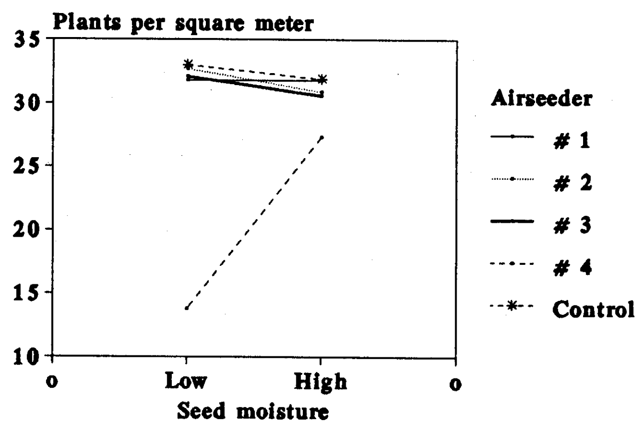
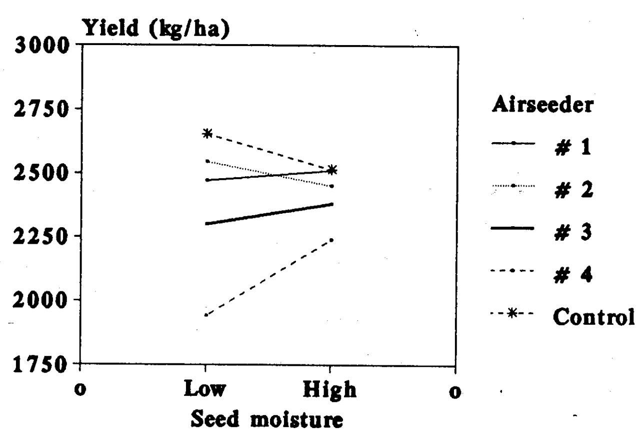


Figure 4. Effect of airseeder and seed moisture on plant stand* -dry bean 1990



* Stand refers to healthy seedlings

Figure 5. Effect of airseeder and seed moisture on yield of dry bean in 1990



Fungicide Evaluation

An experiment designed to evaluate *Sclerotinia* control by three fungicides on dry bean was established under the linear irrigation system. Weather conditions were conducive to infection. Contrast comparisons showed, on average, a significant yield increase due to fungicide application. The Rovral treatment was applied using water to which a buffer solution had been added but there were no significant differences in dry bean yield among fungicide treatments or rates of application.

International Dry Bean Modelling Nursery

This experiment was conducted for the second year in cooperation with dry bean researchers from across North America. The cultivars Viva, NW 63, Redkloud, UI 114 and Fleetwood were grown. Detailed data describing plant growth and development were recorded as input to a computer simulation model of dry bean growth response.

Harvestability Trial

The 1990 harvestability trial results were confounded by a severe *Sclerotinia* infection. As a result, harvest losses were extremely variable and much higher than would normally be expected. This experiment will be modified and expanded in 1991.

Table 6. Comparison of three fungicide treatments applied at three rates on yield of Topaz pinto bean under irrigation at Outlook, Saskatchewan, 1990.

Fungicide treatments			
Product	Rate	Number of sprays	Yield
			kg/ha
Benlate	full	1	2328
	half	1	2649
	half	2	2430
Rovral	full	1	2422
	half	1	2252
	half	2	2536
Easout	full	1	2585
	half	1	2549
	half	2	2485
Control	0	0	2103
CV %			14
LSD (0.05)			379

Plot size: 2.4 m X 3.7 m
Planting date: June 1, 1990
Harvest: Direct combined at maturity
Rainfall: 231 mm Irrigation: 75 mm

Dry Bean Drydown Experiment

Most new dry bean growers have difficulty in determining the correct stage for direct harvesting. An experiment was established to document the drydown rate for two dry bean cultivars, Topaz pinto and Viva pink. Weather in early September was very hot and dry. This greatly accelerated the drydown process compared to the usual September weather patterns. Therefore, only three sampling dates were possible. Figure 7 shows how seed moisture content for both Topaz and Viva dropped from well above to below the recommended moisture content for direct harvest (16-18%) in a three to four day period. This reinforces how important it is for dry bean growers to closely monitor seed moisture content before harvest.

The plant samples from which seed moisture measurements were recorded on September 10, 1990, were also classified according to pod maturity. The percentage of green, yellow (buckskin) and tan (dry, ripe) pods was recorded. The relationship between percent pod maturity and average seed moisture is shown in Figure 6. Although this was a preliminary experiment, the relationship between pod maturity and seed moisture content may prove to be a simple and effective tool for determining the appropriate time for direct harvesting. This experiment will be repeated and expanded in 1991.

Seeding Depth Study

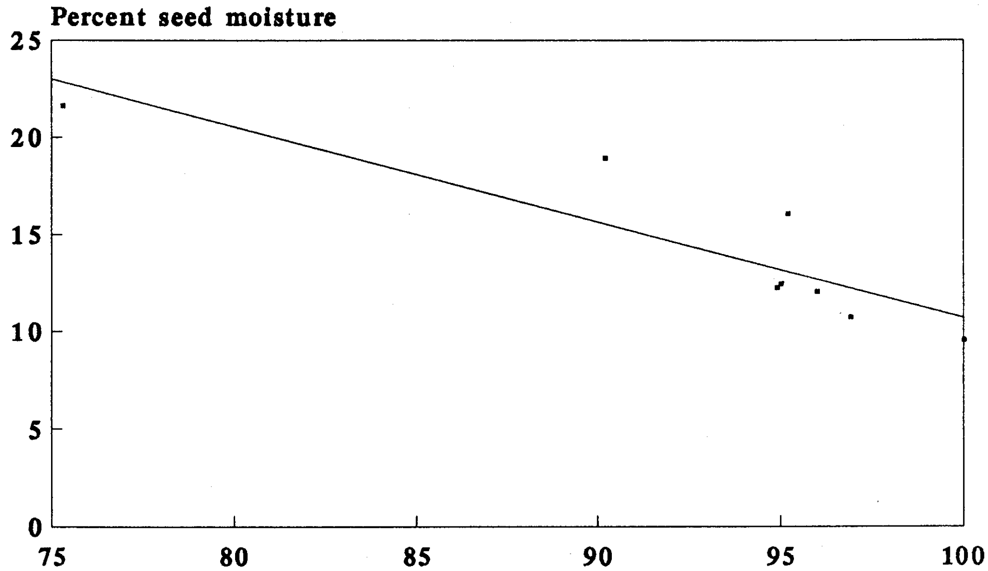
Topaz pinto bean was sown at four depths on May 29, 1990. Seeding at a 2.5 cm depth resulted in significantly lower yield, and reduced canopy height (lodging) compared to the recommended 5.0 to 7.5 cm depth treatments (Table 7). In comparison to the recommended seeding depth range, 10 cm seed depth resulted in significantly reduced stand density and slower emergence based on stand counts on June 12. Differences in *Sclerotinia* infection due to seeding depth may have been related to canopy lodging.

Table 7. Effect of depth of seeding on yield, canopy height, stand density, and percent emergence twelve days after seeding for Topaz pinto bean grown at Outlook, Saskatchewan, 1990.

Seeding depth	Yield	Canopy height	Stand density	Percent of final stand on June 12	*Sclerotinia* infection
cm	kg/ha	cm	plants/m^2	%	%
2.5	2185	34	28.2	66	47
5.0	2461	42	30.1	79	46
7.5	2422	46	30.1	72	32
10.0	2264	47	25.3	52	30
Mean	2333	43	28.4	66	39
CV (%)	10.5	16.7	11.9	24.7	32.0
LSD (0.05)	204	6	2.8	13	10

Plot size: 1.2 m x 3.7 m, 3 rows at 40 cm spacing, 12 replications
Target seeding rate: 35 seeds/m^2 (intended)
Planting date: May 29, 1990
Harvest: Direct combined at maturity, September 12, 1990
Rainfall: 231 mm Irrigation: 75 mm

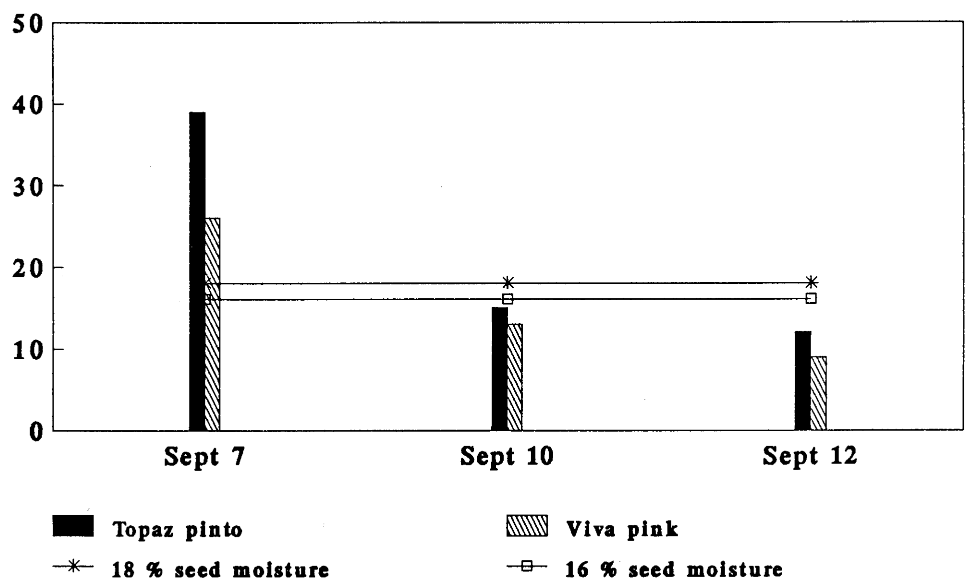
Figure 6. Percent seed moisture vs percent pod maturity for dry bean



Percent dry ripe pods

September 10, 1990

Figure 7. Drydown of two dry bean cultivars at Outlook, 1990



Each value mean of 4 samples

Seed Moisture Study

Raising seed moisture levels may be necessary to allow producers to use airseeders with impact distributor manifolds. This experiment was designed to investigate potential yield or stand loss due to hydrating seed to moisture levels up to 21%. Elevating the moisture content of seed from 11.5% (ambient) to 15, 18 or 21% moisture prior to seeding had no effect on yield in three separate experiments (Table 8). Stand density was not affected by raising seed moisture levels at two sites. These results plus those of the air seeding studies in 1989 and 1990 suggest that raising seed moisture levels before seeding is not harmful to stand establishment or yield of pinto bean.

Fababean Research

General

Growing conditions were favourable for fababean in 1990. Both variety testing and the redefinition of irrigated fababean agronomy were continued for the third year.

Variety Evaluation

The Western Canadian Fababean Cooperative Test was grown in 1990 (Table 9). Once again, Aladin was the highest yielding cultivar. It also had large seed size, a desirable quality characteristic.

Table 8. Effect of raising seed moisture content on yield and stand density of Topaz pinto bean at three sites in 1990.

Initial seed moisture	Bounty (dryland) May 28		SIDC (irrigated) June 1		SIDC (irrigated) May 22
	Yield	Stand density	Yield	Stand density	Yield
%	kg/ha	plants/m^2	kg/ha	plants/m^2	kg/ha
11 (ambient)	849	30	2188	31	2337
15	858	27	2158	31	2348
18	913	30	2247	30	2195
21	926	28	2352	32	2307
Mean	887	29	2236	31	2295
CV%	15.3	7.4	9.4	8.4	9.8
LSD (0.05)	NS	NS	NS	NS	NS

Location and date of seeding

Plot size: 1.2m x 3.7 m, 3 rows at 40 cm spacing, 6 replications
Seeding rate: 35 seeds/m^2 (intended)
Harvest: Direct combined at maturity in September
Rainfall: 231 mm Irrigation: 75 mm

Table 9. Mean yield, seed weight and days to flower for entries in the 1990 Fababean Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield	Seed weight	Days to flower
	kg/ha	mg	
Aladin	4896	352	65
Pegasus	4683	343	64
82RM2227	4538	356	64
Encore	4497	345	64
86LH08	4422	495	58
Herz Freya	4176	347	64
Outlook	3726	301	65
Orion	3643	330	59
Mean	4283		
CV %	15		
LSD (0.05)	NS		

Plot size: 2.4 m x 3.7 m - row spacing 40 cm, 3 replications
Planting rate: 40 seeds/m^2 (intended)
Planting date: April 24, 1990
Harvest: Swathed in early September, combined on September 19, 1990
Rainfall: 231 mm Irrigation: 208.5 mm

Seeding Rate and Row Spacing Study

Results from this experiment were similar to other years with the exception that yield at 60 cm row spacing was significantly reduced (Table 10). This was possibly due to wind damage suffered in early July. Aladin again significantly outyielded Outlook in 1990. Results from this experiment will be incorporated into a revised fababean production guide for irrigated conditions.

Table 10. Effect of seeding rate and row spacing on yield of two fababean cultivars grown under irrigation at Outlook, Saskatchewan, 1990.

Treatment	Cultivar	Yield (kg/ha)			Treatment mean
Seeding rate		20 seeds/m^2	30 seeds/m^2	40 seeds/m^2	
	Aladin	3999	4097	4049	4048*
	Outlook	3727	4007	3619	3784
	Mean	3863	4052	3834	
Row spacing		20 cm	40 cm	60 cm	
	Aladin	4206	4223	3716	4048*
	Outlook	4179	3944	3230	3784
	Mean	4192	4083	3473*	
CV = 14%					

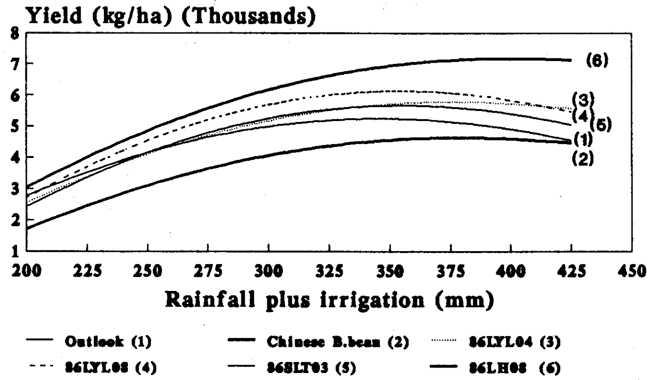
* Significant difference at P=0.05 level
Rainfall: 231 mm Irrigation: 208.5 mm

Chinese Broadbean Study

Breeding lines from hybrids between Outlook fababean and Chinese broadbean were evaluated in cooperation with Dr. G. Rowland, Crop Development Centre, University of Saskatchewan. This experiment was designed to compare the agronomic performance of advanced breeding lines and to compare their responses to irrigation. Twenty replications of six entries were established under the linear irrigation system. The amount of irrigation was systematically varied across the field to simulate irrigation levels and response to irrigation was recorded.

All breeding lines were higher yielding than the parental lines (Table 11). All breeding lines had larger seed size and flowered earlier than Outlook fababean. This material shows promise for future development of new markets for high quality large-seeded fababean. Yield response to irrigation was similar for all entries in the experiment (Figure 8).

Figure 8. Response of Chinese broadbean and fababean lines to irrigation - 1990



Outlook, Saskatchewan

Table 11. Yield, seed weight and days to flower for entries in the 1990 Broadbean Study grown at Outlook, Saskatchewan.

Entry	Yield	Seed weight	Days to flower
	kg/ha	mg	
Outlook fababean	4870	316	50.1
Chinese broadbean	3988	904	42.5
86LYL04	5202	450	48.3
86LYL08	5492	472	48.3
86SLT03	5145	369	49.5
86LH08	5238	479	48.0
Mean	4989	498	48
CV %	8.1	8.1	1.4
LSD (0.05)	255	26	0.4

Irrigation: See Table 1, Block A.

Fababean Irrigation Study

A basin irrigation experiment investigating fababean response to irrigation was established in cooperation with T.J. Hogg and L.C. Tollefson of SIDC. Results are presented in the Soils/Fertilizer/Water section of this report entitled "Irrigation Scheduling of Pulse Crops".

Exotic Fababean Preliminary Investigations

Seed of two Peruvian broadbean accessions was increased in cooperation with Dr. A. Slinkard, Crop Development Centre, University of Saskatchewan. Both were similar to Chinese broadbean in growth habit and seed weight. Both will be evaluated further in 1991.

Two lines of shelling broadbean (Triple White and Windsor) were evaluated for potential as a market garden crop in cooperation with Dr. D. Waterer, Department of Horticulture Science, University of Saskatchewan. Pods were harvested in July and test marketed at the Saskatoon Farmers Market. All samples were of excellent quality and received a favourable reaction from consumers.

Pea Research

General

The field pea agronomic research program emphasizes investigation of agronomic practices that may improve yield under irrigated conditions. Evaluation of potential new varieties is carried out with the objectives of making irrigation specific variety recommendations and of expanding the potential market classes for pea. Weather conditions were very good for irrigated pea crops in 1990.

Variety Evaluations

Three pea variety tests were grown in 1990. The Field Pea Cooperative Test included many semi-leafless and reduced height entries that should be of interest for irrigated production (Table 12). The variety Express continues to perform well under irrigation. This test is grown at many locations across Western Canada and serves as a basis for variety registration.

The Special Purpose Pea Cooperative Test also included a number of semi-leafless entries (Table 13). Most of the entries in this test are intended for use as feed or other specialty markets.

A new preliminary test was grown in 1990. The Pea Screening Cooperative Test included many semi-leafless entries. A large number of these outyielded the check varieties and several lines will be advanced to the Field Pea or Special Purpose Cooperative Tests in 1991 (Table 14).

Several hundred pea breeding lines were increased on a row basis in fill areas in 1990 in cooperation with Dr. A.E. Slinkard, Crop Development Centre, University of Saskatchewan. Most of these fall in the Austrian Winter Pea market class and will be further evaluated in 1991. There may be some potential for diversification of pea production into this market class in the long season irrigated regions of Saskatchewan.

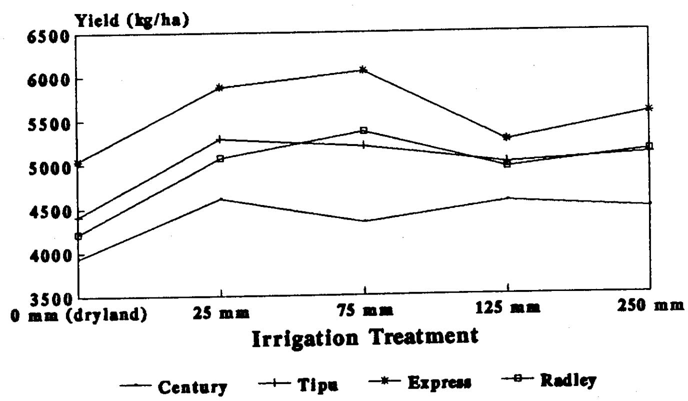
Irrigation, Fungicide, and Variety Interaction Study

This experiment was repeated in 1990 with some modifications. Benlate, Rovral and Easout (main plots) were applied to the variety subplots Express (tare-leaf yellow), Progreta (tare-leaf marrowfat type), and Radley (semi-leafless green). The plots were laid out under the linear irrigation system in three target irrigation zones so that irrigation treatments were replicated twice. No significant differences in yield were observed due to fungicide application or due to fungicide x irrigation interaction. There were, however, significant differences in yield due to both irrigation and variety (Table 15).

Pea Irrigation Studies

Radley (medium height) and Tipu (tall) semi-leafless pea varieties were compared to Express (medium height) and Century (tall) standard leaf varieties at five levels of irrigation. An analysis of variance for yield showed a highly significant interaction between variety and yield. Figure 9 shows that in 1990 a low to intermediate irrigation level was required to increase pea yield above dryland values. Higher levels (125 - 150 mm) tended to reduce yield, likely due to *Sclerotinia* infection. However, the medium height varieties were higher yielding and were able to respond to higher levels of irrigation than either of the tall varieties.

Figure 9. Response of four pea varieties to five levels of irrigation - 1990



Outlook, Saskatchewan

A second pea irrigation study using the basin method was conducted in collaboration with T.J. Hogg and L.C. Tollefson, SIDC. These results are reported in the Soils/Fertilizer/Water section of this report entitled "Irrigation Scheduling of Pulse Crops".

Pea Seeding Rate and Seeding Depth Study

Radley pea was sown at all combinations of three seeding depths (2.5, 5.0 and 7.5 cm) and three intended target plant densities (55, 80 and 110 plants/m^2). No significant differences in yield were observed due to seeding rate or seeding depth (Table 16). Observed stand density was greatly reduced from the intended stand density at the two higher seeding rates. There was some indication that seeding at 5.0 cm or more depth was superior to 2.5 cm.

Garden Pea Evaluation

A preliminary evaluation of potential new shelling, snow and snap pea varieties was performed in cooperation with Dr. D. Waterer, Department of Horticulture Science, University of Saskatchewan. Results were variable. However, yields were similar to the check varieties Organ Sugar Pod (snow type) and Homesteader (shell type). Some lines were resistant to powdery mildew.

Grass Pea

General

Irrigated research of grass pea (*Lathyrus sativus* L.) continued for the third and final year of a project conducted in cooperation with Dr. C. Campbell, Agriculture Canada, Morden and Dr. A.E. Slinkard, Crop Development Centre, Saskatoon. The third year of the project was funded by the Saskatchewan Pulse Crop Development Board.

Variety Evaluation

The Lathyrus Cooperative Test was grown under irrigation for the third year in 1990. Yields were slightly higher than 1990 (Table 17). Above average rainfall and favourable atmospheric conditions for disease development caused a late season *Sclerotinia* stem rot infection. This is the first year that this disease has had a major effect on grass pea.

Irrigation Study

Four grass pea lines with reduced levels of the neurotoxin BOAA and the field pea cultivar Tara were grown at three levels of irrigation. At the time of publication, BOAA analysis was not yet available. Irrigation had little effect on yield for all entries in 1990, partly due to the variability in data (Table 18). Dryland yields for grass pea were higher, on average, than irrigated yields. This is presumed to be a confounding effect due to the high level of *Sclerotinia* infection associated with the favourable weather patterns for this disease in 1990. In 1988 and 1989, dryland yields were less than half of irrigated yields in this experiment. Complete results will be available in the project final report.

Table 12. Mean yield, stand, days to flower, days to maturity, seed weight, vine length and leaf type for entries in the Field Pea Cooperative Test 1990 at Outlook, Saskatchewan.

Entry	Yield	Plant stand	Days to flower	Days to maturity	Seed weight	Vine length	Leaf type
	kg/ha	plants/m^2			mg	cm	
MP1018	4047	81	57	110	241	125	standard
Express	3783	75	58	103	255	64	tare
Titan	3773	59	61	110	279	134	standard
Tara	3721	64	58	104	224	124	standard
CL-85[1]	3683	59	58	102	319	69	semi-leafless
Ricardo	3650	69	57	103	346	50	standard
SV14936	3567	76	55	103	235	83	standard
Century	3533	75	57	110	243	134	standard
SV84539[1]	3504	61	55	100	246	74	semi-leafless
Ruga	3497	67	55	103	302	80	standard
SVE11116	3495	65	55	99	207	69	semi-leafless
NSA 640	3485	67	53	101	298	61	tare
Malinda	3473	64	55	103	295	79	standard
Bahatyr[1]	3459	71	54	102	288	80	standard
RB40	3434	81	55	102	315	67	standard
Lu-Sib	3433	66	55	105	326	77	standard
Mara	3352	66	55	105	303	82	standard
SVE36121	3235	66	56	100	260	59	semi-leafless
4-9037	3111	76	55	97	297	58	semi-leafless
APP-52811	3056	77	55	101	293	83	semi-leafless
Radley	2954	59	55	104	220	68	semi-leafless
MP 1000	2932	90	54	101	273	117	standard
4-9002	2893	79	51	98	328	55	tare
MP 999	2732	67	54	100	278	118	standard
4-9036	2728	67	52	98	256	65	semi-leafless
Mean	3381	70	55	102	277	83	
CV %	9						
LSD (0.05)	408						

[1]Recommended for cultivar registration in 1991.

Plot size: 2.1 m x 3.7 m - 20 cm rows
Planting rate: 80 seeds/m^2 (intended)
Planting date: May 2, 1990
Harvest: Direct combined at maturity, August 15-23
Rainfall: 231 mm Irrigation: 183 mm

Table 13. Mean yield, stand, days to flower, days to maturity, seed weight, vine length and leaf type for entries in the Special Purpose Pea Cooperative Test 1990 at Outlook, Saskatchewan.

Entry	Yield	Plant stand	Days to flower	Days to maturity	Seed weight	Vine length	Leaf type
	kg/ha	plants/m^2			mg	cm	
Anno	3773	86	44	89	277	59	semi-leafless
Bellevue	3571	68	55	101	188	96	standard
BL1887	3503	75	44	92	355	52	semi-leafless
Express	3398	72	53	95	239	53	tare-leaf
Baroness	3388	80	45	96	331	70	semi-leafless
Orb	3374	85	46	88	274	54	semi-leafless
Kasino	3301	76	44	89	301	62	semi-leafless
Tara	3173	69	55	99	202	113	standard
Century	3154	66	55	101	207	129	standard
H-51821	3065	67	46	95	263	53	semi-leafless
CSP5	2969	80	52	92	339	57	standard
Titan	2894	43	55	101	260	137	standard
Radley	2766	78	46	96	218	59	semi-leafless
Emperor	2588	62	54	102	134	133	standard
Duchess	2535	37	52	98	355	66	semi-leafless
Masterman	2407	34	45	98	318	53	tare
Mean	3381	70	49	96	277	78	
CV %	16						
LSD (0.05)	705						

Plot size: 2.1 m x 3.7 m - 20 cm rows
Planting rate: 80 seeds/m^2 (intended)
Planting date: May 14, 1990
Harvest: Direct combined at maturity, August 13-26
Rainfall: 231 mm Irrigation: 183 mm

Table 14. Mean yield, stand, days to flower, days to maturity, seed weight and vine length for entries in the 1990 Pea Screening Test grown at Outlook, Saskatchewan.

Entry	Yield	Stand	Days to flower	Days to maturity	Seed weight	Vine length
	kg/ha	plants/m^2			mg	cm
AG89-10	4994	84	42	104	303	106
1418	4716	73	42	95	275	77
HR-2-1-3	4586	72	43	96	271	90
AG89-3	4530	83	41	96	231	77
Dank	4489	82	43	96	267	82
SVE36121	4475	72	46	97	222	99
VS86282	4435	77	47	96	192	88
BL616	4369	84	45	97	246	101
Impala	4305	78	47	96	237	100
SV86008	4185	70	48	93	188	90
SV84539	4123	76	46	95	210	98
AG89-14	4122	68	44	97	251	88
SVC40129	4093	83	44	102	228	114
AG89-11	4072	82	43	97	288	96
1128	3991	67	40	95	369	77
SVC40143	3983	71	47	99	245	117
AG89-9	3942	95	42	97	262	84
BL621	3871	87	43	96	240	95
Radley	3771	81	45	96	169	87
Consort	3675	81	43	96	290	89
DJ1-1	3674	89	44	93	194	93
Tara	3650	69	53	107	187	148
SVF23011	3637	72	46	96	175	96
SVD24041	3615	75	44	100	205	84
Express	3518	84	46	101	220	80
SVC14936	3323	76	43	96	198	97
Titan	3216	51	53	99	234	157
AG89-1	3072	81	46	105	369	97
SVE11116	3067	79	48	98	225	90
Century	2658	68	53	104	191	156
Bellevue	2637	86	53	107	152	145
Mean	3906	77	45	98	236	100
CV %	12					
LSD (0.05)	657					

Plot size: 2.1 m x 3.7 m in 20 cm rows

Planting rate: 80 seeds/m^2 (intended)

Planting date: May 23, 1990

Harvest: Direct combined at maturity, September 7, 1990

Rainfall: 231 mm Irrigation: 255 mm

Table 15. Yield of three pea cultivars at three levels of irrigation in 1990 at Outlook, Saskatchewan.

Cultivar	Yield: Irrigation level 0 - 25 mm	75 - 100 mm	125 - 150 mm
	kg/ha		
Radley	4228	4688	5161
Progreta	3601	5196	4873
Express	4865	5920	6208

LSD (0.05) = 372 within rows or within columns

Plot size: 2.4 m X 3.7 m in 20 cm rows.
Planting rate: 80 seeds/m^2 (intended)
Planting date: May 18, 1990
Harvest: Direct combined at maturity, Aug. 29 - Sept. 4
Rainfall: 231 mm

Table 16. Stand density and mean yield for Radley pea sown at three seeding rates and three seed depths in 1990 at Outlook, Saskatchewan.

Treatment

Seeding rate:

Seeding rate		Target stand	Observed stand density	Yield
seeds/m^2	lb/ac	plants/m^2	plants/m^2	kg/ha
70	118	55	56	5054
110	186	80	66	5046
155	262	110	77	5177

Seeding depth:

Target seed depth	Observed stand density	Yield
cm	plants/m^2	kg/ha
2.5	66	4834
5.0	68	5180
7.5	65	5234

Plot size: 2.4 m X 3.7 m, 12 rows at 20 cm spacing
Planting date: May 23, 1990
Harvest: Direct combined at maturity, Sept. 6, 1990
CV = 11%
Rainfall: 231 mm Irrigation: 255 mm

Table 17. Mean yield, seed weight, vine length, days to flower, stand and *Sclerotinia* infection for entries in the 1990 Lathyrus Cooperative Test grown at Outlook, Sask.

Entry	Yield	Seed weight	Vine length	Days to flower	Stand	*Sclerotinia* infection
	kg/ha	mg	cm		plants/m^2	%
LS8533	4347	203	118	53	49	10
LS8779	3358	185	134	53	52	25
NC8-39	3342	169	134	52	50	10
NC8-26/2	3300	176	128	54	46	23
LS8789	3295	173	129	53	56	20
LS847	3246	190	129	52	61	18
LS8520	3234	200	110	52	53	23
LS8523	3152	215	128	53	52	25
LS8790	3124	179	121	53	58	20
LS8764	3065	164	129	54	56	18
NC8-1	2933	181	115	54	48	23
LS8787	2882	181	130	53	54	20
NC8-34	2878	164	135	52	48	20
NC8-11	2692	176	118	52	49	23
LS8783	2578	172	123	53	52	20
NC8-79	2241	179	114	54	48	50
Mean	3110					
CV %	19					
LSD (.05)	839					

Plot size: 1.2 m x 3.7 m in 6 rows at 20 cm spacing
Seeding rate: 80 seeds/m^2 (intended) Planting date: May 5, 1990
Harvest date: Direct combined on October 5, 1990
Rainfall: 231 mm Irrigation: 183 mm

Table 18. Effect of irrigation on seed yield and seed weight of grass pea grown at Outlook, Saskatchewan, 1990.

Measurement	Entry	Irrigation treatment: Dryland	Partial	Full	Mean
Yield		kg/ha			
	Nc8a-64	3024	2732	2717	2824
	Nc8a-7	3025	2683	2694	2801
	Nc8a-74/	2523	1842	1425	1930
	Nc8a-84	2651	2767	1628	2349
	Tara	4425	4627	4714	4590
	Mean	3130	2930	2636	
	Standard error				468
	CV = 13.3%				
Seed weight		mg			
	Nc8a-64	188	101	198	192
	Nc8a-7	176	177	193	182
	Nc8a-74/	139	133	145	139
	Nc8a-84	173	183	189	182
	Tara	203	211	189	201
	Mean	169	171	181	
	Standard error				6
	CV = 6.7%				

Replications: 4 Seeding date: May 18, 1990
Water applied: Rainfall plus irrigation: dryland - 235 mm; partial irrigation - 261 mm; full irrigation - 384 mm.
Harvest: Dryland - Aug 18; partial irrigation - Aug 22; full irrigation - Aug 29; bagged and threshed at maturity.

Lentil Research

General

Weather conditions were very favourable for lentil production in Saskatchewan in 1990. Little irrigation was necessary to ensure high yields. Research on irrigated lentil is conducted in cooperation with the Crop Development Centre, University of Saskatchewam. Part of the research is supported by the Saskatchewan Pulse Crop Development Board.

Variety Evaluation

The Lentil Cooperative Test was grown under a pivot system. As in 1988 and 1989, Eston was the highest yielding entry, significantly outyielding Laird (Table 19). As in 1989, the performance of Rose lentil was similar to that of Eston.

Lentil Phosphorus Study

This project is coordinated by Dr. R. Bhatty, Crop Development Centre, University of Saskatchewan. In 1990, Eston lentil was established under dryland and irrigation. Phosphorus fertilizer (P_2O_5 basis) was side-banded at 0, 10, 40, 60, and 80 kg/ha. Harvested seed samples were analysed for P content, phytic acid content and other nutritional qualities. These analyses are in progress. Yield data analysis indicated no yield response to P_2O_5 addition (Table 20). Irrigation significantly increased yield compared to dryland but this difference was much smaller than that expected in most years. There were favourable growing conditions for lentil on dryland in 1990.

Seeding Rate and Row Spacing Study

An experiment was established to investigate the effect of increased seeding rate and reduced row spacing on yield of irrigated Eston lentil. It was necessary to increase the recommended seeding rate by more than 50% to achieve a significantly higher post-emergent stand density (Table 21). Decreasing row spacing significantly increased stand density averaged across all seeding rates, indicating that intra-row competition is a factor in lentil stand establishment. There was no interaction between seeding rate and row spacing. There were no significant differences in seed yield due to either row spacing or seeding rate treatments in 1990. Conditions were very favourable for lentil in 1990. This experiment will be repeated with some treatment modifications in 1991.

Lentil Irrigation Studies

An irrigation response study of Eston lentil was established under the linear irrigation system . It was abandoned after the plots were severely infected with *Sclerotinia* stem rot. A basin irrigation experiment using Eston lentil was conducted in cooperation with T.J. Hogg and L.C. Tollefson of SIDC. The results are reported in the Soils/Fertilizer/Water section of this report entitled "Irrigation Scheduling of Pulse Crops".

Safflower Research

General

Cooperation with the safflower breeding program at Agriculture Canada at the Lethbridge Research Station and with the New Crops Program at Agriculture Canada in Morden continued in 1990. Yield of Saffire was relatively low in 1990 partly due to seeding delays caused by wet weather.

Variety Evaluation

There were 20 entries in the Safflower Cooperative Test in 1990. The highest yielding entries (LE241 series) were recommended for variety registration in 1991 (Table 22). This new variety will be dual purpose for both oilseed and birdseed markets.

Table 19. Mean yield, days to flower, seed weight and canopy height for entries in the 1990 Lentil Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield	Days to flower	Seed weight	Canopy height
	kg/ha		mg	cm
Eston	4475	53	33	46
Rose	4254	52	50	50
LA-16	4129	57	46	57
LA-25	3994	55	42	52
LAX-8	3951	56	49	57
LA-24	3595	57	45	56
VLT-15	3019	55	52	54
Laird	2979	57	70	64
VLT-20	2503	53	45	58
VLT-19	2245	56	46	61
Mean	3589			
CV %	12			
LSD (0.05)	621			

Plot size: 1.2m x 3.7 m - 20 cm rows
Planting rate: 100 seeds/m^2 (intended)
Planting date: May 5, 1990
Harvest: swathed on August 24, combined on August 27, 1990
Rainfall: 231 Irrigation: 183 mm

Table 20. Effect of phosphorus fertilizer addition on seed yield of Eston lentil grown at Outlook, Saskatchewan, 1990.

Measurement	P_2O_5 addition	Dryland	Irrigated	Mean
Yield	-----------------kg/ha-----------------			
	0	2492	3087	2790
	20	2249	3007	2628
	40	2615	2729	2672
	60	2567	3099	2833
	80	2642	2995	2819
Mean		2513	2983	
Standard error				215
CV = 11%				

Plot size: 1.2 m X 3.7 m - 20 cm rows
Planting rate: 100 seeds/m^2 (intended)
Planting dates: May 4 (dryland), May 14 (irrigated)
Harvest: Swathed and combined in August, 1990.
Rainfall: 231 mm Irrigation: 183 mm

Table 21. Effect of seeding rate on stand density and yield of Eston lentil grown under irrigation at Outlook, Saskatchewan in 1990.

Treatment	Yield	Stand density
Seeding rate seeds/m^2	kg/ha	plants/m^2
100 (recommended)	4572	109
125	4821	119
150	4722	114
175	4471	131
200	4474	140
Row spacing (cm)		
10	4625	136
20	4599	102
Mean	4612	
CV %	9	16
LSD	NS	23

Plot size: 1.2 X 3.7 m, 6 replications
Seeding date: May 5, 1990
Harvest date: August 27, 1990
Rainfall: 231 mm Irrigation: 183 mm

Table 22. Mean yield, seed weight, days to flower, canopy height and disease tolerance ratings for entries in the 1990 Safflower Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield	Canopy height	Days to flower	Seed weight	Disease tolerance† Rust	Disease tolerance† Alternaria
	kg/ha	cm		mg		
LE241	3459	69	77	35	4	9
LE241L	3323	64	77	35	4	9
LE241E	3186	63	77	35	5	9
LE264	3025	69	76	30	3	9
LE258	2752	68	77	31	4	9
Saffire	2622	60	74	34	6	9
LE261	2605	64	76	34	4	9
LE273	2460	62	74	33	7	9
SA-23-45	2443	61	76	31	4	9
LE294	2367	59	75	31	6	9
LE271	2366	60	75	37	6	9
SA-23-66	2312	59	75	31	5	9
RH-3	2172	71	78	26	2	9
SA-29-90	2170	62	76	26	5	10
SA-29-92	2154	62	76	27	5	9
SA-29-11	2150	66	78	26	4	9
S-208	2068	73	79	37	4	8
S-541	2061	73	79	38	5	8
Finch	2015	70	78	31	6	9
SA-29-88	1867	64	77	25	5	10
Mean	2479					
CV %	10					
LSD	359					

†Disease rating scale is 1 (least) to 10 (most)
Plot size: 1.2 m x 3.7 m
Planting rate: 25 kg/ha (intended)
Seeding date: May 21
Harvest: Direct combined at maturity, October 5
Rainfall: 231 mm
Irrigation: Rep 1 - 30 mm; Rep 2 - 132 mm; Rep 3 - 153 mm; Rep 4 - 132 mm
See Table 1, Block B

Safflower Irrigation x Seeding Rate Study

Under dryland conditions, there was a significant yield response to increasing seeding rate from 15 to 23 kg/ha for safflower (Table 23). Full irrigation significantly reduced yield compared to dryland and partial irrigation treatments.

Data on the number of flowers/plant were recorded for only two replications. At the P=0.10 level of probability, full irrigation increased the number of flowers per plant compared to dryland. Increasing the seeding rate to 30 kg/ha reduced heads per plant only for the fully irrigated treatment.

Table 23. Effect of seeding rate and irrigation on yield and number of heads per plant for Saffire safflower grown at Outlook, Saskatchewan, 1990.

Measurement	Seeding rate	Irrigation treatment: Dryland	Partial	Full	Mean
Yield			kg/ha		
	15	2473	2707	2081	2420
	23	2923	2585	2398	2635
	30	2928	3053	2516	2832
	Mean	2775	2782	2332	
	LSD (0.05)				436
	CV = 11.2%				
Heads per plant			number		
	15	16.6	18.6	22.5	19.2
	23	14.7	18.6	21.6	18.3
	30	13.3	16.4	15.9	15.2
	Mean	14.9	17.9	20.0	
	LSD (0.10)				3.6
	CV = 12.3%				

Plot size: 1.2 m X 3.7 m - 20 cm spacing, 4 replications within irrigations.
Planting date: May 21, 1990.
Harvest: October 3-5, 1990
Irrigation: See Table 1, Block B; Dryland, Partial I and Full

Canaryseed Research

Canaryseed research in 1990 consisted of evaluation of entries in the Canaryseed Cooperative Test and a preliminary test of lines from the USDA germplasm collection.

In the Cooperative Test, the check lines Keet and Elias were highest yielding (Table 24). In the Preliminary Test, there were several entries that outyielded the checks (Table 25). These will be considered as possible entries in the next level of testing.

Table 24. Mean yield, plant height and days to heading for entries in the 1990 Canaryseed Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield	Height	Days to heading
	kg/ha	cm	
NC123-2 (Keet)	2217	101	56
NC123-3 (Elias)	2160	103	54
NC123-9	2109	98	57
NC123-5	2073	105	54
NC123-10	2033	107	54
NC123-8	1734	91	55
Mean	2033		
CV %	16		
LSD (0.05)	NS		

Plot size: 1.2 m x 3.7 m, 6 rows at 20 cm spacing
Planting rate: 25 kg/ha equivalent
Seeding date: May 26, 1990
Harvest: Direct combined on September 27, 1990
Rainfall: 231 mm Irrigation: 264 mm

Other Specialty Crop Research

General

There are several minor specialty crops that are attracting interest from Saskatchewan growers. There is very little published information on the agronomy of these crops under local conditions, even less so for irrigated conditions. The following results highlight the 1990 irrigated research of some of these crops. The experiments involve either evaluation of germplasm or responses to varying levels of irrigation.

Fenugreek

The 1990 Fenugreek Cooperative Test had three entries. The NC109-1 line again outyielded other entries (Table 26). A preliminary experiment investigating the response of fenugreek to varying levels of irrigation was conducted under the linear irrigation system. Analysis of yield results showed little response to irrigation, though NC109-1 outperformed the Australian selection (Figure 10). The lack of response may be due to disease (possible *Sclerotinia*) or it is possible that the 1990 rainfall was sufficient to maximize potential yield of fenugreek. Figures 11 and 12 show that irrigation did increase dry matter production, and consequently reduced harvest index.

Table 25. Mean yield, plant height and days to heading for entries in the 1990 Canaryseed Preliminary Test grown at Outlook, Saskatchewan.

Entry	Yield	Height
	kg/ha	cm
CAN 14	2989	105
CAN 17	2936	115
CAN 49	2868	102
CAN 37	2703	109
Keet	2701	106
Elias	2560	110
CAN 22	2481	108
CAN 18	2399	103
CAN 9	2358	95
CAN 4	2327	108
CAN 41	2049	125
CAN 24	1999	114
Mean	2531	
CV %	18	
LSD (0.05)	654	

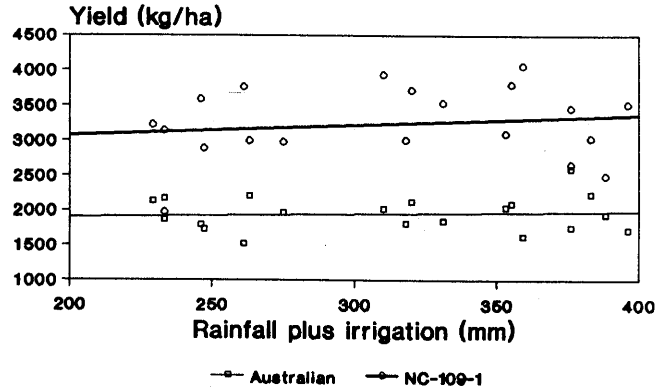
Plot size: 1.2 m x 3.7 m, 6 rows at 20 cm spacing
Planting rate: 25 kg/ha equivalent
Seeding date: May 26, 1990
Harvest: Direct combined on September 27, 1990
Rainfall: 231 mm Irrigation: 264 mm

Table 26. Mean yield, seed weight and canopy height for entries in the 1990 Fenugreek Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield	Seed weight	Canopy height
	kg/ha	mg	cm
NC109-1	3164	21.0	63
NC109-2	2458	16.9	61
NC109-3	2423	16.0	65
Mean	2681		
CV %	5		
LSD (0.05)	232		

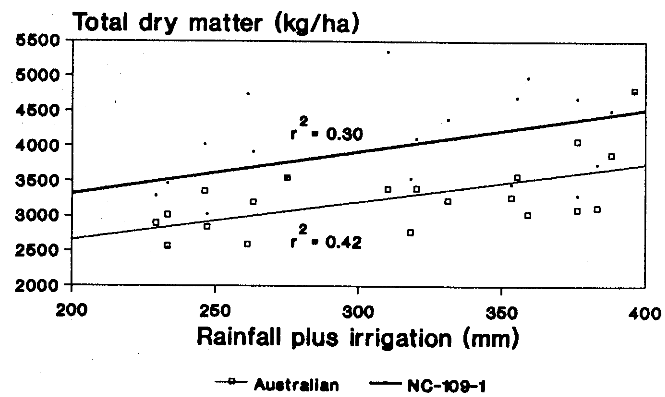
Plot size: 1.2 m x 3.7 m - 6 rows at 20 cm spacing
Planting date: May 21, 1990
Harvest: Direct combined at maturity, October 3, 1990
Rainfall: 231 mm Irrigation: 30 mm

Figure 10. Regression of Yield on Water Application for Fenugreek



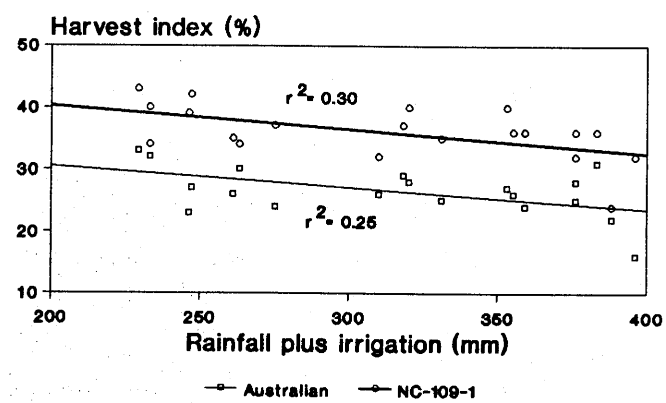
1990 at SIDC, Outlook, Saskatchewan

Fig.11. Regression of Total Dry Matter on Water Application for Fenugreek



1990 at SIDC, Outlook, Saskatchewan

Fig. 12. Regression of Harvest Index on Water Application for Fenugreek



1990 at SIDC, Outlook, Saskatchewan

Coriander

Two observational yield tests of coriander accessions were conducted in 1990. There was a wide range in yield (Tables 27 and 28). In general, the late season, tall types outperformed the short season, dwarf types. This may be due to the long growing season in 1990. This evaluation will continue in 1991.

A preliminary experiment investigating the yield response of coriander to increasing irrigation showed that yield was almost doubled at the highest levels of irrigation in comparison to dryland yield (Figure 13). The field where the experiment was grown was known to have a high level of *Sclerotinia* inoculum. In 1990, most of the legume crops grown on this field suffered yield loss due to *Sclerotinia*, especially at higher levels of irrigation. Coriander may be relatively unaffected by this disease. The experiment will be repeated in 1991 to obtain further information.

Table 27. Yield, lodging score, days to flower and plant height for entries in the 1990 Coriander Observational Yield Test No. 1 at Outlook, Saskatchewan.

Entry	Yield	Lodging	Days to flower	Plant height
	kg/ha	%		cm
Autumn	2800	10	61	118
PGR5741	2549	8	60	117
PGR10058	2237	11	58	102
PGR10059	2144	15	62	123
PGR5742	2044	3	61	114
PGR1219	2013	12	59	121
PGR1218	1951	10	59	122
Early	1936	32	62	117
PGR10056	1922	26	61	109
PGR10055	1879	22	61	117
PGR10057	1855	18	60	113
PGR8580	1776	18	51	91
PGR2658	1648	34	51	102
Susanne	1200	0	46	64
PGR2660	1118	59	49	103
Lisa	900	0	44	61
Indian	96	0	43	33
Mean	1769			
CV %	20			
LSD (0.05)	416			

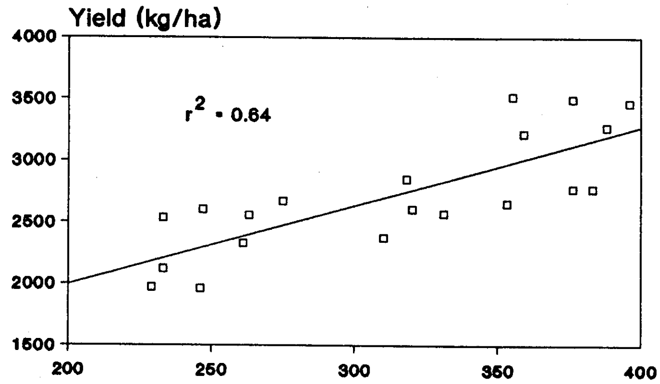
Plot size: 1.2 m x 3.7 m - 6 rows at 20 cm spacing
Planting date: May 23, 1991
Harvest: Direct combined at maturity, September 27, 1991
Rainfall: 231 mm Irrigation: 255 mm

Table 28. Yield and days to flower for entries in the 1990 Coriander Observational Yield Test No. 2 at Outlook, Saskatchewan.

Entry	Yield	Days to flower
	kg/ha	
PGR10057	2692	59
PGR5742	2037	62
PGR10056	1929	60
PGR10059	1830	60
PGR10055	1829	60
COR-0-88	524	47
Mean	1807	
CV %	20	
LSD (0.05)	532	

Plot size: 1.2 m x 3.7 m - 6 rows at 20 cm spacing
Planting date: May 23, 1991
Harvest: Direct combined at maturity, Sept. 27, 1991.
Rainfall: 231 mm Irrigation: 255 mm

Figure 13. Regression of Yield on Water Application for Coriander



1990 at SIDC, Outlook, Saskatchewan

Lupin

A Lupin Cooperative Test was established in 1990 in collaboration with Dr. A.E. Slinkard, Crop Development Centre, Saskatoon. Only three entries were included but the number will expand in future years. The experiment was grown under partial irrigation. There were no significant yield differences among entries, but plant growth and seed yield were promising (Table 29). In 1990 there was no sign of micronutrient deficiency in the lupin test.

Proso Millet

The Proso Millet Cooperative Test was grown in 1990 in collaboration with Agriculture Canada at Morden. Yield was variable (Table 30). A yellow seeded entry (NC22-3) received recommendation for registration in 1991. It will enter the birdseed market under the proposed name AC Prairie Gold.

Table 29. Mean yield, days to flower, seed weight, canopy height and stand for entries in the 1990 Lupin Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield	Days to flower	Seed weight	Canopy height	Stand
	kg/ha		mg	cm	plants/m^2
Ultra	3351	47	353	80	97
Progress	3283	47	357	85	95
Primorski	3118	45	332	80	90
Mean	3250				
CV %	9				
LSD (0.05)	NS				

Plot size: 1.2 m x 3.7 m - 20 cm row spacing
Planting rate: 100 seeds/m^2 (intended)
Seeding date: May 21, 1990
Harvest: Direct combined at maturity, October 5, 1990
Rainfall: 231 mm Irrigation: 89 mm

Table 30. Yield of entries in the 1990 Proso Millet Cooperative Test grown at Outlook, Saskatchewan.

Entry	Yield (kg/ha)
NC22-14	2989
NC22-3	2936
NC22-42	2868
NC22-43	2703
NC22-44/1	2702
NC22-47	2561
NC22-50	2481
NC22-51	2399
Mean	1940
CV %	27
LSD (0.05)	NS

Plot size: 1.2 m x 3.7 m - 6 20 cm rows
Seeding date: May 26, 1990
Harvest: Direct combined at maturity, September 26, 1990
Rainfall: 231 mm Irrigation: 264 mm

Irrigated Dry Bean Demonstrations

Supervisor: A. Kapiniak, B. Vandenberg
Saskatchewan Irrigation Development Centre

Funding: Irrigation Based Economic Development Agreement

Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology

A network of five co-operators at five sites participated in this demonstration. The results from each site are summarized below.

Objectives:
1) to determine what level of yield loss is attributable to *Sclerotinia* (white mold) for irrigated dry bean production in Saskatchewan;
2) to evaluate the effectiveness of fungicidal control of *Sclerotinia* by comparing conventional spraying with airblast spraying;
3) to demonstrate production of a new irrigated specialty crop.

Co-operator: K. Carlson
Location: Outlook (NW-26-30-7-W3)
Progress: Second year of three

Dry bean production under irrigation in south-central Saskatchewan has good potential. The fungal disease *Sclerotinia* (white mold) is a major threat to irrigated dry bean crops. *Sclerotinia* can sometimes be effectively controlled by an application of fungicide. Control is best when the flowers and lower stems are covered with fungicide. A conventional sprayer may not provide adequate coverage of the lower canopy. This demonstration compared two methods the conventional boom spraying method with the airblast spraying method. Four treatments were compared: 2 lb/ac benomyl (Benlate) using a conventional boom sprayer, 2 lb/ac benomyl using an airblast sprayer, 1 lb/ac applied twice using an air blast sprayer and a control. A pre-harvest survey of each treatment strip revealed *Sclerotinia* infection on plants was significantly greater in unsprayed strips (Table 1). There were no significant differences in yield attributable to spray treatments.

Table 1. Effect of Fungicide Application and Sprayer on *Sclerotinia* Infection and Yield of Irrigated Pinto Bean near Outlook, Saskatchewan, in 1990.

Sprayer treatment	Benomyl application Number	Rate (lb/ac)	*Sclerotinia* infection (%)	Net yield† (lb/ac)
Conventional	1	2.0	8.2 a	1578 a
Airblast	2	1.0	5.9 a	1549 a
Airblast	1	2.0	7.1 a	1501 a
Unsprayed	0	0	34.1 b	1618 a
CV (%)				5

a Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).

† Net yield adjusted to 16% moisture. Splits and dockage removed.

Co-operator: R. Derdall
Location: Outlook (NW-19-30-7-W3)
Progress: Second year of three

Irrigated dry bean production in south-central Saskatchewan has good potential. The fungal disease *Sclerotinia* (white mold) is the biggest threat to dry bean production. *Sclerotinia* can be controlled by an application of fungicide. Control is most effective when the flowers and lower stems are covered with fungicide. A conventional sprayer may not provide the best coverage of the flowers and lower stems. This demonstration compared two methods of fungicide application. A conventional boom sprayer and a skid-boom sprayer were used to apply 2 lb/ac benomyl (Benlate) within designated strips of pinto bean on July 17. A survey of each treatment strip for incidence of *Sclerotinia* infected plants was done just prior to harvest. Results show that strips sprayed with benomyl by a conventional sprayer had a significantly lower percentage of infected plants (Table 2). These strips received twice the amount of benomyl as strips sprayed with the airblast sprayer. There were no significant differences in yield among spray treatments. Due to different application rates for each sprayer and low levels of *Sclerotinia*, the relative merits of conventional spraying vs. skid-boom spraying could not be compared in 1990 .

Table 2. Effect of Benomyl Rate Applied with Two Types of Sprayers, on *Sclerotinia* Infection and Yield of Irrigated Pinto Bean near Outlook, Saskatchewan, in 1990.

Sprayer Treatment	Rate of benomyl (lb/ac)	*Sclerotinia* infection (%)	Net yield† (lb/ac)
Conventional sprayer	4.0	2.4 a	1411 a
Skid-boom sprayer	2.0	20.1 b	1347 a
Control	0	27.7 b	1117 a
CV (%)		44	23

a,b Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).
† Net yield adjusted to 16% moisture. Splits and dockage removed.

Co-operator: D. Kelk
Location: Dunblane (NE-36-25-7-W3)
Progress: Second year of three

Dry bean production under irrigation in south-central Saskatchewan has good potential. The fungal disease *Sclerotinia* (white mold) is a major threat to irrigated dry bean crops. *Sclerotinia* can sometimes be effectively controlled by an application of fungicide. Control is best when the flowers and lower stems are covered with fungicide. A conventional sprayer may not provide adequate coverage of the lower canopy. This demonstration compared the conventional boom spraying method with the airblast spraying method. Three treatments were compared: 2 lb/ac benomyl (Benlate) using a conventional boom sprayer, 2 lb/ac benomyl using an air blast sprayer, and a control. A pre-harvest survey of each treatment strip revealed *Sclerotinia* infection on plants was low (Table 3). These low levels of infected plants may be attributed to the field being isolated from other crop producing fields and not having a *Sclerotinia* susceptible crop in the previous cropping history. Yield differences between spraying treatments were not significant.

Table 3. Effect of Fungicide Application and Sprayer on *Sclerotinia* Infection and Yield of Irrigated Pinto Bean near Dunblane, Saskatchewan, in 1990.

Sprayer treatment	Benomyl application Number	Benomyl application Rate (lb/ac)	*Sclerotinia* infection (%)	Net yield† (lb/ac)
Conventional	1	2.0	0.8 a	1156 a
Airblast	1	2.0	0.7 a	1383 a
Unsprayed	0	0	2.6 a	1466 a
CV (%)				13

a Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).
† Net yield adjusted to 16% moisture. Splits and dockage removed.

Co-operator: D. Walberg
Location: Outlook (NW-21-30-7-W3)
Progress: Second year of three

Irrigated dry bean production in south-central Saskatchewan has good potential. The fungal disease *Sclerotinia* (white mold) is the biggest threat to dry bean production. *Sclerotinia* can be controlled by an application of fungicide. Control is most effective when the flowers and lower stems are covered with fungicide. A conventional sprayer may not provide the best coverage of the flowers and lower stems. This demonstration compared two methods of fungicide application. A conventional boom sprayer and a skid-boom sprayer were used to apply 2 lb/ac benomyl (Benlate) within designated strips of pinto bean on July 25. A pre-harvest survey of each treatment strip revealed no *Sclerotinia* infection on plants in this field. The lack of *Sclerotinia* infected plants in this field is possibly due to not having *Sclerotinia* susceptible crops grown within the past five years, and no irrigation in 1990. There were no significant differences in yield among spray treatments. In 1990, the level of *Sclerotinia* infection in this field was too low to cause any yield losses. Therefore, the relative merits of conventional spraying vs. skid-boom spraying could not be compared.

Table 4. Effect of Benomyl Rate Applied with Two Types of Sprayers, on *Sclerotinia* Infection and Yield of Irrigated Pinto Bean near Outlook, Saskatchewan, in 1990.

Sprayer Treatment	Rate of benomyl (lb/ac)	*Sclerotinia* infection (%)	Net yield† (lb/ac)
Conventional sprayer	2.0	0.0	795 a
Skid-boom sprayer	2.0	0.0	761 a
Control	0	0.0	679 a
CV (%)			8

a Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).
† Net yield adjusted to 16% moisture. Splits and dockage removed.

Co-operator: M. Larson
Location: Outlook (SE-30-30-7-W3)
Progress: First year of two

Dry bean production under irrigation in south-central Saskatchewan has good potential. The fungal disease *Sclerotinia* (white mold) is a major threat to irrigated dry bean crops. *Sclerotinia* can sometimes be effectively controlled by an application of fungicide. Control is best when the flowers and lower stems are covered with fungicide. A conventional sprayer may not provide adequate coverage of the lower canopy. This demonstration compared the conventional boom spraying method with the airblast spraying method. Four treatments were compared: 2 lb/ac benomyl (Benlate) using a conventional boom sprayer, 2 lb/ac benomyl using an air blast sprayer, 1 lb/ac applied twice using an air blast sprayer and a control. A pre-harvest survey of each treatment strip revealed *Sclerotinia* infection on plants was significantly lower in strips that had 1 lb/ac applied twice with the airblast sprayer (Table 5). Yield differences between spray treatments were not significant.

Table 5. Effect of fungicide application and sprayer on *Sclerotinia* infection and yield of irrigated pinto bean near Outlook, Saskatchewan, in 1990.

Sprayer treatment	Benomyl application Number	Benomyl application Rate (lb/ac)	*Sclerotinia* infection (%)	Net yield† (lb/ac)
Conventional	1	2.0	43.8 a	1297 a
Airblast	2	1.0	14.6 b	1480 a
Airblast	1	2.0	21.2 ab	1530 a
Unsprayed	0	0	40.8 a	1266 a
CV (%)				12

a Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).
† Net yield adjusted to 16% moisture. Splits and dockage removed.

Irrigated Great Northern Bean: Evaluation of Disease Control Technology

Co-operator: J. Konst
Location: Outlook (NE-3-30-8-W3)
Progress: Second year of three
Objectives:

1) to determine the level of yield loss attributable to *Sclerotinia* (white mold) for irrigated dry bean production in Saskatchewan;
2) to evaluate the effectiveness of fungicidal control of *Sclerotinia* by comparing two methods of spraying;
3) to demonstrate production of a new irrigated specialty crop.

The fungal disease *Sclerotinia* (white mold) is a threat to irrigated dry bean production, particularly in fields that have previously grown a crop susceptible to the disease. *Sclerotinia* can be controlled by an application of fungicide. Control is best when the flowers and lower stems are covered with fungicide. A conventional sprayer may not provide the best coverage of the flowers and lower stems. This demonstration compared two methods of fungicide application, the conventional boom sprayer and a skid-boom sprayer. Each sprayer was used to apply 2 lb/ac benomyl (Benlate) within designated strips of great northern bean on July 30. A survey of each treatment strip revealed *Sclerotinia* infection of plants in this field (Table 1). Percent *Sclerotinia* infection was highly variable, due to the presence of "hot spots" of infection throughout the field. However, there was no significant difference in yield among sprayer treatments.

Table 1. Effect of Benomyl, applied with two types of sprayers, on *Sclerotinia* infection and yield of irrigated Great Northern Bean near Outlook, Saskatchewan, in 1990.

Treatment	Rate of benomyl application (lb/ac)	*Sclerotinia* infection (%)	Net yield† (lb/ac)
Conventional sprayer	2.0	34.0 a	1667 a
Skid-boom sprayer	2.0	17.2 b	1567 a
Unsprayed	0	17.0 b	1593 a
CV (%)		39	9

a,b Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).

† Net yield adjusted to 16% moisture. Splits and dockage removed.

Irrigated Pinto Bean Agronomy: Evaluation of Airseeders

Co-operators: B. Whenham, W. Jones, B. Tullis
Locations: Dunblane, SE of Birsay, SW of Birsay
Progress: Final year
Objectives:

1) to evaluate irrigated pinto bean seeded with an airseeder;
2) to demonstrate irrigated pinto bean production in the Lake Diefenbaker area.

Dry bean seeds are more fragile compared to seeds of other pulse crops, and need to be handled gently in all operations. Gravity flow type seeders (hoe-drill or double-disk press drill) are the recommended seeding equipment. Results from a preliminary test at SIDC in 1989 indicated that airseeding pinto bean was possible if the moisture content of the seeds was raised to 16-18% and the airseeder had one or no impact distributing manifolds. In 1990 three farmers cooperated to evaluate airseeding pinto bean in comparison to hoe-drill seeding. The combined results of these demonstrations, displayed in Table 1, agree with the 1989 research results. There was no significant difference between the net average yield of pinto bean seeded with a hoe-drill or an airseeder. This network of three projects has demonstrated that a productive pinto bean crop can successfully be established with an airseeder when the seeds have a moisture content around 16 percent.

Table 1. Yield and plant density of irrigated pinto bean seeded with a hoe-drill or airseeder in south-central Saskatchewan, 1990.

Field number	Average net yield† (lb/ac)		Plant density (plants/m^2)	
	Hoe-drill	Airseeder	Hoe-drill	Airseeder
1	955	755	28	14
2	721	822	25	25
3	895	924	21	27
Mean	857 a	834 a	25 a	22 a

† Yield adjusted to 16% moisture content. Splits and dockage removed.
a Means within rows followed by the same letter are not significantly different at P=0.05 (Duncan's multiple range test).

Irrigated Pinto Bean Agronomy: Evaluation of Nitrogen Response

There were two co-operators that participated in this demonstration. The results from each site are summarized below.

Objectives:

1) to evaluate the response of irrigated pinto bean to nitrogen fertilizer under south-central Saskatchewan conditions;
2) to demonstrate irrigated pinto bean production in the Lake Diefenbaker area.

Co-operator: C. Millar
Location: Birsay (SE-27-24-8-W3)
Progress: First year of two

Pinto bean is an annual legume crop capable of symbiotic nitrogen (N) fixation. However, it is a poor N fixer and often requires nitrogen from soil organic matter or inorganic fertilizer. Many irrigated fields in south central Saskatchewan have a low organic matter content and test low in N. Therefore, to produce a good crop of irrigated pinto bean, N fertilizer must be used. Part of the response to additional N is lengthening of days to maturity. This may increase the risk of frost if the growing season requirement is extended beyond 110 days in south-central Saskatchewan. A two-year project was developed to demonstrate and evaluate the response of irrigated pinto bean to added N fertilizer and determine the best level of N for irrigated pinto bean production in south-central Saskatchewan. A large percentage of the pinto bean seedlings were damaged by two storms of blasting sand. The result was a low plant density. A low plant population and competition from volunteer flax resulted in exceptionally low yields that did not differ among treatments (Table 1). Seed size was not affected by additional N fertilizer. Further evaluation with better growing conditions will be continued in 1990.

Table 1. Fertilizer rates, net yield and seed size of pinto bean from demonstration site southwest of Birsay, Saskatchewan, in 1990.

Fertilizer rates (lb/ac)	Net yield† (lb/ac)	Seed size (mg)
25	478	349
50	400	333
100	450	345

† Adjusted to 16% moisture content. Dockage removed.

Co-operator: J. Massey
Location: Riverhurst (SE-34-23-6-W3)
Progress: First year of two

Many irrigated fields in south-central Saskatchewan have a low organic matter content and test low in available nitrogen (N). Therefore, to produce a good crop, N fertilizer must be used. Pinto bean is no exception. Though it is a leguminous crop capable of symbiotic N fixation, pinto bean is a poor N fixer and requires nitrogen from soil organic matter or inorganic fertilizer. Part of the response to additional N can be delayed maturity. This may increase the risk of frost if the required growing period is extended beyond 110 days in south-central Saskatchewan. A two-year project was developed to demonstrate and evaluate the response of irrigated pinto bean to added N fertilizer and determine the best level of N for irrigated pinto bean production in south-central Saskatchewan.

Strips of pinto bean had 25, 50, and 100 lbs of actual N applied before seeding. Yield differences among treatments (Table 2) were not significant. Seed size was not significantly affected by increasing fertilizer rates. The overall average net yield from this project is well below the provincial average for irrigated pinto bean. There are several factors that contributed to low yield. Firstly, a discer does not seed at a uniform depth which resulted in uneven plant emergence. A low plant density was a result of placing some seeds too deep and leaving others on the surface. Secondly, the selected field was grass breaking. Grass clods provided some competition to the bean crop by rejuvenating themselves. The clods also made the field rough which resulted in high harvest losses. This project will continue in 1991 using better agronomic practices to obtain a more meaningful evaluation of the effect of added N fertilizer on irrigated pinto bean.

Table 2. Fertilizer rates, net yield and seed size of pinto bean from demonstration site north of Riverhurst, Saskatchewan, in 1990.

Fertilizer rates (lb/ac)	Net yield† (lb/ac)	Seed size (mg)
25	515	380
50	734	376
100	709	364

† Adjusted to 16% moisture content. Splits and dockage removed.

Irrigated Pinto Bean Agronomy: Harvestability Evaluation

Co-operator: B. Davison
Location: Outlook (SW-3-30-8-W3)
Progress: Final year
Objectives:

1) to evaluate the agronomic performance of three varieties of pinto bean under irrigation on a commerical production scale using conventional equipment in south-central Saskatchewan;
2) to demonstrate production of a new irrigated specialty crop.

Compared to areas where pinto bean is traditionally produced, Saskatchewan has a short growing season and producers use a direct harvesting method. The ideal pinto bean variety for Saskatchewan would have an upright plant structure and an early maturity date. Trials at SIDC since 1986 have identified three registered varieties of short season pinto bean that are commercially available: Topaz, Fiesta, and Othello. A one year demonstration comparing these varieties under irrigation on a commercial field scale was conducted in 1990.

Total yield (Table 1) is the harvested yield plus the harvest loss (estimated from counting the number of seeds per 1/4 m^2 on the ground). Harvested yield of Fiesta was lower because of the larger seed size. When the same number of seeds are lost during harvest, the larger seeded variety realizes a greater yield loss. Statistically there was no significant yield difference among varieties. Based on the results from this demonstration, it can be recommended that either Topaz or Othello be used for pinto bean production under irrigation in south-central Saskatchewan.

Table 1. Total and harvested yield and seed size of three pinto bean varieties grown under irrigation in 1990 near Outlook, Saskatchewan.

Variety	Yield† (lb/ac) Total	Harvested	Seed size (mg)
Topaz	2226	1617 a	359
Othello	2179	1641 a	356
Fiesta	2184	1490 a	400
CV (%)		14	

a Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).

† Net yield adjusted to 16% moisture.

Irrigated Field Pea Agronomy: Early Seeding Demonstration

Supervisors: A. Kapiniak, A. Vandenberg
Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: J. Konst, G. Ofstie, M. Purcell
Location: Outlook, Glenside, Pike Lake
Progress: Final year
Objective: To demonstrate the yield benefits of early seeding for irrigated field pea.

The recommendations that field pea be seeded early is based on research from across Western Canada. Field pea plants develop best in cooler moist conditions. Seeding early allows pea plants to thrive in cooler spring weather. An advantage for irrigation farmers is that they can stop watering in mid-July, let the pea plants dry down and harvest in early August. Top quality pea can be harvested by avoiding the damp fall weather. A project to demonstrate the benefits of seeding irrigated field pea early, in south-central Saskatchewan, was initiated in 1988. Results shown in Table 1 are for Radley pea, a determinate semi-leafless variety that was grown at all demonstration sites in 1989 and 1990. Combined average net yields of three cooperators from two years (1989, 1990) show a significant benefit for seeding before May 18 (Table 1). However, field pea seeded before April 25 produced significantly larger seeds, which are desirable in the market place. Earlier seeded pea crops were harvested earlier. This helps spread the work load. In addition, this demonstration indicated that high plant densities produce high yields. Therefore, reducing seeding rates to save input costs may reduce yields, especially for semi-leafless varieties.

Table 1. Dates of seeding and harvest, net average yield and seed size of irrigated field pea grown in south-central Saskatchewan, 1989 - 1990.

Period	Dates	Average days to maturity	Average date of harvest	No. of samples	Average yield† (lb/ac)	Seed size (mg)
1	April 15 - 25	105	Aug. 3	10	3016 a	199 a
2	April 26 - May 6	106	Aug. 14	12	3025 a	187 b
3	May 7 - 17	97	Aug. 18	18	2808 a	180 b
4	May 18 - 28	94	Aug. 24	6	1926 b	139 c
	CV (%)				14	5

a-c Means within columns followed by the same letter are not significantly different at P = 0.05 (Duncan's multiple range test).
† Net yield adjusted to 16% moisture. Dockage removed.

Irrigated Safflower Agronomy: Evaluation of Nitrogen Response in Safflower Production.

Supervisors: A. Kapiniak, A. Vandenberg
Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: J. Massey
Location: Riverhurst (NE-28-23-6-W3)
Progress: Second year of three
Objectives:

1) to evaluate the potential for irrigated safflower production in south-central Saskatchewan;
2) to evaluate the response of irrigated safflower to nitrogen fertilizer.

Safflower is deep-rooted, drought tolerant and well-adapted to light soils. It is grown in the warm longer season areas of southern Alberta and southern Saskatchewan. The irrigated regions of south-central Saskatchewan may be suitable for Saffire, an early maturing variety that is used for birdseed. Safflower has shown a response to supplemental irrigation in Alberta, but is untested under irrigation in Saskatchewan.

In traditional growing areas, safflower shows a yield response to nitrogen fertilizer application under irrigated conditions. Application of nitrogen under irrigated conditions in south-central Saskatchewan may delay maturity so that fall frost causes crop damage. The project objectives are to demonstrate that safflower can be successfully grown under irrigation in south-central Saskatchewan, and to evaluate the response of safflower to nitrogen fertilizer application.

In 1990 the average net yield from strips of safflower increased as higher rates of nitrogen fertilizer were applied (Table 1). The overall average yield of the irrigated treatments was 1372 lb/ac. There were no significant differences in yield among nitrogen treatments. Though there is no statistical difference among yields, the extra yield produced by increased applications of N were economical (based on $.23/lb of N and $.15/lb for safflower seed). Seeds showed no significant difference in size among fertilizer treatments. This project will continue for one more year.

Table 1. Effect of nitrogen application on yield and seed weight of irrigated safflower at Riverhurst, 1990.

Nitrogen application (lb/ac)	Yield† (lb/ac)	Seed weight (mg)
25	1242	32.7
50	1392	33.3
100	1482	33.1
Mean	1372	31.0
CV (%)	15	1.3
LSD (0.05	NS	NS

† Yield adjusted to 9.5% moisture content. Dockage removed.

Irrigated Fababean Agronomy: Demonstration of Benefits of Early Seeding

Supervisors: A. Kapiniak, A. Vandenberg
Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: M. Millar
Location: Birsay
Progress: Final year
Objective: To demonstrate to producers the importance of early seeding for irrigated fababean production.

Fababean producers have problems obtaining consistent yields. Results from research across Western Canada indicate that early seeding increases yield potential. A three year project was initiated in 1988 to demonstrate the benefits of seeding fababean early. The weather patterns in 1988 and 1989 were completely different, yet results from the demonstration were similar. Yield data averaged over both years showed that seeding during period 1 or 2 (Table 1) produced yields that were not significantly different. However, these yields were significantly greater than yields from fababean seeded during periods 3 or 4. The yields of periods 3 and 4 are significantly different. Table 1 also shows that earlier seeded fababean plants produce significantly larger seeds. Seeding fababean early for consistent high yield and larger seeds is highly recommended to irrigated fababean producers in south-central Saskatchewan.

Having similar results for two consecutive years, the emphasis of this project was changed in 1990. Emphasis was on lowering production costs by reducing seeding rate and using a post-emergent harrowing to control weeds (replace costly chemicals). All treatments were seeded on May 8. Fababean yields were significantly higher from seven inch row spacings than from 14 and 21 inch row spacings (Table 2). The seed size of fababean produced in seven inch rows was significantly smaller than seeds produced in 14 and 21 inch rows. Plant density was an important influence on yield and seed size. Strips seeded into 7" row spacings had a plant density almost 50% lower than current recommendations, yet produced yields comparable to strips from 1988 and 1989. The reduction in plant density was related to seeder calibration difficulties caused by inability to adjust the feed wheels at the wider spacings. These results are from one year and are not conclusive for determining the optimum row spacing for irrigated fababean production.

Table 1. Seeding dates, net average yield and seed size of irrigated fababean grown near Birsay, Saskatchewan in 1988 and 1989.

Period	Dates	Average yield[1] (lb/ac)	Number of strips	Seed size (mg)
1	April 20 - 30	3495 a	4	389 a
2	May 1 - 10	3425 a	6	362 b
3	May 11 - 20	2971 b	3	319 c
4	May 21 - 30	2177 c	3	319 c
C.V. (%)		5		4

a-c Means within columns followed by the same letter are not significantly different at P= 0.05 (Duncan's multiple range test).
[1] Net yield adjusted to 16% moisture. Dockage removed.

Table 2. Row spacing, net yield, plant density, and seed size of irrigated fababean produced near Birsay, Saskatchewan in 1990.

Row spacing (in.)	Net yield† (lb/ac)	Plant density (plants/m2)	Seed size (mg)
7	3570 a	22 a	345 a
14	2874 b	19 ab	356 b
21	3029 b	16 b	359 b
C.V. (%)	7	9	1

a,b Means within columns followed by the same letter are not significantly different at $P = 0.05$ (Duncan's multiple range test).
† Net yield adjusted to 16% moisture. Dockage removed.

Response of Norland and Russet Burbank Seed Potatoes from Differences Sources to Accelerated Aging

Principal: J. Wahab, Department of Horticultural Science
Funding: Agriculture Development Fund
Co-investigator: D. Waterer
Location: Saskatchewan Irrigation Development Centre
Progress: Second year
Objectives: To determine whether potato seed-tubers produced under different environmental conditions are of different physiological ages, i.e. (i) if the seed-tubers produced in relatively cooler higher latitudes of Saskatchewan are physiologically younger than seed from comparatively warmer U.S.A locations, (ii) how artificial aging affects the production potential of seed-tubers differing in physiological age.

Physiological age of potato seed-tubers depends on the temperature at the site of production, duration in the field, and storage conditions. Seed-tubers produced in relatively warmer southerly locations (Minnesota, Colorado) could be expected to be comparatively physiologically older than tubers raised in more northerly locales such as Saskatchewan. Studies have shown that physiologically older potato seed-tubers produced plants with more mainstems, higher 'early' yield, and lower 'final' yield than plants derived from physiologically younger tubers.

In 1990, Norland and Russet Burbank seed-tubers from San Luis Valley, Greeley (Colorado), Becker (Minnesota), Outlook, Saskatoon, and Prince Albert (Saskatchewan) were used in this experiment. Tubers stored at 4°C since harvest, were aged by warming to 15°C for 30 days prior to field planting. Non-aged control treatments held continuosly at 4°C were included in the experiment. The field test was conducted at the Saskatchewan Irrigation Development Centre, Outlook under irrigation. Field plots were laid out as a 2 x 6 x 2 (two harvests, six seed sources, two aging treatments) factorial combination in a Randomized Complete Block design with four replications. The crop was harvested 90 or 120 days from planting and the tubers were graded into 'small', 'marketable' and 'large' categories according to tuber diameter.

Comparison of growth and yields of non-aged plants between U.S.A and Saskatchewan seed sources

Comparison of plant characteristics from non-aged northern and southern seed sources provided an indication of the physiological age of the two seed sources. Non-aged Russet Burbank plants from Saskatchewan seed produced significantly fewer mainstems than those from U.S.A seeds (Table 1). Norland plants from the two seed sources produced similar numbers of mainstems.

Table 1. Effect of seed origin on mainstem count and haulm fresh weight of non-aged Norland and Russet Burbank potatoes at 90 days from planting.

Seed	No. mainstems per plant		Haulm fresh weight(kg/plant)	
Source	Norland	R. Burbank	Norland	R.Burbank
U.S.A	3.99	3.72	0.42	0.46
Saskatchewan	4.18	2.79	0.47	0.47
Significance	NS	<0.01	NS	NS
C.V. (%)	15.6	15.6	25.0	8.0

* Group comparison between U.S.A and Saskatchewan seed sources were performed using orthogonal contrasts.

Haulm fresh weights were similar for the Saskatchewan and U.S.A seed sources, although, Saskatchewan seed produced slightly more vigorous plants (Table 1).

Marketable tuber yield

Marketable yields of Saskatchewan grown Norland and Russet Burbank seeds were significantly higher than the U.S.A sources during both the 'early' and 'final' harvests (Table 2).

Tuber set in plants produced from U.S.A grown seed occurred relatively earlier than in plants originating from Saskatchewan seeds. Consequently, early yield expressed as a proportion of final yield, of the U.S.A seed was higher than the Saskatchewan seed (Table 2). For Norland, early yields for the U.S.A and Saskatchewan seed were 92.8% and 88.7%, respectively, of the final yields.

Table 2. Comparison† of mean marketable yield of Norland and Russet Burbank potatoes grown from U.S.A and Saskatchewan seed sources during the early and final harvests.

Harvest period	Marketable yield (t/ha) Norland U.S.A	Norland SASK.	R. Burbank U.S.A	R. Burbank SASK.
Early	27.75	31.14	14.35	15.59
Final	29.91	35.12	20.25	27.41
Significance	NS	NS	1.0	<1.0
C.V. (%)	18.3		27.3	

† - Group comparisons between early and final harvests were made using orthogonal contrasts.

The corresponding yield differences for Russet Burbank were 70.9% and 57.9%, respectively.

The increase in mainstem counts, early tuber set and maturity are indications of advanced physiological age of seed of Russet Burbank produced in U.S.A compared to Saskatchewan seed- tubers.

The response of Russet Burbank is in better agreement with the physiological age theory than Norland.

Effect of accelerated aging on seed vigour

Mainstem count and Haulm weight

Artificial aging did not significantly affect mainstem counts and haulm fresh weight (Table 3). Visually, the aged plants were less vigorous than the non-aged plants.

Table 3. Effect of accelerated aging on average† mainstem count and haulm fresh weights of Norland and Russet Burbank potatoes.

	No.of mainstems/plant		Haulm fresh weight(kg/plant)	
Treatment‡	Norland	R.Burbank	Norland	R.Burbank
Non-aged	4.09	3.25	0.45	0.47
Aged	3.81	3.63	0.44	0.46
Significance	NS	NS	NS	NS
C.V. (%)	15.6	15.6	25.0	8.0

† - Mean of seed sources and harvests
‡ - Aging treatments compared using orthogonal contrasts

Tuber yield

Saskatchewan grown Norland and Russet Burbank seed-tubers produced significantly higher marketable tuber yields than the U.S.A competition (Table 4). The yield superiority of the Saskatchewan seed sources was due to more marketable tubers produced by this seed source.

Table 4. Effect of seed origin on mean† marketable tuber yield of Norland and Russet Burbank potatoes.

Seed‡	Mark. yield (t/ha)		No. mark. tub./pl.		Mean tub.wt.(g)	
source	Norland	R.Burb.	Norland	R.Burb.	Norland	R.Burb.
U.S.A	28.83	17.30	5.22	3.19	150.9	143.8
Sask.	33.13	21.51	5.84	4.00	154.6	143.2
Significance	5.0	1.0	5.0	1.0	NS	NS
C.V. (%)	18.3	27.3	18.6	26.6	11.8	11.7

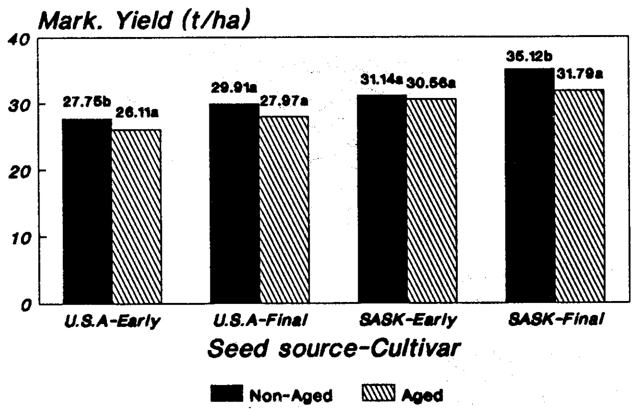
† - Mean of the two harvests
‡ - Seed sources compared using orthogonal contrasts

The yield differences between the non-aged and aged Norlands during the early harvest for the Saskatchewan and U.S.A seed-tubers were 0.48 and 1.65 t/ha respectively (Figure 1). The corresponding yield differences during the final harvest were 4.33 and 1.94 t/ha, respectively. Aged Russet Burbank seed-tubers of U.S. origin produced significantly lower yields than non-aged tubers during the early harvest, whereas, during the final harvest the two age groups produced similar tuber yields. Aged and non-aged Saskatchewan seed-tubers produced similar yields during the early harvest, whereas, during the final harvest the non-aged seed-tubers significantly outyielded the aged seeds (Figure 1).

Conclusions:

Accelerated aging had a significant depressing effect on tuber yields of U.S.A grown Norland and Russet Burbank seeds during the early harvest while aging did not affect early tuber yields of Saskatchewan grown seeds. During the final harvest, non-aged seed from Saskatchewan outyielded aged tubers, whereas, the non-aged and aged seeds from the U.S.A seeds produced similar yields. The increase in tuber yields from early to final harvests were more marked in Saskatchewan grown seeds compared to U.S.A seeds and this phenomenon was particularly evident in non-aged treatments. This could be due to greater vigour of non-aged Saskatchewan seed which produced the highest overall yield. The response of Russet Burbank to accelerated aging appeared to conform to the presently accepted physiological age theory. Additional research is needed to investigate the effect of accelerated aging for Norland.

Norland



Russet Burbank

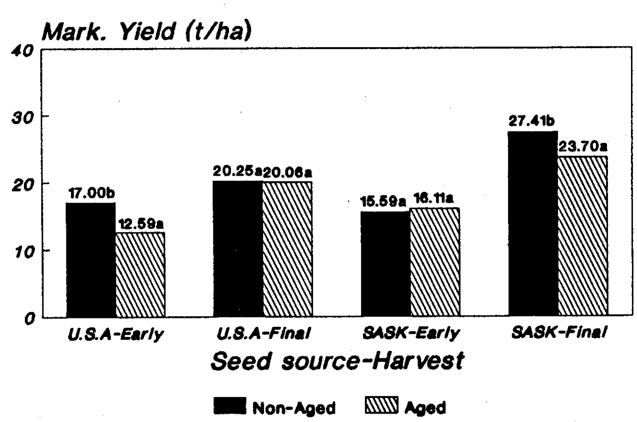


Figure 1. Effect of accelerated aging on marketable yield of Norland and Russet Burbank seed-tubers from Saskatchewan and U.S.A sources.

Influence of Seed Piece Spacing, Fertility and Irrigation on Yields of Whole Seed Potatoes in Saskatchewan

Principal: D.R. Waterer, Department of Horticulture Science
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Location: Outlook and Saskatoon
Progress: Final year
Objective: Recent indications that potato seed tubers grown at high latitudes out-yield seed produced at lower latitudes have encouraged potato growers in the American Northwest to import Canadian seed tubers. To profitably capitalize on the potential markets for their more vigorous seed, Saskatchewan seed potato growers must produce high yeilds of high quality seed tubers of the cultivars in demand in their potential markets. This study examined how seed piece spacing, nitrogen fertility, and moisture availability influenced yield, tuber size distribution and net crop values for seed potatoes. The objective was to develop cultural recommendations which would help Saskatchewan seed potato growers increase production and value of their crop.

Trials were conducted in 1989 and 1990 on sandy loam soils in the Outlook and the Saskatoon areas of Saskatchewan. Norland, Shepody, Russet Burbank and Yukon Gold potatoes were planted in twin 6 m long rows, 1 m apart with in-row spacings of 15, 23 and 30 cm (6, 9 or 12"). In 1989, sufficient 34-0-0 was broadcast prior to planting to raise soil nitrogen to the levels recommended for potatoes by the Saskatchewan Soil Testing Laboratory (200 kg N/ha) or to 1.5 times the recommended level (300 kg N/ha). In 1990, a split application was also tested. Prior to planting, 200 kg N/ha was broadcast, then about 40 days after planting an additional 200 kg N/ha was applied. Half of each plot was kept well irrigated while the other half relied entirely on rainfall. Total, marketable and whole seed yields were determined.

Variable costs for the treatment combinations ranged from $577 to $1379/ha depending on the amount of nitrogen applied, the seed piece spacing and whether the crop was irrigated or grown on dryland.

The dryland plots were drought stressed in both years; otherwise growing conditions were generally favorable. Crop responses to the test variables were relatively similar at both production sites in both years and for all four cultivars grown.

Irrigation increased yields and net returns after variable costs at both sites in both years; the greatest relative benefit occurred when rainfall was most scarce. The yield effect and cost effectiveness of increasing applications of N varied with the year, the site and the availability of irrigation. On dryland, increasing N levels had little effect on yields; consequently the lowest rate of N tested produced the highest net dollar returns. In 1989, increasing N levels increased yields and net crop values of the irrigated crop at both sites. In 1990, the highest N rate (total 400 kg N/ha) again produced the highest yields and net returns for irrigated potatoes at the Outlook site. However, in Saskatoon the higher rates of N suppressed yields, resulting in lower crop values.

When the crop was irrigated, the closer in-row spacings usually produced the highest yields and the highest crop values. On dryland, the close spacing reduced yields of saleable size seed potatoes; consequently crop values were low.

In summary, in this trial, an in-row spacing of 15 or 23 cm and 300 to 400 kg N/ha produced the highest seed yields and net returns for irrigated potatoes in Saskatchewan. On dryland, less nitrogen and wider seed piece spacings are recommended.

This project was designed to help Saskatchewan's seed potato growers make production decisions to improve crop yields and returns. The data generated should be of general use to growers, however, it should be used with caution as the results are based on a limited number of crop years using cost and return figures which may not be valid for all growers or years.

Vegetable Cultivar Testing Program

Principal:	D.R. Waterer, Department of Horticulture Science University of Saskatchewan, Saskatoon, Saskatchewan
Funding:	Agriculture Development Fund
Location:	Saskatoon and Saskatchewan Irrigation Development Centre, Outlook
Progress:	1990 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 compiled in this bulletin are meant to aid commercial and hobby growers in selecting improved vegetable cultivars. Each year, several crops are tested.

The 1990 trials were supported by the Agriculture Development Fund of Saskatchewan Agriculture and Food. The trials were conducted at the Department of Horticulture Science field station in Saskatoon and at the Saskatchewan Irrigation Development Centre in Outlook.

Weather conditions during the 1990 growing season were generally favorable for vegetable production. The unusually late fall frost resulted in high yields of many of the long season crops.

The Saskatoon site was well protected by shelter belts while the Outlook site is much more exposed. Transplants and newly emerged seedlings suffered considerable wind damage at the Outlook site. Yields and quality of most crops were lower at Outlook than in Saskatoon; this emphasizes the importance of shelter in vegetable production.

All crops were planted in twin rows using a randomized complete block design with three replicates. Rows were from 6 - 10 m in length and data was collected from the centre of each plot. A Plant Jr. seeder was used for all direct seeded crops (cabbage, broccoli, cauliflower, lettuce, corn), except the melons which were hand seeded following mulching (1 mil black plastic). The pepper transplants were also hand set.

Crop production and pest control measures all followed recommended practices. Soil fertility was adjusted according to recommendations outlined in the Horticulture Science Publication "Vegetable Crop Fertility Schedules". Overhead or drip irrigation was used to maintain adequate soil moisture levels throughout the growing season.

To enhance crop development, half of the muskmelon and pepper plots were covered with Agryl P-17 field covers until early July. The covers caused significant damage to the pepper transplants resulting in poor early growth and delayed fruiting. The muskmelons responded favorably to the covers. Covered plots produced substantial yields of mature melons, while no fruit matured in the non-protected plots.

Flea beetles caused damage in the direct seeded cole crops at both sites despite applications of pre and post-emergent insecticides.

Broccoli

Premium Crop, Cruiser and Mariner performed well, producing good yields of high quality heads. Uneven maturity was a common problem with many of the other cultivars.

Cauliflower

Among early season cultivars, Snow King was outstanding, producing very early, large, high quality heads. Poor uniformity and lateness were common problems of the main crop types. The main crop cultivar, Snowball has good yield potential.

Cabbage

Of the early types tested, Polar Green produced the best combined yield and head quality. For late cabbage, Lennox was the best cultivar tested.

Romaine (Cos) Lettuce

All tested types performed well. The cultivar Cos was excellent in terms of yield, uniformity, flavour and yield. The cultivar Roseleta produced red-leafed romaine with excellent eye appeal.

Head Lettuce

Loss due top Bottom Rot (Sclerotinia) was the problem in several cultivars. Great Lakes and Mesa-659 combined good yields and appearance with some resistance to bottom rot.

Peppers

Plants under the cover experienced severe damage by abrasion but recovered once the covers were supported above the crop canopy. In terms of yields, super Set and Marengo were impressive, although Marengo plants were brittle and difficult to pick. Big Bertha produced very large, thick walled fruit. There was no significant differences between cultivars in time to 50% yield or development of red fruit.

Sweet Corn

Emergence and early vigour were poor at both sites due to cool spring conditions. Of the normal sugar (Su) types, Butter Vee was the earliest, with Seneca Horizon and Norgold producing the highest yields. Of the high sugar types, Northern Super Sweet was both early and high yielding.

Muskmelons

No fruit of any cultivar matured in the non-covered trial. When covers were used, many cultivars produced substantial yields of mature fruit, but Earligold Hybrid was by far the best in terms of earliness, total yield and fruit quality.

Soils/Fertilizer/Water

Herbicide, Nutrients and Water Drainage from an Irrigated Field

Principal: W. Nicholaichuk
National Hydrology Research Institute
Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Site: Saskatchewan Irrigation Development Centre
Co-investigators: K. Best, R. Grover, J. Foley
Progress: Second year of four
Objectives:

To determine:

a) the impact that low pressure irrigation has on the mobility and degradation of herbicides, pesticides and nutrients, identify breakdown products on a year-to-year basis;
b) the quality of leachate with respect to nutrients, herbicides and pesticides;
c) the amount of subsurface drainage following each irrigation event;
d) the degradation and leaching characteristics of nutrients and herbicides under low pressure irrigation conditions.

The maximum levels of nitrogen observed in the soil water extract (in the range of 150 to 250 cm depth and in the tile drains) generally exceed the drinking water quality guidelines (10 mg/L, McNeely et al. 1979). This suggests that application of chemical fertilizer needs to be carefully managed to minimize impact on drinking water quality. High levels observed may be due to residual effect to high rates of fertilizer application prior to studies in 1988.

Similarly, maximum phosphorus levels in the soil water extract and in the tile drains also exceed drinking water quality guidelines (0.2 mg/L, P. McNeely). Further analysis is required to determine the quantity loss that has the potential to move into the groundwater system and surface system.

With respect to herbicides, the maximum observed concentrations for 2,4-D, Dicamba, Bromoxynil and Diclofop were 2.36, 0.79, 0.47 and 2.01 μg/L respectively (soil water extract). Observed tile drain concentrations were 0.252, < 0.50, < 0.50 and 2.61 μg/L respectively. These levels are considered to be below the LC limits of 10 μg/L for aquatic invertebrates (USPEA 1983). Further analysis is required to estimate percent loss observed below the root zone.

Nitrogen Fertilization and Water Use Efficiency of Irrigated Crops

Principal: C. van Kessel, Department of Soil Science
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-investigator: N. J. Livingston
Location: Saskatchewan Irrigation Development Centre
Progress: Final year
Objective: To maximize N-fertilizer use efficiency of irrigated crops.

The N fertilizer use efficiency of durum, soft wheat and canola (Westar) was evaluated at the Saskatchewan Irrigation Development Centre at Outlook. Crops were seeded in early May and all the fertilizer N was applied at time of seeding or split in half between time of seeding and 45 days after planting for the cereals (Feekes 4-5 growth stage) or 38 days after planting for canola. Total yield and grain yield were recorded and plant parts analyzed for total N and the % of the N recovered in the plant. Soil samples were taken to a depth of 120 cm and also analyzed for the presence of applied N-fertilizer.

Yield of durum and soft wheat reached 68 and 92 bu/ac, respectively, whereas for canola, a final grain yield of 39 bu/ac was reported. A N fertilizer recovery between 40 and 50% was observed for the cereals, but for canola, less than 30% of the applied N was recovered in the crop (straw plus grain). The lower recovery in the canola is caused by leaf fall occurring before the final harvest. Approximately one-third of the applied fertilizer N was recovered in the soil. This indicates that for durum on average one-third of the fertilizer-N, and for soft wheat, 15% of the fertilizer-N, could not be accounted for at the end of the first growing season. As only traces of fertilizer-N were recovered in the 90 to 120 cm depth of the soil profile, N was probably lost through denitrification and volatilization.

Table 1. Total yield and fertilizer recovery in plant and soil.

	Yield (kg/ha)		% N recovered			
Crop	Total	Grain	Plant	Soil	Total	Unaccounted
Durum						
100*† + 100 AN‡	11684	3563	45.7	34.9	80.7	29.3
200* AN	11236	3952	38.9	24.1	63.0	37.0
Soft Wheat						
100* + 100 Urea	12056	5001	44.3	41.0	85.3	14.7
200* Urea	12823	5358	51.1	31.1	82.3	17.7
Canola						
100* + 100 Urea	6648	1746	26.0	33.9	59.9	40.1
200* Urea	6578	1890	28.7	37.3	66.0	34.0

†Denotes 15N-labelled fertilizer
‡Ammonium nitrate

Ripping of Irrigated Solonetzic Soil to Increase Water Penetration and Crop Yield

Principal: M.C.J. Grevers, Saskatchewan Institute of Pedology
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-investigator: G. Weiterman, Saskatchewan Water Corporation, Outlook, Saskatchewan
Co-operators: D. Eliason, J. Eliason, R. & R. Riopka
Location: Outlook
Progress: Final year
Objectives:

a) to increase water penetration in Solonetzic soil;
b) to demonstrate the suitability of these soils for irrigation when properly managed.

Deep ripping had been carried out on three irrigated Tuxford soils to increase crop production and soil-water penetration, and to improve the suitability of these soils for irrigation. Two of the soils were classified as solonetzic, either the entire field plot or part of it, and the third soil was classified as non-solonetzic.

Deep ripping reduced the density of the B horizon (15-30 cm depth) and increased soil-water penetration with depth. Crop production was increased by deep ripping of the Solonetzic soils, but not of the non-Solonetzic soil. The increased crop production lasted from two years to at least three years. Greater water-use efficiency was the main reason for the increased crop production.

Deep ripping improved the suitability for irrigation of the most severe Solonetzic soil from "not suitable" to "suitable". Deep ripping did not affect the irrigability of the second Solonetzic soil, nor that of the non-Solonetzic soil, which was already rated as "suitable" prior to deep ripping.

In summary, it appears that the suitability of Solonetzic soils for irrigation and also the soil productivity can be improved by deep ripping. It is important to determine if the longevity in soil improvement will continue beyond three years as indicated in this study, and if the deep ripping is economically feasible.

Drainage and Subsoiling to Improve the Yield of Alfalfa on Border Dyke Irrigation

Principal:	D. Cameron, Normac AES Ltd. Swift Current, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-operator:	D. Harrigan
Location:	Maple Creek (SW 17-11-26 W3rd)
Progress:	Third year of four
Objective:	To demonstrate methods of improving the productivity of flood irrigated fields affected by salinity, low hydraulic conductivity, low infiltration rate and poor drainage.

In 1988, experimental studies were initiated on Doug Harrigan's border dyke plot to test the effects of the paraplow and mole drainage on improving alfalfa productivity. However, due to dry conditions and high soil salt levels there was a poor alfalfa catch. In 1989, there was no irrigation, weedy growth dominated, and the effect of mole drainage and paraplowing could not be tested. Soil tests taken in July 1989 indicated that both nitrogen and phosphorus levels were deficient. The average first-cut yield was 0.9 T/ha. The plot was re-cultivated in August. In 1990 there was also no water available for irrigation as drought conditions persisted. The first 15 dykes of the plot were used to set-up grass variety and alfalfa establishment experiments. Mr. Harrigan seeded the remainder of the plot to brome in early June 1990.

A chain-trencher (PFRA) was obtained from Moose Jaw and slotted plastic tile from Taber, Alberta. However, in the summer and fall, large cracks (2-5 cm width) appeared throughout the plot areas. Large dry compact clumps of clay could be broken out from between cracks. The soil conditions were unsuitable for subsoiling or drainage installation. These activities were rescheduled for spring 1991. A number of subsoilers were examined for possible use in established stands, but the equipment available was reported to cause too much surface disturbance, because of the shank thickness and parabolic shape. The knife-shin shank produced by John Deere appeared to have the preferred design, but was no longer available. Plans for construction of this shank are being considered.

Irrigation Scheduling Information System

Principal:	F.J. Eley, Canadian Climate Centre, Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigators:	R. Lawford, Canadian Climate Centre, Saskatoon, Saskatchewan W. King, Saskatchewan Water Corporation, Outlook, Saskatchewan N. Livingstone, E.A. Ripley, University of Saskatchewan, Saskatoon, Saskatchewan
Location:	National Hydrology Research Centre, Saskatoon, Saskatchewan Saskatchewan Water Corporation, Outlook, Saskatchewan
Progress:	Final year
Objective:	To develop an irrigation scheduling information system for use by Saskatchewan Water Corporation advisory service to assist in improving water use and reducing soil damage due to overuse.

This project set out to demonstrate utilization of real-time weather data, particularly radar-based rainfall maps, in an irrigation scheduling information system. The project utilized a computer upgrade to the Elbow weather radar installed in July, 1989. Software and procedures were developed in 1989 to produce appropriate radar rainfall maps, and to enable communication and data handling on desk-top computers at the Outlook office of the Saskatchewan Water Corporation. In order to utilize this information effectively, this project also selected and customized an irrigation scheduling model. Because of the late installation of the radar upgrade in 1989, the trial operations occurred in the 1990 season.

Radar-based rainfall maps were generated and made available to Sask Water in Outlook throughout the 1990 irrigation season. Although the daily rain maps were available on a dial-up basis, the weekly rainfall map was used more frequently. This product was distributed to farmers during the 1990 irrigation season as part of a column of advice to irrigators in weekly newspapers throughout the Lake Diefenbaker irrigation districts.

As part of the assessment of this information, 19 farmers were interviewed in August, 1990. Most of them were interested in any rainfall information they could obtain, but weekly data had no effect on their day to day irrigation management. At present, farmers would not be interested in connecting to a source of real-time precipitation information because most of them do not have appropriate equipment. The spatial scale of weather radar information indicates its best application in irrigation is at the district operations level, where immediate information on the effects of localized storms can be utilized in safe and efficient operations.

Irrigation Scheduling Tools for Farm Use

Principal:	B. Irvine, Saskatchewan Irrigation Development Centre
Funding:	Irrigation Based Economic Development Agreement
Progress:	Final year
Objective:	To develop a method or combination of methods which will improve irrigation scheduling by allowing accurate estimation of crop water use.

The project evaluated the performance of soil moisture sensing devices as well as other predictors of irrigation requirements. Soil moisture measuring devices were compared to tensiometers and neutron probe soil moisture measurements. Under controlled conditions the Watermark soil moisture block gave readings which were closely related to the tensiometer readings (r^2=.91). Under field conditions, soil moisture content as measured by tensiometers was quite variable (CV of 15-40% for the same treatment) and the relationship between tensiometer and Watermark readings was not good mainly due to soil variability. The Agwa II sensor was not thoroughly evaluated due to difficulty in hooking the sensors to our datalogger. While other research indicates this device is quite accurate its relatively high cost per field will limit its usefulness. The Aquamiser and Hydromanager can not be recommended due to inconsistent performance. These sensors are designed primarily for landscape watering and once set for a site may function well, however we were unable to make them function satisfactorily in our test. In addition they require AC current which makes them difficult to use as mobile soil moisture sensors. The Aquaterr soil moisture probe was too thick to be inserted into our soils and produced inconsistent results. Further work on this unit may be warranted as the company has redesigned the probe.

The modified Atmometer often gave much lower than expected readings (Table 1). Although the device is simple and inexpensive, determining the correct crop coefficients will be difficult and time consuming. CWSI indicated by the Scheduler is labor intensive and difficult to use since readings must be taken on cloudless days near solar noon. The high cost of the equipment plus the amount of labor involved will limit the application of this device in our environment.

The modified lysimeter concept was tested for only one season but appears to work at a very low cost (Table 1). An inexpensive ($4) valve is used to maintain the moisture content of the soil at field capacity throughout the season. Water use is determined by measuring the water removal from a reservoir. Further work will be required but this appears to be a simple and effective method of determining crop water needs since there are fewer assumptions about stage of development or measurement of environmental parameters.

A modified Jensen-Haise computer model was tested but is best suited to flood or wheel move irrigation where soil moisture can be allowed to be depleted. The user interface of this model made it difficult to use and the model will be retested when the user interface is complete. As with most models the crop coefficients are calculated based on long term average crop development at a given time from seeding and in certain years this is not accurate. In addition, certain assumptions must be made about application efficiency and accurate estimates of initial soil moisture are required.

The use of visible wilting of a plant with access to water at different depths has not yet been successful but efforts will be continued using sunflowers and soybeans.

Table 1. Water use (mm) of canola as estimated by soil moisture depletion, atmometer and modified lysimeter.

Time Period	Moisture use Depletion+irrg	Atmometer Raw	Atmometer *1.6	Modified Lysimeter
June 26-July 9	77.6	41	65.6	---
July 10-July 19	73.4	34	54.4	69.9
July 20-July 30	61.8	28	44.8	61.0
July 31-Aug 13	69.5	55	88.0	70.9
Aug 14-Aug 20	14.8	10	16.0	

Total use for season - 455 mm, includes use prior to June 26.

Denitrification in Irrigated Cropping Systems and Its Significance for Crop Production

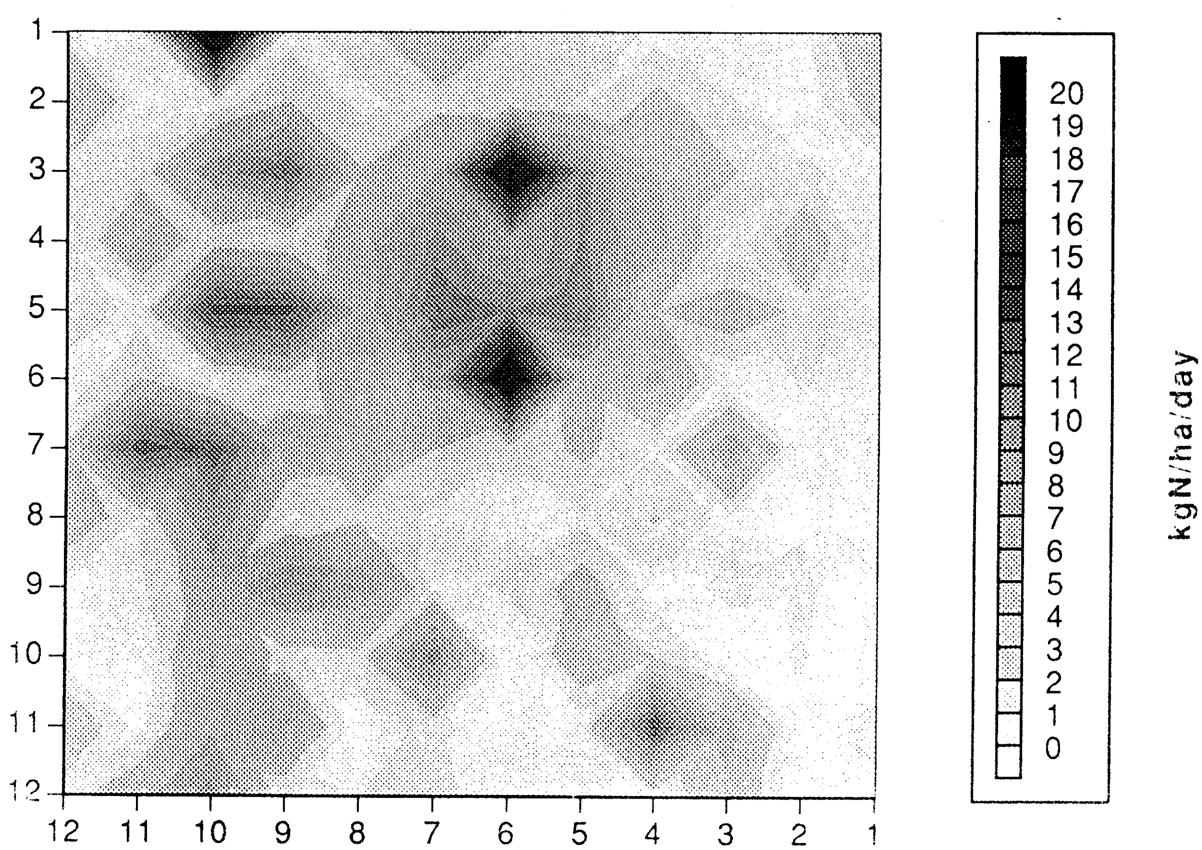
Principal: C. van Kessel, Department of Soil Science
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Location: Saskatchewan Irrigation Development Centre
Progress: Final year
Objective: To determine fertilizer-N losses due to denitrification.

During the 1989 season, large N losses caused by denitrification were observed at the Birsay site, whereas it appeared that N losses were relatively small at the other experimental site in Outlook. To estimate more accurately the total N losses and the variability of the N losses over a larger area, a sampling grid of 110 by 100 m consisting of 144 sampling points was established at Birsay.

Large variations were found in the rate of N losses which were measured within hours after the irrigation event had occurred. At some sampling points, no losses were recorded. In other places, the losses were as high as 20 kg/ha of N per day. The overall average of N losses was 2.7 kg/ha per day.

It was found that the high losses of N all occurred in two landscape units and were particularly high if those landscape units were located in the lower areas of the grid.

Denitrification pattern at Birsay



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

Principal: T.S. Tollefson
Paragon Consultants Ltd.
Mossbank, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: Second year of three
Objectives:

a) to design, construct and test a field scale soil vertical mulcher;
b) to measure the improvement of soil water infiltration and storage as a result of a fall vertical mulch operation followed by irrigation;
c) to monitor the duration of the vertical mulch treatment effect;
d) to compare the yields of crops grown on mulched versus conventionally irrigated fields.

Project emphasis in year two focussed on the redesign of several aspects of the vertical (slot) mulcher to increase its field work rate. The areas where modifications were made included: 1) powershaft design, 2) straw ducting system, and 3) the subsoiler shank profile. A new area of design effort for 1990 was in the construction of several soil packer systems. These packer systems were designed to enhance the shape of the vertical mulch at the soil surface.

Powershaft modifications proved highly successful. The forage harvester component of the vertical mulcher can now be operated at capacity without excessive vibration despite the fact that the power shaft operates continuously at 27° from the perpendicular. Improvements to the system of ducts which pneumatically carries the chopped straw to the soil opening was achieved by increasing the amount of metal and decreasing the amount of flexible rubberized ducting in the system. This design change reduced the amount of internal friction in the duct work and, therefore, improved straw flow characteristics and velocity. This smoother, higher velocity flow allows more coarsely chopped straw material to be successfully conveyed without the degree of plugging which was encountered in the initial design. Coarse straw has the further advantage of requiring less power to produce than finely chopped straw. The combined effect of the modified powershaft, the redesigned ducting and the consequent need for less finely chopped straw has increased the field work rate of the vertical mulcher from 2.5 acres/hr to 5-8 ac/hr depending on ground conditions, depth of tillage, amount and moisture content of straw processed and available tractor horsepower.

It has been reported by several researchers and is evident in the present study that slot mulch infiltration capacity is reduced when loose soil is moved into the surface opening of the slot mulch. Several packer systems were tested to groom and shape the slot opening at the soil surface. The shape of the slot opening is important because it influences the amount of water directed into the slot opening and could potentially reduce the amount of loose soil material washed into the slot opening. The packer systems worked satisfactorily where soil tilth was acceptable, however, in hard soil conditions, the packer systems proved ineffective.

Infiltration measurements of vertical mulch treatments on small plots were completed and results are summarized in Table 1. Field scale trials were established in the fall of 1990 to measure infiltration and moisture storage. Two sites will have their moisture regime monitored by a combination of gravimetric and neutron moisture meter determinations for a period of one year.

The duration of the slot mulch benefit is uncertain at this time. The vertical mulch treatment of benchmark site 1, receiving mechanical tillage since it was established, still shows significant infiltration improvement 24 months later (Table 1). Observations made in the fall of 1990 on several field scale plots established in the fall of 1988 showed that while the surface continuity of the slots were destroyed due to cultivation, the portion of slot situated below the plough layer was still completely intact. If the surface continuity could be re-established with the buried portion of the slots, they would still have the capability to significantly enhance water infiltration.

Table 1. Summary of changes in infiltration measurements with time due to various tillage treatments.

Site	Treatment	Infiltration cm H_2O/min, Time (Mo.) 0	12	24
Benchmark 1†	Slot mulch 16"	2.4	2.0	1.0
	Slot mulch 10"	1.1	0.9	0.6
	subsoil 16"	2.2	0.6	0.3
	subsoil 10"	0.7	0.4	0.3
	Control	0.4	0.3	0.4
Benchmark 2‡	Slot mulch 16"	7.7	0.3	0.4
	Control	1.4	0.3	0.4

†Benchmark site 1 - no cultivation after slot mulch treatment.
‡Benchmark site 2 - cultivated one month after slot mulch treatment.

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: First year of three
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 main objective of year one was to design soil sampling systems that are reproducible in irrigated fields that have received large fertilizer doses in the past.

In six fields, samples were obtained from a large number (45 to 100) individual sites at one foot increments to three feet. In two of the fields, samples were analyzed for NO_3-N on both wet and dry samples and different core diameters were used (0.75", 1.25", 2.5" and 4").

In 18 fields, duplicate composite samples from 30 subsamples each were obtained at one foot increments to two feet. The composite samples were analyzed for NO_3-N.

The detailed sampling showed:

a) that wet or dry samples will provide the same NO_3-N value, after the moisture content correction is done.

b) the use of a larger core size does not reduce the variability or reduce the number of subsamples required to obtain a reproducible composite sample.
c) the NO_3-N data from a single soil depth cannot be used to predict the NO_3-N content of other soil depths.
d) obtaining the mean value, as is done in composite sampling, will overestimate the median NO_3-N content of a field by about 10-20 lbs/ac 2 feet. Thus, routine soil test procedures currently underestimate fertilizer nitrogen requirements on a field basis, by about 10-20 lbs/ac.
e) composite samples from 30 individual soil cores will provide a reproducible NO_3-N value.

Growth of Salt Sensitive Crops on a Saline Field Reclaimed by Subsurface Tile Drainage Installation and Leaching

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Saskatchewan Irrigation Development Centre (SW 15-29-8-W3)
Progress: One year only
Objectives: To determine the growth of salt sensitive crops on the SIDC drainage site.

A demonstration plot was established on the Saskatchewan Irrigation Development Centre drainage site to determine the growth of salt sensitive crops. Soil salinity monitoring had indicated a drastic reduction in salinity since drainage installation and subsequent leaching at this site.

Fababean, pea, lentil and dry bean which tolerate non to slightly saline conditions (ECe < 4 dS/m) as well as HRS wheat which tolerates moderately saline conditions (ECe 4-8 dS/m) were seeded in each of four blocks in the plot area.

Soil samples collected in the Spring prior to seeding indicated the plot area to be slightly saline (Table 1).

All crops had good establishment as indicated by germination plant counts (Table 2) and showed no adverse effects throughout the growing season. The yield of fababean, pea and HRS wheat was low for irrigated production (Table 2) possibly due to the late seeding date. Generally, fababean and pea should be seeded in late April or early May. The lentil yield was very high while that for dry bean was only average.

No adverse effects of salinity were observed during the growing season for these salt sensitive crops. Salinity does not appear to be limiting production. Thus, the primary objective of reclaiming this field using subsurface drainage and leaching appears to have been achieved.

Table 1. Saturated paste electrical conductivity for the salinity reclamation demonstration plot area.

Depth (cm)	ECe (dS/m) Mean	CV%
0-15	2.7	53.8
15-30	3.0	44.4
30-60	2.8	43.9

Table 2. Plant counts and yield for the salinity reclamation demonstration plot.

Crop	Plants/m² Mean	CV%	Grain Yield (kg/ha) Mean	CV%
Orion Fababean	86	16.0	3895	8.9
Century Pea	106	12.7	2098	24.4
Eston Lentil	156	10.5	4184	12.6
Fiesta Dry Bean	45	26.4	2966	20.9
Roblin HRS Wheat	135	5.6	4009	8.4

Evaluation of the Product SPER SAL

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Saskatchewan Irrigation Development Centre
Progress: One year only
Objectives: To evaluate the product SPER SAL as a soil amendment to reclaim irrigated saline soils.

SPER SAL is a liquid comprised of 50% hydrolized polymaleic anhydride, a synthetic low molecular weight anionic polyelectrolyte. It is promoted as a soil amendment for reclaiming saline irrigated soils. This product is not registered for sale as a soil amendment in Canada and as such no information is available under Western Canadian conditions confirming its use in reclaiming irrigated saline soils.

A plot was established on a moderately saline site at the Saskatchewan Irrigation Development Centre to evaluate SPER SAL. Canola and flax were used as the test crops. Treated and non-treated paired comparisons were made for plant emergence and yield. Results indicated that SPER SAL had no positive effect on germination or yield (Table 1). Further testing is required before definite conclusions can be made about the usefulness of this product.

Table 1. The effect of SPER SAL on the germination and yield of canola and flax.

Crop	Mean Plant Counts ($Plants/m^2$)			Mean Yield (kg/ha)		
	Untreated	Treated	t	Untreated	Treated	t
Canola	137	133	0.23 NS†	1398	1278	1.64 NS
Flax	242	195	2.36 ‡	1094	973	1.52 NS

† NS-not significant
‡ significant at P=0.05

Nitrogen Response of Irrigated Barley on Soil with High Residual Nitrogen at Depth

Principal: T. Hogg, Saskatchewan Irrigation Development Centre
Location: Saskatchewan Irrigation Development Centre (SW 15-29-8-W3)
Progress: One year only
Objective: To determine if cereal crops will respond to additional nitrogen applications on soils 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 NO_3-N in the lower sampling depths 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 the Saskatchewan Irrigation Development Centre on a site with large residual nitrogen at depth (Table 1). Irrigated Duke barley showed no significant yield response to additional nitrogen applications. Grain protein and straw nitrogen content were elevated at the higher nitrogen fertilizer application rates. As a result, total nitrogen uptake increased as the rate of nitrogen application increased (Table 2). This would indicate luxury consumption of nitrogen above the level of nitrogen required for maximum yield under these growing conditions.

The amount of available nitrogen in the top 30 cm at this site was obviously sufficient to meet the crop requirements during the early growth stages prior to root extension into the lower depths. However, sites with lower available nitrogen levels in the top 30 cm may respond differently. Additional work is required before definite conclusions can be made.

Table 1. Soil analyses for spring soil sampling of the nitrogen response experiment plot area.

Rep	Depth (cm)	pH	1:1 E.C. (dS/m)	NO_3-N	P	K	SO_4-S
				------------	(kg/ha)†	------------	
1 + 2	0-15	7.9	0.5	25	18	240	24+
	15-30	8.1	0.7	37			24+
	30-60	8.2	1.0	112			48+
3 + 4	0-15	7.9	0.4	23	16	220	16
	15-30	8.1	0.5	26			24+
	30-60	8.1	0.7	59			48+

†kg/ha = ppm x 2 for 15 cm depth and ppm x 4 for 30 cm depth

Table 2. The effect of nitrogen fertilization on the yield, nitrogen content and nitrogen uptake of irrigated Duke barley grown on a soil with a high sub-soil nitrogen level.

N Rate (kg/ha)	Grain Yield (kg/ha) Mean	Grain Yield CV %	Straw Yield (kg/ha) Mean	Straw Yield CV %	Harvest Index Mean	Harvest Index CV %	Grain % Protein†	Straw % N	Nitrogen Uptake Grain	Nitrogen Uptake Straw (kg/ha)	Nitrogen Uptake Total
0	5700	29.6	4777	27.3	0.54	4.1	11.2	1.02	119	49	168
25	6370	13.0	4750	5.9	0.57	2.6	10.8	1.01	127	48	175
50	6134	17.4	4855	10.9	0.56	3.1	11.5	1.36	131	66	197
75	6573	4.2	5397	6.8	0.55	3.3	11.7	1.21	143	65	208
100	6786	7.4	5673	10.0	0.55	1.8	12.4	1.46	156	83	239
L.S.D. (0.05)	NS‡		NS		NS						

†Grain protein content based on % N at 13.5 % moisture x 6.25
‡NS-not significant

Irrigation Scheduling of Pulse Crops

Principal: T. Hogg, L. Tollefson, A. Vandenberg
Saskatchewan Irrigation Development Centre

Location: Saskatchewan Irrigation Development Centre (SW 15-29-8-W3)
Progress: One year only
Objective: To evaluate the response of pulse crops to irrigation at critical growth stages.

An irrigation scheduling experiment was established to evaluate the response of the pulse crops fababean, pea and lentil to irrigation at critical growth stages. A flood basin technique was used. Five water treatments were replicated four times in a randomized complete block design for each crop. The water treatments were designed to provide a soil moisture stress during the vegetative (water A), flowering (water B) and late flowering-early pod fill (water C) growth stages. A fully irrigated (water D) and dryland (water E) treatment were also included. Irrigations were scheduled using tensiometers and water was applied when 50% of the available soil moisture was depleted. Treatment B was not effective in providing a soil moisture stress due to precipitation at the time irrigation water was witheld.

Sensitivity to soil moisture stress for the three pulse crops was of the order fababean > pea > lentil. The yield of fababean was sensitive to moisture stress throughout the growing season (Table 1).

Table 1. The effect of irrigation scheduling on the yield, seeds/m^2, seed weight, % protein and total water use of fababean, pea and lentil.

Crop	Water Treatment	Yield (kg/ha)	seeds/m^2	Seed Weight (mg)	% protein	Total Water Use † (mm)
Fababean	A	4299 b	1220 b	353 b	24.1	491
	B	4702 a	1295 ab	363 b	24.2	495
	C	4302 b	1026 c	421 a	24.8	499
	D	4696 a	1387 a	340 b	24.6	574
	E	2155 c	514 d	408 a	25.7	259
	LSD (0.05)	295	97	27	NS	
Pea	A	4578 a	1822 a	251 b	21.2	393
	B	4536 a	1680 ab	271 a	21.0	384
	C	3910 b	1600 a	245 bc	19.5	392
	D	4545 a	1786 ab	255 b	20.6	456
	E	2702 c	1134 c	238 c	20.9	239
	LSD (0.05)	485	200	15	NS	
Lentil	A	3652 a	10787 ab	34 a	21.8 a	408
	B	3391 a	9771 b	35 a	21.5 a	401
	C	3505 a	10235 ab	35 a	21.6 a	404
	D	3620 a	11446 a	32 b	22.1 a	478
	E	2071 b	5879 c	36 a	20.4 b	248
	LSD (0.05)	430	1300	2	1.0	

a Numbers within columns followed by the same letter are not significantly different at P = 0.05.
† Total water use = rainfall + irrigation + change in soil moisture (spring - fall).

Pea was only sensitive at the late flower-early pod fill growth stage. Lentil showed no sensitivity to moisture stress at any of the growth stages. Late July rainfall was adequate for maintaining lentil yield potential.

Compensation for potential yield decrease due to moisture stress may occur in the form of increased seed weight as shown for fababean and to some extent for pea. This effect appeared to be less important for lentil.

The protein content of fababean and pea was not significantly effected by soil moisture stress. For lentil the dryland treatment (water E) was significantly lower than the irrigation treatments.

Total water use was directly related to the amount of water applied for all three pulse crops. The fully irrigated treatment (water D) had the highest total water use while the dryland treatment (water E) had the lowest total water use. Fababean had a higher total water use than pea or lentil.

Esso Chemical Canada 1990 Field Trials

Principal: Esso Chemical Ag. Biolog icals
Location: Saskatchewan Irrigation Development Centre
Progress: One year only
Objective: To test naturally occurring micro-organisms known as plant growth promoting rhizobacteria (PGPR) on wheat, barley and canola; and nodule promoting rhizobacteria (NPR) along with the Enfix-L and Enfix-P products on lentil and pea. Four types of experiments were looked at entitled Strain Screens, Formulations/Delivery Systems and Chemical Compatibility and Nodule Promotion.

The design of the experiments was a six-replicate RCBD with statistical analysis done on MSTATC and the use of the LSD test at 90 and 95% level of confidence.

Strain Screens:

The crops examined in this experiment were wheat, barley and pea. For the wheat and barley, five strains, carrier control and a untreated control were used. The pea used six strains and an untreated control.

Formulation/Delivery Systems:

For the wheat and barley, two strains in four different formulations, formulation controls and an untreated check were used. The lentil and pea used the Enfix Rhizobium in peat versus a liquid carrier along with untreated controls.

Chemical Compatibility:

Canola was the only crop used with two strains compared with Vitavax RS and Rovrol ST.

Nodule Promotion:

On lentil and pea, NPR strains were used along with the Enfix Rhizobium to compare nodulation activity in peat and liquid formulations.

Observations that were made on these experiments were the following:

- three emergence counts of a 3 m length, using the 3rd as a final stand count.
- acetylene reduction assays on the lentil and pea.
- grain yield was harvested from a 1.8 metre squared area.

PB50 Research Trials

Principal: S. Gleddie, Philom Bios Inc.
Saskatoon, Saskatchewan

Economic and environmental issues generated by current agricultural practices have given rise to an increased emphasis on sustainable agriculture. Combining naturally-occurring biological systems with current agricultural practices may allow farmers to reduce input costs and increase the efficiency of crop production. One such natural microbial product, PROVIDE, a phosphate inoculant, has been generating substantial interest in the agricultural community. PROVIDE has been developed by Philom Bios, a biotechnology company based in Saskatoon.

Phosphorus is one of the key nutrients which are essential for plant growth and development. Most soils contain abundant quantities of phosphate, however, the availability of this nutrient for uptake by plants is restricted by its tendency to precipitate with certain cations (eg. Ca^{2+}, Mg^{2+}, Fe^{3+}, Al^{3+}) or to become tightly bound to or within soil particles. Precipitated or "fixed" phosphates are relatively insoluble and cannot be absorbed by plant roots. Consequently, farmers normally apply fertilizer phosphate in order to supply crop phosphate demands and produce optimum crop yields.

The use of phosphate fertilizer has been proven beneficial, but is also recognized as being inefficient. Numerous studies conducted in Western Canada have shown that on average only up to 30% of the applied phosphate fertilizer is taken up by crop plants in the year that it is applied. The remaining 70% becomes fixed in the soil and is unavailable for crop use. Phosphates from fertilizer are generally considered to be available to plants for only up to four weeks after application.

All soils contain a wide range of micro-organisms such as bacteria and fungi which have the capacity to solubilize fixed inorganic phosphates, thereby making them available for plant use. Researchers led by Dr. R.M.N. Kucey at the Agriculture Canada Research Station in Lethbridge, Alberta, isolated from soil a number of fungi and bacteria capable of solubilizing fixed inorganic phosphate (Kucey, 1983). One of these, an isolate of the fungus *Penicillium bilaji*, was unique in the efficiency with which it solubilized rock phosphate in liquid media.

Bran inoculated with *P. bilaji* applied in-furrow was shown to increase phosphate availability to wheat in greenhouse and field trials established in 1985, 1986, and 1987 (Kucey, 1987; Kucey, 1988); Asea, et al., 1988). The efficiency of *P. bilaji* has been demonstrated under phosphate responsive conditions and registered in Canada by Philom Bios under the trade name PB-50 for in-furrow application with wheat (Reg. #880003A). However, the formulation was not practical for large scale field use. Successful liquid fermentation of *P. bilaji* has enabled the replacement of the in-furrow bran formulation with a water soluble, dry powder, seed inoculant formulation.

Trials to assess the performance of the PB-50 seed inoculant formulation on wheat were established by Philom Bios, the Saskatchewan Wheat Pool, and Westco Fertilizers Limited at 55 locations across the three prairie provinces in 1988, 1989, and 1990. Trials were established at the SIDC research station in 1989 and 1990. Combined analysis indicated that PB-50 increased phosphate availability and uptake by wheat as evidenced by positive yield responses. Overall locations, provided a base level of 10 kg/ha P_2O_5 was applied, PB-50 was able to replace a minimum of 10 kg/ha P_2O_5 while maintaining wheat yields. Optimal response to PB-50 occurred in cropping environments which were conducive to phosphate responses. The PB-50 seed inoculant formulation was subsequently registered for use with wheat (Reg. #8800029A), and will be sold to Western Canada farmers by DowElanco and the Saskatchewan Wheat Pool under the trade name PROVIDE.

PB-50 is also being field tested on crops such as barley, peas, lentils, and canola.