Research and Demonstration Highlights 1989

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SIDC
Introduction

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 in 1988 included farmer membership as well as membership from the University of Saskatchewan, federal and provincial governments and industry. This committee identified, reviewed and suggested proposals for irrigation work to be conducted,

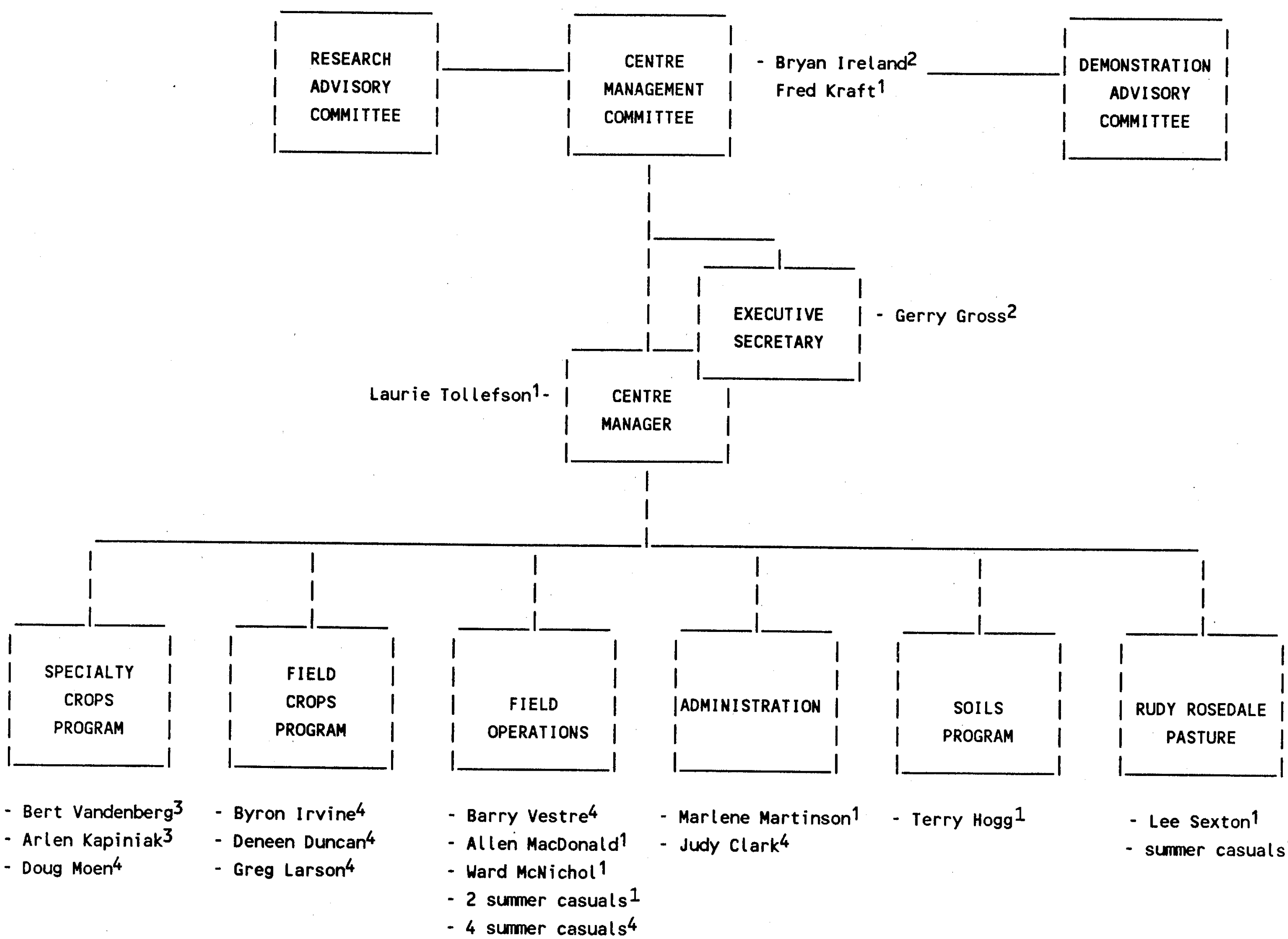
prioritized and recommended proposals to the Centre Management Committee, and advised the Centre Management Committee on all matters related to irrigation research and extension. They also reviewed and assessed research work at the request of the Centre Management Committee.

3. The Demonstration Advisory Committee in 1988 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.

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

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



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

Staff changes in 1989-90 have included the addition of Doug Moen and Greg Larson as technicians in the Specialty Crops and Field Crops Programs, respectively. In addition, Terry Hogg was brought on staff to handle soil-related concerns. Finally, Ward McNichol took over the duties of the irrigation operator.

Centre Funding:

The core funding for the Saskatchewan Irrigation Development Centre is provided by Federal and Provincial A based funding. Additional funds are provided by the Federal-Provincial Irrigation Based Economic Development Agreement (SIBED) and the provincially sponsored Agriculture Development Fund (ADF).

	(Agriculture Canada) PFRA	ADF	SIBED	Sask Water
Salaries	178,400	129,414	182,038	54,510
Operating	139,000	20,586	113,462	1,350
Capital	139,000	---	79,417	
Total	456,400	150,000	374,917	55,860

Total expenditures for the year were $1,037,177

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 $2.5 million for irrigated research and $1.5 million for demonstration. SIDC through the Research Advisory Committee and the Demonstration Advisory Committee recommends projects to the Research and Demonstration Sub-Committee of the SIBED Agreement for approval. A total of 24 irrigated research projects and 59 demonstration projects are currently funded. These are included in the SIDC list of projects.

To obtain SIBED funding, the applicant must have an idea and plan of action which will aid the irrigation farmer. Application forms are obtained from the Centre, which are completed and returned to the Centre. Each application is reviewed and rated by a Research or Demonstration Advisory Committee. These committees advise the Centre Management Committee as to the proposal's merit. Once funding has been obtained, a contract is developed between the Centre and the applicant.

Dates for the submission of applications are January 1, April 1, July 1, and October 1. Applicants are notified of decisions within 90 days of the submission dates.

SIDC Tours - 1989

Tours and extension are an important part of the Centre's activity. Our summer field day was a particularly successful event with 110 people from the research, extension and farming community in attendance. Thirty-five tours were hosted by SIDC in 1989. The average size of group was sixteen people. In total, there were over a thousand visitors to the Centre during the year. A most successful winter annual meeting was held. A total of 143 visitors attended to hear the result of the summer research and demonstration program.

SIDC
List of Projects

Agriculture Development Fund (ADF):

Irrigation Based Economic Development Fund (IBED):

ADF Research Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Plant Disease of Irrigated Cereals Principal: L. Duczek, Ag Canada	Four years	$28,600.00	$111,300.00
Management of Forage Production under Irrigation Principal: B. Goplen, Ag Canada	Four years	$36,000.00	$138,000.00
Starch Potato Yields Principal: J. Wahab, U of S	Four years	0.00	$66,100.00
Irrigation Economics Principal: S. Kulshreshtha, U of S	Four years	$20,000.00	$86,050.00
Irrigation of Dry Beans Principal: A. Slinkard, U of S	Three years Completed 1988	0.00	$102,740.00
Disease Screening Principal: B. Harvey, U of S	Four years	$21,000.00	$91,600.00
Quality of Drainage Water Principal: W. Nicholaichuk, et al NHRI, SCC, Ag Canada	Three years Completed 1988	0.00	$61,100.00
Irrigating with Poor Quality Groundwater Principal: J. Gillies, U of S	Three years Completed 1988	0.00	$47,700.00
Semi-dwarf Barley Principal: B. Rossnagel, U of S	Four years	$35,385.00	$139,855.00
TOTAL		$140,985.00	$844,445.00

ADF Demonstration Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Irrigated Canola Varieties Demonstration Principal: Saskatchewan Canola Growers Assn.	Three years Completed 1988	0.00	$15,400.00
Feed Value of Corn Silage by Harvest Maturity Principal: SCC; Crowle, Ag Canada	Three years Completed 1988	0.00	$12,000.00
TOTAL		$0.00	$27,400.00

IBED Research Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Soil Salinity Investigation at the SSRID #1 Principal: L. Henry, U of S	One year Completed	$0.00	$100,000.00
Methods of Improving Alfalfa Establishment under Irrigated Conditions Principal: B. Irvine, SIDC	Four years	$0.00	$4,700.00
Seed Production of Kentucky Bluegrass Principal: B. Irvine, SIDC	Four years	$0.00	$660.00
Effects of Growth Regulators on Canola Principal: B. Irvine, SIDC	Three years	$0.00	$462.00
Irrigation Scheduling Information Principal: R. Lawford, NHRI	Two years	$19,000.00	$30,000.00
Corn Hybrid Testing Principal: Sask Corn Committee	Three years	$0.00	$17,135.00
Determination of Soil Intake Rates under Centre Pivot Irrigation Systems Principal: D. Norum, U of S	Two years	$31,803.00	$52,600.00
N Fertilization and Water Use Efficiency of Irrigated Crops Principal: C. van Kessel, U of S	Three years	$37,926.00	$134,500.00
The Design and Field Testing of a Vertical Mulcher for Irrigated Soils Principal: Paragon Consultants Ltd., T. Tollefson	Three years	$16,950.00	$73,750.00
Alfalfa Cultivar Evaluation on Flood Irrigated Clay Soils in South West Saskatchewan Principal: P. Jefferson, Ag Canada, Swift Current	Four years	$44,400.00	$210,000.00
Irrigation Scheduling Tools for Farm Use Principal: B. Irvine, SIDC	Three years	$4,429.94	$45,760.00
Evaluation of Conventional Height Semi-Dwarf Cultivars for Irrigated Production in Saskatchewan Principal: P. Hucl, Sask Wheat Pool	Three years	$4,320.00	$14,033.00
Sodicity Hazard of Sodium and Bicarbonate Principal: F. Selles; Contractor: Normac AES Ltd.	Four years	$115,305.00	$349,200.00

IBED Research Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Denitrification in Irrigation Cropping Systems & its Significance for Crop Production Principal: C. van Kessel, U of S	Two years	$12,806.83	$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	$25,831.40	$55,950.00
Disease of Irrigated Wheat to Evaluate Fungicide Sprays for Foliar Disease Control Principal: L. Duczek, Ag Canada, Saskatoon	Three years	$0.00	$41,700.00
Management of Alfalfa for Seed Production under Irrigation Principal: B. Goplen, Ag Canada, Saskatoon	Three years	$0.00	$38,440.00
Irrigated Production of Hybrid Canola Seed Principal: D. Hutcheson, Ag Canada, Saskatoon	Three years	$11,000.00	$91,161.00
Herbicide, Pesticide & Nutrient Loss Using Low Pressure (High Volume) Principal: W. Nicholaichuk, NHRI	Three years	$0.00	$98,200.00
TOTAL		$323,772.17	$1,401,251.00

IBED Demonstration Projects:

PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Irrigated Canola Varieties Demonstration Co-operator: M. Larson	Two years Completed 1988	$24.00	$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: Roger and Richard Bond	Three years	$2,575.00	$10,914.00
Oilseed/Pulse Crop Sequence Co-operator: R. Byron Irvine, SIDC	Three years	$499.00	$2,592.00
Double Cropping of Annual Forages vs. Alfalfa Forage Co-operator: R. Byron Irvine, SIDC	Three years	$554.00	$2,496.00

IBED Demonstration Projects (cont.)

PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Agronomics of Pinto Beans Using Conventional Farm Equipment Co-operator: K. Carlson, Keg Farms Ltd.	Three years	$24.00	$10,500.00
Comparison of Leduc and Virden Barley for Silage Production Under Irrigation Co-operator: R. Byron Irvine, SIDC	Two years Completed 1988	$0.00	$1,800.00
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	$1,723.00	$4,000.00
Irrigated Field Pea Early Seeding Demonstration Co-operator: J. Konst	Three years	$3,778.00	$14,982.00
Ripping Solonetzic Soils Co-operator: M. Grevers	Three years	$3,301.00	$27,253.00
Alfalfa Varieties on Border Dyke Irrigation - Yield and Stand Longevity Contractor: Normac AES Ltd.	Five years	$2,037.00	$12,050.00
Alfalfa Establishment and Fertility for Increased Yield Contractor: Normac AES Ltd.	Five years	$3,870.00	$49,883.00
Maximum Economic Yield Co-operator: Outlook Irrigation Production Club	Four years	$11,310.00	$77,900.00
Finishing & Marketing Options for Lambs Raised on Irrigated Pasture Co-operator: D. Kelman	One year Completed 1988	$0.00	$5,000.00
Creep Feeding Lambs Raised on Irrigated Pasture Co-operator: R.D.H. Cohen	One year Completed 1988	$4,039.00	$12,360.00
Drainage & Subsoiling to Improve the Yield of Alfalfa on Border Dyke Irrigation Contractor: Normac AES Ltd.	Four years	$1,757.00	$14,748.00
Use of Spring Seeding Winter Annual Cereal Grains for Grazing I. Large Animal Trial Co-operator: Vestre Farms	Two years	$2,130.00	$8,720.00
Use of Lentil as a Companion Crop in Establishing Irrigated Alfalfa for Seed Production Co-operator: Keg Farms Ltd.	Three years	$0.00	$15,260.00

IBED Demonstration Projects (cont.)

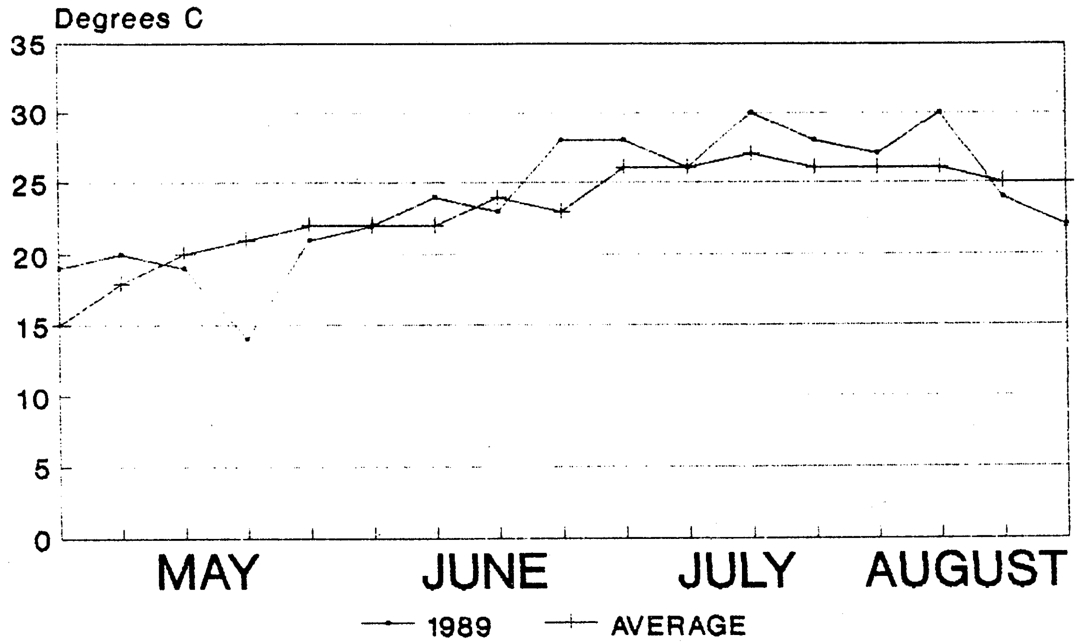
PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Irrigated Fababean Agronomy Demonstration of Benefits of Early Seeding Co-operator: M. Miller	Three years	$3,188.00	$11,232.00
Canola Variety Demonstration, Site 2 Co-operator: D. Duncan, SIDC Site: C. Bagshaw	Three years	$400.00	$5,050.00
Evaluation 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	$2,062.00	$2,220.00
Kochia Production under Irrigation Contractor: Normac AES Ltd.	Three years	$827.00	$6,180.00
Using Chemical Desiccants to Speed Curing of Alfalfa Forage Co-operator: L. Knapik	Two years	$836.00	$3,212.00
Irrigated Field Pea Agronomy Co-operator: G. Follick	One year Completed 1988	$3,198.00	$3,738.00
Irrigated Alfalfa Seed Production Co-operator: M. Millar	Three years	$5,500.00	$15,500.00
Different Semi-dwarf Barley vs. Trad. Varieties Grown under Irrigation Co-operator: J. Senger	One year Completed 1989	$1,945.00	$1,945.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: L. Murray	Three years	$1,440.00	$7,695.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: J. Eliason	One year Completed 1989	$2,975.00	$2,975.00
Increasing Returns from Irrigated Grass Pastures Grazed by Sheep Contractor: Riverside Sheep Co.	One year Completed 1989	$1,366.00	$1,980.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: Derdall Irrigation	Three years	$4,310.40	$17,715.00

IBED Demonstration Projects (cont.)

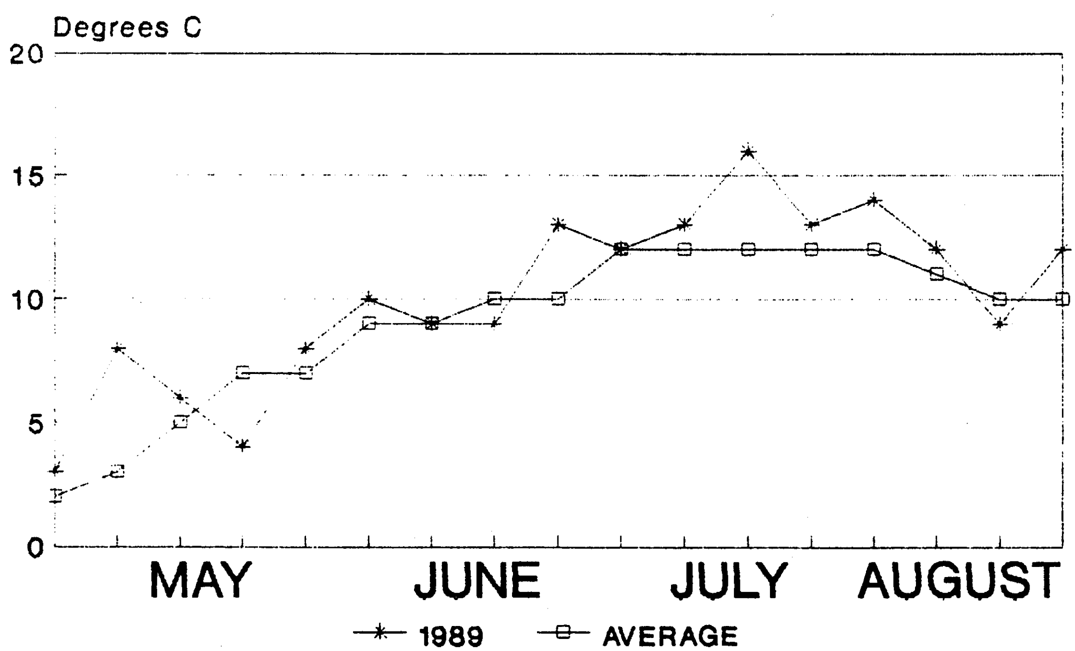
PROJECT NAME AND CO-OPERATOR	TERM	1989 EXPENDITURES	TOTAL $
Irrigated Safflower Agronomy: Evaluation of Nitrogen Response in Safflower Productivity Co-operator: J. Massey	Three years	$2,677.46	$8,007.00
Irrigated Great Northern Bean: Evaluation of Disease Control Technology Co-operator: J. Konst	Three years	$2,329.06	$5,190.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: Lakeview Ranch	Three years	$5,585.60	$17,715.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: K. Carlson	Three years	$3,893.60	$17,715.00
Skid Boom Sprayer Evaluation for Sclerotinia Control in Irrigated Pinto Bean Co-operator: J. Konst	One year Completed 1989	$3,044.36	$4,900.00
Timothy Production under Irrigation Co-operator: P. & S. Verwimp	Three years	$3,600.00	$10,000.00
Irrigated Lentil Agronomy Co-operator: G. Ofstie	Three years	$799.30	$4,302.00
Irrigated Field Pea Agronomy: Early Seeding Date Control Technology Co-operator: G. Ostie	Two years	$3,046.12	$7,848.00
Demonstration of Alfalfa Seed Production Under Irrigation Co-operator: M. and R. Larson	Three years	$5,500.00	$15,500.00
Timothy Production under Irrigation Co-operator: Kelvin Bagshaw	Three years	$3,600.00	$6,400.00
Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology Co-operator: D. Walberg	Three years	$3,704.30	$12,525.00
Irrigated Field Pea Agronomy: Early Seeding Demo Co-operator: M. Purcell	Two years	$0.00	$9,148.00
TOTAL		$103,448.20	$478,676.45

SIDC
Meteorological and Irrigation Data

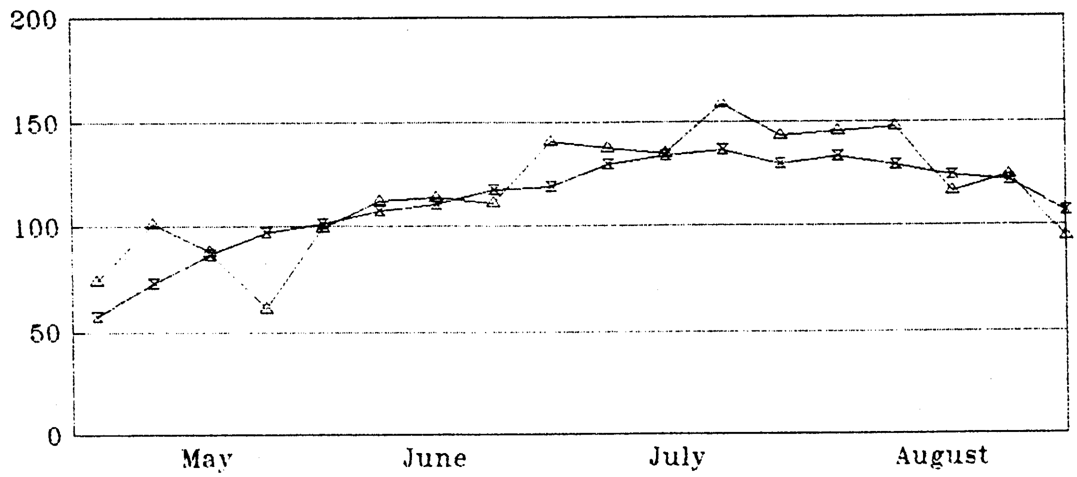
WEEKLY MEAN MAXIMUM TEMPERATURE S.I.D.C.



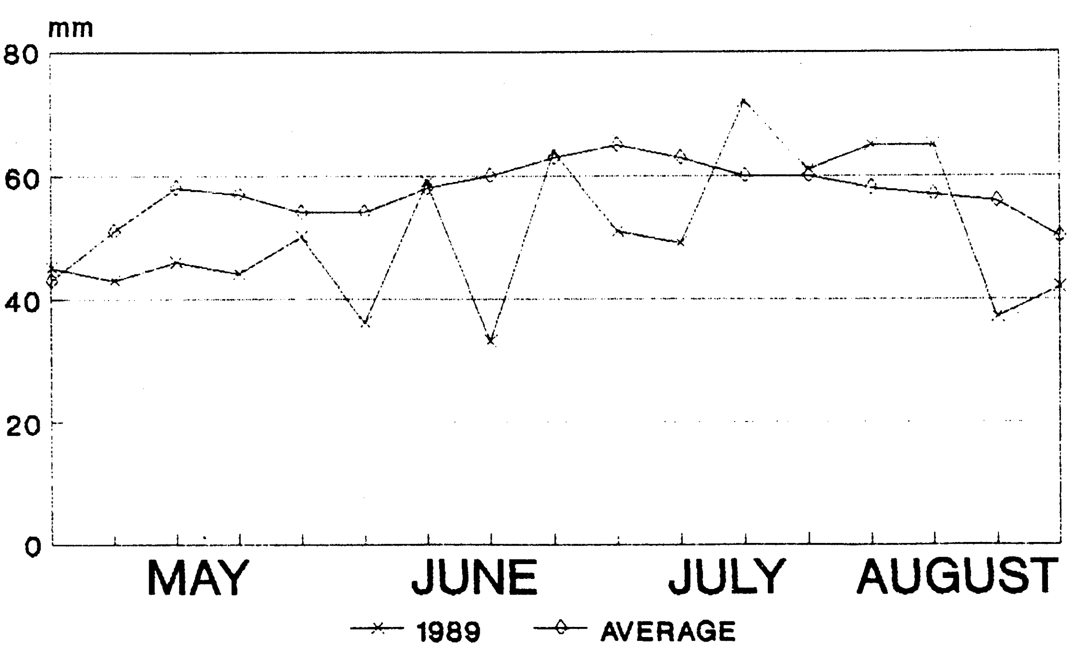
WEEKLY MEAN MINIMUM TEMPERATURE S.I.D.C.



Growing Degree Days
Weekly Accumulation
S.I.D.C.

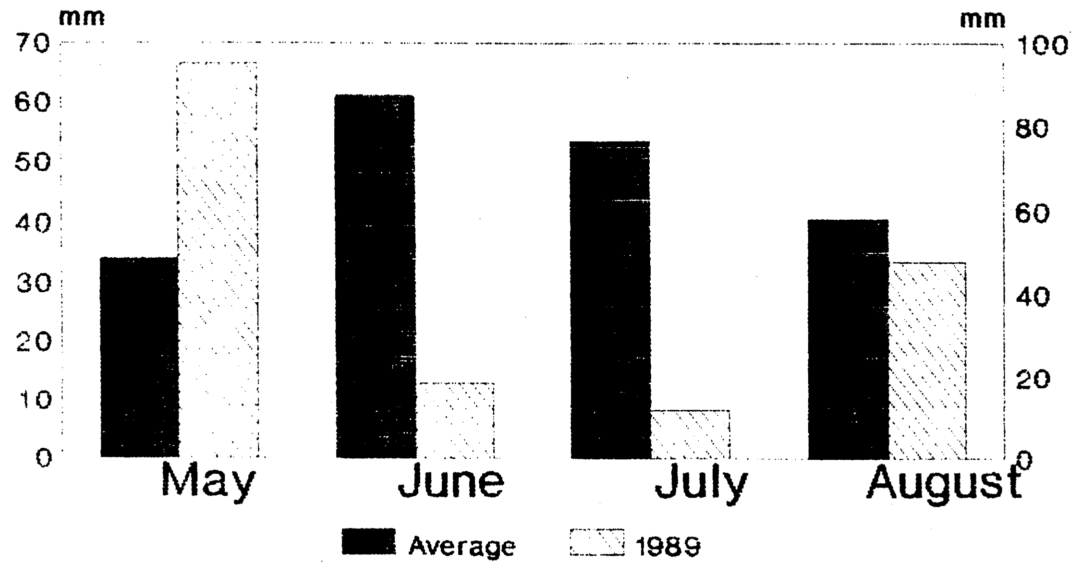


WEEKLY EVAPORATION
S.I.D.C.



CLASS A PAN

Precipitation
Monthly Accumulation
S.I.D.C.



1989 Irrigation Data (mm)

CROP	MAY	JUNE	JULY	AUGUST	SEPTEMBER	Total through Growing Season	Fall Irrigation	Total Irrigation
Corn	0.0	92.5	149.5	90.0	0.0	332.0	0.0	332.0
Sunflower	0.0	92.5	172.0	105.0	0.0	369.5	0.0	369.5
Barley (Winchester)	0.0	92.5	149.5	90.0	0.0	332.0	0.0	332.0
Sudan Grass	0.0	92.5	172.0	90.0	0.0	369.5	0.0	369.5
Alfalfa	0.0	June 23 (flooded)	July 7&24 (flooded)	Aug. 10 (flooded)	0.0		0.0	
Wheat (Katepwa)	0.0	85.0	130.0	0.0	0.0	215.0	0.0	215.0
Canary Seed	0.0	65.0	150.0	0.0	0.0	215.0	0.0	215.0
Barley (Winchester)	0.0	71.0	183.0	35.0	0.0	289.0	0.0	289.0
Alfalfa	0.0	142.5	168.0	65.0	0.0	375.5	0.0	375.5
Barley (Winchester)	0.0	100.0	220.0	25.0	0.0	345.0	0.0	345.0
Seed Potatoes	0.0	100.0	220.0	25.0	0.0	345.0	0.0	345.0
Cereal Disease Study	0.0	100.0	169.0	25.0	0.0	294.0	0.0	294.0
Wheat (Katepwa)	0.0	100.0	169.0	25.0	0.0	294.0	0.0	294.0
Wheat (Laura)	0.0	97.5	157.5	27.5	0.0	282.5	0.0	282.5
Durum (Arcola)	0.0	79.0	157.5	0.0	0.0	236.5	0.0	236.5
Semi-dwarf Barley	0.0	96.5	243.0	77.5	0.0	417.0	0.0	417.0
Early Seeded Barley	0.0	102.0	222.5	0.0	0.0	324.5	0.0	324.5
Late Seeded Barley	0.0	102.0	222.5	147.5	0.0	472.0	0.0	472.0
HY355	0.0	102.0	193.0	0.0	0.0	295.0	0.0	295.0
Barley (Bonanza)	0.0	115.5	125.0	0.0	0.0	240.5	355.0	595.5
Soft Wheat (Fielder)	0.0	94.5	182.5	70.0	0.0	347.0	25.0	372.0
Durum (Sceptre)	0.0	105.0	191.0	75.0	0.0	371.0	25.0	396.0
Fababean	0.0	97.5	197.5	70.0	0.0	365.0	25.0	390.0
OSPC Year II	0.0	97.5	200.0	79.5	0.0	377.0	25.0	402.0
Durum (Medora)	20.0	52.5	190.5	22.5	0.0	285.5	25.0	310.5
Oilseed Demos	20.0	62.0	183.0	72.5	0.0	337.5	0.0	337.5
Cereal Demos	20.0	57.5	189.0	72.5	0.0	339.0	0.0	339.0

Cereals

Spring Grain Regional Adaptation Trials

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

The Regional Spring Grain Variety Testing Program is a co-operative venture of the University of Saskatchewan, Crop Development Centre, Saskatchewan Rural Development Extension Service and participating farmers and agricultural societies. The location at SIDC in Outlook is the only irrigated testing site in Saskatchewan.

For the past few years, an irrigated trial has been set up at SIDC focusing on varieties of canola, flax and durum wheat. With the current lack of varietal performance data, choice of a variety for irrigation is a difficult one. However, once there is an accumulated data base, irrigated producers will be able to choose an appropriate variety based on repeated performance under irrigation. Based on five years data for flax and canola and on three years data for durum wheat, the following tables show results already obtained at the SIDC irrigated site.

Spring Grain Irrigated Variety Trials, Outlook, Saskatchewan, 1986-1989:

Table 1. Yield as a % of Westar and Tobin

CANOLA	85	86	87	88	89	Ave.
B. napus						
Westar		100	100	100	100	100
Regent		77	98	102	91	92
Tribute		55	68	56	64	61
Profit				107	116	111
DO-195				84		84
ACS-N1					89	89
ACS-N3					101	101
ACS-N4					91	91
ALTO				107	90	98
Legend				103	117	110
Celebra					114	114
Vanguard					118	118
Delta					121	121
Hyola 40					108	108
Andor		80				80
Triton		55				55
B. campestris						
Tobin	100	100	100	100	100	100
Horizon				101	123	112
Colt				91	98	95
Parkland				109	97	103
Candle	105	73				89
DN-1507	114					114

Table 2. Yield as a % of Norlin

Flax	85	86	87	88	89	Ave.
Norlin	100	100	100	100	100	100
Dufferin	74	86	76	117	105	92
Linott	93	99	72	109		93
McGregor	90	108	98	114	101	102
Noralta	97	94	97	96	92	95
Norman	95	109	86	115	102	102
Vimy		97	75	123	90	96
Andro	100	92	78	94	93	91
Somme					114	114
Flanders					108	108

Table 3. Yield as a % of Kyle

Durum	87	88	89	Ave.
Kyle	100	100	100	100
Wascana	93	72		82
Arcola	116	93		105
Medora	97	86	148	110
Sceptre	91	92	143	109
Wakooma	96	71	94	87
DT 606			142	142
DT 242			165	165
DT 462			159	159

Table 4. Yield as a % of HY320 (86,87) and as a % of HY355 (88,89)

High Yield Wheat	86	87	88	89	Ave.
HY2	90	99		95	95
Glenlea	105	102	71		93
HY320	100	100	86		95
HY355		138	100	100	113
HY358	115				115
HY362	98				98
HY363	131				131
HY364	103	107	93		101
HY365	102				102
HY366	122				122
HY367	115	104			109
HY368		123	94	92	103
HY369		120			120
HY370		123			123
HY371		113	84		99
HY372			87	88	88
HY373			85	100	93
HY374			97		97
HY375			85		85
HY376			100		100
HY377			90		90
HY378			94		94
HY379			99		99
HY380			109	108	108
HY381			101		101
HY382			85	95	90
HY383			90	89	90
HY384				92	92

High Yield Wheat	86	87	88	89	Ave.
HY411	99				99
HY412				105	105
HY522		93			93
Laura			65		65
HY607			88		88
HY608			72		72
HY609			90		90
HY610				92	92
HY611				98	98
HY803				97	97
HY804				81	81
HY908	106				106
HY919	92				92
HY923	75				75
HY924	98				98
HY925				78	78
Oslo	91	82	63		78
HY927	120				120
HY929	105				105
HY930	73				73
Nordic	134	114	92		114
HY932		82			82
HY933		87	87	96	90
HY934		100			100
HY935				114	114
HY936				98	98
HY937				106	106
HY938				107	107

Evaluation of Durum Cultivars for Irrigation in Saskatchewan

Principal:	P. Hucl, Saskatchewan Wheat Pool, Product Development #15 Innovation Blvd. Saskatoon, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-investigator:	R.J. Graf
Location:	1 km east of Outlook
Progress:	Second year of three
Objective:	To evaluate the potential of semi-dwarf versus conventional height amber durum wheat (*Triticum turgidum L. var. durum*) cultivars and lines under irrigation production conditions.

The 1989 irrigated durum test was a 19 entry, RCBD with 4 replicates. All genotypes seeded in the 1988 test were included, with an additional 4 entries (2 semi-dwarf, 2 tall). Neepawa and Fielder were sown as standard CWRS and CWSWS checks.

The trial was seeded on May 5, 1989 at a site approximately 1 km east of the town of Outlook. The seeding rate was ca. 440 seeds/m^2. Fertilizer application consisted of 55 kg/ha fall applied anhydrous ammonia (82-0-0) as well as 45 kg/ha actual N applied through the irrigation water. 50 kg/ha of 11-51-0 was drilled in with the seed. A top-dressed application of N at Zadoks stage 30-50 was not deemed necessary in 1989 as protein levels in previous years were very high. Weed control consisted of an application of Banvel/2,4-D tank-mix on May 30. Minimal hand-weeding was performed in mid-July. The plots headed July 3 - 9 and reached maturity August 14 - 21. Harvest of the 4.5m^2 plot took place on August 31.

In addition to collecting standard agronomic data, several quality tests were performed, including NIR protein determination, mixograph, SDS sedimentation and pigment extraction. Samples of each line were also sent to the Canadian Grain Commission for official grading.

<u>Results and Discussion</u>

1. Sceptre is presently the best choice for irrigated durum production. It combines high yield and superior lodging resistance while obtaining top CWAD grades.

2. Arcola is similar to Sceptre in yield but lodges significantly more. In some years it may receive a better grade than Sceptre as a result of its higher protein content.

3. Medora may not yield as well as Sceptre and Arcola but has lodging resistance similar to Sceptre. Grading of this variety has been more variable than other registered varieties in the test.

4. Kyle is a high yielding, tall durum that lodges severely under irrigation. It is therefore not recommended for irrigated production.

5. Semi-dwarf cultivars have the potential for high yield and good quality, with reduced height compared to conventional cultivars.

6. DT 905, a semi-dwarf line in its first year of testing in the Durum Co-operative Testing system may have a future for irrigated production if quality and yield are maintained in succeeding years.

Table 1. Agronomic summary for irrigated durum at Outlook, Saskatchewan (1988, 1989 means).

	Height	Yield			Heading	Maturity	Height	Test Wt.	1000 K	Grade	
	Class	kg/ha	% Kyle	Rank	(d)	(d)	(cm)	(kg/hl)	(g)	1988	1989
Wakooma	T	5105	90	12	59.6	98.8	102.0	80.0	43.6	2	1
Kyle	T	5644	100	5	55.6	97.3	93.5	80.0	48.6	1	1
Sceptre	M	5224	93	11	54.5	94.8	81.0	79.0	45.8	2	2
Arcola	M	5493	97	8	53.8	94.3	89.8	77.5	43.9	1	2
Medora	M	5514	98	7	53.3	94.8	89.5	80.5	47.5	1	3
Coulter	M	5271	93	10	53.6	95.3	88.0	79.0	44.5	1	3
Laker	Rht	5961	106	2	57.1	98.8	83.8	80.5	51.0	2	2
DT 901	M	6004	106	1	53.9	98.0	101.0	81.0	47.3	2	2
HD 84-1805	M	5924	105	3	55.0	98.8	90.3	79.5	48.9	2	2
DT 905	Rht	5744	102	4	54.3	96.3	76.5	79.5	48.9	1	1-2
WA 883-411	M	5558	98	6	54.1	97.0	96.5	80.0	47.1	2	2
WA 885-421	Rht	4763	84	13	52.8	97.3	85.5	79.5	47.4	2	2
WA 885-424	Rht	5303	94	9	55.9	98.8	79.5	79.0	49.5	2	2
Neepawa	--	4746	84	--	--	--	83.8	--	--	1	2
Fielder	--	5724	101	--	57.3	98.3	79.0	79.0	41.8	2	2
LSD(0.05)		500									
<u>Height Class Contrasts</u>											
Tall (T)		5493	100	57.4	97.7	98.7	79.8	46.6			
Medium (M)		5604	102	54.0	96.1	90.9	79.5	46.4			
Semi-dwarf (Rht)		5527	101	55.3	97.9	79.0	79.3	49.7			

Soft White Spring Wheat Co-operative Trial

Principal: R.J. Baker, Crop Development Centre
University of Saskatchewan
Saskatoon, Saskatchewan

Twenty-five spring wheat cultivars, including two check cultivars, one fifth-year entry, two fourth-year entries, three third-year entries, four second-year entries and thirteen first-year entries, were evaluated in a four-replicate test at the Saskatchewan Irrigation Development Centre at Outlook. The same test was also grown at Saskatoon, and at Lethbridge, Vauxhall, Bow Island and Iron Springs in Alberta. Two of the check varieties (Fielder and Owens), one fourth-year entry (ID0266) and one first-year entry (ID0348) are from the USDA program in Idaho, the remaining entries are all from the Agriculture Canada Station in Lethbridge. Average 1989 yields (kg/ha) at Outlook and over all six test sites are reported below.

Table 1. Average 1989 yields.

Entry	Year in test	Yield (kg/ha) Outlook	Average	Entry	Year in test	Yield (kg/ha) Outlook	Average
Fielder	Check	4,740	6,450	83190-360	1	5,050	6,260
Owen	Check	5,620	6,980	83190-324	1	6,420	6,950
L2630-25	5	5,430	6,460	83190-323	1	5,300	6,370
ID0266	4	6,880	7,130	83226-407	1	5,840	7,050
L2634-23	4	5,720	6,630	83351-799	1	6,130	6,890
85-WI-0263	3	6,030	6,470	85CR-27-34	1	4,280	5,940
85-WI-0546	3	5,560	6,500	83226-419	1	4,980	6,200
84-2094	3	6,130	6,330	83190-260	1	4,760	5,880
83111-130	2	5,280	6,090	85CR-25-10	1	5,290	6,140
83104-42	2	5,200	6,480	85CR-27-17	1	4,480	6,050
83351-796	2	5,720	6,780	85CR-27-31	1	3,950	5,840
83351-795	2	5,740	6,660	ID0348	1	5,810	6,690
83226-420	1	5,030	6,260				

Irrigated Semi-dwarf Barley: Maximizing Barley Production Under High Input Conditions via Semi-dwarf Varieties in Saskatchewan

Principal: Brian Rossnagel, Crop Development Centre
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Agriculture Development Fund
Progress: Final Year

From 1986-1989 several experiments were conducted both under irrigation and at non-irrigated sites to evaluate and compare newly available semi-dwarf barley cultivars for maximum productivity in Saskatchewan.

The semi-dwarf varieties Duke, Samson and Winchester were compared with the standard height cultivars Heartland and Leduc. As anticipated, under irrigation where yields were approximately 5,500 kg/ha (100 bu/ac), the semi-dwarfs demonstrated superior overall performance due to improved straw strength. Their value was especially notable when yields exceeded these levels and conditions led to early season lodging of standard varieties. With irrigation, minimum barley yields of 5,500 kg/ha should be expected and it should be possible to increase these to 7,000 kg/ha.

On dryland, where yields averaged 3,000 kg/ha, the semi-dwarfs as a group did not perform as well as the standard varieties, although Duke, developed at the Crop Development Centre, University of Saskatchewan, was not a significantly poorer performer than the standard cultivar Heartland.

Of the semi-dwarfs, Duke was the best overall performer under both the high yielding irrigated conditions and on dryland. The American variety Winchester, while not as high yielding, did demonstrate a significant maturity advantage, but, its lack of adequate disease resistance for Saskatchewan makes it a definite second choice. Samson demonstrated no yield advantage over Duke, was consistently more prone to lodging and produced grain of lower quality. Thus, it would obviously be the third choice.

Despite reports to the contrary, the semi-dwarfs did not produce grain of lower quality than the standard cultivars under either high or low yielding environments. In fact, Duke and Winchester consistently produced heavier grain than all other varieties and Samson, consistently the poorest of the three semi-dwarfs, was not different from the standard height cultivars. Under these very high yield conditions six-row barley in general will demonstrate lower test weight and grain plumpness than at intermediate yield levels. In this study kernel characteristics were negatively affected at the non-irrigated locations due to drought stress, but even under these conditions Duke and Winchester produced grain of superior quality compared with Heartland and equal to that of Leduc.

In addition to variety comparisons, experiments were conducted to substantiate or disprove the purported need to use heavier seeding rates for semi-dwarfs and that they could not tolerate normal or deeper than normal depths of planting. The results of this study clearly indicate that neither of these claims are valid as the three semi-dwarfs responded in exactly the same fashion as did the standard cultivar Heartland.

It was demonstrated, however, that regardless of variety under high yielding irrigated conditions, a greater than "normal" seeding rate should be considered to maximize production. Normal seeding rates of 260 viable seed/m^2 should be increased to 330/m^2.

In regard to seeding depth, there was no evidence that the semi-dwarfs had more difficulty than Heartland when planted at 10.0 cm. However, all varieties did suffer when planted at that depth. It appears that a "normal" planting depth of 5.0-7.5 cm was optimal and, in fact, the shallowest depth (2.5 cm) was the riskiest of all. Based on the results of this study, which demonstrated a clear lodging resistance advantage to deeper planting, it is recommended that producers plant at a 6 to 7 cm depth using high quality seed treated with an appropriate fungicide to avoid seedling disease problems which may be more prevalent under irrigated conditions.

In addition to the agronomic work described, studies were undertaken to determine optimum methodologies and timing for straw strength selection and genotype evaluation in a semi-dwarf barley breeding program. It was found that hill plots can be effectively used and that row plots offer little advantage for straw strength selection. Spaced single plant nurseries are not effective except for visual selection for short stature and the semi-dwarf plant type. It is recommended that selection for lodging resistance begin in hill plots at the F_5 generation. Once the yield plot test stage is reached, regular breeding plots can be effectively utilized, but it is necessary to border each test plot with a common strong strawed genotype as a spacer plot to avoid inter-plot interference due to differential lodging.

This project also assisted in the partial evaluation of several thousand semi-dwarf breeding lines from the Crop Development Centre breeding program during 1986-1989. Some 200 lines underwent yield tests. Several were advanced to regional and co-operative pre-registration trials. Of these, two lines, SB86337 and SB86382, both of which demonstrate superior performance, maturity and disease resistance when compared with Duke, Samson and Winchester, are still in pre-registration trials.

The final area this project attempted to investigate was the purported extra sensitivity of semi-dwarf barleys to residual trifluralin herbicide. Unfortunately, the drought conditions of 1988 and 1989 severely affected these trials such that no conclusions could be drawn.

Varieties of Different Semi-dwarf Barley vs. Traditional Varieties of Barley Grown under Irrigation

Principal: Jack Senger, Allan, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: One year only
Objective: To help producers evaluate barley varieties for adaptability to irrigation. The objective is to find varieties that respond to high rates of fertilizer, provide high yields and do not lodge.

Four ten-acre plots and one five-acre plot were staked out under a 112-acre pivot system. The ten-acre plots were seeded to the varieties Duke, Tupper, Harrington and Samson, from west to east and the five-acre plot was seeded to Virden. The remaining 67 acres under the pivot were seeded to Harrington.

All plots were treated as follows:
- Seeded with a double disc press drill at 1.75 bushels per acre except Virden which was seeded at one bushel per acre. All seed was treated with Vitavax Dual seed treatment. Duke and Tupper were seeded on May 23 while the Samson, Harrington and Virden plots and the remaining field were seeded on May 30.
- 80 lbs. nitrogen per acre prior to seeding.
- 40 lbs. phosphorus seed placed.
- 35 lbs. nitrogen and 15 lbs. potassium broadcast on the crop June 14th.
- Sprayed with 2,4-D LV96 at 7 oz. per acre on June 18th.
- Approximately 18" of crop water use.

Results and Discussion

Semi-dwarf varieties did not lodge while other varieties lodged to a point where harvesting was difficult and yields were disappointing. Extra nitrogen on the plots appeared to give a positive response except for Harrington. On Harrington, the lodging was made worse by the extra nitrogen as compared to the surrounding field which was seeded to Harrington and didn't receive the extra nitrogen.

Table 1. Yields and lodging ratings.

Variety	Yield (kg/ha)	Lodging Rating (0-10)	Comments
Duke	6773.8	0	No lodging
Tupper	5548.0	8	Badly lodged
Harrington	3623.4	6	General lodging
Samson	5919.0	1	Bent over, went down
Virden	5537.3	2	Spot lodging
Harrington (Field Scale)	4300.8	5	General lodging

Conclusions

The results demonstrate the yield advantage of growing barley varieties with "very good" (VG) resistance to lodging. Extra nitrogen can be applied and extra bushels harvested. Malt barley (variety Harrington), on the other hand, lodged and stained with water and mildew. The yield was, consequently, disappointing.

The producer's conclusion is that satisfactory yields of feed barley can be obtained using the variety Duke. He plans to grow this on his own irrigation land in future.

Dwarf Oat Trial 1989 Demonstration

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Location: Outlook
Progress: Year two of ongoing
Objective: To determine the yield and quality of semi-dwarf and conventional height oat cultivars.

Plots were 11 rows, 20 cm apart and 7.8 m long. The interior 7 rows were harvested for grain. All varieties were seeded at 250 seed/m^2. Nutrients were applied to surpass soil test recommendations.

No significant lodging occurred in 1989 probably due to late seeding and high temperatures. Disease incidence was insignificant in both seasons. The line W86718 (OT257) had the best lodging resistance combined with good yields. This line is in the second year of co-op testing and could be registered in 1991 providing an excellent alternative for irrigated production of oats for specialty markets.

Table 1. Dwarf Oat Trial 1989

Variety	Yield (kg/ha) 1988	1989	Mean (% of Calibre)	Lodging 1-9*	Height (cm)
Calibre	4356	7117	5737(100)	6.2	120
Robert	4577	7085	5831(102)	6.0	116
W86012	4692	7586	6139(107)	4.3	104
W86718 (OT257)	4405	7392	5899(103)	1.0	94
W86120		6624		7.8	123
W86693		6176		6.3	117

* 1-erect; 9-flat

Plant Diseases of Irrigated Cereals

Principal:	L.J. Duczek, Agriculture Canada Research Station Saskatoon, Saskatchewan
Funding:	Agriculture Development Fund
Co-investigator:	C.R. Kindrachuk
Location:	Main site at SIDC
Progress:	Final year
Objective:	To evaluate the incidence, severity and control of cereal crop diseases under irrigated conditions.

Crop: **Spring wheat, cv. Katepwa, Fielder**

Title: **Effect of seed treatment fungicides on emergence, percent foliar disease and yield of irrigated spring wheat, 1989**

Materials: UBI 2100-2 (Vitavax Single Solution, carbathiin 230 g/L), Uniroyal; CGA 169374 (Dragon, undisclosed compound 150 g/L), Ciba Geigy; AGROX FLOWABLE (maneb 250 g/L), Chipman; TF 3765 (flutriafol 25 g/L), Chipman; TF3480 (triadimenol 75 g/L), Chipman.

Methods: The experiment was done at the Irrigation Development Centre, Outlook, Saskatchewan. Irrigation water was applied during the growing season when tensiometer readings measured -0.5 bar. Treatments were replicated four times in a split plot design with cultivars being the main plots and treatments as subplots. The fungicides were applied by first distributing the chemical on the inside surface of a 0.5 L glass jar, then adding 250 g of seed and finally, shaking for several minutes. Treatment rates for each fungicide are given in Table 1. Each plot consisted of four 6-m rows with 350 seeds planted per row. Seeding and fertilizing (60 kg/ha of 11-55-0) occurred on May 2. Emergence was recorded on May 23 in 2 m of the two center rows. Ten randomly selected penultimate leaves were collected July 26 from the two center rows of each subplot and stored at 5°C until they could be rated for percent disease coverage using the Horsfall-Barratt scale. Samples were retained for subsequent identification of the pathogens involved. Harvesting of 4 rows X 5 m long was done on September 23 with yield recorded as grams per plot.

Results: The results are summarized in Table 1. There was a significantly (P=0.05) higher level of emergence in Katepwa (98) as compared to Fielder (64). There was, however, no significant (P = 0.05) difference in foliar disease levels (Katepwa - 22%, Fielder - 16%), nor in yield (Katepwa - 2018, Fielder - 2259 g/plot) between cultivars. The cultivar X treatment interaction was not significant for emergence, foliar disease or yield; therefore, the data for cultivars were combined for analysis.

Conclusions: Although none of the treatments were significantly (P = 0.05) different from the control, TF 3480 and GCA 169374 had the lowest levels of foliar disease. These two treatments significantly (P = 0.05) reduced emergence and yield.

Table 1. Effect of Seed Treatment Fungicides on Emergence, Percent Foliar Disease and Yield of Irrigated Spring Wheat, 1989.

Treatment	Rate (g a.i./kg seed)	Emergence	Foliar Disease (%)	Yield (g)
Control		89 a*	18.1 ab*	2215.0 a*
UBI 2100-2	0.55	83 a	23.6 a	2145.0 ab
CGA 169374	0.40	74 b	14.7 b	2038.0 b
Agrox Flowable	0.85	90 a	22.2 ab	2297.0 a
TF 3765	0.10	71 b	20.2 ab	2001.0 b
TF 3480	0.15	78 ab	14.4 b	2135.0 ab

* Values in the same column which are not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.

Crop: **Spring barley, cv. Duke, Harrington**

Title: **Effect of seed treatment fungicides on emergence, percent foliar disease and yield of irrigated spring barley, 1989**

Materials: UBI 2100-2 (Vitavax Single Solution, carbathiin 230 g/L), Uniroyal; CGA 169374 (Dragon, undisclosed compound 150 g/L), Ciba Geigy; AGROX FLOWABLE (maneb 250 g/L), Chipman; TF 3765 (flutriafol 25 g/L), Chipman; TF3480 (triadimenol 75 g/L), Chipman.

Methods: The experiment was conducted at the Irrigation Development Centre, Outlook, Saskatchewan. Irrigation water was applied during the growing season when tensiometer readings measured -0.5 bar. Treatments were replicated four times in a split plot design with cultivars being the main plots and treatments as subplots. The fungicides were applied by first distributing the chemical on the inside surface of a 0.5 L glass jar, then adding 250 g of seed and finally, shaking for several minutes. Treatment rates for each fungicide are given Table 2. Each plot consisted of four 6-m rows with 350 seeds planted per row. Seeding and fertilizing (60 kg/ha of 11-55-0) occurred on May 10. Emergence was recorded on May 23 in 2 m of the two center rows. Ten randomly selected penultimate leaves were collected July 26 from the two center rows of each subplot and stored at 5°C until they could be rated for percent disease coverage using the Horsfall-Barratt scale. Samples were retained for subsequent identification of the pathogens involved. Harvesting of 4 rows X 5 m long was done on September 23 with yield recorded as grams per plot.

Results: The results are summarized in Table 2. There was no significant difference (P=0.05) between the cultivars in emergence (Harrington - 115, Duke - 109), percent disease (Harrington - 13.8%, Duke 9.1%) nor in yield (Harrington - 2600, Duke 3104 g/plot). The cultivar X treatment interaction was not significant for emergence, foliar disease or yield; therefore, the data for cultivars were combined for analysis.

Conclusions: The CGA 169374 treatment resulted in a significantly lower emergence (P = 0.05). There were no significant differences (P = 0.05) in % foliar disease among the treatments. Yields of the UBI 2100-2 and CGA 169374 treatments were significantly lower than the control.

Table 2. Effect of Seed Treatment Fungicides on Emergence, Percent Foliar Disease and Yield of Irrigated Spring Barley, 1989.

Treatment	Rate (g a.i./kg seed)	Emergence	Foliar Disease (%)	Yield (g)
Control		115 a*	12.8 a*	3093 a*
UBI 2100-2	0.55	112 a	12.0 a	2766 b
CGA 169374	0.40	96 b	12.4 a	2796 b
Agrox Flowable	0.85	119 a	11.3 a	2855 ab
TF 3765	0.10	120 a	9.9 a	2771 a
TF 3480	0.15	108 ab	10.4 a	2830 a

* Values in the same column which are not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.

Crop: **Spring wheat, cv. Katepwa, Fielder**

Title: **Effect of foliar fungicide treatments on foliar disease and yield of irrigated spring wheat, 1989**

Materials: TILT (propiconazole 250 g/L), Ciba Geigy; DITHANE DG (mancozeb 75% WP), Rohm and Haas; HWG 1608 (ethyltrional 3.6F), Chemagro; SPORTAK (prochloraz 400 g/L), Elanco; Bravo 500 (chlorothalonil 500 g/L), Biotech; POLYRAM DF (metiram 80% WP), BASF.

Methods: The experiment was conducted at the Irrigation Development Centre, Outlook, Saskatchewan. In the spring 100 kg/ha of 34-0-0 was broadcast. During the growing season, water was applied when tensiometer readings measured -0.5 bar. A split plot design was used with the cultivars being the main plots and treatments as subplots. There were four replications. Each subplot was eight rows, 6 m long and each row contained 350 seeds. Four rows of barley were planted between subplots. Seeding and fertilizing (60 kg/ha of 11-55-0) occurred on May 2. Treatments were applied to the foliage of the 8 subplot rows (the control was sprayed with water) with a hand-held, CO_2-pressurized, 4-nozzle boom sprayer (nozzle size 0.01) delivering 225 L/ha at 240 kPa. The rates applied are as indicated in Table 3. In the case of Sportak, 500 ml/ha of Enhance was added. Spraying was done on June 27 (flag leaf fully extended to heads emerging, G.S. 37-41), and July 5 (inflorescence complete to start of kernel development, G.S. 69-72). Ten randomly selected penultimate leaves were collected on July 27 from the two center rows of each subplot and stored at 5°C until they could be rated for percent disease coverage, using the Horsfall-Barratt scale. Samples were retained for subsequent identification of the pathogens involved. Harvesting of 4 rows X 5 m long was done on September 23 with yield recorded as grams per plot.

Results: The results are summarized in Table 3. The cultivars were significantly (P=0.05) different in percent foliar disease (Katepwa - 19.9%, Fielder - 12.9%) and yield (Katepwa - 3211, Fielder - 2181 g/plot). The cultivar X treatment interaction was not significant; the data for cultivars were combined for analysis.

Conclusions: The Bravo 500 treatment had significantly (P=0.05) less foliar disease (12.6%) than the untreated control (18.2%). The Bravo 500 treatment had the highest yield but this was not significantly different from the control.

Table 3. Effect of Foliar Fungicide Treatments on Foliar Disease and Yield of Irrigated Spring Wheat, 1989.

Treatment	Rate (g a.i./kg seed)	Spray Schedule June 27	July 5	Foliar Disease (%)	Yield (g)
Control		spray	spray	18.2 a*	2299 a
Tilt - 1 spray	125	---	spray	16.6 ab	2331 a
Tilt - 2 sprays	125	spray	spray	15.8 ab	2202 a
Dithane DG	1800	spray	spray	14.4 ab	2113 a
Bravo 500	1000	spray	spray	12.6 b	2365 a
HWG 1608	54	---	spray	18.6 a	2180 a
Polyram DF	1800	spray	spray	18.1 a	2251 a
Sportak	400	---	spray	16.3 ab	2174 a

* Values in the same column which are not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.

Crop: Spring barley, cv. Harrington, Duke

Title: Effect of foliar fungicide treatments on foliar disease and yield of irrigated spring barley, 1989

Materials: TILT (propiconazole 250 g/L), Ciba Geigy; DITHANE DG (mancozeb 75% WP), Rohm and Haas; HWG 1608 (ethyltrional 3.6F), Chemagro; SPORTAK (prochloraz 400 g/L), Elanco; Bravo 500 (chlorothalonil 500 g/L), Biotech; POLYRAM DF (metiram 80% WP), BASF.

Methods: The experiment was conducted at the Irrigation Development Centre, Outlook, Saskatchewan. In the spring 100 kg/ha of 34-0-0 was broadcast. During the growing season, water was applied when tensiometer readings measured -0.5 bar. A split plot design was used with the cultivars being the main plots and treatments as subplots. There were four replications. Each subplot was eight rows, 6 m long and each row contained 350 seeds. Four rows of wheat were planted between subplots. Seeding and fertilizing (60 kg/ha of 11-55-0) occurred on May 10. Treatments were applied to the foliage of the 8 subplot rows (the control was sprayed with water) with a hand-held, CO_2-pressurized, 4-nozzle boom sprayer (nozzle size 0.01) delivering 225 L/ha at 240 kPa. The rates applied are indicated in Table 4. In the case of Sportak, 500 ml/ha of Enhance was added. Spraying was done on June 27 (flag leaf just visible to flag leaf extending, G.S. 37-41), and July 5 (inflorescence 1/2 emerged to beginning of anthesis, G.S. 55-61). Ten randomly selected penultimate leaves were collected on July 31 from the two center rows of each subplot and stored at 5°C until they could be rated for percent disease coverage, using the Horsfall-Barratt scale. Samples were retained for subsequent identification of the pathogens involved. Harvesting of 4 rows X 5 m long was done on September 23 with yield recorded as grams per plot.

Results: The results are summarized in Table 4. The cultivars did not differ significantly (P=0.05) in foliar disease (Harrington - 12.9%, Duke - 17.8%). However, Duke significantly (P=0.05) outyielded Harrington (3162 and 2784 g/plot), respectively. The cultivar X treatment interaction was not significant; the data for cultivars were combined for analysis.

Conclusions: There was no significant (P=0.05) difference in percent foliar disease between the control and the treatments. There was no significant (P=0.05) difference in yield among the treatments either.

Table 4. Effect of Foliar Fungicide Treatments on Foliar Disease and Yield of Irrigated Spring Barley, 1989.

Treatment	Rate (g a.i./kg seed)	Spray Schedule June 27	July 5	Foliar Disease (%)	Yield (g)
Control		spray	spray	15.1 ab*	2942 a
Tilt - 1 spray	125	---	spray	17.8 a	2897 a
Tilt - 2 sprays	125	spray	spray	10.8 b	3051 a
Dithane DG	1800	spray	spray	16.6 ab	2832 a
Bravo 500	1000	spray	spray	13.5 ab	3027 a
HWG 1608	54	---	spray	16.1 ab	2943 a
Polyram DF	1800	spray	spray	15.3 ab	3056 a
Sportak	400	---	spray	17.3 ab	3008 a

* Values in the same column which are not followed by the same letter are significantly different at the 0.05 level of probability according to Duncan's Multiple Range Test.

Disease Screening

Principal: B.G. Rossnagel, Crop Development Centre
University of Saskatchewan
Saskatoon, Saskatchewan
Funding: Agriculture Development Fund
Location: Main site at SIDC
Co-operators: Saskatchewan Irrigation Development Centre
Progress: Final year
Objective: To evaluate the incidence, severity and control of cereal crop diseases under irrigated conditions.

A unique cost-efficient effective automated high frequency low intensity irrigation system specifically designed for the development and maintenance of foliar plant disease epidemics, in an otherwise unsuitable environment for those diseases, was developed assembled operated and modified at Saskatoon. This system has proven effective for screening for genetic resistance or tolerance to net-blotch in barley, ascochyta blight in lentil and septoria in wheat. In addition, a simple standard wheel move irrigation system has been utilized to screen for stem and leaf rust resistance in both wheat and barley. The development of this one of a kind system has demonstrated that, with this minor environmental modification, typically non-disease environments such as that normally encountered at Saskatoon, are actually more efficient locations for mass field screening for plant disease resistance since contamination due to indigenous non-target pathogens is eliminated.

From 1986-1989 this irrigated disease nursery has been utilized to effectively screen in excess of 400,000 genotypes as single plants and over 70,000 individual breeding lines of barley, lentil and wheat for resistance to the diseases noted. Superior disease resistant selections within each crop kind have been found and advanced for further testing and planned eventual release as new, more stable varieties for Saskatchewan producers.

Maximum Economic Yield

Principal: Outlook Irrigation Production Club
Funding: Irrigation Based Economic Development Agreement
Progress: Second 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.

Traditional cereals are a major crop in the irrigated regions of Saskatchewan. Producers have experience growing cereals and it is agronomically sound to include them in the crop rotation. The aim of the crop club is to investigate management methods which will increase the net return to irrigated cereal cropping.

The nine club members held five information and planning meetings during 1989. The meetings involved discussion on production problems and successes, proposed club activities, and results of the 1988 program. A tour of the fields was held July 26. The tour generated interest and discussion within the group.

Investigations carried out on the fields included application of additional fertilizer, of plant growth regulator, and of fungicide. As in 1988, fields were monitored weekly for moisture status, disease, and other production concerns. Soil and tissue tests were taken and evaluated. Plant and head counts were recorded as was all pertinent harvest data. On average each field was visited 23 times over the course of the season.

Crop emergence was 54% of seed sown for durum wheat. This is lower than 1988. Seeding rates of durum averaged 366 seeds/m^2 while the number of established plants averaged 195/m^2. Emergence of hard red wheat was 70% of seed sown with resulting plant stands of 300/m^2. Yields achieved for both crops were above average, suggesting that it may not be necessary to target 350 plants/m^2 under our growing conditions. Two more years of field data under this project will help to set plant density targets appropriate for Saskatchewan.

The use of additional fertilizer produced no differences in yield. Soil plus applied nitrogen averaged 150 lbs/ac over the nine fields. This, plus the seasonal release of nitrogen from the soil was sufficient for the yields attained. Tissue tests confirmed that all fields had an adequate supply of nutrients.

Leaf diseases were of no economic significance in 1989. Three fields experienced an explosive late season development of Septoria. The crop was sufficiently advanced that no yield loss could be attributed to the disease. The field of soft wheat in the project suffered a 30 - 40% yield loss due to a severe root rot infestation. The yield loss was manifested in a reduction in kernel size to 2/3 of normal, and as an increased incidence of lodging.

The growth regulator Terpal C performed well, as it had in 1988. The early season conditions promoted tall, lush growth and lodging became a significant problem. The growth regulator was applied at full flag leaf extension at the recommended rate. This treatment controlled lodging in Medora durum and HY355. Yield increase in durum was 9 bu/ac. This was sufficient to cover the cost of the application, but the marginal return is low, making this an economically risky practice. It was noted that much less straw was put through the combine when harvesting the growth regulator plots. As a result, ground speed could be increased 30 - 40%.

The average yield for durum wheat was 4,650 kg/ha (69 bu/ac). HY355 yielded 5,050 kg/ha (75 bu/ac) while hard wheat yields were 3,000 kg/ha (45 bu/ac) and 4,400 kg/ha (66 bu/ac).

Table 1. Net returns to intensive cropping inputs, 1989

	Yield Increase (kg/ha)	Increase return ($/ha)	Increase cost ($/ha)	Net Return ($/ha)	Net Return ($/ac)
Extra fertilizer - durum wheat	100	17	52	-35	-14
- HRS wheat	0	0	52	-52	-21
- HY355	70	8	52	-44	-18
Growth regulator/fertilizer					
- durum wheat	740	126	105	21	8
- HY355	600	72	105	-33	-13

Irrigated Soft Wheat Production Package

Principal: Deneen Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Location: Outlook (NW-26-29-8-3)
Progress: Year one of three
Objective: To develop a production package for irrigated soft wheat that will consistently produce economically high yields with acceptable seed quality.

The concept of the production package was established to compare combinations of various factors (ie. row spacing, seeding rate, soil fertility, fungicide application) that could affect crop yield and seed quality. Studies in Alberta have shown that the most effective seeding rate for obtaining the maximum economic yield of soft white spring wheat is in the area of 170 kg/ha. This level of seeding rate in combination with a narrow row spacing has also produced economically high yields. Alberta research has also indicated that large applications of nitrogen to soft wheat is not necessary to produce high yields. Fungicide applications on soft wheat have been economical in some years, but there is still a risk in their use because of the unpredictability of disease and the high cost of the fungicide. The consideration of this information resulted in the development of a soft wheat production package involving a single seeding rate (350 seeds/m^2) in combination with three nitrogen rates (165, 140, and 112 kg/ha), two row spacings (8 and 16 cm), and two fungicide applications (recommended rate and a check).

Only one year of information has been collected and thus no conclusions or recommendations can be made regarding the irrigated soft wheat production package. Yields of the Fielder soft wheat in 1989 were excellent, ranging from a low of 4894 kg/ha (73 bu/ac) to a high of 7683 kg/ha (114 bu/ac) and an overall average of 6422 kg/ha (96 bu/ac).

Irrigated Durum Production Package

Principal: Deneen Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Location: Outlook (NW-26-29-8-3)
Progress: Year one of three
Objective: To develop a production package for irrigated durum that will consistently produce economically high yields with acceptable seed quality.

The concept of the production package was established to compare combinations of various factors (ie. row spacing, seeding rate, soil fertility, fungicide application) that could affect crop yield and seed quality. Research conducted in various areas of Saskatchewan on spring wheat have indicated a positive yield response to reduced row spacing. A combination of high seeding rates with the narrowest row spacing also produced yield increases. Larger yield differences were evident under moist growing conditions. Likewise, tests conducted in the intermountain region of California (short growing season with limited frost-free days) on durum wheat indicated that the yield and yield components were strongly affected by irrigation frequency, nitrogen rate and seeding rate. The consideration of this information resulted in the development of a durum production package involving the combination of two nitrogen levels, three seeding rates (215, 320, 430 seeds/m^2) and four row spacings (solid seed, 8, 16, and 20 cm).

Only one year of information has been collected and thus no conclusions or recommendations can be made regarding the irrigated durum production package. Complications delayed the seeding of the Sceptre durum until the end of May, but the yields were still good ranging from a low of 3334 kg/ha (50 bu/ac) to a high of 4779 kg/ha (71 bu/ac) and an overall average of 3965 kg/ha (59 bu/ac).

Relative Yields of Cereal Cultivars

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Progress: Year one of an ongoing project
Objectives: To determine yields of all types of cereal grains when grown under the same non-yield limiting conditions. Two or three of the best cultivars of each crop type are grown to ensure that the species or type is given a fair evaluation.

Materials and Method

Two tests were planted the first on May 12 and the second on May 30. All crops were planted at 300 seeds/m^2. Soil test results indicated the following nutrient levels (kg/ha): nitrogen 40, phosphorous 22, potassium 320, sulfur 105+. Nitrogen, as ammonium nitrate, was broadcast and incorporated at 110 kg/ha and 44 kg/ha of P_2O_5 was sidebanded.

Height, lodging, days to maturity and grain yield were determined for each plot. Grain yields are reported at the moisture levels considered "dry" by the Canadian Grain Commission. Grade, protein, test weight and seed size were taken on a composite sample from all replicates of the variety being tested.

Results and Discussion

The early seeded test had higher overall yields for all cultivars except the barley cultivars which had similar yields at both seeding dates (Table 1). At least part of the reason for lower yields of the late seeded test was due to the fact that lodging occurred earlier and to a greater extent than in the early seeded test. HY368 had much higher yields than HY355 presumably due to differences in lodging.

HY368 was the highest yielding wheat, yielding slightly more than Fielder. The durum cultivars yielded 6 to 8% more than hard red spring wheats. This difference may be more like 10% but there were some problems accurately determining dockage of durum due to extremely large seeds being cleaned out of the durum samples. Duke was the only barley cultivar which did not lodge to any extent in 1989 and at the late seeding date outyielded the hard red spring wheats by 47%. The malting line TR930 had very high yields at the early seeding date and yielded the same as TR490 and Harrington at the late seeding date.

Oats were not harvested from the early seeding date test since adverse harvest weather caused a high degree of shattering to occur before the crop could be swathed. The yields of oats were somewhat lower than those of barley and with current prices would not be profitable unless they could be sold into the food or race horse market.

More years of data are required to determine what the effects of seeding date are in the absence of water stress. However, later seeding generally results in plants being exposed to greater temperature stress and thus lower yields might be expected in many years from delayed seeding. This is the first year of an ongoing program to determine the potential yields of cereal grain types.

Table 1. Relative yields of cereal cultivars.

Cereal crop		Grain Yield (kg/ha)			% HRS	Lodging (1-9)		Ht(cm)		Days to mature	
		late	early	mean		late	early	late	early	late	early
Barley	Duke	6006	5953	5980	127	2.4	1.3	93	96	93	96
Barley	Harrington	4883	4806	4845	103	6.0	5.3	101	100	88	91
Barley	TR490	4927	4967	4947	105	6.0	4.0	98	106	92	92
Barley	TR930	4889	5887	5388	114	6.6	3.8	93	106	90	91
CPS	HY355	4316	5394	4855	103	5.4	4.5	104	102	106	104
CPS	HY368	4905	6629	5767	122	3.6	1.3	86	92	109	103
Durum	Arcola	4466	5624	5045	107	6.6	2.8	109	110	105	103
Durum	Medora	4171	5555	4863	103	7.0	2.0	105	119	106	104
Durum	Sceptre	4397	6222	5309	113	5.8	1.8	106	103	105	104
HRS	Katepwa	4233	5455	4844	103	4.6	3.5	99	104	101	101
HRS	Laura	3543	5183	4363	93	5.8	2.3	101	102	103	102
HRS	Roblin	4437	5416	4926	105	4.0	1.3	101	99	101	99
Oats	Calibre	4597	--	4597	98	3.8	--	122	--	103	--
Oats	Robert	4777	--	4777	101	5.4		122	--	103	--
SWS	Fielder	4868	6234	5551	118	1.6	1.0	95	95	107	104
Barley		5176	5403	5290	112	5.3	3.6	97	102	91	92
CPS		4578	6011	5295	112	4.5	2.9	95	97	107	103
Durum		4349	5800	5074	108	6.5	2.2	107	110	105	103
HRS		4071	5351	4711	100	4.8	2.3	100	102	102	100
Oats		4687	--	4687	99	4.6	--	122	--	103	--
SWS		4868	6234	5551	118	1.6	1.0	95	95	107	104
CV		9.9	7.2			51.6	39.2		4.3	2.0	1.8
LSD		584	582			2.0	2.5		6.3	1.8	2.6

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

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Progress: Year one of an ongoing project
Objective: To determine the effect of plowing, discing and spiking combined with removal or retention of crop residues on the yields of subsequent crops.

The tillage and residue management treatments listed below were conducted after harvest as outlined:

Crop	Residue	Tillage	Treatment
durum	retained	spiked	10 cm
durum	removed	spiked	10 cm
durum	retained	disced	10 cm
durum	removed	disced	10 cm
durum	retained	plowed	15 cm
durum	removed	plowed	15 cm
flax	removed	spiked	10 cm
flax	removed	disced	10 cm
flax	removed	plowed	15 cm
flax	retained	plowed	15 cm
canola	retained	spiked	10 cm
canola	retained	disced	10 cm
canola	retained	plowed	15 cm

While this is not a balanced design for all treatments it represents the logical residue management options for these three crops. It is our intent to determine the effect of each of these treatments on the yields of Biggar (CPS wheat) and Harrington barley.

Oilseeds

Irrigated Canola Production Package

Principal: Deneen Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Location: Outlook (NW-26-29-8-3)
Progress: Year one of three
Objective: To develop a production package for irrigated canola that will consistently produce high yields with acceptable seed quality.

The concept of the production package was established to compare combinations of various factors (ie. row spacing, seeding rate, soil fertility, fungicide application) that could affect crop yield and seed quality. Small seeded crops require more precision and care during seeding than larger seeded crops to ensure adequate and uniform germination. Alberta research has shown yield increases of up to 30% for some canola varieties when row spacing was reduced to 7.5 cm from 17.5 cm. An increasingly important factor in canola production is sclerotinia infection and how to forecast and control the disease. A petal testing procedure designed to forecast sclerotinia infection levels was developed at the University of Saskatchewan with the intentions of aiding the producer in fungicide application decisions. The rate of fungicide applied and the number of applications made are dependent on the results of the petal test, the crop density, and the disease risk related to weather conditions. This information prompted the development of a canola production package consisting of three fungicide treatments (check, normal rate, based on petal test recommendations) to determine the efficiency of the petal test and five seeding methods (20 cm spacing using an air drill, broadcast and incorporate, 8 cm spacing using a hoe drill, 16 cm spacing using a hoe drill, solid seeded using an 8 cm spaced drill with band sowing shoes).

Variations in nitrogen levels were ignored as part of the production package because excessively high levels appear to be directly related to increases in seed chlorophyll without any apparent yield advantage. As well, seeding rates were targeted to obtain 105-130 seeds/m^2 (10-12 seeds/ft^2) because research has indicated that seeding rate has no consistent effect on canola yield.

Only one year of information has been collected and thus no conclusions or recommendations can be made regarding the irrigated canola production package. Yields of the Global canola in 1989 were very good, ranging from a low of 2126 kg/ha (38 bu/ac) to a high of 3200 kg/ha (57 bu/ac) and an overall average of 2580 kg/ha (46 bu/ac). The petal test was accurate in predicting the level of sclerotinia infected plants in the check treatments.

Irrigated Canola Variety Demonstration Update (1986-1989)

Principal: Deneen Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Locations: Outlook and Birsay
Progress: Fourth 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. All data collection measurements are taken from replicated plots that are a minimum of 4.5 metres x 30 metres in size.

Westar is an early maturing, high oil content canola that is very susceptible to blackleg and is included in the variety test because it is still commonly used. The remaining varieties were all developed in Sweden except for Pivot which was developed at the University of Manitoba. **Topaz, Pivot,** and **Global** are 5-10 days later maturing than Westar, but have better blackleg and lodging resistance. **Delta** and **Legend** were introduced into the variety comparison in 1989 and are similar in maturity to Westar and have slightly better blackleg and lodging resistance.

Table 1. Main characteristics of the current varieties grown in the irrigated canola variety demonstration in the Outlook and Birsay area (1986-1989).

Variety	Years	Average Yield (% of Global)	Days to Swathing	Sclerotinia Infection (%)	Blackleg Infection (%)	Seed Chlorophyll (ppm)	Green Seeds (%)
Westar	6	84	95	37.3	25.8	20.3	2.9
Global	6	100**	106	30.1	10.8	13.0	1.2
Pivot	6	88	101	29.2	15.9	17.2	1.8
Topaz	5	99	106	28.4	9.9	13.0	0.9
Delta	2	81	97*	29.1	17.5	6.4	1.3
Legend	2	80	91*	21.4	18.1	9.2	1.3

* only 1 site year was used to record days to swathing

** the average yield of Global = 2284 kg/ha (41 bu/ac)

Irrigated Production of Hybrid Canola Seed

Principal: D.S. Hutcheson, Agriculture Canada Research Station Saskatoon, Saskatchewan

Funding: Irrigation Based Economic Development Agreement

Progress: First 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. Since the production of hybrid seed will be a high input, high value activity, it will be less risky and most profitable under irrigated conditions.

The development of cms-based F_1 hybrid canola is proceeding rapidly in both private and public canola breeding programs in Canada. The first hybrid canola cultivar was supported for registration in early 1989 and hybrid cultivars should be a very significant part of canola production by 1993. The only major impediment to the rapid adoption of hybrid cultivars appears to be the economical production of commercial quantities of F_1 seed. Much of the hybrid seed production research in Canada has been conducted by private breeding companies and the data collected are proprietary.

While "conventional" cms-based hybrid seed production techniques, using varying numbers of male sterile and fertility restorer rows, must be developed to a practical level, other novel procedures for the production of hybrid or near hybrid canola seed should also be investigated. It is possible that hybrid mixtures produced by physically mixing and subsequently harvesting the male sterile and fertility restoring lines could provide a "low tech, low cost" alternative.

This project will investigate both conventional and novel seed production techniques in terms of the costs of seed production, level of hybridity achievable and the performance of hybrids and hybrid mixtures.

In 1989, two hybrid seed production experiments were conducted under irrigation at Dalmeny. Preliminary results indicate yields of 600-750 kg/ha of hybrid canola seed are possible using conventional procedures involving separate planting of the male fertile and male sterile parents of the hybrid. Yields in hybrid mixture production plots ranged from 1100 to 1900 kg/ha depending on the amount of the pollen bearing parent present. In 1990, hybrid and hybrid mixture seeds from the 1989 tests will be entered into multi-location yield trials. The seed production experiments will also be repeated.

While these results represent only one year's data they are very encouraging. It is possible that irrigated production of hybrid canola seed may become a profitable alternative for producers in Saskatchewan.

1989 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, 19 in Saskatchewan, 2 in Alberta, 3 in Eastern Canada and 8 in the Northern States. Due to dry conditions in the latter part of the growing season complete tests were lost at Fox Valley, Riverhurst, Elrose, Canora, Jedburgh, Watrous, Lethbridge dryland and Minot. In addition, the *B. napus* portion of the test was lost at Assiniboia and Shellbrook as well as the *B. campestris* portion of Cando.

Both species at Alameda, Outlook Irrigated, Indian Head and Prosser had CVs over 25%, as well as the *B. napus* entries at Pinewoods, St. Hilaire and Cando, and the *B. campestris* entries at Breckenridge. Yield data was not used from these locations in calculating the overall average yields. Only a few tests had a CV less than 10%.

The design of the test was a randomized complete block with 3 or 4 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.

Table 1. Yield of Seed (00's kg/ha).

B. napus	Outlook Farm Lab	Outlook Irrigated
<u>Strains</u>		
Westar	17.3	8.9
Regent	15.7	9.0
Tribute	11.0	8.4
Profit	20.0	18.1
ACS-N1	15.4	20.9
ACS-N3	17.4	15.1
ACS-N4	15.8	6.9
Legend	20.3	19.3
Celebra	19.7	16.4
Vanguard	20.4	17.0
Alto	15.5	7.7
Delta	21.0	18.2
Hyola 40	18.7	15.9
Average	17.6	14.0
CV	17.8	28.8
L.S.D. 5%	4.5	5.8

B. campestris

<u>Strains</u>		
Tobin	15.3	13.2
Horizon	18.8	13.1
Colt	15.0	12.2
Parkland	14.8	13.6
Average	16.0	13.0
CV	8.4	41.3
L.S.D. 5%	2.0	N.S.

Table 2. Oil Content in Percent of dry weight.

B. napus	Outlook Farm Lab	Outlook Irrigated
<u>Strains</u>		
Westar	37.9	39.0
Regent	38.8	37.8
Tribute	35.0	36.4
Profit	40.2	40.4
ACS-N1	39.4	40.6
ACS-N3	38.1	39.2
ACS-N4	37.2	38.5
Legend	38.1	39.2
Celebra	39.7	39.2
Vanguard	38.8	39.4
Alto	38.6	40.1
Delta	36.3	36.6
Hyola 40	37.8	37.2
Average	38.1	38.7
CV	1.8	2.7
L.S.D. 5%	1.2	2.2

B. campestris

<u>Strains</u>		
Tobin	39.5	40.0
Horizon	39.1	40.8
Colt	39.4	40.8
Parkland	41.0	40.9
Average	39.8	40.6
CV	1.2	1.2
L.S.D. 5%	0.9	N.S.

Table 3. Resistance to lodging.

B. napus	Outlook Irrigated
<u>Strains</u>	
Westar	4.5
Regent	3.5
Tribute	4.5
Profit	3.8
ACS-N1	3.8
ACS-N3	2.8
ACS-N4	4.5
Legend	2.0
Celebra	1.0
Vanguard	1.8
Alto	4.8
Delta	1.5
Hyola 40	3.8
Average	3.2

(1-Good, 5-Poor)

Effects of Growth Regulators on Canola

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Second year of three
Objective: To determine if the growth regulator Triggrr can increase the yields of canola.

Materials and Methods:

The growth regulator Triggrr was applied to a stand of Global canola in 1988 and Westar canola in 1989. Canola had been seeded at 9 kg/ha in 15 cm rows. Weed control was obtained by applying Treflan (trifluralin) at 2.0 L/ac in 1988 and Edge DF 2.0 kg/ha (ethalfluralin) in 1989. Soil fertility levels and fertilizer applications are given in Table 1.

Table 1. Nutrient levels (kg/ha)

Nutrient	1988	1989
Soil test N	48	22
Soil test P	13	23
Soil test K	452	286
Soil test S	106	100
Fertilizer N	122	100
P_2O_5	56	15

All plots were treated with Rovral Flo at 3 L/ha (iprodione) in 1989 for sclerotinia control. Application was made at 25% bloom in 200 L/ha of water.

Triggrr was applied during the 4th leaf and bud growth stages at 0.6 L/ha of product in 100 L/ha of water. The pH of the water was adjusted to 6.3 prior to adding the Triggrr. There were 6 replicates of each treatment and 12 replicates of the control (untreated) plots in 1989 and 5 replicates in 1988.

Results and Discussion:

There was no observable effect either positive or negative from application of Triggrr in either year. Yields in these tests were quite low. Either a great deal more work on rates and timing is required or this product does not influence canola yields under irrigated conditions in Saskatchewan. The results obtained in 1989 were the same as those in 1988. This project has been terminated due to the lack of response.

Table 2. Effect of Triggrr on yields of canola.

Treatment	Seed yield (kg/ha)	
	1989	1988
control	1236	1637
3rd leaf		1699
4th leaf	1180	
bud (bolting)	1218	1730
Prob >F	0.68	0.87

The Effect of Rescheduling of Irrigation During Flowering on Sclerotinia Stem Rot and Yield of Canola

Principal: K.B. Teo, Deptartment of Biology
University of Saskatchewan
Saskatoon, Saskatchewan
Co-investigators: R.A.A. Morrall, P.R. Verma
Location: Saskatchewan Irrigation Development Centre
Objective: To determine the effect of different times of cessation of irrigation on the development of *Sclerotinia* stem rot.

In order to assess the effect of irrigation on the incidence of *Sclerotinia* stem rot and yield of canola, the treatments used were as follows:

Irrigation ceased at the following growth stages:

1) rosette, 2) budding, 3) 25% flowering, and 4) ripening.

When rainfall was low < 140 mm irrigation increased disease marginally. In relatively moist years irrigation after the rosette stage increased disease and reduced yields. Good soil moisture is required through ripening to produce maximum yields in the absence of disease. However, soil moisture storage at the rosette stage is not sufficient to allow maximum yields.

Canola/Rapeseed Co-operative Trials at Outlook

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

The test was grown at 30 locations in Western Canada, 14 in the mid season zone, 8 in the long season zone, 6 in the short season zone and 2 in the irrigation zone. Complete tests were lost at Vermilion, Olds, Lethbridge dryland, Rosebank, Loon Lake, Watrous, Vegerville and Altona. All portions of the test at Westbank as well as the *B. napus* and the Triazine Resistant *B. napus* at Ellerslie had a CV over 25%. Yield data from these sites were not included in the averages. All locations either cut or straight combined strains according to maturity.

The Saskatoon *B. campestris* strain ACS-C1 was licensed and named Parkland. The following *B. napus* strains were also licensed and named: DN-188, Profit (Saskatoon), Sv02403, Celebra (Svalof) Sv02404, Vanguard (Svalof), 81-17016A, Alto (U. of A.), WW1449 Delta, (Allelix), CS002, Hyola 40 (Garst), and S82-4362, Hero, High Erucic Low Glucosinolate (U. of M.)

The 54 entries were grown at all locations. The 30 *B. napus* entries were arranged in a 5 X 6 rectangular lattice while the 4 Triazine Resistant *B. napus* and 20 *B. campestris* entries were arranged in randomized complete block. All entries were replicated 4 times at each location.

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

The test was coordinated by the Saskatoon Research Station, only the irrigation zone results are reported here.

Table 1. ***Brassica napus*** Co-op A Test, 1989, at Outlook, Saskatchewan

Strains	Yield (00's kg/ha)	Oil content (%)	Days from seeding to maturity
B. napus			
Westar	23.8	42.0	78
Regent	22.5	40.8	82
Legend	30.1	41.5	83
ACS-N1	29.5	43.0	81
ACS-N3	28.9	41.8	80
BSI-87	24.2	40.1	85
Proft	25.0	44.4	81
S84-2208	29.5	43.6	80
Hero	27.2	45.0	79
M86-001	24.8	41.4	85
C62287	23.4	42.2	81
CS010	22.0	41.0	78
CS011	24.3	40.4	79
CS005	24.4	41.2	83
BS3-87	25.7	40.6	86
Global	21.9	36.1	86
K7-1	23.1	41.6	81
K4-87	23.8	40.6	80
K36-87	18.2	40.8	81
AU154	27.4	40.8	80
AU275	23.1	41.0	82
AU012	29.6	40.0	82
A091	31.9	42.2	78
B093	33.9	42.9	79
D095	28.0	41.0	80
XE1516	26.1	41.6	80
KW1517	21.7	40.6	82
PB1471	11.3	38.2	79
MLSP001	22.6	41.2	83
Delta	25.9	40.8	82
Average	25.1	41.3	81
CV	13.2	1.6	
LSD 5%	4.6	1.4	
B. napus Triazine tolerant			
Tribute	14.2	37.8	
ACS-N4	20.3	41.0	
Sv8525953	15.9	37.6	
Westar	18.6	43.2	
Average	17.3	39.9	
CV	24.3	2.5	
LSD 5%	N.S.	3.1	

Table 2. *Brassica campestris* Co-op Test, 1989, at Outlook, Saskatchewan

Strain	Yield (00's kg/ha)	Oil Content %
Tobin	16.3	41.6
Parkland	19.0	42.6
83-51249N	21.4	41.9
83-51243N	22.3	42.8
84-56552N	19.5	42.1
84-58559N	19.5	43.3
S83-5009W	20.5	43.4
S83-4302W	17.3	42.2
S84-3529	16.8	43.6
S83-4533	24.0	42.6
RR83-5370	25.6	42.8
Colt	18.2	41.8
Horizon	20.0	41.2
Sv03503	13.6	40.2
DL6272	20.5	41.0
DK6277	24.9	41.2
J57	21.5	40.6
P38	24.5	41.9
AU045	18.0	40.2
Sv03350	21.5	40.8
Average	20.2	41.9
CV	18.5	2.6

Mustard Co-operative Trials at Outlook

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

The test was grown at 21 locations, three in Alberta, five in Saskatchewan, five in Manitoba and eight in the Northern States. The tests at Watrous, Cando and Minot were lost due to a severe drought in July and August. The average yield was 300 kg/ha, lower than last year. The oil content was .5 percent lower than last year. Allyl isothiocyanate concentration was 1.8 mg/g lower than last year on an oil free basis and 1.1 mg/g lower than last year.

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

The test was coordinated by the Saskatoon Research Station, only the Outlook results are reported here.

Table 1. Mustard Co-operative Trial, 1989, 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	30.1	36.7	76	1.0	18.8	
Leth. 22A	30.5	34.8	78	2.8	15.4	
Blaze	24.4	33.5	78	1.5	14.8	
Comm. Brown	21.8	34.0	76	2.2	14.3	
Forge	31.2	33.0	77	1.8	22.0	
Zem 87-1	24.3	34.2	76	2.0	18.0	
Average	27.0	34.4	77	1.9	17.2	
CV	14.3	2.6				
L.S.D. 5%	5.8	2.3				
S. alba						
Gisilba	15.5	26.3	79	1.8		196.0
Ochre	17.8	26.2	77	1.2		198.8
Tilney	11.9	23.2	80	1.0		208.6
CW/89/TY	12.9	24.6	79	1.0		196.5
Average	14.5	25.1	79	1.2		200.0
CV	20.5	0.4				
L.S.D. 5%	N.S.	0.3				

Interaction Between Seeding Method and Fertilizer Placement on the Yields of Flax

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Progress: Second year of an ongoing project
Objective: To determine the effect of seeding method and nitrogen and phosphorus placement on the yields of flax.

<u>Materials and Methods</u>:

McGregor flax was seeded on May 13 at 45 kg/ha in 20 cm rows or broadcast and cultivated 5 cm deep followed by harrowing. Hoe type openers were used to seed the 20 cm row spacing. The design was a split plot having 4 replicates. Seeding method was the main treatments and the 4 Nitrogen and

Phosphorus application methods were randomized within each seeding method. Plots were 5.2 m wide and 15.25 m long. Yields were determined by harvesting an area 1.98 m wide and 15.25 m long from the center of each plot. Initial soil test fertility levels (kg/ha) were: nitrogen 25, phosphorus 24, potassium 286 and sulfur 110+. Each seeding method had the following fertilizer treatments applied prior to seeding at right angles to the direction of seeding:

100 N broadcast	40 P_2O_5 narrow band
100 N broadcast	40 P_2O_5 wide band
100 N narrow band	40 P_2O_5 narrow band
100 N wide band	40 P_2O_5 wide band

Weed control was obtained by applying Poast 1.6 L/ha (sethoxydim) and Buctril M 1 L/ha (bromoxynil and MCPA 1:1).

Flax stand (flax#/m^2) and green foxtail population (GF#/m^2) were determined by counting 2 m^2 samples per plot.

Results and Discussion

The 20 cm row spacing had a much lower plant number than the broadcast seeding method (Table 1). This was likely the result of seeding too deep and therefore the comparisons between seeding methods should be treated with great caution. Due to the low plant numbers, a second flush of green foxtail grew in the 20 cm row spacing; this did not occur in the broadcast seeded area. This second flush of green foxtail occured in an adjacent stand of flax seeded in 20 cm row where the emergence was excellent. Broadcast seeding resulted in good yields for all fertilizer application methods. There was no interaction between seeding method and either N or P fertilizer placement. Other workers had previously reported a reduction in P uptake and lower yields when high rates of N were placed in the P band.

Broadcast seeding is being practiced by some producers and appears to be a viable method of obtaining excellent crop yields and producing additional weed competition. This year's data indicates that on soils with moderate levels of soil test P, nitrogen and phosphorus placement have relatively little effect on final yields. This test should be conducted on soils with very low soil test P levels to better determine the effects of the N and P placement.

Table 1. Effect of seeding method, phosphorus band width and nitrogen placement on flax.

Seeding Method	Width of P band	N placement	seed yield (kg/ha)	GF# /m^2	Flax# /m^2
20 cm rows	2 cm	broad	1949	58	266
20 cm rows	2 cm	in row	1806	65	192
20 cm rows	12 cm	broad	1741	73	159
20 cm rows	12 cm	in row	1920	100	259
Mean			1854	74	219
broadcast	2 cm	broad	2471	12	258
broadcast	2 cm	in row	2446	9	144
broadcast	12 cm	broad	2538	13	157
broadcast	12 cm	in row	2459	14	288
Mean			2479	12	212
Phosphorus band width Narrow			2209	213	32
Phosphorus band width Wide			2212	217	45
Nitrogen broadcast			2222	210	35
Nitrogen placed with phosphorus			2200	220	42

Oilseed Pulse Crop Sequence Study

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Progress: Year three of four

Background and Rational

The assumption on which crop rotation is based is that cereal grains grow better after broadleafed crops and vice versa. Generally the disease control is the major reason for rotation with weed control, crop residue management, soil structure and insect control being to lesser importance. There is still a great lack of information on how well crop rotation controls some diseases under center pivot irrigation in Saskatchewan. The weak link in the crop rotation is sclerotinia for the broadleafed crops such as canola, mustard, bean and lentil. However, if canola is grown frequently on the land blackleg becomes the major concern. The weak link in cereal grain production appears to be root rot and Septoria.

Materials and Methods:

This is the third year of a four-year experiment. In the first year of a cycle, oilseed and pulse crops are planted and harvested for seed. The plots are of sufficient size to allow Harrington barley, Fielder soft wheat and Sceptre durum wheat to be planted at 3 or 4 nitrogen levels at right angles to the oilseed and pulse crop plots. This 4 replicate test allows us to determine if there is a difference in the yield of cereal grains following pulse crops relative to oilseed crops.

In the two years of testing, cereal grains appear to produce similar yields on canola, pea or fababean stubble (Table 1). The yields varied between the seasons probably as a result of extreme heat in 1988. The yield differences between the classes of crops will change based on the year and the amount of weed competition. Visual observation in 1988 suggested that barley was the most competitive crop followed by durum wheat and then soft wheat. There will be differences in competitive ability within each class of crop but control of weeds and volunteer broadleafed crops in the subsequent cereal grain crop is essential to good quality and high yields. It was observed that (bromoxynil:MCPA) did not always kill volunteer fababeans since it killed only the leaves and new leaves were regenerated from the stem. Likewise volunteer flax was difficult to control.

Table 1. Yield of Cereal grains on stubble of oilseed and pulse crops (kg/ha).

	Current crop and year				
	1988		1989		
Previous crop	Sceptre	Fielder	Sceptre	Fielder	Harrington
Canola	3921	3861	5789	6978	6728
Pea	4405	4254	5097	6751	6377
Peaola	4271	3287	5655	6720	6563
Fababean	4007	3539	5570	6679	6248

There was no interaction between the amount of nitrogen and grain yields on various types of stubble (Table 2). The nitrogen rates employed were relatively high and there was a small yield increase from 110 to 150 kg/ha. Similar response on canola and pea stubble might be expected since the nitrogen content of the residue is similar. Response on flax and wheat straw will be interesting since these crops differ in disease response and total amount of crop residue but have similar nitrogen contents in the crop residue.

Table 2. Effect of previous crop and nitrogen rate on grain yields (kg/ha)*

	Soil plus fertilizer N (kg/ha)		
Previous crop	110	130	190
Canola	6340	6480	6551
Pea	5841	6227	5946
Peaola	6120	6425	6385
Fababean	6271	6293	6159

*Mean yield of Sceptre, Fielder, Harrington, HY320

Protein contents of the succeeding cereal grains were higher on fababean stubble than on canola stubble (Table 3). Increasing the nitrogen level in the soil also increased protein content to some degree. In no case did the protein levels of Fielder exceed acceptable milling standards for this class of wheat. There appears to be an advantage to growing durum on pulse stubble but a great deal of work will be required to determine the extent of this protein increase that can be expected but other work suggests 0.5%.

Table 3. Effect of previous crop and nitrogen level on percent grain protein.

Previous crop	Nitrogen (kg/ha)	Current crop Sceptre	Fielder	HY320
Canola	110	11.9	9.9	11.5
Canola	150	13.4	11.2	11.5
Canola	190	13.6	12.0	12.5
Fababean	110	13.3	11.5	12.4
Fababean	150	13.9	11.6	11.9
Fababean	190	14.3	11.7	12.6

This experiment was expanded in 1989 so that in 1990 the cereal grains will also be seeded on wheat stubble. While this experiment is not complete nor are the reasons for the lack of differences between canola and fababeans totally understood it would be inadvisable to significantly reduce nitrogen fertilization on pulse crop stubble under centre pivot irrigation until better information is availbable. It would appear that malt barley production should not be attempted on legume stubble due to potentially higher seed protein levels.

The yields of the pulse and oilseed crops have been variable with poor seeding accounting for the low canola yields in 1987 and 1989 (Table 4). Fababean yields have been considerably higher than pea yields and in 1989, when sclerotinia infection of the pea crop was intense, fababean plots within 1 m were not significantly infected. If fababean prices are 8 cents per lb, a 3,500 lb/ac fababean yield would produce the same gross revenue as a 70 bu/ac crop of durum wheat at $4.00/bu without the constraints of quota. This return is similar to 40 bu/ac flax at $7.00/bu or 44 bu/ac canola at $6.50/bu.

Our attempts to produce pea and canola on the same area (peaola) have not been consistent. Westar lodges too easily, and we do not know if the mixture will respond to added nitrogen later in the season.

Table 4. Yields of oilseed and pulse crops under irrigation (kg/ha)

Crop	Variety	Year 1987	1988	1989
Pea	Victoria	2804	3085	1954**
Canola	Westar*	1607***	2476	960**
Fababean	Outlook	3676	4324	4344
Flax	McGregor	--	2498	2514

* Globala in 1988

** Severe sclerotinia

*** Weak poor stands not representative yields

<u>Conclusions</u>:

This experiment is not yet complete but it appears that producing malt barley on pulse crop stubble would have to the potential for higher protein contents. Likewise the production of durum or CPS wheat on pulse crop stubble may improve protein but does not warrant reducing nitrogen levels significantly.

Forages

Management of Forage Production under Irrigation

Principal: B.P. Goplen
Agriculture Canada Research Station, Saskatoon, Saskatchewan
Funding: Agriculture Development Fund
Co-investigators: B.D. Gossen, J. Soroka, R.P. Knowles
Location: Outlook and Miry Creek
Progress: Final year
Objectives:

a) to investigate the potential for alfalfa seed production under irrigation in the Outlook area;
b) to identify the fertilizer requirements for optimum alfalfa seed and forage production under irrigation in Saskatchewan;
c) to evaluate alfalfa cultivars for production potential under irrigation management;
d) to compare the production potential of several bluegrass lines selected at Saskatoon with other forage grasses under irrigation;
e) to examine the effect of cutting management on stand longevity, yield and disease incidence under irrigated conditions;
f) to monitor disease progress of alfalfa root and crown disease under irrigation conditions;
g) to compare selected alfalfa cultivars currently recommended in Saskatchewan for resistance to *Coprinus psychromorbidus*;
h) to survey irrigated alfalfa fields for the presence of *Verticillium wilt*.

Uniform Alfalfa Variety Tests: Uniform alfalfa forage and seed variety tests were seeded in 1986 on the assigned forage research block at SIDC. Germination and seedling emergence occurred as expected but within two weeks, the newly emerged seedlings died in large areas of the tests. It became apparent that the southern quarter of the block had toxic herbicide residue in the soil. The area affected corresponded to a crop of potatoes grown previously and treated with a pre-plant herbicide. The 1986 alfalfa seed test was in the affected area and was subsequently discarded. However, the 1986 alfalfa forage test was located north of the toxic area and established successfully. There were significant differences in yield and winter survival among the varieties tested. A new alfalfa seed test was seeded in 1987 in a residue-free area and establishment was excellent. Very high seed yields were obtained in 1988 (mean 750 kg/ha) and 1989 (mean 530 kg/ha). There were significant differences in seed production among the strains and advanced lines in both years.

Stand Density Trial: Irrigated Beaver alfalfa was grown for seed production in 0.9 ha plots at SIDC from 1987 to 1989. Average seed production over all three years was 446 kg/ha. No significant correlation was developed between plant density and yields; on a per m^2 basis the thinnest stands had the lowest yields in two years. Plant bugs surpassed the economic threshold and were controlled in all three years. Leafcutter bee cell replication averaged approximately 3.3 times the amount of bees set out in the summer.

Diseases: Verticillium wilt (*Verticillim albo-atrum*) was identified in the south-western region of the province, and an eradication program has been initiated. Spring black stem (*Phoma medicaginis*) is the predominant foliar pathogen of alfalfa in central and southern regions. Cottony snow mold (*Coprinus psychromorbidus*) is not an important factor contributing to winter kill of alfalfa under irrigation in central and southern Saskatchewan.

Forage Grasses: Yields of Kentucky bluegrass seed have been low and highly variable between years and locations, but the stands appear healthy and vigorous. Agronomy work is needed to increase the yield of this crop. First and second year data from two forage grass species trials demonstrate that very high forage yields (>10,000 kg/ha DM) are possible with several species when adequate fertility is maintained.

Conclusions:

The alfalfa seed production studies demonstrated that the appropriate irrigation management package, coupled with leafcutter bee pollination and insecticide applications to control plant bugs, can result in excellent yields of alfalfa seed. Curtailing irrigation when plants began to bud stressed the crop slightly and promoted flowering. The year, i.e. the heat and sunshine which directly affected pollinator activity, greatly influenced subsequent yield, while stand density did not. Four years after initial establishment, plant stands were uniform despite different seeding methods and cultivation practices. Plant bug populations reached economic thresholds and had to be controlled each year. Leafcutter bees were effective pollinators and were not adversely affected by the exposed nature of the field. High bee cell parasitism levels indicate that parasite control is required when incubating cells before release of adults in the spring. Key factors for successful production of alfalfa seed under irrigation in the Outlook area include good stand establishment, heavy irrigation until the prebud stage of alfalfa growth, weed and pest insect control, and proper management of leafcutter bees.

The success of this study has encouraged two growers in the Outlook region to establish 35 acre demonstration plots of alfalfa for seed. Another grower has sown 70 acres of bluegrass for seed production. The alfalfa variety trials are filling an important gap which currently exists in recommendations for varieties under irrigated conditions, and the improved recommendations arising from these studies should continue to have an impact on irrigated forage production well into the future. The forage species studies demonstrate the potential of a number of grass species under irrigated conditions. While conclusions are limited due to insufficient years of data, continued production data over the next two growing seasons will provide insight into the potential for utilization of these species.

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 centre pivot irrigated alfalfa to the farmers in the area.

Operation

The rotation of cereals upon breaking of alfalfa was continued. Calibre Oats were planted on the northeast quarter (80 kg/ha) using a press drill. Beaver Alfalfa (8 kg/ha) plus Calibre Oats (38 kg/ha) as a companion crop were planted on the southeast 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 at soil test recommendations.

The northwest quarter was broken in the fall of 1989 using a heavy duty cultivator and spikes. It will be rotated with a cereal in 1990 and re-established with alfalfa in 1991.

The re-established alfalfa stand flourished in 1989. The overall yield was 9.9 t/ha. The green oats were harvested at kernel formation and yielded an average of 6.7 t/ha.

The following summary 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

Year	Alfalfa Hay (t/ha) 1st cut	2nd cut	3rd cut	Total	No. of bales	Greenfeed Oats (t/ha) 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

Table 2. Forage Quality at Rudy Rosedale Community Pasture in 1989.

Location	Quantity (no.)	Protein (%)	TDN (%)	Nitrates (%)	Ave. weight (lbs)
SW 1st cut	585	16.27	56-58		
NW 1st cut	653	12.12	56-58		
NW 2nd cut	312	17.76	58-60	Trace	
SW 2nd cut	537	17.77	58-60	Trace	1014
NW 3rd cut	173	17.07	56-58		1311
SE oats	715	10.32	57-59	Trace	
NE oats	767	9.22	53-56	1.56	1142

Table 3. 1989 bale allocation

	Alfalfa	Oat
Maple Creek Community Pasture	60	--
Big Stick	60	--
McCraney	120	30
Mount Hope-Prairie Rose	210	60
Rudy-Rosedale	180	46
Usborne	30	30
Willner-Elbow	180	30
Wolverine	90	30
Ituna Bon Accord	--	150
Dundurn	60	--
Garry	--	90
Coalfields	210	60
Hillsburgh	30	--
Antelope Park	60	--
St. Larzare Bull Station	--	60
Maple Creek Bull Station	--	120
Kindersley - Elma	60	90
Fairview	30	30
Eagle Lake	90	--
Mantario	60	120
Monet	90	30
Newcombe	90	120
Battle River - Cut Knife	120	90
Mariposa	90	--
Montrose	60	--
Paynton	150	--
Progress	30	--
Auvergne - Wse Creek	30	30
Beaver Valley	60	30
Lone Tree	30	--
Swift Current	--	30
Laurier	--	60
Lamont #3	--	30
Wreford	--	30
Wellington	--	60
Misc. (broken, etc.)	--	26
Total	2,280	1,482

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. Wright
Location: Saskatchewan Irrigation Development Centre
Progress: First year of Four
Objectives:

a) to examine the response of new alfalfa lines for their potential in the irrigation 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 management.

All the trials for this study were successfully established. Weed control was generally satisfactory, and yield assessments will be started in 1990.

A. Alfalfa seed production trials

Uniform alfalfa variety test (Seed) - An alfalfa variety test was established on the SIDC site in May 1989. The test consisted of 19 new varieties and strains, plus Beaver, Vernal, Anchor and Rambler as check varieties. The varieties were seeded in single row plots, each 6 m long, spaced 1 m apart, with 5 replicates. This test established well and the varieties will be compared for seed yield in 1990.

Effect of row spacing and seeding rate on alfalfa seed yields - An alfalfa experiment was seeded on the Larson farm to determine the optimum row spacing and rate of seeding for maximum seed production under irrigation in the Outlook area. The test was seeded with breeder seed of Beaver alfalfa and consisted of a factorial design with 2 rates of seeding (1 vs. 2 kg/ha), 4 row spacings (1, 2, 3, 4 ft.) and 5 replicates. Each plot was 4m X 6m in size. Seed yields will be taken starting in 1990.

Eastern variety trial - A 3-replicate test of 31 alfalfa varieties recommended for eastern Canada was established at SIDC in a randomized complete block design (RCBD) in May 1989. The varieties selected included well-known lines as well as some new cultivars whose popularity may increase in the future. The stands are unlikely to persist for more than a couple of years because they may lack the winter hardiness required for western Canada. However, production of these varieties can open up large markets if their seed yields during the first few years provides an adequate return to producers.

Stand density trial - In this trial, we have utilized the co-operator's (Larson) management practices, but altered the stand density. In 1989, Mr. Larson seeded pedigreed Beaver alfalfa at approximately 2 kg/ha in 3-ft. row spacings, with a flax (cv. Vimy) cover crop sown at right angles to the alfalfa rows. Fifty-five kg/ha of nitrogen was applied in the form of anhydrous ammonia. Alfalfa stand establishment and the flax yield were good.

The stand density trial consists of a 6-replicate RCBD with four treatments: 1) cultivation at right angles to the alfalfa rows using an 8-foot cultivator with nine sweeps, each 4 inches wide, 2) cultivation at right angles and one diagonal, 3) cultivation at right angles and two diagonals, and 4) the check treatment, which is the uncultivated, original stand. Each treatment plot is 5.3m X 23m (0.01 ha), separated by 6 m pathways, for a total area of 0.6 ha. The replicate blocks are arranged in two rows of three replicates each. The plots were cultivated on 19 October, 1989.

B. Meadow bromegrass seed production (Fleet)

A 5-replicate split plot design was used with a 2 kg/ha seeding rate of Fleet Meadow bromegrass with row spacings of 1, 2 and 4 feet, and subplots consisting of a control, fall burn, fall clipping and a mechanical disruption consisting of rotovation between the rows. The two new cultivars of Meadow bromegrass, Paddock and Fleet, are similar in genetic base, and are expected to react in a similar fashion to row spacing and cultural treatment. Therefore, only one cultivar was seeded to maximize resource efficiency.

Alfalfa Seed Production under Irrigation

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: Michael Millar, Birsay, Saskatchewan
Objective: To demonstrate the successful production of alfalfa seed and to determine if broadcast or row seeding is the best method of establishing the correct stand of alfalfa.

Prior to seeding, 165 lb/ac of P_2O_5 was banded. Flax was broadcast at 20 lb/ac with 15 lb/ac of additional P_2O_5 being seed placed. The flax was seeded in 18 cm (7 in) rows at right angles to the direction of seeding of the alfalfa. The crop was seeded May 29 but no water was added after this since the soil was very wet from pre-irrigation and heavy rains. Algonquin alfalfa was seeded at 2 kg/ha either in rows 30 cm apart or broadcast. Six strips of each treatment were seeded in a paired plot system across the field.

Weed control using preplant granular trifluralin and post emergence bromoxynil was quite good. Flax yields were approximately 1200 kg/ha (20 bu/ac). Except for one strip approximately 6 m (20 ft) wide excellent plant stands were obtained.

Demonstration of Alfalfa Seed Production under Irrigation

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: Merle and Robert Larson, Outlook, Saskatchewan
Objective: To demonstrate that good yields of alfalfa seed can be produced under irrigation in Saskatchewan using wide rows.

Soil test nutrient levels prior to seeding were as follows (kg/ha): N 87, P 20, K 473, S 106+. Nitrogen was applied May 2 at 66 kg/ha. Prior to seeding 110 kg/ha of P_2O_5 was applied with granular Trifluralin and worked into the top 10 cm of the soil. Flax was seeded June 5 at 22 kg/ha in rows 30 cm apart. The area was shallow cultivated and harrowed after seeding the flax. Beaver alfalfa was seeded June 10 in rows 90 cm apart at 1.37 kg/ha. The alfalfa rows were at about a 30 degree angle to the flax rows.

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
Location: Southwest Saskatchewan
Progress: One of four years
Objective:
a) to determine the validity of these 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 cutlivars with smooth brome (*Bromus inermis* Leyss.) and intermediate wheatgrass (*Thinopyrum intermedium* Host., Barkworth and Dewey) for irrigated forage production.

This project was initiated to test forage yield performance of 11 alfalfa cultivars grown in monoculture and in mixtures with intermediate wheatgrass (IWG) and smooth bromegrass (BG) on irrigated heavy clay soils in southwest Saskatchewan. The Swift Current Research Station was used as a control site along with three other suitable sites, Miry Creek, Ponteix, and Rush Lake. Two sites were sprinkler irrigation and two sites were border dyke flood irrigation. Eight currently recommended cultivars (Beaver, Roamer, Anchor, Vernal, Algonquin, Apica, Heinrichs, and Barrier) along with three older cultivars or strains (Ladak, Grimm, and SC MF3713) were seeded in a split plot design with six replications. Grass species (IWG, BG, or none) were the main plot treatments and the alfalfa cultivars were the subplot treatment. Environmental conditions (soil and air temperature, precipitation, irrigation level, soil moisture) were monitored at each site. Establishment year forage yields, forage quality (IVDMD, N, P, ADF, NDF), and soil nutrient (N, P, EC) levels were obtained for each location. Results presented for forage quality are preliminary since the bulk of analysis is not complete. Environmental conditions were variable between locations and influenced cultivar establishment, ranking, and to a lesser degree, forage quality. However location effect on forage quality appeared to be less dramatic than on forage yield and botanical composition. It appeared that soil type influenced alfalfa cultivar performance to a greater degree than irrigation system. Bromegrass had higher DM yields than IWG at all locations. It also appeared that BG slightly increased the quality of the alfalfa when the two are grown in mixture and that IWG had no effect on alfalfa quality. Alfalfa variety or alfalfa grass mixtures recommendations for a given location cannot be made based on establishment years data.

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

Principal: Doug Cameron, Normac AES Ltd.
Swift Current, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Location: Swift Current, Saskatchewan
Progress: Second year of five
Objective: To determine the best method of establishing alfalfa grown on the clay soils of the Maple Creek area.

In 1988, combinations of zero tillage versus conventional tillage with and without companion crops were tried on field border dyke strips in the Roy Harrigan plot on Maple Creek Irrigation project in order to determine the best method for alfalfa establishment. Although adequate germination was achieved with one irrigation, the very dry summer conditions resulted in very streaky growth patterns across the plot area masking any of the tillage effects which may have been present. The variable growth conditions were investigated and appeared to be primarily related to the salt content of the soil and to a lesser extent to the textural nature of the soil and the water application pattern. In tall thick alfalfa growth areas with adequate water, first cut yield of up to 8.7 tonnes/ha were measured. However, the good growth streaks were limited and made up only a portion of the area. The average first-cut yield was calculated to be approximately 1.44 tonnes/ha.

In 1989, the emphasis of the study was broadened in order to examine other factors which might affect crop establishment. An experiment was set-up on three different plot areas to look at the application of gypsum in order to improve soil tilth for better germination. In addition, the application of manure, nitrogen and improved weed control will be examined as part of this project.

Alfalfa Varieties on Border Dyke Irrigation: Yield and Stand Longevity

Principal:	Doug Cameron, Normac AES Ltd. Swift Current, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-operator:	Ross Anderson
Location:	Maple Creek (NW 8-11-26)
Progress:	Second 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. There was no first irrigation because of dry conditions. Average yields from the various replicates taken during the first-cut ranged from a low of 1.43 for Beaver to a high of 1.95 tonnes/ha for Heinrichs. However, a second irrigation was possible in July because of high June rainfall and resulting reservoir storage. Second-cut yields ranged form a low of 1.05 for Heinrichs to a high of 1.22 tonnes/ha for Barrier. Analyses of variance on the yield results showed no significant differences between varieties. However, the analyses did show a significant difference between the first and second cuts.

EM38 mapping of the plot area showed that the south portion of the plot containing the block 3 replicates was highly saline compared to the slight to moderate salinity in the other two blocks of replicates. However, the analyses of variance did not show the block effects were significant in 1989.

The nutrient analyses on the second-cut forage samples did not show differences between the varieties. However, compared to common composition of average dairy cattle alfalfa, the analysis showed higher protein levels (possibly due to drought stress and levels of maturity) and slightly elevated levels of potassium, sulfur, magnesium, sodium, iron and manganese. It is believed the elevated levels are due to the higher salinity levels in the Maple Creek soils.

Irrigated Production of Texas Kochia on Saline Land

Principal: Deneen Duncan, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: Ray Derdall
Location: Outlook (SE-32-30-7 W3rd)
Progress: Final year
Crop: Texas Kochia (*Kochia scoparia*)
Objective: To evaluate the irrigated production potential of Texas kochia on saline land.

Kochia offers an excellent alternative for increasing the production potential of severely saline land. The major disadvantage of using kochia as a forage crop is the high levels of nitrates and oxalates that may be present in the feed sample. Although kochia may have a similar feed quality to alfalfa, current recommendations lean towards the use of kochia as a feed for maintenance animals only, with kochia making up less than 45% of the total ration to eliminate nitrate and oxalate toxicity problems. It is essential that a feed analysis be conducted on the kochia before using it as a part of the feed operation.

Table 1. Yield and feed quality of Texas kochia (1989).

D.M. WT. (kg/ha)	Protein (%)	T.D.N. (%)	Calcium (%)	Phosphorus (%)	Nitrate (%)	*Oxalates (%)
5990	15.88	58-60	0.82	0.22	1.00	3.60

NOTE: the feed analysis is based on 100% dry matter
*Soluble oxalates may cause symptoms of dullness, depression, colic, dyspnoea, prostration, coma, and death. It is recommended that a feed ration contain <0.1% of the weight of a fasted animal in soluble oxalates.

Effect of Nitrogen Timing on Timothy Yields

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operators: Paul and Silke Verwimp, Outlook, Saskatchewan
Kelvin Bagshaw, Birsay, Saskatchewan
Objective: To determine the potential yields of timothy under irrigation as influenced by the timing of nitrogen.

Phosphorus and nitrogen fertilizer were applied prior to seeding and incorporated. Timothy (cv. Clair) was broadcast seeded in both sites. Grass weed control (green foxtail) in timothy was a problem at both sites. A third site failed probably due to "deep" seeding, even though timothy was broadcast on the surface and harrowed in. For Timothy to be successfully established, the seedbed should be firm and moist so the seed is very shallow. If green foxtail control has been good for the previous two seasons this would greatly reduce this problem.

Corn Hybrid Testing

Principal: D. Belisle, Saskatchewan Corn Committee
L. Crowle, Agriculture Canada, Saskatoon, Saskatchewan

Funding: Irrigated Based Economic Development Agreement

Co-investigators: L. Townley-Smith, Agriculture Canada, Melfort, Saskatchewan
D. Derksen, Agriculture Canada, Indian Head, Saskatchewan

Progress: Second year of three

Objectives:
a) to continue the provision of accurate unbiased information on corn hybrids and their suitability for Saskatchewan conditions;
b) to enhance technology transfer through the involvement of the Saskatchewan Cattlefeeders Association;
c) to aid in the development of an annual forage crop for Saskatchewan.

Table 1. SCC Silage Corn Commercial Trials, 1989, at Outlook, Saskatchewan

Variety	Days 50% silk	Popn ,000/ha	Moist %	Yield t/ha(dry)	Y/M index
K - 730	88.5	43.5	73.0	9.2	1.3
K - 030	85.0	59.7	70.5	11.2	1.6
K - 148	89.0	58.6	74.2	12.8	1.7
P - 3979	86.5	55.4	69.6	13.8	2.0
P - 3953	88.5	56.4	73.1	14.4	2.0
P - 3954	87.0	60.2	71.5	14.3	2.0
P - 3995	86.0	44.1	67.7	7.5	1.1
P - 3994	85.5	37.6	71.7	7.4	1.0
DK - 233	86.5	49.5	70.0	9.4	1.3
DK - 235	88.0	42.5	71.6	11.2	1.6
PIC - 2435	86.5	49.5	69.1	9.8	1.4
PIC - 2477	86.5	46.2	71.6	10.2	1.4
LX - 153	85.0	22.6	65.2	3.6	0.5
LX - 155	85.0	24.2	62.6	4.0	0.6
LX - 174	86.5	32.8	65.1	6.0	0.9
LX - 181	84.5	24.2	65.8	4.0	0.6
Mean	86.5	44.2	69.5	9.3	1.3
LSD (.05)	1.9	9.4	2.7	2.0	0.3

Use of Spring Seeded Winter Annual Cereal Grains for Grazing

Principal: R. Byron Irvine, Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Crop: Irrigated annual pasture
Cooperator: Vestre Farms
Location: NW-33-27-7 W3rd
Progress: Final year
Objective: To develop a grazing system using annual forage crops. This system could be used to complement perennial pastures.

Summary:

Spring seeded winter wheat was rotational grazed in 1988 and 1989 with replacement heifers and cows with calves. Grazing commenced in mid-June; the forage available at the time was wild oats and volunteer barley. Carrying capacity under the flood irrigation and other management employed was 5,074 and 6,800 animal unit grazing days in 1988 and 1989, respectively. Perennial species can be grazed in May and do not have an annual establishment cost, putting the winter wheat pastures at a disadvantage. For best production winter wheat should be grazed no closer than 5 cm (2 in) to improve the rate of regrowth. The best use of winter wheat may be when it is underseeded with a grain crop of wheat and used for fall grazing when perennial pastures have declined.

Materials and Methods 1988:

A 42-acre border dyke irrigated area was divided into 4 paddocks of approximately equal size. The crops listed below were seeded with a double disc press drill on April 23.

1. Norstar winter wheat plus Eston lentil
   - test strips of Persian clover and tangier flat pea were seeded to observe their tolerance to grazing.
2. Musketeer fall rye
3. Norstar winter wheat
4. Bonanza barley underseeded to Norstar winter wheat

Table 1. Soil test nutrient levels (kg/ha)

Field #	N	P	K	S
1	85	37	740	108
2	17	9	280	108
3	53	19	426	108
4	53	19	426	108

Table 2. Amount and timing of fertilizer applications (kg/ha)

Field #	Date of application	N	P_2O_5
1,2,3,4	April 20	90	45
1,2,3,4	April 23		45
1,2,3,4	July 21	55	

Results and Discussion 1988:

All fields had a heavy infestation of wild oats which were grazed. Grazing commenced on June 13. In retrospect, this was too late, as the wild oats were more mature than desirable by the time all paddocks had been grazed. The competition from the wild oats and the high grazing intensity appeared to restrict the regrowth of the winter cereals and animals gains and carrying capacity were low.

Stocking rates for 42-acre annual pasture varied with time and are given below:

Table 3. Stocking rates

Date	# Heifers	# Cow-calf units
June 13-June 27	21	34
June 28-Aug 5	21	50
Aug 6-Sept 5	21	30
Sept 6-Sept 12	0	0
Sept 13-Oct 13	21	0

There was considerable variation in animals weights over the season (Table 4). This variation is difficult to explain but may have been due to gut fill differences. However, over the entire season the animals gained very little.

Table 4. Mean animal weights during the 1988 grazing season (kg)

	June 18	July 3	Aug 15	Oct 13
Mean	449	416	432	463

n = 13

The tangier flat pea and the lentil plants were eliminated by the first grazing while the Persian clover regrew more rapidly than the winter wheat. The poor regrowth of the winter wheat may have been due to overgrazing, nutrient shortage or high temperatures but regardless of the cause the carrying capacity of the land base was low. Persian clover could be underseeded in a crop of canola to provide fall pasture as it is resistant to trifluralin and is seeded at the same depth.

Materials and Methods 1989:

Winter wheat was seeded May 1 and May 8 using a double disc press drill with a 15 cm (6 in) row spacing. Winter wheat was seeded at 155 kg/ha (140 lbs/ac). The total area seeded was 55 acres in 1989. Nitrogen was applied at 110 kg/ha (100 lbs/ac) prior to seeding and additional 55 kg/ha (50 lbs/ac) was applied in early July.

There were several changes from the 1988 project. The lentil crop was eliminated as it did not regrow and contributed very little to the total grazing. The stocking rate was reduced to 34 cow-calf units on 54 acres (.62 animal units per acre) and the fields were grazed to a height of 7 cm (2.75 in).

Grazing commenced on June 12. There was a very heavy growth of volunteer barley and wild oats which were grazed on one field but cut for hay in early July on 20 acres. An additional 18 cow calf units were placed on the field on July 20 due to a shortage of dryland pasture and an abundance of forage on the irrigated pasture.

Results and Discussion 1989:

Calves were weighed in 1989. Over the period June 12 to July 12 calves gained 1.4 kg/day (3 lbs/day) (Table 5). This gain dropped sharply after August 12. The dramatic reduction in rate of gain in the later portion of the year is a function of too little forage being available for the number of animals present. At this time of year the cows should be supplemented with a lower energy and protein diet such a whole crop barley and the calves should receive a high energy supplement of grain. The barley hay area should be underseeded with winter wheat and thus provide additional grazing late in the season.

It is questionable whether the 6,800 animal unit grazing days is profitable if alternative dryland pastures are available. Using the total number of calves on the pasture at a given time, the calculated total calf gain is 5,583 kg or 254 kg/ha (12,282 lbs or 227 lbs/ac). These figures suggest that cow-calf units do not return sufficient income to warrant grazing on irrigated conditions where animal gains of yearlings can be in excess of 800 lbs/ac if supplementation is practiced from mid August through the end of October.

There are considerable labor costs involved in raising cattle relative to grain operations. The equipment costs for grazing are relatively low but the cost of purchasing breeding stock and paying interest on these animals is high. Since crop residue is a by-product of grain production and double cropping of annual forages may be possible under irrigated conditions, grazing annual forage crops with cow-calf units does not seem viable in the long term.

It is my opinion that the best grazing system would be to use a combination of annual and perennial crops. The perennial crops would provide a greater amount of forage starting in late May through mid August and could be supplemented with grain or the animals moved to annual pasture for late August, September and October. Since not much growth occurs at this time most of the forage would have already been produced during the summer. Underseeding crops with winter wheat may provide a portion of this fall grazing and would be the best system of producing fall grazing for a cow-calf operation.

Recommendations:

1. Graze early if there are significant amounts of wild oats or other weeds.
2. Maintain a relatively low stocking rate and ensure the highest possible gains by actively growing animals during the early part of the year.
3. Serious consideration should be given to underseeding winter wheat and Italian ryegrass with a crop of wheat harvested for grain to provide grazing during September.

Table 5. Mean calf weights when grazing with their dams on irrigated winter wheat pasture, 1989 (kg).

	June 12	July 12	Aug 12	Nov 10
Mean	122	164	197	265
ADG kg	1.40	1.09	0.75	

n = 30

Specialty Crops

Specialty Crop Development Program

Principal: A. Vandenberg
Saskatchewan Irrigation Development Centre

Dry Bean Research

General

Research related to variety development and to irrigated dry bean agronomy continued in 1989. The 1989 growing season was cool during May and June, resulting in slightly delayed seeding, flowering and crop development relative to previous years. A killing frost occurred on September 10. The early frost provided an effective screen for early maturity in a short season environment.

Variety Evaluations

The U.S. Dry Bean Cooperative Nursery was grown for the fourth consecutive year (Table 1). The early frost limited the yield potential of late-maturing entries.

The Prairie Dry Bean Cooperative Test was grown for the second year (Table 2). This test is grown at 8 locations across Western Canada and serves as the base for cultivar registration recommendation. The first registered varieties will be advanced from this test after the 1990 season. Entries with poor performance based on the first two years of evaluation will be dropped from the test and replaced by promising new entries.

The Pinto Observational Test was grown for the second year (Table 3). Several early-maturing entries were higher yielding than the check varieties Fiesta, Othello and Topaz. Those for which two year data are available will be considered as entries in the Prairie Dry Bean Cooperative Test in 1990.

Two Coloured Bean Observational Tests were grown in 1989 (Tables 4,5). The first included black bean lines from Western and Eastern Canada. This was the first year for this trial. The second test included first and second year entries of great northern, red, pink and black bean types from U.S. breeding programs. Promising entries will be considered for advancement to the Prairie Dry Bean Cooperative Test in future years.

A seed increase of the 1989 entries for the Prairie Dry Bean Cooperative Test was grown as a seed source for the 1990 season. These were grown under flood irrigation to minimize the risk of spreading foliar diseases. The frost damaged late-maturing entries. New seed supplies will be acquired for those entries with low germination.

A small number of single row observational plots was grown to identify possible entries in observational yield trials in 1990. All entries were damaged by the early frost. Only those lines with high germination rates will be considered for advancement to the yield trial.

Table 1. Mean yield, days to flower, days to maturity, seed weight, plant height and canopy type for entries in the US Dry Bean Cooperative Nursery grown at Outlook, 1989

Market class	Entry	Yield	Days to flower	Days to maturity	Seed weight	Plant height	Canopy type†
		kg/ha			mg	cm	
Small red	NW 63	2798	54	117	339	25	4.5
	K0228	2588	54	113	291	19	4.8
Pinto	D85212	3645	56	113	340	20	4.8
	ISB82-354	3296	56	109	393	20	4.5
	Olathe	3191	58	122	304	22	5.0
	Sierra	3132	61	120	282	35	3.0
	UI 114	1926	57	125	358	23	5.0
Pink	Flamingo	3660	54	111	383	24	4.3
	Yolano	3612	55	113	350	23	4.5
	55037	3285	55	110	349	19	4.8
	UNS-117	2775	54	111	350	23	4.5
	Viva	2729	54	113	279	19	4.8
Navy or small white	Mayflower	2315	61	122	160	43	2.3
	Fleetwood	2252	60	123	164	30	3.0
	Aurora	2037	57	121	128	32	3.0
	ISB86-672	1982	57	117	168	46	1.0
	6137	1846	55	113	184	28	2.8
Kidney	Redkloud	3347	49	109	540	42	1.3
	ISB82-865	2655	52	115	530	53	1.5
	ISB82-772	2426	49	114	650	44	1.3
	Montcalm	2026	57	122	497	43	2.0
	K407	2010	57	119	472	45	1.8
Great northern or large white	GN-WM-85-43	3174	57	122	394	27	4.3
	GN-WM-85-55	2030	61	125	305	22	5.0
	UI 59	1700	63	121	268	20	4.3
	Harris	1211	56	127	285	29	4.8
Black	UI 906	3062	59	114	174	46	1.8
	Midnight	2108	59	125	161	50	1.0
Mean		2601					
CV %		19.6					
LSD (0.05)		740					

† 1 = upright, 5 = flat. Recorded at harvest.

Table 2. Mean yield, days to flower, days to maturity and seed weight for entries in the Prairie Dry Bean Cooperative Test at Outlook, 1989

Market class	Entry	Yield	Days to flower	Days to maturity	Seed weight
		(kg/ha)			(mg)
Small red	D79144	3377	58	107	370
	Garnet	3304	56	111	302
	UI36	3037	59	117	317
	ISB480	2942	62	113	306
	NW63	2898	57	121	320
Pinto	D81122	3370	59	118	356
	Othello	3290	62	112	374
	Topaz	3276	65	111	362
	D81127B	3177	58	110	377
	UI111	2621	63	121	320
	UI126	2235	64	124	309
	UI129	2018	58	125	299
	NW590	1906	63	124	278
	Fiesta	1874	58	117	382
	NW410	1868	65	126	274
Pink	55001	3766	57	114	304
	D80192	3737	60	117	288
	Viva	3596	60	111	275
	ISB473	3584	57	110	314
	Harold	2664	60	113	304
Navy or small white	D80024	3075	61	115	190
	UI158	3042	64	120	159
	K0107	2695	64	120	176
	L9322	2523	66	125	173
	D84071	2402	59	120	160
	L9340	2322	70	124	169
	OAC Cygnus	2249	64	117	183
	ISB85486	1933	56	120	149
	ISB82258	1751	62	113	177
	HR16-818	1710	66	120	163
	ISB1	1443	61	112	188
	OAC Sprint	1137	59	115	207
	Centralia	1080	61	119	197
	82W83-3	957	59	120	180
	OAC Seaforth	216	62	113	164
Kidney	Redkloud	3514	56	117	516
	ISB82865	3133	60	114	518
	Montcalm	1018	65	127	496
Great northern or large white	Beryl	3700	59	113	320
	GN1140	3474	57	116	316
	83B352	2881	59	112	333
	83B342	2136	62	120	355
Cranberry	Taylor	3284	53	109	566
	UI686	1869	57	119	293
Black	UI906	3214	66	117	167
	Loop	2359	70	121	170
	X3160-5	2231	61	125	132
	MDA07506	2105	70	122	157
	94041	1582	65	118	165
Mean		2555			
CV %		19.8			
LSD (0.05)		734			

Water applied (mm):		Irrigation	Rainfall	Total
	May 1-31	0.0	63.0	63.0
	Jun 1-30	97.5	18.4	115.9
	Jul 1-31	102.0	11.5	113.5
	Aug 1-31	49.0	48.0	97.0
	Total	248.5	140.9	389.4

Replications: 4
Plot size: 1.2 m x 3.7 m - 60 cm rows
Planting rate: 30 seeds/m^2
Planting date: May 23, 1989
Harvest: Direct combined at maturity in late September

Table 3. Yield, days to flower, plant height, days to maturity and seed weight of entries in the 1989 Pinto Observational Test at Outlook, Saskatchewan

Entry	Yield	Days to flower	Plant height	Days to maturity	Seed weight
	kg/ha		cm		mg
8173-6E	4739	50	44	107	369
ISB82-354	4379	51	21	109	422
ISB84-114	4110	52	20	114	441
Sierra	3993	58	32	124	317
NW410	3944	56	23	119	340
Fiesta	3927	51	20	111	452
Othello	3891	54	23	111	372
Nodak	3817	54	19	113	324
NW590	3675	54	19	120	319
UI114	3663	55	23	120	369
Topaz	3659	54	26	110	380
UI 111	3582	55	20	120	363
Bill Z	3528	54	18	120	352
Viva	3503	51	19	111	290
Olathe	3491	55	21	122	338
81-127B	3262	56	35	108	398
Ouray	3184	55	29	121	393
6315	3175	54	28	106	365
Pindak	3153	54	20	117	300
5325	3135	54	29	107	365
81-125	2789	61	23	119	345
Mean	3672	54	24	114	363
CV %	15				
LSD (0.05)	785				

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	0.0	63.0	63.0
Jun 1-30	97.5	18.4	115.9
Jul 1-31	102.0	11.5	113.5
Aug 1-31	49.0	48.0	97.0
Total	248.5	140.9	389.4

Replications: 4
Plot size: 1.2 m x 3.7 m - 60 cm rows
Planting rate: 30 seeds/m^2
Planting date: May 27
Harvest: Bagged and stationary combined at maturity in late September

Table 4. Days to flower, stand, yield, canopy height and seed weight for entries in the Coloured Bean Observation Test No. 1 at Outlook, Saskatchewan, 1989

Entry	Yield	Days to flower	Canopy height	Seed weight
	kg/ha		cm	mg
8	3702	58	36	185
15	3618	55	32	152
7	3436	60	24	181
13	3435	60	28	182
9	3420	60	34	170
24	3311	57	40	158
5	3284	56	37	199
10	3251	63	27	156
3	3185	59	31	156
22	3018	56	37	167
19	2990	49	26	221
16	2888	49	22	179
18	2795	58	28	152
T-39	2763	67	18	151
Midnight	2750	67	23	150
Loop	2713	66	18	157
23	2663	60	27	146
20	2661	61	25	144
11	2642	64	19	142
17	2607	59	31	167
GTS 0681	2506	67	17	142
14	2346	56	27	161
12	2040	51	26	170
21	2035	56	28	159
4	1602	58	42	142
Seaforth	1157	56	27	--
6	1070	63	32	122
Mean	2736	59	28	162
CV %	21	4	24	4
LSD (0.05)	826			

Water applied (mm):	Irrigation	Rainfall
May 1-31	0.0	63.0
Jun 1-30	97.5	18.4
Jul 1-31	102.0	11.5
Aug 1-31	49.0	48.0
	-----	-----
Total	248.5	140.9

Replications: 4
Plot size: 1.2 m x 3.7 m - 60 cm rows
Planting rate: 30 seeds/m^2
Planting date: May 23
Harvest: Hand harvested and threshed in belt thresher

Table 5. Yield, days to flower, days to maturity, frost damage, seed weight canopy type and canopy height of entries in 1989
Coloured Bean Observation Test #2 at Outlook, Saskatchewan

Market class	Entry	Yield	Days to flower†	Days to maturity‡	Frost damage	Seed weight	Canopy type§	Canopy height
		kg/ha				mg		cm
Black	UI 906	3785	51	126	1	173	2	40
	Blackhawk	3285	VL	133	3	191	1	47
	GTS 0681	3093	VL	133	3	161	3	27
	Loop	2691	VL	133	3	166	3	24
Great northern or large white	Peridot	4048	51	123	1	338	5	17
	Beryl	4031	52	126	1	323	4	19
	K0440	3819	54	131	2	311	5	18
	54026	3092	52	129	1	331	5	19
	85:598	2595	53	122	1	307	4	17
	83B282	2566	53	115	0	310	3	22
	UI 59	2429	VL	133	3	292	5	20
Pink	55009	4324	53	124	1	343	3	24
	5524	4263	54	120	1	347	2	26
	5521	4113	50	116	0	349	4	19
	Viva	3622	50	125	1	280	4	18
Red	Garnet	4147	51	126	1	293	5	18
	52024	4068	51	117	0	335	4	18
	5217	3988	50	117	0	346	4	16
	52009	3825	51	116	0	336	4	14
	D79144	3648	51	119	0	379	4	15
	K0228	3372	52	127	1	302	5	16
Mean	Mean	3559						
CV %		13.8						
LSD (0.05)		719						

† VL - very late flowering in 1989 - near end of July
‡ 0 = none; 3 = severe
§ 1 = upright; 5 = flat

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	0.0	63.0	63.0
Jun 1-30	97.5	18.4	115.9
Jul 1-31	102.0	11.5	113.5
Aug 1-31	49.0	48.0	97.0
Total	248.5	140.9	389.4

Replications: 4
Plot size: 1.2 m x 3.7 m - 60 cm rows
Planting rate: 30 seeds/m^2
Planting date: May 27
Harvest: Direct combined at maturity in late September

Irrigation Scheduling Studies

An irrigation scheduling experiment was established using flooded basins. The experiment was similar to one conducted in 1988 except that steel borders were used to delineate plots in contrast to the usual border dikes. There were significant differences due to irrigation treatments for all plant measurements except the number of nodes per plant (Table 6). With the exception of the number of seeds per pod, there were no differences in any of the plant measurements when irrigation at 60% field capacity was compared to irrigation at 40% field capacity. These results confirm that dry bean can be classified as a low water use crop compared to cereals and alfalfa. Crop water requirements are closer to that of lentil.

A second preliminary experiment involving dry bean irrigation scheduling was established under the linear irrigation system using overhead sprinklers. Topaz pinto bean and Viva pink bean were included. The results were similar to those of the flooded basin experiment (Table 7). Dryland irrigation treatments were significantly different from full irrigation treatments for all plant measurements. Significant differences between full and partial irrigation treatments were observed for both Topaz and Viva for yield, plant height and number of nodes per plant.

Results from both experiments show that total water use requirements for adapted dry bean varieties are in the order of 325-400 mm provided that a pre-irrigation has occurred.

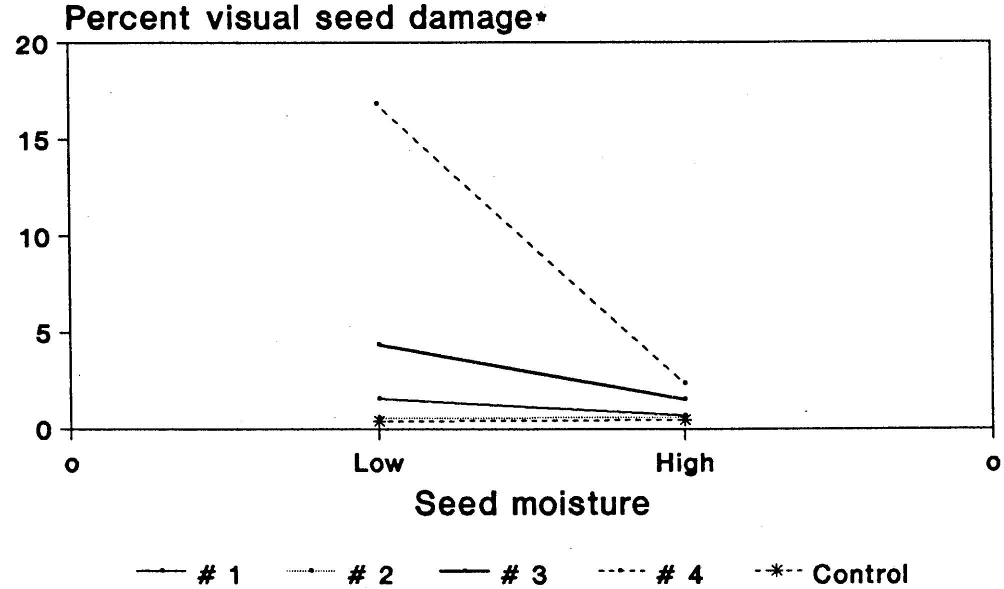
Table 6. Mean yield, seed weight, harvest index, plant height, number of seeds per pod, and number of nodes, pods, and per plant for Topaz pinto beans grown at four levels of flood irrigation in 1989 at Outlook, Saskatchewan.

Treatment	Number of Irrigations	Water Application † Rainfall	Irrigation	Total	Yield	Seed weight	Harvest index	Plant height	Number of seeds per pod	Numbers per plant Nodes	Pods	Seeds
		mm	mm	mm	kg/ha	mg		cm				
60% FC	4	95	304	399	3102 a	332 a	0.41 a	56 a	4.5 a	11.0 a	7.0 a	31.1 a
40% FC	3	95	228	323	2812 a	348 ab	0.40 a	56 a	3.8 b	11.4 a	7.0 a	26.0 ab
Visible	2	95	152	247	2056 b	323 ab	0.39 a	51 a	3.5 b	11.3 a	6.4 a	22.5 b
Dryland	0	95	0	95	386 c	293 b	0.26 b	32 b	2.3 c	11.3 a	1.9 b	4.4 c
Mean					2233	328	0.37	50	3.6	11.3	5.8	22.0
CV %					17.1	11.8	8.8	11.5	11.1	8.3	23.5	26.3

† Rainfall from May 15 to August 15

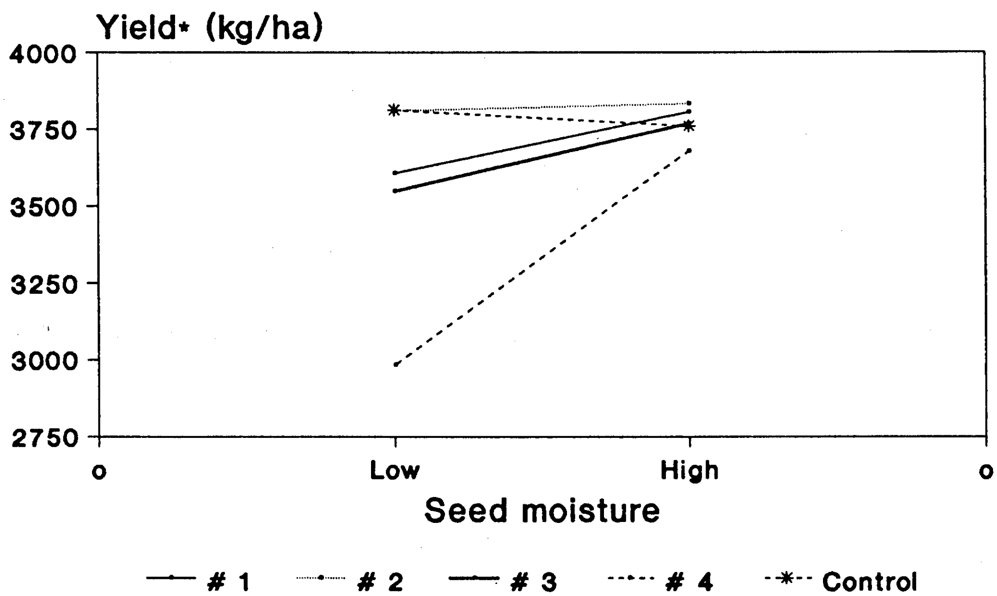
a Numbers within columns followed by the same letter are not significantly different (P<0.05) based on a protected LSD test.

Fig. 1 Effect of seed moisture and distribution system on seed damage



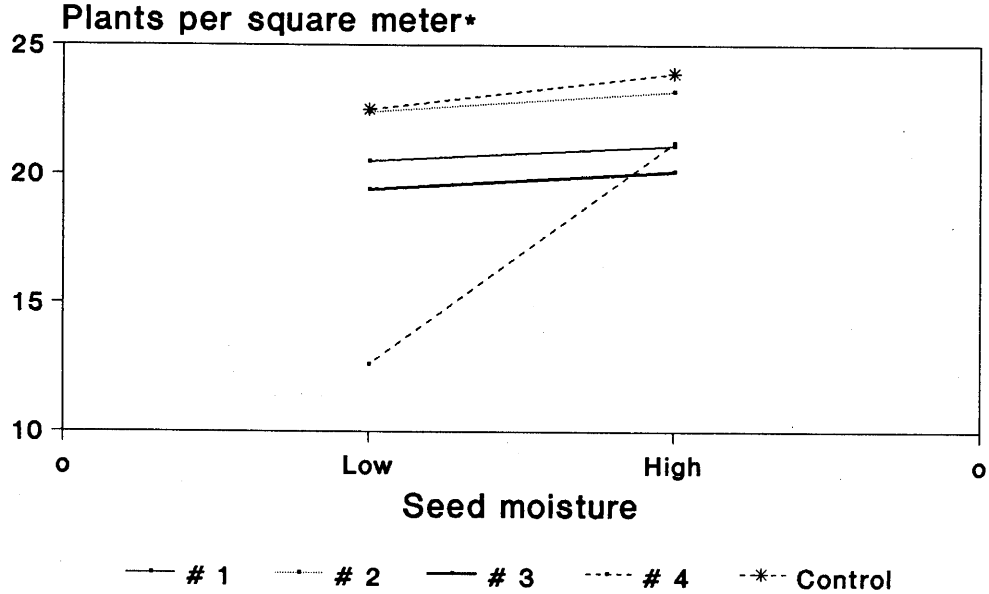
*Mean of three cultivar treatments

Fig. 2 Effect of seed moisture and distribution system on dry bean yield



*Mean of three cultivar treatments

Fig. 3 Effect of seed moisture and distribution system on plant population



*Mean of three cultivar treatments

Fig. 4 Drydown of Seafarer navy bean seed at Outlook, 1989

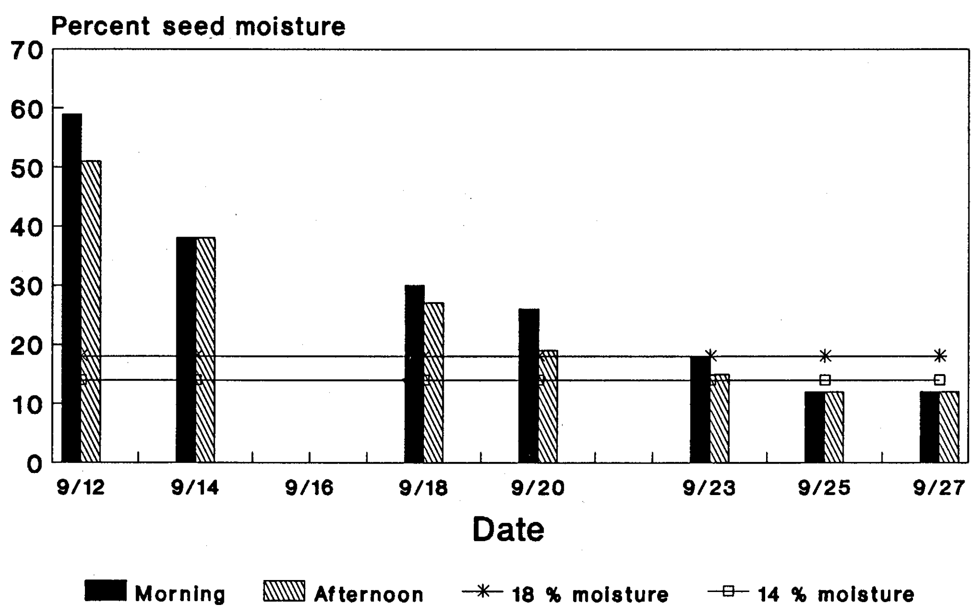


Table 7. Mean yield, seed weight, harvest index, plant height, number of nodes, pods and seeds per plant for Topaz pinto bean and Viva pink bean grown at three levels of sprinkler irrigation in 1989 at Outlook, Saskatchewan

Irrigation treatment	Mean water applied†	Variety	Yield	Seed weight	Harvest index	Plant height	Numbers per plant		
							Nodes	Pods	Seeds
	mm		kg/ha	mg		cm			
Full	342	Topaz	3903	409	0.59	75	13.5	11.5	49.6
Partial	261	Topaz	3143	393	0.57	64	12.3	11.9	42.3
Dry	95	Topaz	742	312	0.37	49	11.6	3.6	9.2
Full	342	Viva	4068	303	0.65	49	14.4	19.6	85.7
Partial	261	Viva	2923	288	0.57	41	12.8	18.0	73.5
Dry	95	Viva	608	215	0.40	21	11.2	6.9	21.5
LSD (0.05)			670	22	0.08	6	0.8	2.8	9.0

†Rainfall plus irrigation from May 15-August 15

Airseeding study

Table 8 lists the treatments included in this experiment. Highly significant main treatment effects and two-way interactions were observed for percent visual seed damage and plant stand. Highly significant main treatment effects and a seed moisture x airseeder interaction was observed for yield. Figures 1, 2 and 3 highlight the most agronomically important interactions. Airseeders equipped with impact manifold distributors had negative effects on seed quality, plant population and yield if dry bean seed was at ambient moisture. These detrimental effects were largely overcome by raising the initial seed moisture to approximately 16%. These results will be confirmed in 1990 at both the research and commercial demonstration scale.

Table 8. Treatment combinations used in the airseeding experiment in 1989 at Outlook, Saskatchewan

Cultivar and seed size	Seed moisture level	Airseeder	
		Number	Type of distributor
Beryl-280 mg	Ambient, low	1	Single impact
Topaz-240 mg	(about 11.5%)	2	Direct delivery
Topaz-320 mg	Elevated, high	3	Single impact
	(16-18%)	4	Double impact
		5	Control

International Dry Bean Modelling Nursery

The dry bean cultivars Viva, NW 63, Redkloud, UI 114 and Fleetwood were entries in a nursery established to collect data for a computer modelling study. Detailed data on plant growth and development were recorded as input to a computer model. These data will be combined with information from numerous sites across North America. The eventual goal of the project is to identify the physiological and genetic basis for varietal adaptation to particular environments. This information could be of use in a dry bean breeding program in a short season environment like south-central Saskatchewan.

Harvestability trial

An experiment was established to determine the yield losses attributable to direct harvesting with a Massey seed increase combine. The combine had a pickup reel and a conventional cutter bar. Nine cultivars were seeded at 16 inch row spacing in 8'x 24' plots. Yield losses were estimated by counting the number of seeds on the ground after harvest.

Significant yield differences due to cultivar were observed (Table 9). However, conclusions from this type of experiment can only be drawn after at least one more year of data collection because yield loss estimates were highly variable. Results were confounded by the killing frost on September 10 and by a high incidence of *Sclerotinia* in some plots. Taylor cranberry bean had the highest percent loss because this cultivar is prone to shattering. Compared to other cultivars with a vine growth habit, yield losses for Topaz pinto were significantly lower. This is possibly due to greater tolerance of *Sclerotinia* leading to a more upright canopy at harvest. It cannot be assumed that the results of this experiment are applicable to a commercial air reel/flex header harvesting system. Field scale evaluation of harvesting technology will be required to document true cultivar differences in yield loss potential.

Dry bean drydown experiment

An experiment was established to document the drydown rate for three dry bean cultivars - Topaz pinto, Viva pink and Seaforth navy. The killing frost confounded the results of this experiment. Frozen pods and seeds do not follow the normal drydown pattern. Only Seaforth navy was completely mature by the time of the frost. Available results are shown in Figure 4. In 1989 there was approximately a "one week window" during which seed of the navy bean Seaforth was in the harvestable range of 14-18% moisture. Seed moisture content reduction from morning to afternoon on sampling days was variable, ranging from as much as 4% reduction during rapid drying weather, to a negligible amount during humid weather.

Nitrogen fertilizer study

An experiment designed to observe the effect of additional nitrogen application on yield of irrigated pinto bean was abandoned after seeding. There were confounding effects of irregular flood irrigation and *Sclerotinia* infection. This aspect of dry bean agronomy will be evaluated on a commercial field scale in 1990.

Fungicide evaluation

A preliminary experiment to evaluate *Sclerotinia* control by three fungicides was established under the linear irrigation system. Control plots were not included to reduce the land required for the evaluation. Results were inconclusive although plots treated with Easout were the highest yielding (Table 10). The low yield of the full rate Benlate treatment is anomalous. Rovral treatments were the lowest yielding, but it may be necessary to buffer the water used for the spray solution to obtain maximum benefit. A more detailed experiment will be established in 1990 so that results can be incorporated into field scale evaluations underway in the demonstration program in 1991.

Table 9. Yield and yield loss for direct harvesting of nine dry bean cultivars grown under irrigation in 1989 at Outlook, Saskatchewan

Growth habit	Market class	Cultivar	Harvested yield	Harvest loss	Percent loss	Potential yield
			kg/ha	kg/ha		kg/ha
Vine	Pinto	Topaz	4073	517	12	4590
		Othello	3370	1169	35	4539
		Fiesta	3321	778	22	4099
	Great northern	Peridot	3973	1475	37	5447
		Beryl	3815	1040	28	4855
Semi-vine	Pink	Viva	3850	1027	27	4877
Bush	Kidney	California	3537	197	7	3734
	Cranberry	Taylor	2694	1201	45	3895
	Kidney	Montcalm	2564	293	11	2857
CV %			14.1	31.4		
LSD (0.05)			716	548		

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	0.0	63.0	63.0
Jun 1-30	97.5	18.4	115.9
Jul 1-31	102.0	11.5	113.5
Aug 1-31	49.0	48.0	97.0
Total	248.5	140.9	389.4

Replications: 4
Plot size: 2.4 m x 7.4 m - 60 cm rows
Planting rate: 30 seeds/m^2
Planting date: May 27
Harvest: Direct combined at maturity in late September

Table 10. Comparison of three fungicide treatments applied at three rates on yield of Topaz pinto bean under irrigation at Outlook, Saskatchewan, 1989

Fungicide treatments				
Product	Rate	Number of sprays	Yield	
			kg/ha	
Benlate	full	1	3579	c
	half	1	3921	abc
	half	2	3946	ab
Rovral	full	1	3691	bc
	half	1	3664	bc
	half	2	3773	abc
Easout	full	1	3975	ab
	half	1	4090	a
	half	2	3961	abc
CV %			5.5	
LSD (0.05)			310	

a-c Treatments followed by the same letter are not significantly different at P=0.05 according to Duncan's Multiple Range Test.

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	0.0	63.0	63.0
Jun 1-30	97.5	18.4	115.9
Jul 1-31	102.0	11.5	113.5
Aug 1-31	49.0	48.0	97.0
	-----	-----	-----
Total	248.5	140.9	389.4

Replications: 4
Plot size: 2.4 m x 3.7 m - 60 cm rows
Planting rate: 30 seeds/m^2
Planting date: May 29
Harvest: Direct combined at maturity in late September

Fababean Research

General

In 1989, the fababean research program continued based on 1988 results. Two variety evaluations were conducted and two agronomic experiments were established. The overall goal of this program is to redefine the agronomy of fababean for irrigated conditions in south-central Saskatchewan.

Variety Evaluations

The Western Canadian Fababean Cooperative Test was grown in 1989 (Table 11). Aladin was the highest yielding overall. This variety has also performed well in agronomic trials in comparison to the variety Outlook.

The Determinate Fababean Test was grown for the second year in 1989. Once again, the indeterminate varieties selected in Western Canada outyielded the European determinate fababean varieties by a substantial margin (Table 12).

Seeding Rate and Row Spacing Study

Results from this experiment in 1989 were almost identical to the results of 1988 (Table 13). Seeding rate reduction of up to 50% had no significant effect on yield. Widening row spacing from 20 cm to 40 or 60 cm had no effect on yield. Aladin again significantly outyielded Outlook in 1989.

Potassium Response Study

In 1989 there was no yield response to potassium fertilizer application to fababean (Table 14). Individual plot soil analysis before seeding showed that potassium levels were highly variable within the experimental plot area. The range observed in the soil test was 140 to 360 lb/acre. A correlation analysis of crop yield and total potassium in the 0-20 cm soil layer (test level plus added) showed no significant relationship.

Pea Research

General

Emphasis in the field pea research program is placed on investigating agronomic practices that may improve potential yield under irrigated conditions, and on evaluating new pea varieties that may show better suitability for irrigated production. This was the second year of the program.

Variety Evaluations

Two variety tests were grown in 1989 - the Special Purpose Pea Cooperative Test (Table 15) and the Field Pea Cooperative Test (Table 16). Many of the new pea lines under test are shorter and higher yielding than the standard Century and Trapper types traditionally grown in Saskatchewan. Each year more semi-leafless entries are entered in the trials. In 1989, semi-leafless types as a group were slightly below average yield. Higher seeding rates may be necessary to achieve true yield potential.

Potassium Response Study

The results of the potassium response study for pea were similar to the results of the fababean study. There was no significant difference in yield attributable to the addition of potassium fertilizer (Table 17). Soil analysis of potassium on a plot to plot basis was even more variable than for the fababean experiment, ranging from 140 to 900 lb/acre. There was no significant correlation between yield and the total potassium available (test plus added) based on a correlation analysis.

Table 11. Days to flower, yield, plant height, seed weight and days to maturity for entries in the 1989 Fababean Cooperative Test grown at Outlook, Saskatchewan

Entry	Days to flower	Yield	Plant height	Seed weight	Days to maturity
		kg/ha	cm	mg	
Aladin	58	5533	139	438	120
Encore	63	5263	121	412	120
Herz Freya	59	5254	139	432	119
Orion	54	5041	104	408	117
Outlook	60	5014	136	420	121
82RM2227	59	4701	136	449	118
Pegasus	61	4528	127	429	120
BYJOFBI	62	4194	99	592	121
Mean	59	4866	128	443	119
CV%		15			
LSD (0.05)		1217			

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	0.0	63.0	63.0
Jun 1-30	97.5	18.4	115.9
Jul 1-31	197.5	11.5	209.0
Aug 1-31	70.0	48.0	118.0
Total	365.0	140.9	505.9

Replications: 3
Plot size: 2.4 m x 3.7 m - 20 cm rows
Planting rate: 40 seeds/m^2
Planting date: May 1
Harvest: Swathed and combined at maturity in late September

Table 12. Days to flower, yield, plant height, seed weight and days to maturity for 1989 Fababean Determinate Test grown at Outlook, Saskatchewan

	Days to flower	Yield	Plant height	Seed weight	Days to maturity
		kg/ha	cm	mg	
Erfordia	61	4577	116	495	113
Outlook	60	4460	110	432	114
Aladin	61	4425	110	481	114
Encore	62	4384	104	426	113
Orion	53	3754	85	398	113
Mythos	56	3540	72	471	113
Tigo	62	3512	69	566	114
Tina	61	3504	74	541	113
Fritel	62	3449	68	530	114
Tinova	61	3401	72	574	114
326/3	62	2603	91	484	114
Ticol	61	2579	102	535	119
Mean		3682			
CV %		17.5			
LSD (0.05)		939			

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	0.0	63.0	63.0
Jun 1-30	97.5	18.4	115.9
Jul 1-31	197.5	11.5	209.0
Aug 1-31	70.0	48.0	118.0
Total	365.0	140.9	505.9

Replications: 4
Plot size: 2.4 m x 3.7 m - 20 cm rows
Planting rate: 40 seeds/m^2
Planting date: May 1
Harvest: Swathed and combined at maturity in late September

Table 13. Effect of seeding rate and row spacing on yield of two fababean cultivars grown under irrigation at Outlook, Saskatchewan, 1989

Treatment	Cultivar				Treatment mean
Seeding rate		20 seeds/m^2	30 seeds/m^2	40 seeds/m^2	
	Aladin	4077	4481	4453	4337*
	Outlook	3809	4078	3941	3943
	Mean	3943	4279	4197	
Row spacing		20 cm	40 cm	60 cm	
	Aladin	4239	4455	4317	4337*
	Outlook	3922	4109	3798	3943
	Mean	4081	4282	4057	
CV = 14%					

* Significant difference at P=0.05 level

Water applied (mm):		Irrigation	Rainfall	Total
	May 1-31	0.0	63.0	63.0
	Jun 1-30	97.5	18.4	115.9
	Jul 1-31	197.5	11.5	209.0
	Aug 1-31	70.0	48.0	118.0
	Total	365.0	140.9	505.9

Replications: 6
Plot size: 3.6 m x 4.9 m
Planting date: May 3
Harvest: Swathed and combined at maturity in late September

Table 14. Effect of potassium fertilizer application on yield and seed weight of Outlook fababean at Outlook, Saskatchewan in 1989

Potassium application			
Amount K20	Source	Yield	Seed weight
kg/ha		kg/ha	mg
0	None	4461	382
50	Chloride	4589	402
100	Chloride	4249	408
200	Chloride	4589	375
50	Sulphate	4461	388
100	Sulphate	4461	385
200	Sulphate	4461	389
Mean		4467	390
Standard error		248	

Water applied (mm):		Irrigation	Rainfall
	May 1-31	20.0	63.0
	Jun 1-30	62.0	18.4
	Jul 1-31	183.0	11.5
	Aug 1-31	72.5	48.0
	Total	337.5	140.9

Replications: 6
Plot size: 2.4 m x 7.4 m - 20 cm rows
Planting rate: 40 seeds/m^2
Planting date: May 3
Harvest: Swathed and combined at maturity in late September

Table 15. Mean yield, days to flowering, days to maturity, seed weight, vine length and leaf type for entries in the Special Purpose Coop Test, 1989, at Outlook, Saskatchewan

Entry	Yield	Days to flower	Days to maturity	Seed weight	Vine length	Leaf type
	kg/ha			mg	cm	
RB-40	5654	51	85	242	83	standard
Tara	5455	56	90	200	89	standard
Kasino	5164	49	84	274	62	standard
Victoria	4707	52	87	155	87	standard
CPS-5	4622	50	86	286	64	standard
Bellevue	4472	59	92	168	71	standard
Marrowfat	4447	51	89	342	55	standard
Orb	4436	51	84	224	49	standard
Consort	4422	51	86	303	63	semi-leafless
Radley	4404	51	88	199	62	semi-leafless
Golf	4314	56	90	262	84	standard
Stehgolt	4111	50	85	287	46	standard
Tiara	3846	47	83	164	56	semi-leafless
Progreta	3232	52	87	319	53	tare
Mean	4520					
CV %	12					
LSD (0.05)	832					

Reps	Level	Irrigation	Rainfall	Total
1+2	Partial	130.0	95.3	225.3
3+4	Full	224.0	95.3	319.3

Plot size: 1.2 m x 3.7 m - 20 cm rows
Planting rate: 80 seeds/m^2
Planting date: May 10
Harvest: Undercut and stationary combined at maturity

Table 16. Mean yield, days to flower, days to maturity, vine length, seed weight and leaf type for entries in the Field Pea Coop Test 1989 at Outlook, Saskatchewan

Entry	Yield	Days to flower	Days to maturity	Vine length	Seed weight	Leaf type
	kg/ha			cm	mg	
Titan	4988	58	84	93	251	standard
Belinda	4748	51	80	43	280	standard
Amino	4638	52	81	55	301	standard
MP1005	4441	54	83	70	244	standard
MP990	4254	53	83	65	299	standard
MP1003	4155	55	84	88	287	standard
BL81	4130	54	80	48	307	standard
Ricardo	4035	53	82	46	289	standard
LU-SIB	3936	53	81	63	260	standard
4-9002	3936	50	81	52	269	standard
MP999	3711	52	80	86	237	standard
Danto	3696	54	80	45	242	semi-leafless
CPS-1	3586	52	79	53	239	semi-leafless
SV12924	3550	54	81	58	170	standard
CL85	3549	55	82	65	267	semi-leafless
Miranda	3484	51	78	45	328	standard
Princess	3434	52	77	55	173	standard
SV84552	3378	54	80	71	221	semi-leafless
SV12920	3331	54	80	61	167	standard
Century	3129	59	83	85	190	standard
SV14936	3129	52	81	62	193	standard
Trapper	3020	54	80	62	198	standard
Bohatyr	2896	52	77	64	257	standard
Radley	2820	--	84	--	174	semi-leafless
SV84539	2541	54	78	58	181	standard
MP997	2510	52	84	69	237	standard
Mean	3654				244	
CV %	21					
LSD (0.05)	1043					

Reps	Level	Irrigation	Rainfall	Total
1+2	Partial	130.0	95.3	225.3
3+4	Full	224.0	95.3	319.3

Plot size: 1.2 m x 3.7 m - 20 cm rows
Planting rate: 80 seeds/m^2
Planting date: May 9
Harvest: Undercut and stationary combined at maturity

Table 17. Effect of potassium fertilizer addition on yield and seed weight of Victoria field pea at Outlook, Saskatchewan in 1989

Potassium application		
Amount of K_2O	Source	Yield
kg/ha		kg/ha
0	None	4342
50	Chloride	4620
100	Chloride	4557
200	Chloride	4162
50	Sulphate	4362
100	Sulphate	4458
200	Sulphate	4210
Mean		4396
Standard error		208

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	20.0	63.0	83.0
Jun 1-30	62.0	18.4	80.4
Jul 1-31	183.0	11.5	194.5
Aug 1-15	72.5	0.6	73.1
Total	337.5	94.5	431.0

Replications: 6
Plot size: 2.4 m x 7.4 m - 20 cm rows
Planting rate: 80 seeds/m^2
Planting date: May 4
Harvest: Direct combined at maturity on August 22

Fungicide Study

An experiment was established to determine the effect of fungicide application (main plots) on yield of three irrigated pea varieties (sub-plots). Benlate, Rovral and Easout were applied to Radley (semi-leafless), Progreta (tare leaf) and Victoria (standard leaf) pea. The plots were laid out so that five replications were parallel to the travelling direction of the linear irrigation system. The level of irrigation applied to each replication varied from supplemental to full irrigation.

Results indicated significant increases in yield for Benlate and Easout treatments in comparison to a non-sprayed control (Table 18). Progreta significantly outyielded the two other varieties. There was no interaction between fungicide and variety. There was an interaction between fungicide and replication. Increased water application raised the potential for yield loss due to disease. Therefore, fungicide applications were more effective in the heavily irrigated replications.

Seeding Rate and Seeding Depth Study

Radley pea was seeded at all combinations of three seeding depths (2.5, 5.0 and 7.5 cm) and three intended seeding rates (55, 80 and 110 seeds/m^2). There were five replications. There were no significant differences in yield due to seeding depth (Table 19). Stand counts were made to assess intended seeding rate. The high seeding rate treatments had reduced stands at all three seeding depths. In general, plant population was highly variable and may have affected the yield results. This experiment will be repeated in 1990 with modifications to ensure more accurate control of intended seeding rate treatments.

Irrigation Scheduling Study

This study was a preliminary experiment designed to evaluate irrigation scheduling treatments for field pea using the linear irrigation system. Difficulties with post harvest seed processing precluded using the data for meaningful analysis. The experiment will be repeated in 1990.

Grass Pea Research

General

Irrigated research on grass pea (*Lathyrus sativus* L.) continued in 1989 in cooperation with Dr. A. Slinkard, Crop Development Centre, Saskatoon and Dr. C. Campbell, Agriculture Canada, Morden. The project is jointly funded by the Saskatchewan Pulse Crop Development Board and the Canada/Saskatchewan subsidiary Agreement on Agricultural Development (ERDA).

Variety Evaluations

The Lathyrus Cooperative Test was grown under irrigation for the second year in 1989 (Table 20). The plots received partial irrigation, therefore yields were lower than in 1989. The two highest yielding entries in 1989 were also at the top end of the yield range in 1988.

Irrigation Study

Lines with reduced levels of the neurotoxin BOAA were included in this experiment. Tara field pea was included as a check comparison for yield and seed weight in 1989. There were significant increases in yield, vine length, and seed weight due to increased irrigation level (Table 21). Significant reductions in BOAA content were observed in response to increased irrigation. A significant interaction between irrigation treatment and variety was observed for yield. The grass pea lines Nc8a-7 and Nc8a-74/ did not show a significant increase in yield for full irrigation compared to partial irrigation. There were significant differences in the BOAA content of the grass pea lines but there was no interaction between BOAA content and irrigation level. The reduction in neurotoxin content in response to irrigation may be caused by altered protein content or composition. This project will continue for one more year.

Table 18. Effect of fungicide application on yield of three pea cultivars under irrigation at Outlook, Saskatchewan in 1989

Treatments		Yield	Standard error
		kg/ha	
Fungicide	Control	3473	
	Benlate	4181	
	Rovral	3639	
	Easout	4220	
	Mean	3878	271
Cultivar	Radley	3749	
	Progreta	4145	
	Victoria	3740	
	Mean	3878	127

Reps	Level	Irrigation	Rainfall	Total
1	Dry	0.0	95.3	95.3
2+3	Partial	130.0	95.3	225.3
4+5	Full	224.0	95.3	319.3

Plot size: 2.4 m x 3.7 m - 20 cm rows
Planting rate: 80 seeds/m^2
Planting date: May 11
Harvest: Direct combined at maturity

Table 19. Effect of seeding depth and seeding rate on yield of Radley field pea grown under irrigation at Outlook, Saskatchewan in 1989

Measurement	Intended seeding rate	Seeding depth 2.5 cm	Seeding depth 5.0 cm	Seeding depth 7.5 cm
	seeds/m2			
Yield		kg/ha		
CV = 8.5 %	55	3370	3492	3593
	80	3650	3687	3356
	110	3721	3570	3485
Stand		plants/m^2		
CV = 18.9 %	55	66	52	65
	80	80	70	74
	110	79	88	82

Reps	Level	Irrigation	Rainfall	Total
1	Dry	0.0	95.3	95.3
2+3	Partial	130.0	95.3	225.3
4+5	Full	224.0	95.3	319.3

Plot size: 2.4 m x 3.7 m - 20 cm rows
Planting date: May 9
Harvest: Undercut and stationary combined at maturity

Table 20. Days to flower, vine length, yield and seed weight for entries in the 1989 Lathyrus Cooperative Test at Outlook, Saskatchewan

Entry	Yield	Days to flower	Vine length	Seed weight
	kg/ha		cm	mg
NC8-26/1	3723	51	50	221
NC8-61W	3305	52	43	223
NC8-97W	3212	51	44	206
NC8-99M	3136	51	49	207
NC8-26/2	3126	51	45	213
NC8-1M	3083	52	40	213
NC8-91C	3024	52	42	166
NC8-95C	2964	52	40	163
NC8-101M	2855	50	41	215
NC8-2/2C	2843	51	37	216
NC8-92C	2828	51	43	197
NC8-96W	2787	52	39	193
NC8-94C	2648	51	39	158
NC8-93C	2624	51	37	159
NC8-100C	2616	51	42	160
NC8-98C	2549	50	35	158
Mean	2957	51	42	192
CV %	12			
LSD (0.05)	517			

Reps	Level	Irrigation	Rainfall	Total
1+2	Dry	0.0	95.3	95.3
3	Partial	130.0	95.3	225.3
4	Full	224.0	95.3	319.3

Plot size: 1.2 m x 3.7 m - 20 cm rows
Planting rate: 80 seeds/m^2
Planting date: May 10
Harvest: Direct combined at maturity

Table 21. Effect of irrigation on seed yield, vine length, BOAA content and seed weight of grass pea grown at Outlook, Saskatchewan, 1989

Measurement	Entry	Irrigation treatment: Dryland	Partial	Full	Mean
Yield		kg/ha			
	Nc8a-64	1699	2918	4340	2986
	Nc8a-7	1794	2830	3139	2588
	Nc8a-74/	1728	2519	3381	2543
	Nc8a-84	1950	3036	4054	3013
	Tara	1828	2987	4864	3226
	Mean	1800	2858	3955	
	Standard error				233
	CV = 16.2%				
Vine length		cm			
	Nc8a-64	34	52	91	59
	Nc8a-7	36	55	92	61
	Nc8a-74/	32	47	84	54
	Nc8a-84	34	53	83	56
	Tara	--	--	--	--
	Mean	34	51	87	
	Standard error				5
	CV = 16.7%				
BOAA content		% of seed dry weight			
	Nc8a-64	0.35	0.29	0.22	0.29
	Nc8a-7	0.34	0.29	0.25	0.29
	Nc8a-74/	0.28	0.22	0.16	0.22
	Nc8a-84	0.28	0.25	0.22	0.25
	Tara	--	--	--	--
	Mean	0.31	0.27	0.21	
	Standard error				0.01
	CV = 10.0%				
Seed weight		mg			
	Nc8a-64	203	209	218	210
	Nc8a-7	170	173	182	175
	Nc8a-74/	138	153	170	153
	Nc8a-84	189	203	201	198
	Tara	183	204	223	203
	Mean	175	184	193	
	Standard error				6
	CV = 5.9%				

Replications: 4 Seeding date: May 10, 1989
Water applied: Rainfall plus irrigation: dryland - 95 mm; partial irrigation - 225 mm; full irrigation - 320 mm.
Harvest: dryland - Aug 18; partial irrigation - Aug 22; full irrigation - Aug 29. Bagged and threshed at maturity.

Lentil Research

General

Research on irrigated lentil is performed in cooperation with the Crop Development Centre at University of Saskatchewan. Part of the research is supported by the Saskatchewan Pulse Crop Development Board.

Variety Evaluation

The Lentil Cooperative Test was grown under sprinklers using the linear irrigation. There was a moisture gradient across replications so that two of the four replicates received only partial irrigation. As in 1988, Eston was significantly higher yielding than Laird (Table 22). The new red lentil variety Rose was also high yielding for the second year of the irrigated test, indicating that its performance under irrigation is similar to Eston.

Lentil Phosphorus Study

This project is coordinated by Dr. R. Bhatty of the Crop Development Centre, University of Saskatchewan. Eston lentil was established under dryland, partial and full irrigation using the linear irrigation system. Phosphorus fertilizer was side-banded at 0, 20, 40, 60, and 80 kg/ha. Seed samples were analysed in P content and nutritional factors, including phytic acid content. These analyses are in progress. An analysis of yield data indicated significant response to irrigation but not to P fertilizer (Table 23). Irrigation significantly increased seed size in comparison to the dryland treatment.

Safflower Research

General

Cooperation with the safflower breeding program at Agriculture Canada at Lethbridge Research Station and with the New Crops Program at Agriculture Canada in Morden continued in 1989.

Variety Evaluation

There were fewer entries in the Safflower Cooperative Test in 1989 (Table 24). Several entries were slightly higher yielding than the check Saffire. Two replications unavoidably received less than optimum irrigation due to their position under the linear irrigation system in relation to irrigation scheduling experiments.

Seeding Rate and Irrigation Scheduling Study

In 1989, there were no significant differences in the yield of Saffire due to lowering or raising the recommended seeding rate by 30% (Table 25). There were highly significant yield differences among all three levels of irrigation. There was no interaction between seeding rate and irrigation level.

Stands were highly variable and in some cases plant population varied greatly from that intended by the seeding rate treatments. An analysis of the number of heads per plant showed a highly significant increase for both irrigation treatments (Table 25). A significant interaction between irrigation treatment and seeding rate was likely due to the variability in stand, not due to changes in seeding rate.

Table 22. Yield, days to flower and seed weight for entries in the 1989 Lentil Cooperative Test grown at Outlook, Saskatchewan, 1989

Entry	Yield	Days to flower	Seed weight
	kg/ha		mg
Eston	2167	46	34
LAx174310-8	2022	47	49
Rose	2008	45	46
179310xLA-33	1729	48	41
179310xLA-25	1717	48	44
Laird	1672	48	77
T-B 406M	1624	47	38
179310xRC-16	1589	48	50
179310xLA-24	1556	48	49
179310xLA-7	1430	48	49
Mean	1756		
CV %	13		
LSD (0.05)	328		

Reps	Level	Irrigation	Rainfall	Total
1	Dry	0.0	94.7	94.7
2	Partial	130.0	94.7	224.7
3+4	Full	224.0	94.7	318.7

Plot size: 1.2 m x 3.7 m - 20 cm rows
Planting rate: 100 seeds/m^2
Planting date: May 16
Harvest: Direct combined at maturity

Table 23. Effect of phosphorus fertilizer addition and irrigation on seed yield and seed weight of Eston lentil grown at Outlook, Saskatchewan, 1989

Measurement	P_2O_5 addition	Irrigation treatment: Dryland	Partial	Full	Mean
Yield	kg/ha	----------- kg/ha			
	0	677	2465	3489	2210
	20	482	2298	3368	2049
	40	516	2399	3536	2150
	60	577	2422	3136	2045
	80	498	2167	3215	1960
	Mean	550	2350	3349	
	Standard error				137
	CV = 13.3%				
Seed weight		----------- mg			
	0	30	37	37	35
	20	30	35	35	33
	40	31	35	35	34
	60	31	36	36	34
	80	30	35	38	35
	Mean	30	36	36	
	Standard error				1
	CV = 7.3%				

Replications: 4 Seeding date: May 16, 1989
Water applied: Rainfall plus irrigation: dryland - 95.3 mm; partial irrigation - 225 mm; full irrigation - 320 mm.
Harvest: Dryland - Aug 3; partial irrigation - Aug 10; full irrigation - Aug 17; direct combined at maturity.

Table 24. Days to flower, rust infection level, seed weight and yield of entries in the 1989 Safflower Cooperative Test at Outlook, Saskatchewan

Entry	Days to flower	Rust infection	Seed weight	Yield
		(1-9)	mg	kg/ha
Lesaf261	75	8.5	34	2682
Lesaf271	75	8.8	40	2635
Lesaf256	78	7.8	32	2583
Lesaf241	78	8.8	38	2562
Lesaf260	76	8.4	33	2511
Saffire	77	9.0	37	2502
Lesaf269	78	7.5	32	2353
S-208(Y-O)	77	8.3	39	2313
S-541	78	8.5	40	2187
Mean	77	8.4	36	2481
LSD	1.5	NS	1.4	357
CV %	1.1	7.6	2.7	9.9

Replications: 3 for days to flower, 4 for other measurements
Irrigation and rainfall in mm by month:

	Reps 1,2 total	Reps 3,4 total	All reps rainfall
May	64.8	64.8	64.8
June	85.4	115.4	18.4
July	64.5	113.5	11.5
August	100.0	105.0	48.0
September	25.0	25.0	25.0

Table 25. Effect of seeding rate and irrigation on yield and number of heads per plant for Saffire safflower grown at Outlook, Saskatchewan, 1989

Measurement	Seeding rate	Irrigation treatment: Dryland	Partial	Full	Mean
Yield	-kg/ha-	kg/ha			
	15	1505	1880	2826	2070
	23	1513	1951	2543	2002
	30	1550	2017	2769	2112
	Mean	1523	1949	2713	
	Standard error				117
	CV = 11.5%				
Heads per plant		number			
	15	8.3	13.0	17.0	12.8
	23	8.3	9.5	14.5	10.8
	30	5.8	9.3	18.0	11.0
	Mean	7.4	10.6	16.5	
	Standard error				0.9
	CV = 16.2%				

Replications: 4 Seeding date: May 4, 1989
Water applied: Rainfall plus irrigation: dryland - 167.5 mm
partial irrigation - 297.2 mm; full irrigation - 392.2 mm.
Harvest: October 4, 1989

Canaryseed Research

General

Canaryseed research in 1989 was restricted to the evaluation of entries in the Canaryseed Cooperative Test and an observational test made up of entries from the USDA germplasm collection. The Canaryseed Cooperative Test was damaged by flooding and poor drainage. This test was abandoned because yield data were available for only one of the four replications.

The Canaryseed Observational Test results were also variable but did indicate that there are several lines that have yield potential similar to Elias (Table 26). This test will be repeated in 1990 with a reduced number of entries.

Other Specialty Crop Research

Fenugreek

The Fenugreek Cooperative Test was grown in 1989. Once again, NC109-1 significantly outyielded the other two entries (Table 27). Harvest index was also significantly higher for NC109-1 in comparison to the other entries. This line is less susceptible to late season root rots and is therefore able to continue seed filling for a longer time.

Table 27. Yield, plant height and harvest index for entries in the Fenugreek Cooperative Test at Outlook, Saskatchewan, 1989

Entry	Yield	Plant height	Harvest index
	kg/ha	cm	
NC109-1	1499	25	0.35
NC109-2	747	34	0.20
NC109-3	756	37	0.25
Mean	1001	32	0.27
CV %	10	9	8
Standard error	50	2	0.01

Observational Plots

Several varieties of narrow-leafed and white lupin were grown as observational plots in 1989. Unlike 1988, there was no obvious nutrient deficiency associated with high pH soil. It was noted that the narrow-leafed lupin in particular was preferentially attacked by blister beetles during flowering.

Table 26. Yield, days to anthesis, plant height and lodging score for entries in the Canaryseed Observational Test at Outlook, Saskatchewan, 1989

Entry	Yield	Days to anthesis	Plant height	Lodging
	kg/ha		cm	
CAN22	2448	52	91	6
CAN41	2409	55	99	7
Elias	2401	51	88	5
CAN4	2380	54	91	5
CAN49	2336	53	92	6
CAN37	2283	51	89	4
CAN14	2266	53	80	7
CAN9	2251	49	82	3
CAN17	2205	51	86	7
CAN24	2191	56	91	4
CAN18	2176	50	87	7
CAN46	2163	53	90	7
CAN12	2159	52	86	6
CAN50	2152	57	95	7
CAN48	2104	52	83	5
CAN5	2066	53	89	4
CAN6	2061	49	75	4
CAN27	2060	55	91	5
CAN10	2038	50	85	3
CAN38	2023	51	83	6
CAN36	1989	52	86	4
CAN19	1982	48	81	6
CAN15	1968	53	90	6
CAN40	1965	57	92	5
CAN54	1964	49	86	5
CAN20	1954	56	89	4
CAN29	1943	55	90	5
CAN32	1930	53	89	5
CAN21	1926	51	87	4
CAN11	1911	51	82	8
CAN26	1908	54	89	6
CAN51	1904	51	83	7
CAN33	1901	54	89	5
CAN16	1896	55	91	6
CAN3	1849	52	87	3
CAN2	1792	48	75	4
Mean	2083			
CV %	15.6			
Standard error	188			

Lodging score: 1 = no lodging, 9 = 90% lodged

Water applied (mm):	Irrigation	Rainfall	Total
May 1-31	20.0	63.0	83.0
Jun 1-30	57.5	18.4	75.9
Jul 1-31	189.0	11.5	200.5
Aug 1-31	72.5	48.0	120.5
Total	339.0	140.9	479.4

Replications: 3
Plot size: 1.2 m x 3.7 m - 20 cm rows
Planting rate: 25 Kg/ha
Planting date: May 17
Harvest: Direct combined at maturity in late September

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

Co-operator: Keith Carlson
Location: NW-8-31-7 W3rd
Progress: First year of three
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.

Dry bean production under irrigation in south-central Saskatchewan has good potential. The fungal disease *Sclerotinia* (white mold) is the biggest threat to irrigated dry bean production. *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 the best coverage of the flowers and lower stems. This demonstration compared two methods of fungicide application, the conventional boom sprayer and an airblast sprayer. 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 a small percentage of plants (Table 1). There were no significant differences in yield or *Sclerotinia* infection 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 1989.

Sprayer Treatment	Benomyl application Number	Benomyl application Rate (lb/ac)	Sclerotinia infection (%)	Net yield† (lb/ac)
Conventional	1	2.0	0.1 a	1718 a
Airblast	2	1.0	0.6 a	1569 a
Airblast	1	2.0	1.0 a	1445 a
Unsprayed	0	0	0.1 a	1704 a

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. Two replications per treatment.

Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology

Co-operator: Jerry Eliason
Location: SW-2-30-6 W3rd
Progress: Completed
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.

Both sprayers made one application of benomyl (Benlate) at two pounds per acre on July 20. The airblast sprayer was also used for a split application treatment where the benomyl was applied at one pound per acre on July 20 and August 14. The results are shown in Table 1. There were no significant yield differences among treatments. The weather pattern in 1989 was not favourable for *Sclerotinia* development in irrigated dry bean.

Table 1: Sprayer treatments, fungicide application rates among volumes, yield and Sclerotinia infection for irrigated pinto bean near Outlook, Saskatchewan, in 1989.

Sprayer Treatment	Benomyl Application Number	Benomyl Application Rate (lb/ac)	Sclerotinia infection (%)	Net yield† (lb/ac)
Conventional	1	2.0	0.0	1031 a
Airblast	2	1.0	0.0	930 a
Airblast	1	2.0	0.8	1185 a
Unsprayed	0	0	0.0	934 a

† Adjusted to 16% moisture content. Two replications per treatment.
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. Two replications per treatment.

Although *Sclerotinia* is a real threat when growing irrigated dry bean, infection does not occur every year. To make sound management decisions about fungicide application, dry bean growers should become acquainted with the development stages of the dry bean plant, with the disease *Sclerotinia,* their interaction and the risks involved in selecting fields with a previous history of *Sclerotinia* problems. If all aspects are monitored closely, an application of fungicide may be avoided. In years with cool damp weather prior to or at flowering, two applications of fungicide may be necessary if the crop is grown on a field with high infection potential.

Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology

Co-operator: Dennis Kelk
Location: SE-13-26-7 W3rd
Progress: First 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 the biggest threat to irrigated dry bean production. *Sclerotinia* can be controlled by fungicide application. *Sclerotinia* control using fungicides is most effective when the flowers and lower stems are covered prior to a period when disease development potential is high. A conventional sprayer may not provide the best coverage of the flowers and lower stems. This demonstration evaluated two methods of fungicide application, the conventional boom sprayer and an airblast sprayer in comparison to a control. Each sprayer was used to apply benomyl (Benlate) at 2 lb/ac to designated strips of Topaz pinto bean on July 21. A survey of each treatment strip revealed a low level of *Sclerotinia* infection (Table 1). There were no significant yield differences among spray treatments.

The effectiveness of fungicidal control of *Sclerotinia* by a conventional sprayer compared to an airblast sprayer could not be compared in 1989 at this site because of the lack of *Sclerotinia* infecton.

Table 1: Effect of benomyl rate applied with two types of sprayers, on Sclerotinia infection and yield of irrigated pinto bean near Dunblane, Saskatchewan, in 1989.

Sprayer Treatment	Rate of benomyl (lb/ac)	Sclerotinia infection (%)	Net yield† (lb/ac)
Conventional sprayer	2.0	0.2 a	629 a
Airblast sprayer	2.0	0.6 ab	950 a
Unsprayed	0	1.6 b	841 a

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. Two replications per treatment.

Irrigated Pinto Bean Agronomy: Evaluation of Disease Control Technology

Co-operator: Dennis Walberg
Location: NE-21-30-7 W3rd
Progress: First 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.

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 21. At harvest, a survey of each treatment strip revealed *Sclerotinia* infection on a negligible number of plants in this field. There were no significant differences in yield among spray treatments. In 1989, 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 1: Effect of benomyl rate applied with two types of sprayers, on Sclerotinia infection and yield of irrigated pinto bean near Outlook, Saskatchewan, in 1989.

Sprayer Treatment	Rate of benomyl (lb/ac)	Sclerotinia infection (%)	Net yield† (lb/ac)
Conventional sprayer	2.0	0.0	1141 a
Skid-boom sprayer	2.0	0.0	1164 a
Control	0	0.1	1053 a

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. Two replications per treatment.

Irrigated Great Northern Bean: Evaluation of Disease Control Technology

Co-operator: John Konst
Location: NE-3-30-8 W3rd
Progress: First 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. 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 21. A survey of each treatment strip revealed *Sclerotinia* infection on a small percentage of plants in this field. Percent *Sclerotinia* infection was highly variable, due to the presence of a small "hot spot" of infection within one of the control strips. However, there were no significant differences in yield among sprayer treatments.

Table 1: Effect of benomyl, applied with two types of sprayers, on Sclerotinia infection and yield of irrigated pinto bean near Outlook, Saskatchewan, in 1989.

Treatment	Rate of benomyl (lb/ac)	Sclerotinia infection (%)	Net yield† (lb/ac)
Conventional sprayer	2.0	1.5 a	2013 a
Skid-boom sprayer	2.0	1.5 a	2016 a
Unsprayed	0	12.9 a	2018 a

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. Two replications per treatment.

Skid Boom Sprayer Evaluation for Sclerotinia Control in Irrigated Pinto Bean

Co-operator: John Konst
Location: Outlook
Progress: Completed
Objective:
1) to construct a skid-boom spray unit that can be used in conjunction with traditional seeding equipment for irrigated dry bean production.
2) to evaluate the economics of skid-boom spraying for irrigated dry bean production by using the spray unit in a network of demonstration projects.

A skid-boom sprayer was designed and manufactured to apply fungicide for controlling *Sclerotinia* in irrigated dry bean. The sprayer was successfully used at three demonstration sites. An effective comparison to a conventional sprayer for fungicidal control of *Sclerotinia* in dry bean was not possible in 1989 due to a lack of *Sclerotinia* infection on irrigated dry bean. The skid-boom sprayer will be used in 1990 and 1991 in a network of irrigated dry bean demonstrations to compare this method of spraying fungicide to conventional spraying for control of *Sclerotinia* in irrigated dry bean.

The fungal disease *Sclerotinia* (white mold) is always a threat to irrigated dry bean production. *Sclerotinia* can be controlled by an application of fungicide. Control is best when the flowers, lower branches and stem are covered with fungicide. A conventional sprayer may not provide the best coverage. Flowers, lower branches and stem of dry bean plants may get better fungicide coverage from a skid-boom sprayer. This demonstration involved designing and manufacturing a skid-boom sprayer.

The skid-boom sprayer has skid plates that slide on the ground between rows. Two nozzles are mounted at upward-facing angles on each plate, directing the spray at the blossoms, lower branches and stem of the dry bean plants. This model has a 14 foot wide boom with eight skid plates. Skid plate spacing is adjustable to accommodate various dry bean row spacings. The boom and skid plates are mounted on the front of the tractor while the tank (3-point hitch mounted) and pump are at the rear.

Three irrigated dry bean demonstrations utilized this skid-boom sprayer as a comparison to a conventional sprayer for fungicidal *Sclerotinia* control. The weather pattern in 1989 was not conducive to development of *Sclerotinia*. Without *Sclerotinia* infection, disease control with fungicide applied by either sprayer could not be evaluated. The skid-boom sprayer will be used in future dry bean demonstrations to determine which sprayer type is superior for fungicidal control of *Sclerotinia*.

Irrigated Field Pea Demonstrations

Supervisor: A. Kapiniak, B. Vandenberg
Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement

Irrigated Field Pea Agronomy: Early Seeding Demonstration

Co-operator: John Konst
Location: Outlook (SE-10-30-8-3)
Progress: Second year of three
Objective: To demonstrate the yield benefits of early seeding for irrigated field pea.

Early seeding of field pea is a recommended practice for field pea production throughout western Canada. Hot weather stresses pea plants and may cause flower abortion. Seeding early encourages vegetative growth and flowering during the cooler part of most growing seasons. Results from 1989 were inconclusive (Table 1). There was no late-seeded treatment. Although the May 10 seeding date was highest yielding, results were inconclusive because of herbicde interaction. Lower yield of the first two seeding dates was attributable to an application of Basagran during the early stages of flowering. This caused flower and young pod abortion. Seed size was slightly lower for the third seeding date but all dates had large seed size for the variety Radley grown on dryland. There was no quality loss due to bleaching.

Table 1: Effect of seeding date on yield, seed size, and grade of irrigated Radley field pea near Outlook, Saskatchewan in 1989.

Seeding date	Average yield† (kg/ha)	Seed weight (mg)	Grade
April 17	2658	205	Peas 1 Canada Green
April 25	2997	203	Peas 1 Canada Green
May 10	3508	195	Peas 1 Canada Green
Mean	3054	201	

† Not adjusted for moisture content differences.

Irrigated Field Pea Agronomy: Early Seeding Demonstration

Co-operator: Gordon Ofstie
Location: Glenside (SW-17-29-6-3)
Progress: First year of two
Objective: To demonstrate the yield benefits of early seeding for irrigated field pea.

Early seeding of field pea is a recommended practice for field pea production throughout western Canada. Hot weather stresses pea plants and may cause flower abortion. Seeding early encourages vegetative growth and flowering during the cooler part of most growing seasons. Less stress during flowering should increase yield potential. This demonstration was irrigated using a side-roll sprinkler system. The north half was lower and received more moisture. Results were inconclusive because the third date was hailed out prior to harvest. Samples from all three seeding dates were graded "Peas 1 Canada Green" by the Canadian Grain Commission. Seed size was reduced for the later seeding dates.

Table 1: Effect of seeding date on yield, seed size, and grade of irrigated Radley field pea near Glenside, Saskatchewan in 1989.

Seeding date	Average yield (kg/ha) North half	Average yield (kg/ha) South half	Seed weight (mg)	Grade
April 25	2344	2317	196	Peas 1 Canada Green
May 9	2686	2240	178	Peas 1 Canada Green
May 27	1608	1301	168	Peas 1 Canada Green

Irrigated Field Pea Agronomy: Early Seeding Demonstration

Co-operator: Murray Purcell
Location: Pike Lake (SE-10-33-6-3)
Progress: First year of two
Objective: To demonstrate the yield benefits of early seeding for irrigated field pea.

Early seeding of field pea is a recommended practice for field pea production throughout Western Canada. Seeding early encourages vegetative growth and flowering during the cooler part of most growing season. If plants are less stressed during flowering, a greater yield should be gained from seeding early. Results from this project in 1989 were inconclusive because no yield data were obtained for the April 30 seeding date. A strong wind rolled the sample swath, mixing it with the other swaths prior to harvest. Seed size was larger for the earlier seeding date (Table 1). However, seed size was small for both seeding dates when compared to seed from other demonstrations. The smaller seed size indicates a lack of water during the pod filling growth stage. Samples from both seeding dates were graded "Peas 1 Canada Green" by the Canadian Grain Commission.

Table 1: Effect of seeding date on yield, seed size, and grade of irrigated Radley field pea near Pike Lake, Saskatchewan in 1989.

Seeding date	Average yield† (kg/ha)	Seed weight (mg)	Grade
April 30	----	-----	------------------
May 7	2038	153	Peas 1 Canada Green
May 21	1669	113	Peas 1 Canada Green
Mean	1854	133	

† Adjusted to 16% moisture content.

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: Michael Millar
Location: Birsay (NE-5-24-7-3)
Progress: Second year of three
Objective: To demonstrate to producers the importance of early seeding for irrigated fababean production.

Inconsistent yield is a major problem for fababean producers. Research across Western Canada shows that early seeding increases yield potential. The beneficial effect of early seeding for fababean was demonstrated in 1989. Yield from plots seeded April 21 was 1% greater than from plots seeded on May 2, but 42% greater than those seeded on May 28 (Table 1). The earliest seeding date produced the largest seeds. Significantly smaller seeds were produced when seeding was delayed. These results are consistent with the 1988 demonstration results.

Considering results from the past two years of this demonstration in south-central Saskatchewan, it is highly recommended that irrigated fababean be seeded as early as possible to obtain maximum yield.

Table 1: Effect of seeding date on yield of Outlook fababean under irrigation in 1989 at Birsay.

Date of seeding	Yield (kg/ha)	Yield (lbs/ac)	Seed weight (mg)
April 21	4195	3746	376
May 2	4162	3716	362
May 28	2438*	2177*	330*
Mean	3598	3213	356
CV	6.9%		1.4%

* Significant difference at P > 0.05 levels.

Irrigated Lentil Agronomy: Irrigation Scheduling Demonstration

Supervisors: A. Kapiniak, A. Vandenberg
Saskatchewan Irrigation Development Centre
Funding: Irrigation Based Economic Development Agreement
Co-operator: Gordon Ofstie
Location: Glenside (SW-17-29-6-3)
Progress: First year of three
Objective: To evaluate irrigation strategies for lentil production.

Lentil is a specialty crop that is successfully produced under dryland conditions. Production under irrigation has shown erratic yield results. The choice of variety for irrigated lentil production is important. Eston or French lentil are recommended. Water scheduling is also an important consideration for irrigated production. This demonstration was set up to evaluate four irrigation strategies for lentil production using a side-roll sprinkler system. These are: 1) pre-irrigate and irrigate once at flowering, 2) pre-irrigate, irrigate once at flowering and once two weeks later, 3) same as two except no pre-irrigation, and 4) pre-irrigate only. Results for 1989 are shown in Table 1.

The field was on the side of a hill. Due to yield potential differences, the upper and lower parts were separated into fields "A" and "B", respectively, for more realistic comparisons. The crop was damaged by hail, therefore, average yields did not reach their potential. Treatment Number 4 was excluded from the statistical analysis because it was not replicated. Within each field the yield from each irrigation schedule (treatment) were not significantly different. For the lower part of the field, treatments with pre-irrigation and at least one irrigation at the beginning of flowering were consistently higher yielding than those with no pre-irrigation or no post-emergent irrigation. The swathed crop received several rain showers while laying in the field. The crop was graded as "Lentils 1 Canada". Seed size was unaffected by irrigation treatment. Considering the yield, the hail damage and grade received in 1989, French lentil shows good potential as an irrigated specialty crop.

Table 1: Effect of irrigation schedule on yield and seed size, of irrigated French lentil near Glenside, Saskatchewan in 1989.

Field	Irrigating treatment number	Pre-irrigation	Number of post-emergent irrigations†	Number of strips	Average yield‡ (lb/ac)	Seed weight (mg)
A	1	Yes	1	2	1103	30
	2	Yes	2	3	1189	30
	3	No	2	2	900	30
	4	Yes	0	1	825	29
Mean					1004	30
B	1	Yes	1	2	1501	30
	2	Yes	2	3	1444	30
	3	No	2	2	1250	29
	4	Yes	0	1	1151	29
Mean					1337	30

† First irrigation at flowering; second irrigation two weeks later.
‡ Adjusted to 14% moisture content.

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: Jim Massey
Location: Riverhurst (SW-35-23-6 W3rd)
Progress: First 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. Application of nitrogen under irrigated conditions in south-central Saskatchewan may delay maturity so that fall frost causes crop damage.

In 1989, the average yield of all treatments was 1280 lb/ac (Table 1). Potential yield (2500 to 4000 lb/ac) was not realized due to competition from weeds. Increased nitrogen application increased weed growth, which resulted in decreased safflower yields. There were no significant differences in yield among nitrogen treatments. Seed size followed the same trend as yield.

Further evaluation with better weed control will be necessary to determine the response of irrigated safflower to nitrogen fertilizer.

Table 1: Effect of nitrogen application on yield, seed weight, and plant density of irrigated safflower at Riverhurst, 1989.

Nitrogen (N) application (lb/ac)	Yield† (lb/ac)	Seed weight (mg)	Plant population (plants/m^2)
25	1377	31.4	41
50	1465	32.0	33
100	998	29.7	30
Mean	1280	31.0	35
CV% =	18	5	14
LSD (0.05)	NS	NS	NS

† Yield adjusted to 9.5% moisture content. Three replications per treatment.

Sunflower Co-operative Trial

Principal: D. S. Hutcheson
Agriculture Canada Research Station
Saskatoon, Saskatchewan
Co-operator: Saskatchewan Irrigation Development Centre

All tests were conducted by the Saskatchewan Sunflower Committee with funds provided by testing fees paid by companies submitting entries. The test was grown at several locations in Saskatchewan.

Each test was arranged in a randomized complete block design with four replicates. Oilseed types were grown at a population of 45,000 plants/ha. Protection from bird damage was provided for all sites. Oil content and confection seed sizing was carried out at the Saskatoon Research Station.

The test was co-ordinated by the Saskatoon Research Station.

Table 1. Main characteristics of varieties under irrigation at Outlook.

Variety	Yield as % of USDA 894	Average maturity in days	Oil%
894	100	127	44.7
DO-755	106	128	45.2
DO-855	104	126	45.6
IS 7000	97	125	48.1
IS 7111	89	127	48.2
S 1296	104	126	46.8

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: First year of two
Objective:

Recent indications that potato seed tubers grown at high latitudes out-yield seed produced at lower latitudes has 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 yields of high quality seed tubers of the cultivars in demand in their potential markets. The greatest demand and highest prices are for whole seed; this study will examine the cultural practices required to increase yields of the desired size seed. Planting density, fertility and moisture availability affect both yields and tuber size distribution of potatoes. The direct effects and interactions between these factors on yield of whole seed tubers of the potato cultivars with the greatest potential market demand will be examined in this study. Based on these trials, cultural recommendations for optimizing production of whole seed tubers will be developed.

Trials were conducted in the summer of 1989 at the S.I.D.C. in Outlook and at the University of Saskatchewan field plots in Saskatoon. Both sites had been planted to barley in 1988.

The trials were 2 X 2 X 4 X 3 factorial combinations of moisture availability (irrigated and dryland), N fertility (1 and 1.5 times S.S.T.L. recommendations for potatoes), cultivar (Norland, Russet Burbank, Shepody and Yukon Gold) and in-row spacing (15, 23 or 30 cm). The design employed was a split-split-split plot with two replicates. Moisture availability was the main plot, nitrogen fertility the sub-plot, cultivar the sub-sub-plot and spacing the sub-sub-sub-plot. Two weeks prior to planting, the plots were double disked. Sufficient 11-55-0 was broadcast and incorporated to raise soil P concentrations to the level recommended by the S.S.T.L. for potatoes (112 kg/ha). Sufficient 34-0-0 was broadcast and incorporated to raise the soil N in the plots to the level recommended by the S.S.T.L. (200 kg/ha) or to 1.5 times the recommended level (300 kg/ha).

The Saskatoon and Outlook sites were hand planted on May 15/16 and May 19, respectively. Certified seed of Norland, Russet Burbank, Shepody and Yukon Gold potatoes was cut and handled according to commercial practices then planted at 15, 23 or 30 cm in-row spacings. Each spacing plot consisted of two 6 m long rows, 1 m apart.

Soil moisture tensions were measured using tensiometers installed at 20, 35 and 50 cm depths in the rows at two sites in each moisture availability treatment. Soil moisture potentials were measured 1-2 times weekly. Rainfall and irrigation input were recorded at 4 locations at each site. The moisture treatments were established immediately following planting using a solid set irrigation system. Irrigated plots were watered when soil water potentials averaged over the three soil depths reached -30 cbar. Irrigation continued until the SWP at 20 cm approached 0 cbars.

Sweep (Paraquat, Chipman Co.) was applied at 1.75 L/a for pre-emergent control of broadleaf and grassy weeds. Emergence counts were taken on June 29 in Saskatoon and June 30 in Outlook. A Lilliston rotary cultivar was employed to control weeds between the rows and to hill the potatoes.

The trials were harvested following the first killing frost on September 18 in Saskatoon, and September 20/21 in Outlook using a small plot digger. Mainstem counts were taken just prior to harvest. The following yield data were collected at grading; total yield, marketable yield (45 to 85 mm diam) drop seed yield (< 45 mm diam) oversize yield (> 85 mm diam) and seed yield (total-oversize). The number of tubers in each category also were determined.

Data were subjected to analysis of variance (ANOVA) and means were separated by Duncan's multiple range tests when significant ($P < 0.10$) F values were obtained in the ANOVA.

Results and Discussion:

Conditions were favorable for potato production at both sites providing that irrigation was used to supplement the inadequate moisture supplied by rainfall. The dryland plots experienced significant drought stress resulting in restricted vegetative growth and poor yields.

Irrigation increased yields of all grades of tubers at both sites. Irrigated yields were somewhat higher than those expected for irrigation commercial operations in Saskatchewan, while the very low dryland yields reflected the scarcity of rainfall at both sites. Irrigation reduced the percentage of total yield suited for use as drop seed, although actual yields of drop seed increased under irrigation. Irrigation appears to promote tuber bulking more than tuber initiation.

At Outlook, applying N at 1.5 the S.S.T.L. recommended rate increased total yields, marketable yields and yields of tubers suited for use as seed, relative to N at 1 X the S.S.T.L. recommendation. The N effect was consistent across irrigation treatments, the cultivar tested and the in-row spacing used. Yields of drop seed were similar at the two N rates, but the high N rate encouraged tuber bulking, thereby significantly reducing the percentage of the total yield suited for use as drop seed. At Saskatoon, the N variable had no significant effect on any of the yield variables examined. The irrigation X nitrogen level interaction was, however, significant for total, marketable and seed yields. The higher N rate improved yields when irrigation was used to provide sufficient moisture for crop growth. When crop growth was limited by moisture stress, nitrogen availability had no effect on yield.

The four cultivars responded similarly to the irrigation, N fertility and spacing variables at both sites. Yields of Yukon Gold were somewhat lower than the other cultivars, due to poor stand establishment and losses to soft rot. Drop seed yields and the percentage of total yield suited for use as drop seed were higher for Russet Burbank than for the other cultivars. Russet Burbank set more tubers than the other cultivars which could result in more small tubers suited for use as drop seed. We suspect that the higher drop seed yields for the Russets merely reflects the fact that tuber diameter was used to segregate the yield categories. The long thin Russet tubers would be graded as drop seed based on their diameter more frequently than equivalent weight tubers from more blocky or oblong shaped cultivars.

At both sites, the 15 cm in-row spacing resulted in significantly higher total, marketable, drop seed and total seed yields than the wider spacings. This yield advantage was consistent across the fertility and cultivar variables. The percentage of the total yield fitting into the drop seed category was higher at the 15 and 23 cm in-row spacing than at 30 cm. The increased interplant competition stemming from the closer spacing likely reduced the average tuber size, allowing more to fit into the drop seed category.

Yields were less affected by N in the drylands trials. Benefits after cost ranged from $-500 to $+2000, with the largest losses occurring when the high rate of N actually suppressed yields.

On irrigated land, the closest in row spacing (15 cm) produced the highest net returns after costs, even if seed costs were high ($300/T) but eventual prices low ($200/T). Differences between net returns with 23 and 30 cm spacings were variable, depending on seed costs versus prices.

For dryland production, the optimum in-row spacing varied between sites and cultivars. At Saskatoon, dryland yields were uniformly low at all in-row spacings, consequently the higher input costs associated with narrow seed piece spacing resulted in lower net returns. At Outlook, the higher yields associated with close seed piece spacings were sufficient to overcome the higher costs.

Irrigation was cost effective under this year's growing conditions in south central Saskatchewan.

<u>Cost Analysis Summary</u>:

The highest net returns after variable costs were obtained with the 15 cm in-row spacing, 300 kg N/ha and irrigation. The figures presented should be used with caution as they are based on a single season under Saskatchewan growing conditions using cost and return figures which may not be valid for all growers or years.

Table 1. Summary of Significant Yield Components - Saskatoon Site.

Source	Total wt.	Marketable wt.	Drop wt.	% Drop	Seed wt.
		(T/ha)			
Irrigation					
Dryland	5.4	3.0	2.2	41	5.4
Irrigated	37.6	30.1	6.4	17	36.6
Cultivar					
Norland	20.6b*	16.4b	2.8b	14b	19.5b
Russet Burbank	22.0ab	14.9b	7.2a	33a	21.6ab
Shepody	24.5a	20.5a	3.8b	15b	24.3a
Yukon Gold	18.5c	14.7b	3.5b	19b	18.2c
Spacing					
15 cm	23.0a	16.6a	5.9a	26a	22.6a
23 cm	21.3ab	16.8a	4.9ab	23a	21.0b
30 cm	20.6b	16.5a	3.0b	14b	20.0b
Nitrogen					
1 X recommended	19.0	14.2	4.5	23	18.7
1.5 X recommended	24.0	19.0	4.4	18	23.4

* Values within columns followed by the same letter are not significantly different by Duncan's test for mean separation (P = 0.05).

Table 2. Summary of Significant Yield Components - Outlook Site.

Source	Total wt.	Marketable wt.	Drop wt.	% Drop	Seed wt.
		(T/ha)			
Irrigation					
Dryland	16.0	12.1	3.6	23	15.8
Irrigated	31.5	26.9	4.1	13	31.0
Cultivar					
Norland	24.8a*	21.2a	2.9b	12c	24.2a
Russet Burbank	25.8a	19.04a	6.7a	26a	25.6a
Shepody	25.9a	22.9a	2.7b	10c	25.6a
Yukon Gold	18.4b	14.9b	3.4b	18b	18.4b
Spacing					
15 cm	26.1a	21.3a	4.5a	17a	25.8a
23 cm	21.9b	17.9b	3.7b	17a	21.6b
30 cm	23.3b	19.3ab	3.5b	15b	23.0b
Nitrogen					
1 X recommended	20.8	17.0	3.6	17	20.5
1.5 X recommended	26.6	22.0	4.1	15	26.4

* Values within columns followed by the same letter are not significantly different by Duncan's test for mean separation (P = 0.05).

Evaluation of Seed Potatoes at Northern Latitudes

Principal:	M.N.J. Wahab, Department of Horticulture Science University of Saskatchewan, Saskatoon, Saskatchewan
Co-investigators:	D.R. Waterer, C. Stushnoff

Progress:	Final year
Objectives:	a) to determine which cultivar(s) will regularly yield the maximum quantity of starch per unit area under irrigated production in Saskatchewan; b) to determine and demonstrate agronomic and irrigation management techniques required for maximum production of potato starch per unit area.

This trial is part of a larger project conducted by the Department of Horticulture Science, University of Saskatchewan to study the influence of site of production of potato seed-tubers on growth and productivity of the progeny.

Elite III seed-tubers of cvs. Norland and Russet Burbank from Pemberton Valley, British Columbia were multiplied in Becker (Minnesota), Outlook, Saskatoon, and Prince Albert (Saskatchewan) during the summer of 1988. These seeds were stored under uniform storage conditions in Saskatoon and then grown in replicated yield trials at several locations including the Irrigation Centre, Outlook in 1989. The experiment was laid out as a Randomized Complete Block Design with six replications. Yield estimations were made at 90 days ('Early' harvest) and 120 days ('Final' harvest) from planting. Tubers were graded into different categories according to diameter viz. 25-45 mm (small), 45-90 mm (marketable), and >90 mm (over-size). The marketable tubers described in this paper comprises both marketable and over-size grades.

Results

At the 'Early' harvest the average tuber yield of cv. Norland was significantly higher than Russet Burbank; Norland and Russet Burbank produced 31.07 and 6.99 t/ha marketable yield respectively. Russet Burbank seeds which originated in Becker produced the lowest yield, and Outlook, Saskatoon, and Prince Albert seed sources recorded 9, 12 and 6 fold yield increases compared to the Becker source (Table 1). With Norland the Becker source produced the lowest tuber yield, and the Outlook, Saskatoon and Prince Albert sources outyielded the Becker Source by 67.2%, 76.3%, and 79.5% respectively (Table 1). For Russet Burbank the Becker source produced fewer tubers which were considerably smaller in comparison to marketable tubers obtained from the three Saskatchewan sources. The drop in yield with Norland from the Becker source was primarily due to lesser number of tubers that attained marketable grade (Table 1).

At the final harvest, Russet Burbank from Becker produced extremely low marketable tuber yields and the three Saskatchewan seed sources recorded over 10-fold yield increases over the Becker source (Table 2). The yield increases of Russet Burbank from the Saskatchewan seed sources compared to the Becker source was as a result of greater number and larger marketable tubers produced by the former seed sources. The marketable yields resulting form the three Saskatchewan seed-tubers were not significantly different (Table 2).

For Norland crops produced from the Saskatchewan seeds significantly outyielded the crop produced from the Becker source at the final harvest (Table 2). The yield advantage through the Outlook, Saskatoon, and the Prince Albert sources over the Becker source were 47.1%, 47.3%, and 51.3% respectively. The superiority in tuber yield of the Saskatchewan seed sources during the 'Final' harvest were mainly due to greater number of marketable tubers per plant (Table 2).

The plants produced from the Saskatchewan seed sources grew more vigorously than those from Becker seeds (indicated by shoot fresh weight during 'Early' harvest, Table 1). With Norland, although, there were no significant differences in haulm weight between the seed sources, the shoot weights of plants produced from the three Saskatchewan sources were more than 25% higher than that of plants produced from the Becker source.

Table 1. Effect of seed source on marketable[1] tuber yield, yield components, and shoot fresh weight during the 'Early' harvest.

Cultivar/source	Marketable tubers[1] Yield (t/ha)	No. per plant	Mean wt. (g)	Shoot fresh per plant (kg)
Russet Burbank				
Becker	0.12	0.03	100.00	0.23
Outlook	9.14	1.70	147.03	1.04
Saskatoon	12.35	2.27	149.99	1.26
Prince Albert	6.36	1.07	161.83	1.06
Northland				
Becker	19.94	3.83	137.72	0.54
Outlook	33.33	5.84	155.18	0.69
Saskatoon	35.16	5.97	157.46	0.68
Prince Albert	35.80	5.75	167.78	0.72
Sgnif. level (%)	<1.0	<1.0	5.00	<1.0
LSD (5.0%)	7.18	1.15	21.27	0.29
C.V. (%)	32.21	29.59	11.89	31.98

[1]-Tubers > 45 mm in diameter

Table 2. Effect of seed source on marketable[1] tuber yield, yield components of cvs. Norland and Russet Burbank during the 'Final' harvest.

Cultivar/source	Marketable tubers[1] Yield (t/ha)	No. per plant	Mean wt. (g)
Russet Burbank			
Becker	3.80	0.85	123.81
Outlook	41.85	4.98	229.41
Saskatoon	38.89	4.78	216.82
Prince Albert	37.27	4.45	225.35
Northland			
Becker	33.83	4.75	194.02
Outlook	49.77	8.32	163.39
Saskatoon	49.82	7.32	182.39
Prince Albert	51.17	6.72	207.38
Sgnif. level (%)	<1.0	<1.0	<1.0
LSD (5.0%)	9.37	1.30	25.95
C.V. (%)	20.86	21.10	11.48

[1]-Tubers > 45 mm in diameter

Soils/Fertilizer/Water

Determination of Soil Intake Rates under Center Pivot Irrigation

Principal: D. I. Norum
Department of Agricultural Engineering
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: Final year
Objectives:
a) to determine improved design and operating criteria for center pivot sprinkler systems taking into consideration the types of nozzles used, the application rate and the soil and crop canopy conditions;
b) to determine actual infiltration rate curves for various soils that are being sprinkler irrigated.

Tests were carried out on loam and sandy loam soils in the Outlook area to determine the time to reach surface ponding conditions when water was applied at different constant rates by sprinklers. Tests were conducted on bare soil, soil with a cereal cover, and soil with alfalfa cover. Both high pressure and low pressure sprinklers were used. The results show that, in general, application rates of more than 10 mm/hr result in ponding if more than 30 mm is being applied; however, for the low pressure tests, ponding occurred at less than 10 mm/hr. Slightly higher application rates could be used for the alfalfa cover.

Recommendations:

Based on the results of over 150 tests on loam and sandy loam soils, it appears that application rates of more than 10 mm/h will result in surface ponding under high pressure sprinklers and even lower rates will cause ponding on bare soil if low pressure sprinklers are used. If more than 30 mm is to be applied at a time, the application rate may have to be even lower than 10 mm/hr if ponding is not to occur. Alfalfa cover did not affect the final intake rate to any great extent; however, the rate did not decrease as rapidly as for cereal cover and bare soil, consequently, a greater depth of application could be used on the alfalfa.

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: Pederson Farm
Co-investigators: K. Best, R. Grover, J. Foley
Progress: First 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.

Preliminary results from a leachate study when irrigating Bonanza barley crop on a field at the Saskatchewan Irrigation Development Centre at Outlook using the linear low pressure sprinkler method (high volume) suggest the nitrogen concentration levels decreased with depth compared with phosphorus (which was opposite and not as expected). However, there was evidence that nitrogen levels increased at each depth interval with successive irrigations suggesting that some leaching occurred with time. At the 180 cm depth (lower root zone of a growing crop) the maximum observed concentrations for nitrogen and phosphorus was 8 and 0.12 mg/l, respectively.

With respect to Microtox Toxicity Bioassay test that uses non-pathogenic luminescent marine bacteria to measure the toxicity of the soil and water extract, a majority of the samples (66%) exhibited very low or no toxicity, 28% exhibiting low to moderate toxicity with only a small percentage (7.4%) and only 7% showing a medium to high toxicity. Further analysis are required to interpret the significance of the results.

Herbicide analysis were incomplete at the time of preparation of the report.

N-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
Objectives:	To maximize N-fertilizer use efficiency of irrigated crops

The efficiency and benefits of split N application by cereals and oilseeds were evaluated at the Centre at Outlook. In 1988, canola (Westar) received 0, 75+75, or 150 kg N/ha in the form of urea (U) or urea-ammonium nitrate (UAN). In 1989, durum (Kyle), soft wheat (Fielder) and canola (Westar) received 0, 100, 100+100, or 200 kg N/ha in the form of U or ammonium nitrate (AN). Plants were harvested five times during the growing season. In 1988, the second N application occurred at 54 days after planting. In 1989, the second N application for durum and soft wheat occurred at 45 days after planting (Feekes 7) and 38 days after planting for canola.

In 1988, unfertilized canola showed a grain yield of 1,832 kg/ha whereas the application of 150 kg N increased grain yield to 3,012 kg/ha. Split-N application, however, did not increase grain yield as compared with canola fertilized with 150 kg N/ha at time of seeding. No significant differences in grain yield between U and UAN fertilized canola were found.

In 1989 canola, durum and soft wheat responded strongly to N fertilizer. Unfertilized durum showed a grain yield of 2,267 kg/ha whereas durum fertilized with 200 kg N/ha showed a grain yield of 3,952 kg/ha. Grain yields for unfertilized and fertilized soft wheat were 2,981 and 5,358 kg/ha, respectively. N fertilization increased grain yield of canola from 1,049 to 1,890 kg/ha. However, no differences in grain yield were found between crops that received all fertilizer-N at time of seeding and crops that received half of the fertilizer-N 38 days after planting.

It was found that most of the N required for crop growth was taken up early in the growing season (Fig. 1 and 2). It appears that N should be available soon after seeding and that under Saskatchewan growing conditions, the time frame during which the second split N application can be carried out successfully is short, or, perhaps, even non-existent.

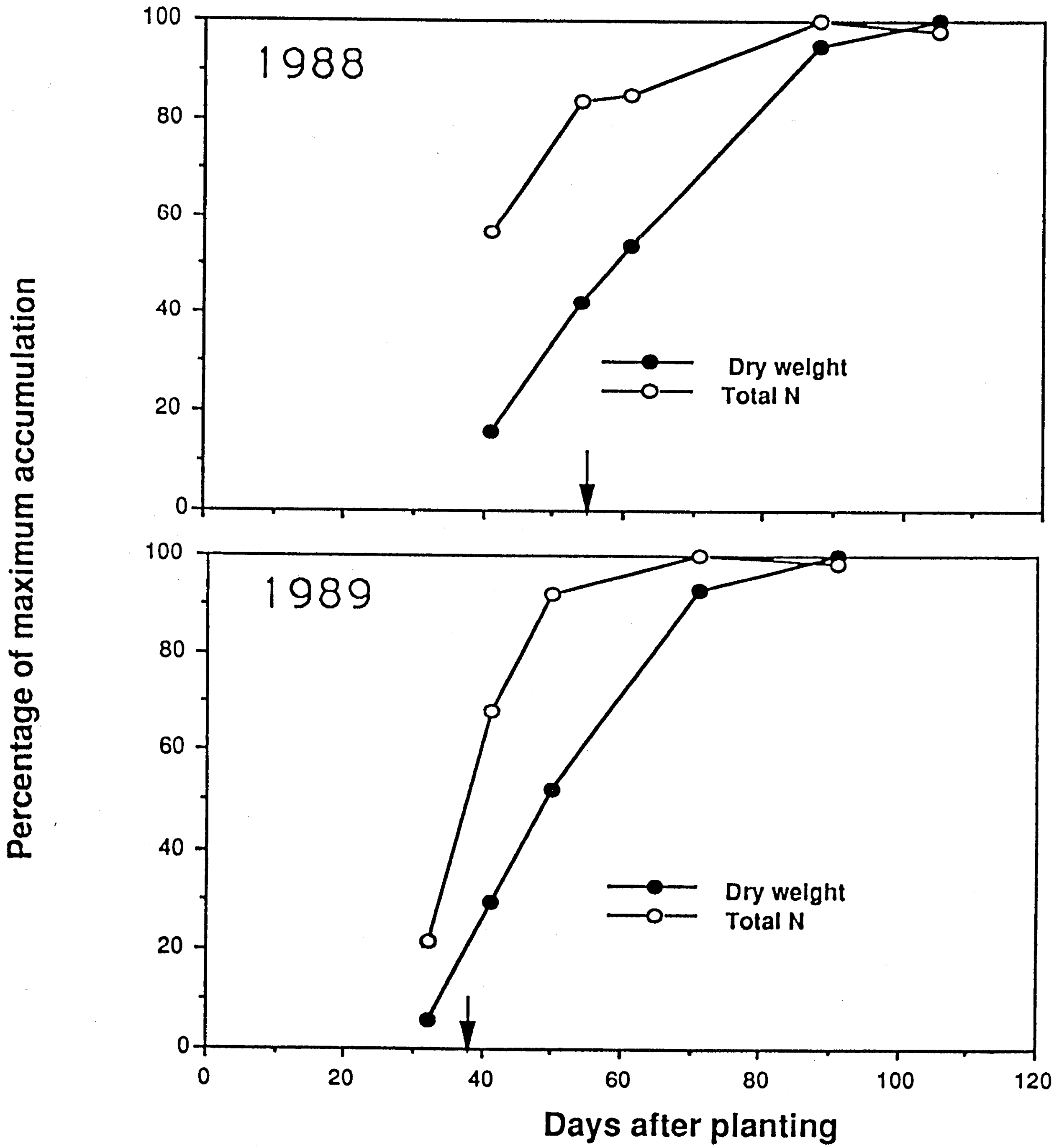


Fig. 1. Dry matter and total N accumulation in canola
Arrow indicates time of second split-N application

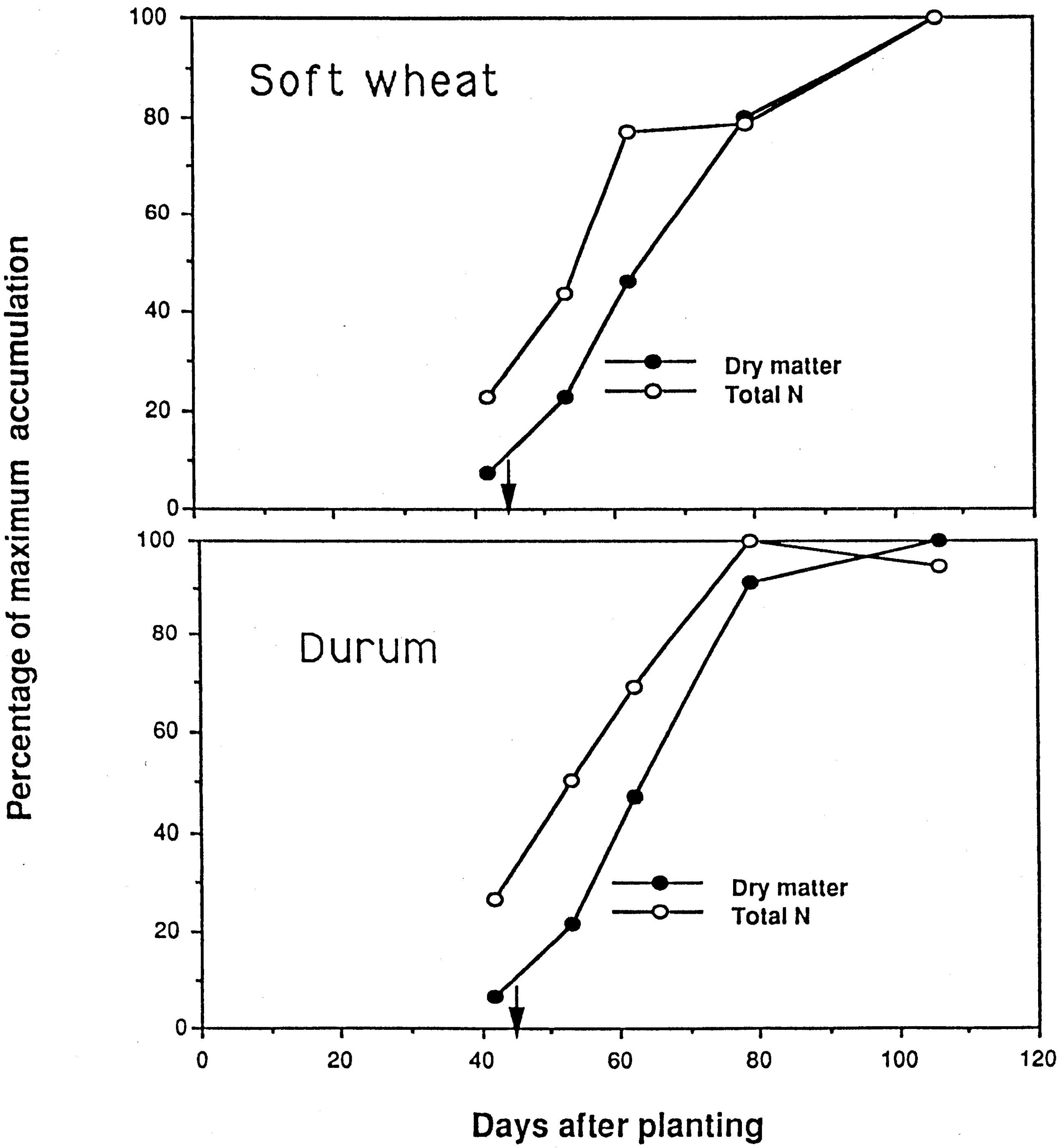
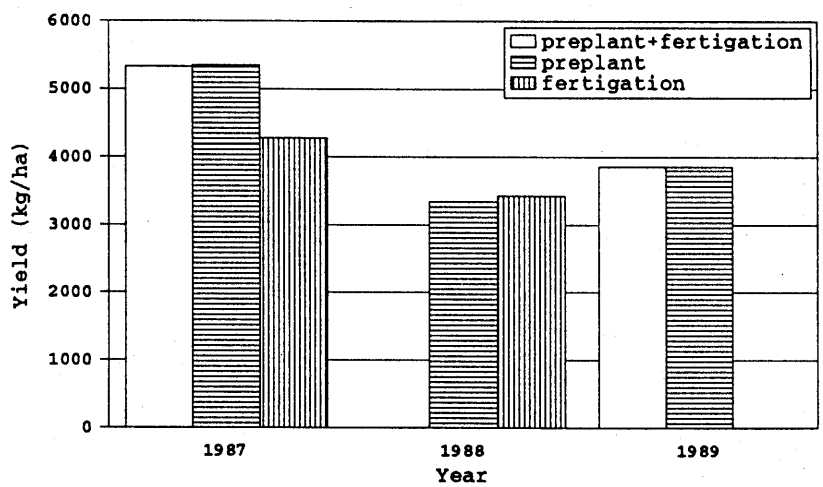


Fig. 2. Dry matter versus total N accumulation in soft wheat and durum
Arrow indicates time of second split-N application

Fertigation on Sandy Soils

Principal:	Deneen Duncan, Saskatchewan Irrigation Development Centre
Funding:	Irrigation Based Economic Development Agreement
Co-operator:	Roger & Richard Bond
Location:	Donavon (NW-27-32-6-3)
Progress:	Final year
Crop:	Katepwa wheat
Objective:	To evaluate the efficiency of fertigation as a method of applying nitrogen to crops.

Fertigation is no more or no less efficient than preplant applications of nitrogen fertilizer in terms of yield and seed quality. The most important information gained in the three years of the demonstration was that if a system involving 100% fertigation is preferred, the producer should be sure to conduct a soil test to determine that adequate levels of the essential nutrients are present during the initial phases of plant growth and until the first fertigation is applied. In 1987, soil test levels of nitrogen were very low (18 kg/ha) and were not enough to fully support plant growth until the first fertigation application. The result was a yield reduction for the 100% fertigation treatments. This was not evident in 1988 where the initial soil nitrate levels were 30 kg/ha. A combination of preplant nitrogen and fertigation is probably the easiest method to guarantee adequate nitrogen levels during plant growth. Only in 1989 did fertigation cause a statistically significant effect on seed protein. This difference in protein content was only 0.5% and is unlikely to ever have any economic impact for the producer.



1987-Samson Barley;1988/89-Katepwa Wheat

Fig 1: Effect of fertigation on yield.

In the past few years the price of a nitrogen solution (28-0-0) has been similar to the price of urea fertilizer which removes cost as a decision making factor between fertigation and preplant nitrogen. Convenience becomes the remaining factor. Size and orientation of the land base, cropping sequence, and reduced tillage requirements may cause fertigation to be a more convenient method of nitrogen application for part or all of a particular farm operation.

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

Principal: M. Grevers
Saskatchewan Institute of Pedology
University of Saskatchewan, Saskatoon, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Co-operators: Jerry Eliason, Dale Eliason, Randy & Roland Riopka
Location: Outlook
Progress: Second year of three
Objectives:
a) to increase the depth of moisture penetration in solonetzic soil;
b) to demonstrate the suitability of these solonetzic soils for irrigation when properly managed.

This report deals with the monitoring of soil properties and of crop production in the second year following deep ripping at three farm sites in the Outlook area (north-east of Glenside). Based on soil physical and soil chemical characteristics, deep ripping at Site DE (Dale Eliason farm) and Site JE (Jerry Eliason farm) should improve crop production, while at Site RR (Riopka farm), deep ripping is not expected to result in large differences in crop production. Deep ripping improved crop yields at only one of three sites (JE) in 1988, and not at the other two sites (possibly due to poor weed control).

In the spring of 1989, there were apparent differences in soil structure between the soils in the deep ripped and in the non-ripped areas of the fields. The 15-35 cm depth increment of the deep ripped soils was more porous than that of the non-ripped soils at Site DE and at Site JE. The same was also apparent at Site RR, however, the differences were less dramatic. The apparent differences in soil structure for the three sites persisted in the Fall of 1989.

The effect of deep ripping on the ability of the soil to conduct water (saturated hydraulic conductivity, K-Sat) was analyzed in May, 1990. For two of the sites (DE and RR), deep ripping appeared to have increased K-Sat of the 0-15 cm depth, however, these differences were not statistically different at the 5% significance level. At the third site (JE), there were no differences in K-Sat attributable to deep ripping.

Deep ripping significantly increased crop production at the DE site, where the yield of Durum increased by 40% from 54 to 75 bu/ac. At the JE site, the yield of beans was slightly greater (but not at the 5% significance level) in the deep ripped area of the field (38 bu/ac) compared to the non-ripped area of the field (33 bu/ac). At the RR site, the yields were similar: 49 bu/ac and 47 bu/ac of wheat for the deep ripped and the non-ripped areas of the field, respectively.

In summary, it appears that the effect of deep ripping on soil physical properties was still apparent in the second year of the experiment. Crop growth was improved where large differences in soil structure were apparent in the spring of 1989. The increased crop growth at the Dale Eliason farm site in 1989 suggests that substantial increases in crop growth might also have occurred in 1988 had it not been for crop failure due to poor weed control.

Drainage Investigations at SIDC

Principals: L. Tollefson, Saskatchewan Irrigation Development Centre
B. Harron, PFRA, Regina, Saskatchewan
B. Vestre, Saskatchewan Irrigation Development Centre

Salinity monitoring and reclamation activities were continued at the SIDC drainage site.

The area was planted to Bonanza barley (100 kg/ha) using a press drill on May 10, 1989. Fertilizer application was based on soil test recommendations. Weed control was adequate using diclofop methyl + bromoxynil at 3.5 l/ha and dichloroprop + 2-4D at 1.75 l/ha.

A total of 178 mm of irrigation water was applied during the growing season using a linear irrigation system. A post-harvest leaching irrigation was applied. A total of 355 mm of irrigation water was applied after harvest and prior to freeze-up.

An excellent crop of barley resulted in 1989 yielding 4,570 kg/ha. Lodging was a severe problem.

Monitoring:

Once the leaching irrigation had been completed, the drainage area was monitored on a 15-metre grid using an EM38 in the horizontal and vertical position. This EM38 data was then gridded and contoured using geostatistical software. Geosoft permits the calculation of the real extent of salinity at contour intervals selected to represent non-saline, slight, moderate and severely saline levels. The resulting contour maps of the readings are shown in Figure 1. The changes between the classes were as follows (Table 1):

Table 1. EM38 (Horizontal) reading changes, 1986-1989.

	1986	1989
	(% of field)	
Non-saline (< 2 mS/cm)	22	74
Slightly saline (2-4)	19	24
Moderately saline (4-8)	36	2
Severely saline (8-16)	23	0

Certainly a dramatic change has occurred as now approximately 98% of the field is classified non or slightly saline.

Detailed salinity analysis, utilizing the saturated paste extract (ECe), was conducted on soil samples taken at specific grid points in 1986, 1988 and 1989. In 1986, sixteen sites were sampled, fourteen were moderately to severely saline in the 0 - 50 cm depth. In 1989, fifteen of these sites were non or slightly saline. Table 2 summarizes the comparison.

Figure 1. EM38 Vertical and Horizontal Reading Contour Maps of Field #11.

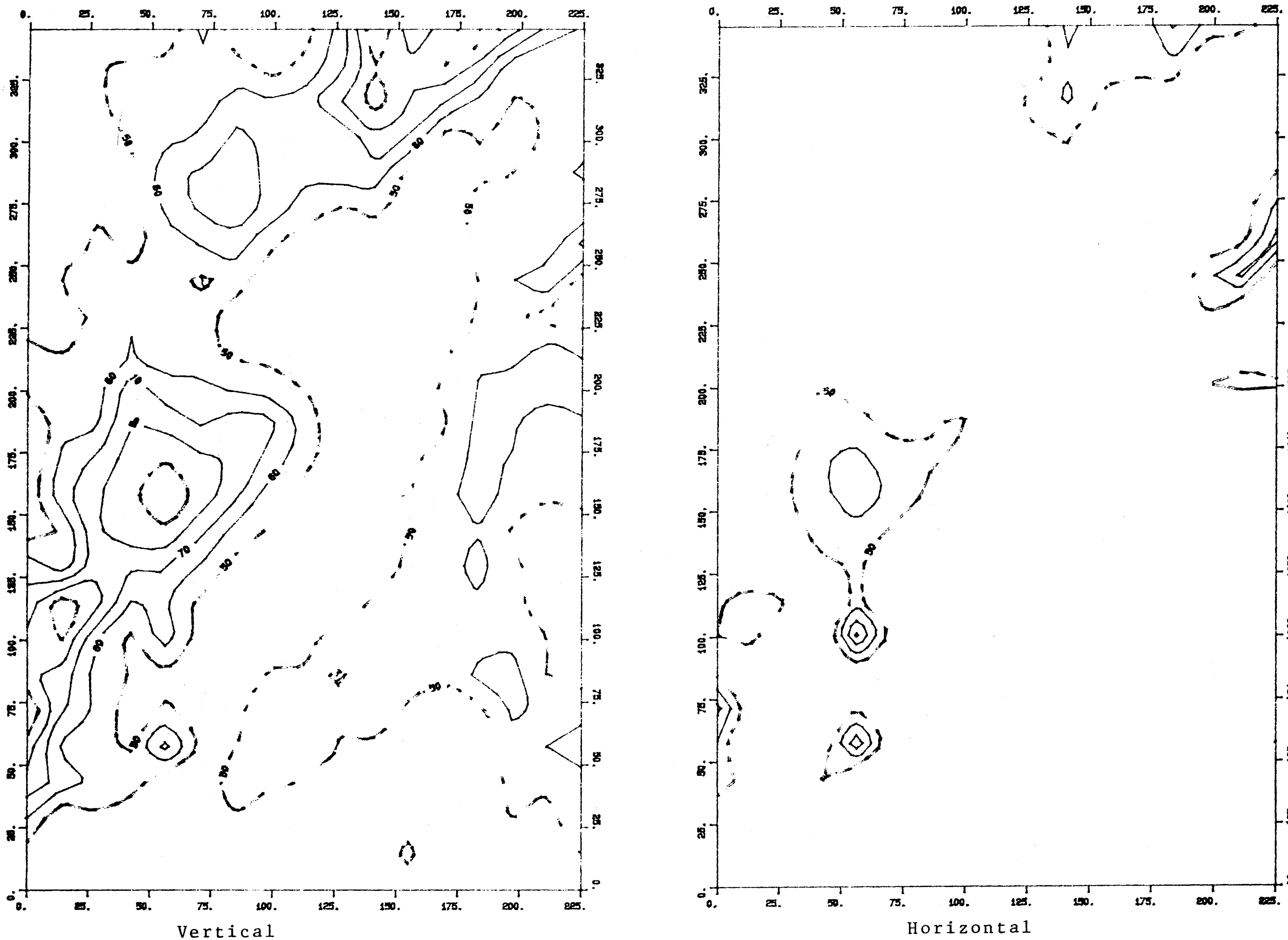


Table 2. Paired t-test comparing EC_e on Field 11.

Mean EC_e	1986 (0-0.5 m)	8.51 mS/cm
Mean EC_e	1988 (0-0.6 m)	2.73 mS/cm
Mean EC_e	1989 (0-0.6 m)	1.55 mS/cm
Mean differences 1986 to 1988		5.78 mS/cm**
Number of pairs		14
t		6.69
$t_{0.01}$		2.65
Mean difference 1986 to 1989		6.57 mS/cm**
Number of pairs		16
t		7.23
$t_{0.01}$		2.60
Mean difference 1988 to 1989		1.24 mS/cm**
Number of pairs		14
t		4.39
$t_{0.01}$		2.65
since $t > t_{0.01}$		

** difference is highly significant at the 99% level of confidence.

The mean EC_e difference is 6.57 mS/cm between 1986 and 1989.

It is evident that the soluble salt has been leached past the 0.6 m depth. Good crop growth has resulted. Continued leaching will occur in 1990.

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

Principal:	D. Cameron, Normac AES Ltd. Swift Current, Saskatchewan
Funding:	Irrigation Based Economic Development Agreement
Co-operator:	Doug Harrigan
Location:	Maple Creek (SW 17-11-26 W3rd)
Progress:	Second 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 on irrigated land. Due to dry conditions and high soil salt levels, there was not an adequate alfalfa catch on the plot area in 1988.

Soil tests taken in July 1989 indicated that both nitrogen and phosphorus levels were deficient. Fourteen large bales of material were harvested from this plot area giving an approximate yield of 900 kg/ha.

In 1990, Mr. Harrigan is considering reseeding the area to grass. The area to the west of the mole drain study will be utilized as part of a more comprehensive alfalfa establishment experiment. To date, gypsum has been applied on two strips.

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 N. Livingstone, E.A. Ripley, University of Saskatchewan
Location:	National Hydrology Research Centre, Saskatoon, Saskatchewan
Progress:	Second year of three
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.

The Atmospheric Environment Service weather radar at Elbow, Saskatchewan was upgraded in 1989 with the addition of a computer control and data processing system. The data processing component is operated by the Canadian Climate Centre's Hydrometeorological Research Division at the National Hydrology Research Centre in Saskatoon. To make the radar data available to the Saskatchewan Water Corporation's irrigation advisory service, software was developed to display and print rainfall maps with an IBM-PC compatible computer. In order to utilize this information effectively, an assessment of irrigation scheduling models was carried out and on the basis of that review one model was selected and improved for application at Outlook.

Irrigation Scheduling Model

A literature search for existing microcomputer soil moisture models was conducted in late 1988. Three models were selected for testing using data gathered by the University of Saskatchewan on an irrigated field near Birsay. Models were assessed according to their ability to track moisture through the growing season. The models investigated are described as follows:

Versatile Soil Moisture Budget (VSMB), as described in: Dyer, J.A. and A.R. Mack, 1984. The versatile soil moisture budget-version three. Tech. Bull. 1984-1E, Research branch, Agriculture Canada, Ottawa. The model used in these tests had been modified by E. de Jong and J.R. Bettany, 1986, of the Department of Soil Science, University of Saskatchewan, Saskatoon.

Irrigate, as described in: Boisvert, J., A. Bootsma and L. Dwyer, 1988. Irrigate, User's Guide. Central Agricultural Research farm, Agriculture Canada, Ottawa. This model incorporates the VSMB.

CERES, a crop growth model incorporating a soil moisture model, described in: J.T. Ritchie and S. Otter, 1985. Description and performance of CERES-wheat: a user-oriented wheat yield model, pp. 159-175 in Willis, W.O. (Ed.) ARS Wheat Yield Project, ARS-38, USDA-ARS, Temple, Texas.

The Irrigate model had the best moisture tracking capability. This capability was further improved by some refining during the current project. It also had the most convenient operation and data input/output for the purpose of irrigation scheduling, both at the irrigation advisory service and on the farm. This model was transferred to Saskatchewan Water Corporation (SWC) in May, 1989. SWC is in the process of testing the model's performance further on data gathered at several sites in the Outlook-centred Irrigation District No. 1 in 1989, and conduct operational trials of the model in 1990.

Radar Rainfall Maps

The upgrade of the Elbow radar involved a complex of computer facilities at the radar site, the National Hydrology Research Centre in Saskatoon and the Saskatoon Weather office. An interface was engineered and built for the radar by McGill University. The upgrade was financed by the Canadian Climate Centre, in part to meet the needs of this project. This upgrade became operational in mid-July, 1989, close to the end of the local irrigation season. A few rain maps were received at Outlook, viewed and printed during the summer season. Several man-months of software development for microcomputers to handle the data at the main processing site and in the SWC office were required to prepare and transmit these products.

Further development work on the radar processing system during the winter of 1989-90 will improve the calibration of rainfall estimates from the radar, and should reduce ambiguities in the rainfall maps. Operational trials will be conducted in the summer irrigation season of 1990.

The project will include an evaluation of the effectiveness of the radar-based precipitation information, the irrigation scheduling model, and any integration of these that is attempted during the 1990 season.

Irrigation Scheduling Tools for Farm Use

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

The Watermark sensor was compared with the tensiometer in the field and with gypsum blocks in containers in the lab. The Aquamiser and Hydrovisor (glass bead tensiometer) were compared to the tensiometer in large boxes of uniform soil type and density. Plants were grown in each container to extract water.

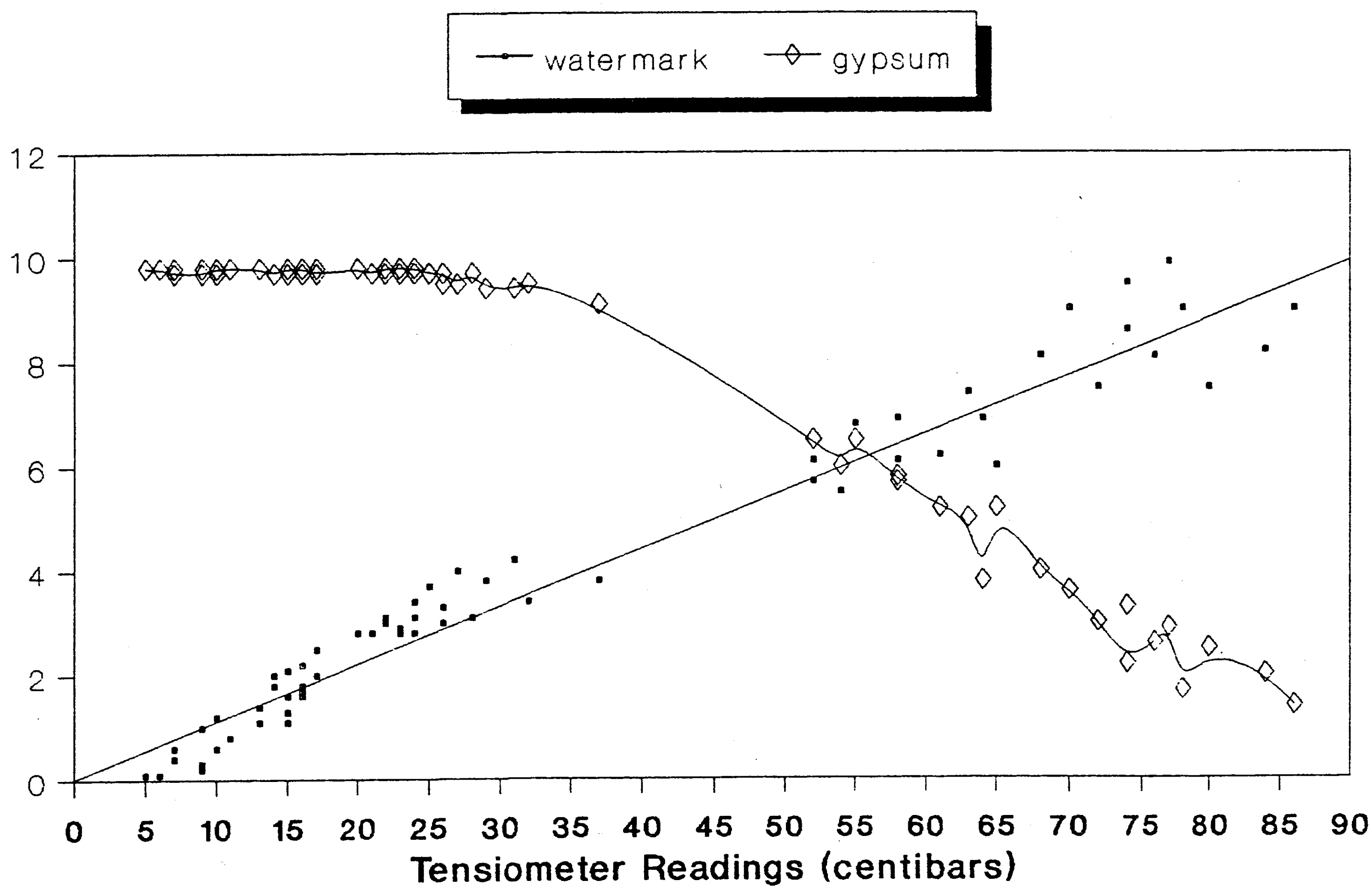
Results and discussion

The Watermark™[1] had a linear response to soil moisture tensions between 10 and 85 centibars in our tests on sandy and loamy soils (Fig 1). The regression between tensiometer reading and watermark reading was highly significant with a coefficient of determination (r^2=0.95). The deviations between predicted and observed tensiometer readings were greater at higher soil moisture tensions. This may be due in part to unequal removal of water from the containers and the difficulty in obtaining reliable tensiometer readings at greater than 70 centibars. It would appear that the Watermark™[1] sensors would be more useful than standard gypsum blocks on loam and sandy soils found in much of the irrigated area of Saskatchewan. Current prices for sensors are approximately $20.00 and a reader $200.00. At least six sensors, shallow and deep at three sites would be required on each field. The manufacturer claims the sensors do not degrade and can be used for several seasons. As yet we have not tested these sensors over a wide range of soils or in saline soils.

The Hydrovisor™[2] soil moisture sensor appears to have significant merit for controlling irrigation of lawns and park areas as well as irrigating high value crops where solid set or trickle irrigation systems are used. Their use may be limited by their price and the fact that the acreage of high value crops is small enough that growers can easily check soil moisture in all of their fields. Potentially these sensors

[1]Mention of trade names does not imply endorsement or indicate that other suitable products may exist which have not been tested.
[2]Use of trademark does not imply endorsement

Fig 1. Comparison of Watermark and Gypsum Block with Tensiometer Readings



could be used to directly estimate crop water use. We will be setting out tests with the following system. A glass bead tensiometer which will maintain the soil at a constant moisture level, buried trickle irrigation hose and a water meter. We will be testing the hypothesis that we can determine crop water use directly by this system and together with soil moisture monitoring improve soil moisture management.

The Agwatronics™[1] soil moisture sensor has been tested by the Civil Engineering department at the University of Saskatchewan and found to be quite accurate. The need for a dedicated sensor reader, approximately $500, and the sensor cost of $120 each will likely restrict their use to high value crops and research applications.

A new device known as the Aquaterr™[2] has just been received. This device looks much like a soil probe and uses RF capacitance to estimate soil moisture. Testing has just begun, but if the device is sufficiently accurate its portability and relatively low cost ($450 US) will make this an attractive option.

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

Objective:
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 vertical mulching prior to irrigation;
c) to measure the duration of vertical mulch treatment effect;
d) to measure crop yields on mulched vs. conventionally irrigated fields to further substantiate benefits.

1988 was the initial season of field testing for the soil vertical mulcher designed and constructed by Paragon Consultants Ltd. The initial design functioned well although the forage harvester component of the machine had less straw processing capacity than was anticipated. This reduced the forward speed attainable during vertical mulch operation. This is undesirable if large acreages must be covered. The vertical mulcher was capable of a maximum work rate of about 2.5 ac/hr.

Irrigation of vertical mulched fields showed that major increases in the rate of water infiltration can be expected. If during the application of water, a large amount of loose surface soils is washed into the top of the slot, it's infiltration capacity was reduced. This soil tended to cap (seal) the slot. This reduced the effective infiltration rate of the slotted treatment to that of the soil material in the cap. In an attempt to firm up this surface soil and prevent it from washing into the slot, several packer systems will be tested.

Forage Harvester Modification

The conventional powershaft designed for the forage harvester experienced excessive vibration when operated under heavy load. This necessitated reduced rates of operation to avoid damaging vibration. To correct this problem, an Ontario firm was contracted to build an improved power shaft assembly for the forage harvester. It consists of a heavier power shaft with constant velocity rather than conventional universal joints. This allows the power shaft to operate at greater angles without creating undue vibration. It is anticipated that this modification will allow the machine to operate at maximum capacity.

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[1] Use of trademark does not imply endorsement

[2] Use of trademark does not imply endorsement

In a further attempt to improve straw processing capacity, the forage harvester has been fitted with a coarser recutter screen. This modification to the harvester will produce straw material which is less finely cut than produced initially. Increasing the size of cut will substantially increase the harvester's straw processing capacity.

Subsoiler Modifications

The shielded shank of the subsoiler, which creates the soil opening into which is injected the chopped straw, performed satisfactorily.

In subsequent irrigation trials of slot mulched fields, it became obvious that it would be desirable to pack the sides of the slot to prevent soil from being washed into the slot. This soil effectively capped to the surface opening of the slot created and reduced its ability to infiltrate water. Therefore, a packer wheel assembly to firm the soil around the slot opening is being investigated. It is hoped that this modification will have the further benefit of leaving the soil surface smooth enough that it could be seeded with no further preworking necessary. Several packer wheel designs will be tested in 1990.

Preliminary Infiltration Data from Bench Mark Sites

The second set of infiltration measurements for the benchmark sites was made approximately one year after the plots were initiated. Where no subsequent tillage had taken place vertical mulch channels were still completely intact and continued to provide a major increase in the infiltration rates as compared to untilled or conventionally tilled fields. This fact is illustrated in Table 2 for benchmark site 2 where no tillage of the plot took place over the entire year.

Any tillage operation carried out subsequent to the establishment of the slots will dramatically reduce their effectiveness (see Table 1 for benchmark site 1). This tillage destroys the surface continuity of the pore system so that no gravitational movement of water into the soil profile is possible. The infiltration rate of slot mulched fields which have been subsequently tilled is virtually the same as unmulched soil. It is obvious, therefore, that to achieve the maximum infiltration gain from this technique, water must be added before any further tillage takes place. This technique would also seem to have promise on zero till operations. Under these conditions, a single slot mulch operation might give several years of improved infiltration benefit. A slot mulch operation prior to establishing a perennial forage has the potential to deliver increased water infiltration rates to that crop for a number of years.

Table 1. Measurement of water infiltration rates on benchmark, Site 1*

Treatments	Infiltration rates (cm H_2O/min)	
	Year 1**	Year 2**
Slot mulch 16"	7.7	0.25
Control	1.36	0.27

*Plots were not disturbed by tillage over the entire period of the experiment
**Year 1 = July 88; Year 2 = July 89

Table 2. Measurement of water infiltration rates on benchmark Site 2*

Treatments	Infiltration rates (cm H_2O/min)	
	Year 1**	Year 2**
Slot mulch 16"	2.44	2.0
Slot mulch 10"	1.10	0.9
Subsoil 16"	2.2	0.62
Subsoil 10"	0.66	0.42
Control	0.38	0.30

* Plots tilled 1x cultivator prior to second (yr. 2) infiltration measurement.
**year 1 = July 88; year 2 = July 89

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: First year of two
Objective: To determine fertilizer-N losses due to denitrification.

In 1989, at two locations, Outlook and Birsay, N-losses due to denitrification after irrigation were determined by means of acetylene blockage. Experiments were carried out on farmers' fields. Hard wheat and durum were grown at Outlook and Birsay, respectively. Crops received 200 kg N/ha, applied at time of seeding. Yield, total N and fertilizer use efficiencies are reported in Table 1.

Nitrogen losses caused by denitrification were small at one location but significant at another. At the location with low input of N and irrigation water (Outlook), the N-losses were practically zero before the onset of irrigation, increased to a maximum loss of 50 g N/day/ha at 4 h after irrigation and declined to low levels at 10 h after irrigation (Fig. 1). At the other location, with high N and irrigation water (Birsay), the N losses from fertilized soil due to denitrification were approximately 5,000 g N/day/ha, increased to 12,500 g N/day/ha at 4h after the application of water and declined to approximately 5,000 g N/day/ha at 10 h after the water was applied.

Table 1. Total yield and fertilizer use efficiency of durum and hard wheat at Birsay and Outlook, Saskatchewan, 1989

		Total (kg/ha)			kg N/ha			%Ndff		%FUE			Havest
Treatment	N/ha	Total	Grain	Straw	Grain	Straw	Total	Grain	Straw	Grain	Straw	Total	index
					Durum (Birsay)								
Control	0	12833	4693	8140	108.0	31.1	139.1	--	--	--	--	--	0.37
Urea	200	13203	3634	9569	106.9	83.0	190.0	16.7	19.7	9.1	8.0	17.2	0.28
AN	200	13741	4176	9665	123.6	76.7	200.3	29.9	29.0	18.6	11.1	29.7	0.30
LSD(P<0.05)	--	NS	NS	884	NS	17.7	42.8	3.8	7.8	2.1	2.2	4.1	0.07
CV(%)	--	3.7	14.1	5.6	15.5	16.0	14.0	9.2	18.7	8.7	14.0	10.1	12.8
					Hard Wheat (Outlook)								
Control	0	4213	2064	2149	52.2	7.1	59.3	--	--	--	--	--	0.49
Urea	200	6951	2937	4014	89.3	14.0	103.3	41.1	41.8	18.4	2.9	21.3	0.42
AN	200	6193	2765	3428	85.8	12.3	98.1	44.5	44.3	19.3	2.7	22.0	0.44
LSD(P<0.05)	--	1605	NS	799	23.6	2.4	25.7	2.3	NS	NS	NS	NS	0.03
CV(%)	--	16.0	18.5	14.4	18.0	12.7	17.1	3.1	5.4	16.3	8.3	15.1	3.9

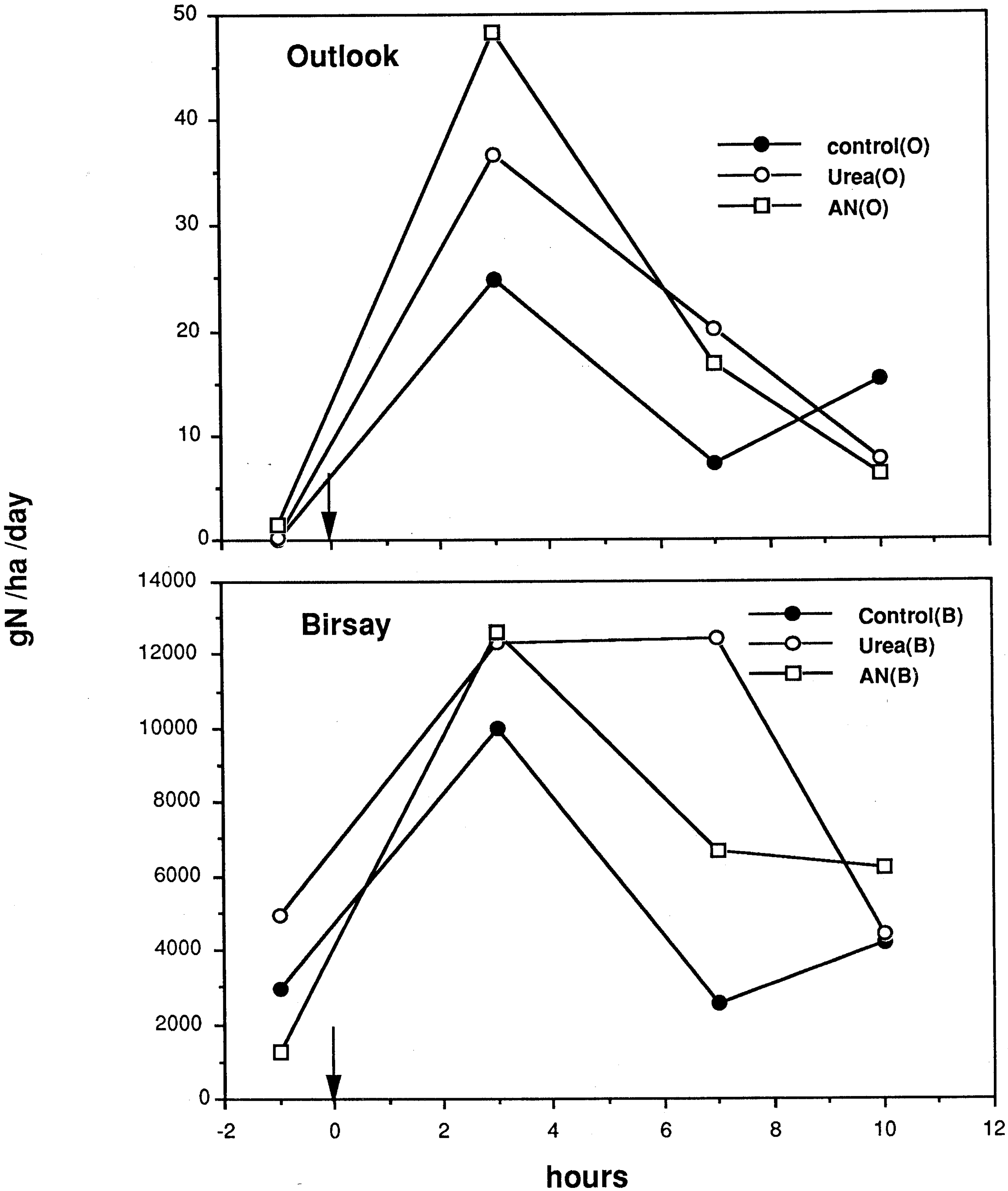


Fig.1 Denitrification rates as affected by N application and irrigation. Arrow indicates initiation of irrigation.

Sodicity Hazard of Sodium and Bicarbonate Containing Waters on Long-term Productivity of Irrigated Soils

Principal: F. Selles, Agriculture Canada, Swift Current, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Contractor: D. Cameron, Normac AES Ltd., Swift Current, Saskatchewan
Progress: Year one of four
Objectives:

a) to identify and evaluate the carbonate-related factors and processes affecting the chemical properties of selected irrigated soils in Saskatchewan, which have shown strong tendencies towards sodification;
b) to determine the rates of physicochemical deterioration of these soils in order to obtain sufficient information so as to improve the accuracy and precision of general irrigation water quality criteria; and
c) to predict the severity of salinization and sodification of these soils when irrigated with poor quality water and to determine their reclamation possibilities and their rates of amelioration.

Field investigations of previously-irrigated sodic soils included physicochemical characterization and the initiation of experimental reclamation plots at two sites. The chemical amendments being evaluated are gypsum, calcium chloride, and an acidifying chemical (bisulfate). Measurements of soil texture, sodium content and water infiltration rate have confirmed earlier suspicions that considerable areal variation exists at these sites. Careful attention to sampling procedure will be necessary to draw valid conclusions about sodicity hazards and the effectiveness of reclamation remedies. Spot comparisons between remnant "pivot corners" and "field centres" should be avoided.

Laboratory studies were conducted to determine the extent to which various soils lose their ability to transmit water when leached with sodium-calcium solutions varying in sodicity and electrolyte concentration. In all soils, permeability decreased as the sodium adsorption ratio increased and electrolyte concentration decreased. However, sensitivity to sodic solutions varied considerably from soil to soil when adjusted for textural differences. The cause of these differences are still under investigation. The likely mechanism responsible for decreased permeability is clay particle dispersion followed by the clogging of soil pores. An evaluation of the sodicity and electrolyte concentration under which dispersion occurs showed that in some soils even low levels of sodicity (ESP of 5 or less) can increase the potential for dispersion. Whether this potential is realized in the field is dependent on many factors, including mechanical disturbance (raindrop impact, etc.).

These field and laboratory findings suggest changes to the planned greenhouse studies. Tentatively, soil monoliths excavated from the field sites will be irrigated with carbonated sodic waters to further understand the sodification processes and to evaluate promising amendments in reclamation trials. These tests will include actively-growing plants to study the influences of CO_2 respiring roots in the soil-water system. However, the requirement for a uniform soil may be difficult to fulfill, or the time required to observe these influences may exceed the life of the project. Perhaps carbonate testing should be reduced and complemented with promising studies on dispersion and water transmission.

PB50 Research Trials

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

PB-50 is a microbial inoculant which contains the spores of a naturally-occurring soil fungus, *Penicillium bilaji*, as the active ingredient. *P. bilaji* colonizes plant roots and produces organic acids which solubilize fixed unavailable forms of phosphate into plant available forms.

Field trials to evaluate the PB-50 seed inoculant formulation on wheat were established at 38 locations across the prairies in 1988 and 1989 (Table 2). One of these trials was established at the Saskatchewan Irrigation Development Centre in Outlook, Saskatchewan in 1989 (Table 1). All field trials were arranged in split-plot designs; the effects of seed inoculation with PB-50 were evaluated over several rates of phosphate fertilizer.

Table 1: Outlook,1989
Effect of PB-50 on the Yield of Wheat

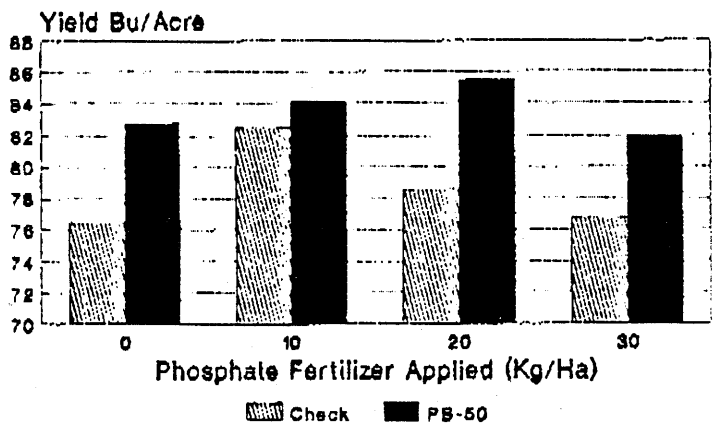
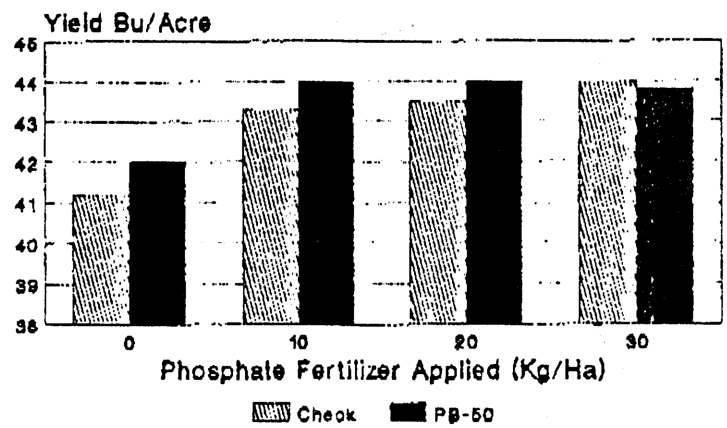


Table 2: 38 Location Summary 1988,1989
Effect of PB-50 on the Yield of Wheat



In summary, field data confirms that PB-50 increases phosphate availability and uptake by wheat as evidenced by positive yield responses. Over all 38 locations (Table 2), provided a base level of 10 kg/ha P_2O_5 is used, PB-50 may replace a minimum of 10 kg/ha P_2O_5 while maintaining wheat yields.

PB-50 is registered for use with wheat and will be available in limited quantities to Western Canadian producers in 1990. Research is continuing with other crops such as peas, canola, and barley.

Livestock

Increasing Returns from Irrigated Grass Pastures Grazed by Sheep

Principal: N. McLeod
Riverside Sheep Company, Outlook, Saskatchewan
Funding: Irrigation Based Economic Development Agreement
Progress: One year only
Objectives: To develop a management system which will give the maximum returns to an irrigated pasture grazed by a) ewes and lambs by utilizing silage instead of hay as a method of feeding back excess forage produced in June, b) restricting access of the ewes to the pasture once the ewes have been weaned and high quality feed is not required.

Abstract:

Feeding ammoniated straw to ewes increased the returns to irrigated pasture by ensuring that most of the high quality forage was consumed by growing lambs rather than ewes. This increased the carrying capacity of the pasture at a low cost improving the profitability of the pasture by approximately $900.

Materials and Methods:

Prior to ammoniation the straw had a protein content of 5.6% and estimated TDN of 42%. Ammoniation increased protein to 10.4% and TDN to 47%. Ewes were given free choice access to straw and allowed to graze for a shorter time as the season progressed so that the proportion of grass to straw increased from 15% of the diet to nearly 50% by the first of September.

Results and Discussion:

The intake of ammoniated straw levelled out at approximately 25% of the dry matter intake of the ewes. There are no significant differences between this year and previous years when ammoniated straw was not fed. Ewes maintained their body weight throughout the peak lactation period and gained approximately 0.25 lb/day during August.

		Wt. in lbs
Lambs	Average weight when put into pasture	24.5
	Average weight August 30	68.5
	Average daily gain	0.375
Ewes	Average weight May 15	150
	Average weight August 1	150
	Average weight August 30	157.5

Lambs were naturally weaned allowing ewes to build up reserves. As the lambs were weaned the ewe's feed consumption declined. This type of ewe has an ideal weight of about 165 lbs.

This year 52 acres of grass was cut for hay versus 35 acres in the two previous years.

Economics:

COSTS:

	Amoniation
Straw	$1,400.00
Ammonia	335.00
Plastic	240.00
Labour and Machine	1,980.00

	$3,955.00

RETURNS:

17 ac of hay @ 1.5 t/ac hay @ $75/ton =	$1,912.50	
Cutting 6.60/ac @ 17 ac =	112.00	
Baling 4.80/bale =	244.80	

Net Return from hay	$1,555.70	
Return from extra grazing = $0.20/day @ 30 days @ 550 =	$3,300.00	(estimated)
Total returns	$4,855.50	
Total costs	$3,955.00	
Increased revenue	$900.50	

Previous experience has indicated that the ewes perform nearly as well on 2 or 3 year old straw that has been weathered as on ammoniated straw. If this type of straw is available the economics of this type of management would be improved by the cost of the ammonia and straw.

The economic value of feeding ammoniated straw was not as high as hoped for but appeared to be a profitable system with a return to labor and investment of over 20%.

Economics

Economics of Irrigation in Saskatchewan

Principal: S.N. Kulshreshtha
Department of Agricultural Economics
University of Saskatchewan
Saskatoon, Saskatchewan
Funding: Agriculture Development Fund
Co-operators: Twenty-five irrigation farmers
Location: Various locations
Progress: Final year
Objectives:
a) to develop a simulation model for on-farm decision making with respect to irrigation under Saskatchewan conditions;
b) to generate a data base for formulation of public policies on irrigation development;
c) to gather production data through a three-year series of farm workshops using the Schoney Top Management Model;
d) to develop an irrigation investment analysis program for use by extension staff and farmers.

The last in a series of three sets of workshops was held to estimate the average costs and returns, on a per acre basis, for irrigated crops in Saskatchewan. Twenty-five farmers participated in the study in 1989, and they were able to produce a detailed business plan for their operation for the coming five years.

The participants profile is summarized in Table 1. The farm data is processed using the Top Management Model developed at the University of Saskatchewan.

Results:

The results of the 1987-1989 workshops are published by the University of Saskatchewan. Economics of Irrigation in Saskatchewan: Results of the three Farm Workshops. R.G. Roy, W.J. Brown, S.N. Kulshreshtha, D.D. Featherstone, Department of Agricultural Economics. Research Report: 89-01.

Some highlights are presented here. Estimated returns and costs for a selection of the crops are given in Table 2 and Table 3.

Conclusions and Implications:

This data comes from a continuing effort to try and determine the economics of irrigation in Saskatchewan. Due to the three-year nature of this study, all data from 1987 to 1989 have been reported. This allows for a year to year comparison, on a per acre basis for individual cropping enterprises. In addition, costs and returns have been shown on a per bushel basis, where comparisons were available. Expressing costs on a per bushel basis demonstrated that the high costs of incorporating irrigation into a farming enterprise is not as extreme as just viewing costs on a per acre basis. Costs between dryland and irrigation crops, on a per bushel basis, tend to remain relatively constant.

The data collected strengthens the view that it is the current low prices of produce that results in poor returns to irrigation. It suggests that irrigation is not inefficient in comparison to dryland farming. Variable costs under irrigation on a per bushel basis are relatively close to those of dryland. This is again the case with total costs per bushel. Increases in the price of the product will benefit irrigation to a greater degree than dryland as the potential for increased returns is greater. Returns will increase relative to the yield as prices increase though some returns may get capitalized back into land and equipment values. Since irrigation has a greater capital investment than dryland, there is no guarantee that the result of increased returns may leave irrigation better off. Variable costs may also increase to a greater degree, than the price increase. The increased variable costs and capitalization effects may influence irrigation to a greater degree than dryland production, resulting in a decrease in profits.

Care should be taken in interpreting the results as they represent the economic costs of production as opposed to the accounting costs of production. This reflects all costs, cash or otherwise.

With an increased number of participants, enterprises can be subdivided into high and low cost groups. In 1989, this was done for alfalfa hay under irrigation. Dividing the participants into the two groups gives a better indication of management efficiency.

Machinery costs were also presented in order to allow producers to compare the costs of their own machines with the averages of the participants. Although the results are based on a small sample size and participants vary over the three years, it is hoped that the facts summarized provide some insights into the current debate on the economics of irrigation in Saskatchewan.

The results of this report are based on projections. Cost-of-production data is based on projected costs and returns estimated by workshop participants. Rotations and operating costs may be close to actual results, however, expected yields and prices may not be. Further work could include a study using data based on actual yields, prices, rotations and costs. In this way, factors that one cannot predict, such as weather, will be better taken into account. A larger sample size may lead to the identification of factors that are not observable within a small population. Increasing the sample size would enable an analysis which could look at the high verses low cost producers as was done for irrigated alfalfa.

The report can assist irrigation producers in improving their management skills. Producers can use the results as a benchmark in their decision making process. Factors that affect the economics of irrigation can also be identified, for example, the increased level of fixed costs.

Results in this report are based on an irrigation delivery infrastructure designed some 20 to 25 years ago. Some of the current delivery systems, such as the pressurized irrigation pipelines, are somewhat more expensive. These systems would have an impact on the cost structure of irrigated crop production, particularly if producers are required to pay the total cost. Social or private desirability of pressurized irrigation pipelines must be carried out, particularly as it affects producers' returns from irrigation and its adoption on farms.

Table 1. Profile of workshop participants, 1987 and 1989.

	Age	Education	Farm size	Percentage of land under irrigation	Assets	Debts	Equity	D/A*
	Years	Years of schooling	Acres	%	$	$	$	
1989 Average	35.6	13.4	1,831	21.3	851,974	245,336	606,638	0.29
1989 Range:								
High	59	16	3,600	69.0	2,014,618	778,239	2,014,618	0.78
Low	21	10	580	0.8	304,941	0	106,736	0.00
1988** Average	34.8	13.2	1,839	23.0	791,468	291,396	500,072	0.37
1988** Range:								
High	54	16	3,621	71.0	1,885,720	803,043	1,082,677	0.75
Low	21	8	581	0.0	372,003	32,345	121,162	0.06
1987*** Average	36.6	12.5	1,800	28.8	609,739	232,261	377,478	0.38
1987*** Range:								
High	53	15	3,760	100.0	1,644,595	745,784	943,823	1.02
Low	22	8	400	1.6	160,642	30,542	5,456	0.07

* Debt-Asset Ratio
** Profile of 1987 workshop participants
*** Profile of 1988 workshop participants

Table 2. Estimated returns and costs for wheat, 1989

Crop and Type of Irrigation		Average Value ($/Acre) Pivot Irrigation CWAD	Average Value ($/Acre) Dryland Stubble CWRS
Number of farms reports		8	10
a) Total Return			
Yield (bushels)		57.20	21.60
Price		4.71	4.21
Other Returns, e.g. SCGP		1.98	0.04
Gross Returns		271.39	90.98
b) Variable Costs			
Direct			
Seed		9.92	6.23
Fertilizer - N		19.89	7.31
- P_2O_5		13.38	5.70
- Other, e.g. Blend		0.61	0.19
Chemicals - Broadleaf		0.89	2.87
- Grassy		4.76	4.28
- Broadleaf and Grassy		7.89	0.29
Crop and Hail Insurance		5.67	3.21
Irrigation Machinery and Equipment	- Fuel	8.91	--
	- Repair	2.27	--
Other Machinery and Equipment	- Fuel	7.19	3.85
	- Repair	5.28	3.47
Custom Work Hired		0.00	0.00
Water tax		8.15	---
Other, e.g. Machine Lease		1.20	0.25
Total Direct Costs		96.01	37.65
Returns above Direct Costs		175.38	53.33
Operating Capital Charges		5.59	2.30
Operator Labour		14.48	6.57
Total Variable Costs		116.08	46.52
Returns above Variable Costs		155.31	44.46
c) Fixed Costs			
Equipment and Buildings CRC		98.67	21.49
Land		24.26	24.73
Management		22.62	6.47
Indirect Overhead		37.11	13.87
Total Fixed Costs		182.66	66.56
Returns above Variable and Fixed Costs		-27.35	-22.70

Table 3. Estimated returns and costs for alfalfa, 1989

Crop and Type of Irrigation		Average Value ($/Acre) Pivot Irrigation	Dryland
Number of farms reports		7	11
a) Total Return			
Yield (ton)		4.20	1.10
Price		79.26	63.64
Gross Returns		332.89	70.00
b) Variable Costs			
Direct			
Fertilizer - N		0.00	1.68
- P_2O_5		14.30	0.32
- Other, e.g. Blend		1.82	0.00
Chemicals - Broadleaf		0.00	0.00
- Grassy		0.00	0.00
- Broadleaf and Grassy		0.00	0.17
Crop and Hail Insurance		1.60	0.00
Irrigation Machinery and Equipment	- Fuel	27.63	---
	- Repair	9.82	---
Other Machinery and Equipment	- Fuel	19.92	3.53
	- Repair	11.56	3.25
Custom Work Hired		0.02	0.00
Water Tax		3.73	---
Other, e.g. Machine Lease		2.54	1.89
Total Direct Costs		92.94	10.84
Returns above Direct Costs		239.95	59.16
Operating Capital Charges		5.40	0.76
Operator Labour		36.06	5.93
Total Variable Costs		134.40	17.53
Returns above Variable Costs		198.49	52.47
c) Fixed Costs			
Equipment and Buildings CRC		89.97	14.40
Land		23.72	17.61
Management		20.36	3.35
Indirect Overhead		33.69	8.47
Total Fixed Costs		167.74	43.87
Returns above Variable and Fixed Costs		30.75	8.60