Northwestern Agricultural Research Center
of the
Department of Research Centers
Montana Agricultural Experiment Station
Montana State University

ANNUAL REPORT
2003 CROP YEAR

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NORTHWESTERN AGRICULTURAL RESEARCH CENTER
STAFF 2003

Full Time Staff Members	**Years in Service**
Duane L. Johnson – Superintendent & Associate Professor of Agronomy/Plant Breeding Began January 2001	2
Robert N. Stougaard – Associate Professor, Weed Science Began November 1991	12
Qingwu Xue – Research Associate Began February 2000	3
Louise M. Strang – Research Associate Began May 1983	20
Fernando R. Guillen-Portal – Post-doctoral Research Scientist Began July 2002	1
Gary R. Haaven – Ag Research Specialist Began April 1982	21
Barbara F. Honeycutt – Administrative Support Began December 1999	3
Paul P. Koch – Ag Research Technician Began May 1995	7
Janice Haaven – Research Aide Began March 2003	1

Vern R. Stewart – Professor Emeritus
Leon E. Welty – Superintendent Retired

Part Time Employees

Donald E. Burtch (June – August)
Sarah Gunderson (June-August)
Amy Smith (June-September)

Student Interns

Jennifer Grace (May-August)

Student Employees

Jessica David (May-August)
Amy Edsall (June-August)
Sue Ann Hamdan (June)
Elizabeth M. McAllister (July – August)

CLIMATOLOGY

Weather information as recorded at the Northwestern Agricultural Research Center, Kalispell, Montana.

CLIMATOLOGICAL OVERVIEW 2003
NORTHWEST AGRICULTURAL RESEARCH CENTER
Kalispell, MT

The 2002/2003 crop year began with drier and warmer conditions than normal. September precipitation was 1.18 inches while the long term average was 1.53 inches. Rainfall continued to be far below average until December. From December to April, rainfall was above average. After April, rainfall again fell far below average. By September of 2003, we were at 14.91 inches compared to the long-term average of 19.67 inches. In terms of temperature we were also above average at 44.7 F compared to the long-term average of 43.2 F. This is also expressed in our frost-free days at 132 versus the long-term average of 115 days.

Because of our dry spring, fields were worked earlier than normal. The dry weather limited any disease and increased temperatures were helpful in extending the harvest on forages. The dry summer conditions, however, severely limited yield of crops under dryland conditions and made it extremely difficult to apply enough water to irrigated crops. The results were low test weights on small grains and canola. Yields in our peas and lentils were significantly reduced. Mint and alfalfa yields were excellent given the constraints of the hot summer.

The fall of 2003 provided more moisture and probably a better crop all around in 2004, assuming the drought is reduced.

Summary of Climatic Data by Months for the 2002-2003 Crop Year - September 2002 - August 2003 and Averages for the Period 1984-2003 at the Northwestern Agricultural Research Center
Kalispell, Montana

ITEM	Sept. 2002	Oct. 2002	Nov. 2002	Dec. 2002	Jan. 2003	Feb. 2003	Mar. 2003	Apr. 2003	May 2003	June 2003	July 2003	Aug. 2003	Total or Average
Precipitation (inches) Current Year	1.18	0.25	0.87	1.67	1.63	1.01	2.32	2.23	1.78	1.57	0.05	0.35	14.91
Avg. CY84 - CY03	1.62	1.34	1.75	1.44	1.23	1.21	1.41	1.78	2.50	2.96	1.69	1.16	20.09
Average Temperature (F) Current Year	54.4	37.5	32.6	30.6	28.8	25.7	33.4	44.5	50.5	60.1	69.1	66.9	44.7
Mean CY84 to CY03	53.5	41.8	32.4	23.9	24.5	26.6	34.3	43.5	51.6	57.7	64.1	63.2	43.1

Last killing frost in spring

Spring 2003	May 20, 29°F
Avg. 1949-2003	May 22

First killing frost in fall

Fall 2003	September 30, 31°F
Avg. 1949-2003	September 13

Frost Free Period

2002-2003	132
Avg. 1949-2003	115

Growing Degree Days (base 50):	2217.0 days	April 2003 - October 2003
	1883.7 days	1949-2003 Average
Growing Degree Days (base 32):	5148.0 days	April 2003 - October 2003
	4830.0 days	2001-2003

Maximum summer temperature	96°F July	on July 24, 2003
Minimum winter temperature	-1°F	on March 9, 2003

In this summary 32 degrees is considered a killing frost.

MAXIMUM / MINIMUM TEMPERATURES BY MONTH & DAY
JANUARY 2003 - DECEMBER 2003

YR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
03	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1	38	27	46	36	33	23	58	40	59	35	59	51	84	44	94	53	83	42	69	31	28	8	37	18
2	36	25	45	29	34	23	57	28	61	38	69	50	82	85	94	52	85	45	68	31	30	17	26	20
3	45	30	41	29	34	25	43	25	60	32	66	41	74	40	91	57	85	43	77	32	33	20	40	25
4	44	25	33	20	27	11	40	28	64	38	71	37	76	49	69	55	84	45	73	30	28	10	43	16
5	37	28	29	19	31	12	43	28	54	37	74	41	81	49	79	47	87	46	71	31	25	9	33	15
6	37	26	35	13	29	17	44	30	50	37	75	49	75	42	90	55	87	43	71	32	27	10	33	29
7	31	27	31	14	23	13	45	29	46	37	72	43	79	48	85	49	86	46	75	38	19	10	41	22
8	30	27	29	23	16	0	53	34	46	27	75	45	82	52	90	50	82	53	66	40	29	12	34	18
9	28	18	32	24	18	-1	65	38	57	33	75	42	72	44	90	55	57	44	67	39	33	19	28	16
10	31	7	33	27	23	15	56	30	56	29	74	46	82	45	94	54	54	38	57	29	34	19	27	15
11	24	7	35	23	40	23	68	33	60	29	64	48	85	49	95	48	61	41	52	29	42	34	22	4
12	25	13	41	16	43	34	61	32	58	33	68	45	90	52	88	46	64	45	49	38	45	22	20	12
13	32	25	43	14	51	37	59	34	66	32	76	45	93	59	82	47	60	39	49	40	43	17	34	17
14	38	27	35	15	66	36	51	37	64	35	68	44	74	47	87	46	64	37	52	29	39	18	31	18
15	34	26	35	24	66	30	51	33	71	39	69	41	80	43	91	51	70	38	50	31	34	27	34	26
16	24	21	38	28	47	32	50	32	63	36	76	43	89	54	91	54	69	40	58	35	37	29	36	26
17	32	19	42	28	46	31	55	31	52	29	80	44	90	60	82	53	54	37	58	40	40	34	37	26
18	27	22	40	27	51	27	55	33	47	33	91	55	91	48	76	49	51	37	71	35	44	34	41	12
19	29	24	42	27	50	25	51	29	49	30	92	61	95	51	85	47	59	40	68	33	56	41	31	9
20	29	26	43	29	52	24	57	28	55	29	80	53	96	52	91	54	66	41	65	33	58	27	32	15
21	34	16	41	32	50	29	64	28	63	40	62	48	92	53	82	43	64	35	65	47	35	18	26	18
22	25	11	44	27	46	40	72	36	57	46	62	45	91	53	84	46	63	35	77	39	19	3	31	25
23	18	11	40	1	48	31	71	40	65	49	55	46	95	52	82	54	74	36	68	39	19	9	31	20
24	37	18	19	0	44	32	60	43	74	42	66	42	95	56	74	47	71	35	68	25	29	17	31	20
25	21	38	20	1	44	26	66	41	85	52	69	48	90	57	80	48	68	36	51	23	36	18	31	22
26	42	37	26	7	44	30	55	34	82	54	70	51	89	54	83	46	77	48	51	22	31	25	35	21
27	48	40	34	9	38	31	55	36	64	48	81	57	89	55	89	51	78	38	54	28	35	15	30	21
28	47	32	40	17	39	30	55	30	73	46	82	49	91	49	78	45	75	38	58	37	34	15	30	14
29	44	25			42	30	54	37	83	53	82	46	92	55	76	43	74	39	53	32	39	23	25	9
30	37	26			44	32	61	40	83	44	90	57	93	52	75	38	68	31	33	24	46	29	25	-2
31	46	32			67	38			69	52			95	56	79	40			28	8			17	1
AVG	33.9	23.7	36.1	20.0	41.5	25.4	55.8	33.2	62.5	38.5	73.1	###	86.5	51.8	84.7	49.1	70.7	40.4	60.4	32.3	34.9	19.6	31.4	17.0

MAXIMUM TEMPERATURE	96	MINIMUM TEMPERATURE	-2

Summary of precipitation records at the Northwestern Agricultural Research Center on a crop year basis

Total precipitation in inches by month and year

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL
1983-84	1.70	1.13	1.96	2.57	0.80	2.19	1.81	1.93	2.91	2.07	0.31	0.55	19.93
1984-85	2.15	2.25	1.40	1.29	0.31	1.28	0.90	1.31	2.81	1.89	0.35	1.62	17.56
1985-86	5.35	1.55	1.61	0.51	2.39	2.33	0.50	1.34	2.92	1.83	2.09	0.81	23.23
1986-87	3.63	0.80	1.78	0.63	0.38	0.46	3.47	1.15	1.89	1.95	4.85	0.98	21.97
1987-88	0.81	0.12	0.91	1.18	0.98	1.03	0.77	1.36	3.60	1.98	1.07	0.13	13.94
1988-89	2.30	0.62	1.39	1.69	1.39	1.48	2.29	1.09	2.70	2.05	2.70	3.69	23.39
1989-90	1.50	2.29	3.75	1.92	0.96	1.00	1.76	1.63	3.74	2.68	2.34	2.44	26.01
1990-91	T	2.32	1.37	2.60	1.41	0.41	0.72	1.21	2.72	5.36	0.77	1.15	20.04
1991-92	0.80	0.75	2.26	0.58	1.17	0.61	0.83	1.18	1.65	5.34	2.24	0.94	18.35
1992-93	1.21	1.07	2.37	1.53	1.68	0.60	0.73	3.77	2.22	4.00	7.00	1.19	27.37
1993-94	1.54	0.83	1.23	1.27	1.43	1.49	0.11	2.01	1.79	2.59	0.10	0.23	14.62
1994-95	0.46	2.12	1.89	1.07	1.17	0.90	2.33	2.25	1.44	5.63	1.91	1.47	22.64
1995-96	1.21	2.75	2.33	1.91	2.22	1.18	1.19	3.32	4.58	2.05	0.95	0.80	24.49
1996-97	2.67	1.58	3.99	3.52	1.50	1.62	1.18	1.69	2.62	3.41	0.99	1.94	26.71
1997-98	2.36	0.94	0.33	0.42	0.77	0.33	2.64	1.80	5.14	4.64	1.18	0.72	21.27
1998-99	1.48	0.71	1.11	1.47	1.05	1.18	0.90	0.55	1.32	2.74	1.63	1.93	16.07
1999-00	0.36	1.72	2.33	1.08	1.46	1.81	1.30	2.21	0.89	1.80	0.84	0.35	16.15
2000-01	1.40	1.23	0.62	1.23	0.75	1.54	1.03	2.62	0.57	3.29	0.91	0.54	15.73
2001-02	0.32	1.80	1.44	0.59	1.21	1.66	1.48	0.91	2.72	2.39	1.45	1.44	17.41
2002-03	1.18	0.25	0.87	1.67	1.63	1.01	2.32	2.23	1.78	1.57	0.05	0.35	14.91
MEAN	1.62	1.34	1.75	1.44	1.23	1.21	1.41	1.78	2.50	2.96	1.69	1.16	20.09
	SEPT	OCT	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL

Mean precipitation for the past 20 years: 20.09

YEAR 2003 - GROWING DEGREE DAYS APRIL THROUGH OCTOBER 2003

Calculated at Both Base 50 and Base 32

April	MAX	MIN	Base 50	Base 32
1	58	40	4.0	17.0
2	57	28	3.5	12.5
3	43	25	0.0	5.5
4	40	28	0.0	4.0
5	43	28	0.0	5.5
6	44	30	0.0	6.0
7	45	29	0.0	6.5
8	53	34	1.5	11.5
9	65	38	7.5	19.5
10	56	30	3.0	12.0
11	68	33	9.0	18.5
12	61	32	5.5	14.5
13	59	34	4.5	14.5
14	51	37	0.5	12.0
15	51	33	0.5	10.0
16	50	32	0.0	9.0
17	55	31	2.5	11.5
18	55	33	2.5	12.0
19	51	29	0.5	9.5
20	57	28	3.5	12.5
21	64	28	7.0	16.0
22	72	36	11.0	22.0
23	71	40	10.5	23.5
24	60	43	5.0	19.5
25	66	41	8.0	21.5
26	55	34	2.5	12.5
27	55	36	2.5	13.5
28	55	30	2.5	11.5
29	54	37	2.0	13.5
30	61	40	5.5	18.5

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
55.8	32.2	105.0	396.0

May	MAX	MIN	Base 50	Base 32
1	59	35	4.5	15.0
2	61	38	5.5	17.5
3	60	32	5.0	14.0
4	64	38	7.0	19.0
5	54	37	2.0	13.5
6	50	37	0.0	11.5
7	46	37	0.0	9.5
8	46	27	0.0	7.0
9	57	33	3.5	13.0
10	56	29	3.0	12.0
11	60	29	5.0	14.0
12	58	33	4.0	13.5
13	66	32	8.0	17.0
14	64	35	7.0	17.5
15	71	39	10.5	23.0
16	63	36	6.5	17.5
17	52	29	1.0	10.0
18	47	33	0.0	8.0
19	49	30	0.0	8.5
20	55	29	2.5	11.5
21	63	40	6.5	19.5
22	57	46	3.5	19.5
23	65	49	7.5	25.0
24	74	42	12.0	26.0
25	85	52	18.5	36.5
26	82	54	18.0	36.0
27	64	48	7.0	24.0
28	73	46	11.5	27.5
29	83	53	18.0	36.0
30	83	44	16.5	31.5
31	69	52	10.5	28.5

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
62.2	38.5	204.5	582.5

June	MAX	MIN	Base 50	Base 32
1	59	51	5.0	23.0
2	69	50	9.5	27.5
3	66	41	8.0	21.5
4	71	37	10.5	22.0
5	74	41	12.0	25.5
6	75	49	12.5	30.0
7	72	43	11.0	25.5
8	75	45	12.5	28.0
9	75	42	12.5	26.5
10	74	46	12.0	28.0
11	64	48	7.0	24.0
12	68	45	9.0	24.5
13	76	45	13.0	28.5
14	68	44	9.0	24.0
15	69	41	9.5	23.0
16	76	43	13.0	27.5
17	80	44	15.0	30.0
18	91	55	20.5	38.5
19	92	61	23.5	41.5
20	80	53	16.5	34.5
21	62	48	6.0	23.0
22	62	45	6.0	21.5
23	55	46	2.5	18.5
24	66	42	8.0	22.0
25	69	48	9.5	26.5
26	70	51	10.5	28.5
27	81	57	19.0	37.0
28	82	49	16.0	33.5
29	82	46	16.0	32.0
30	90	57	21.5	39.5

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
73.1	47.1	356.5	835.5

July	MAX	MIN	Base 50	Base 32
1	84	44	17.0	32.0
2	82	85	33.5	51.5
3	74	40	12.0	25.0
4	76	49	13.0	30.5
5	81	49	15.5	33.0
6	75	42	12.5	26.5
7	79	48	14.5	31.5
8	82	52	17.0	35.0
9	72	44	11.0	26.0
10	82	45	16.0	31.5
11	85	49	17.5	35.0
12	90	52	19.0	37.0
13	93	59	22.5	40.5
14	74	47	12.0	28.5
15	80	43	15.0	29.5
16	89	54	20.0	38.0
17	90	60	23.0	41.0
18	91	48	18.0	35.0
19	95	51	18.5	36.5
20	96	52	19.0	37.0
21	92	53	19.5	37.5
22	91	53	19.5	37.5
23	95	52	19.0	37.0
24	95	56	21.0	39.0
25	90	57	21.5	39.5
26	89	54	20.0	38.0
27	89	55	20.5	38.5
28	91	49	18.0	35.5
29	92	55	20.5	38.5
30	93	52	19.0	37.0
31	95	56	21.0	39.0

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
86.5	51.8	566.0	1097.5

Aug	MAX	MIN	Base 50	Base 32
1	94	53	19.5	37.5
2	94	52	19.0	37.0
3	91	57	21.5	39.5
4	69	55	12.0	30.0
5	79	47	14.5	31.0
6	90	55	20.5	38.5
7	85	49	17.5	35.0
8	90	50	18.0	36.0
9	90	55	20.5	38.5
10	94	54	20.0	38.0
11	95	48	18.0	35.0
12	88	46	18.0	34.0
13	82	47	16.0	32.5
14	87	46	18.0	34.0
15	91	51	18.5	36.5
16	91	54	20.0	38.0
17	82	53	17.5	35.5
18	76	49	13.0	30.5
19	85	47	17.5	34.0
20	91	54	20.0	38.0
21	82	43	16.0	30.5
22	84	46	17.0	33.0
23	82	54	18.0	36.0
24	74	47	12.0	28.5
25	80	48	15.0	32.0
26	83	46	16.5	32.5
27	89	51	18.5	36.5
28	78	45	14.0	29.5
29	76	43	13.0	27.5
30	75	38	12.5	24.5
31	79	40	14.5	27.5

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
84.7	49.1	526.5	1047.0

Sept	MAX	MIN	Base 50	Base 32
1	83	42	16.5	30.5
2	85	45	17.5	33.0
3	85	43	17.5	32.0
4	84	45	17.0	32.5
5	87	46	18.0	34.0
6	87	43	18.0	32.5
7	86	46	18.0	34.0
8	82	53	17.5	35.5
9	57	44	3.5	18.5
10	54	38	2.0	14.0
11	61	41	5.5	19.0
12	64	45	7.0	22.5
13	60	39	5.0	17.5
14	64	37	7.0	18.5
15	70	38	10.0	22.0
16	69	40	9.5	22.5
17	54	37	2.0	13.5
18	51	37	0.5	12.0
19	59	40	4.5	17.5
20	66	41	8.0	21.5
21	64	35	7.0	17.5
22	63	35	6.5	17.0
23	74	36	12.0	23.0
24	71	35	10.5	21.0
25	68	36	9.0	20.0
26	77	48	13.5	30.5
27	78	38	14.0	26.0
28	75	38	12.5	24.5
29	74	39	12.0	24.5
30	68	31	9.0	18.0

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
70.7	40.4	310.5	705.0

Oct	MAX	MIN	Base 50	Base 32
1	69	31	9.5	18.5
2	68	31	9.0	18.0
3	77	32	13.5	22.5
4	73	30	11.5	20.5
5	71	31	10.5	19.5
6	71	32	10.5	19.5
7	75	38	12.5	24.5
8	66	40	8.0	21.0
9	67	39	8.5	21.0
10	57	29	3.5	12.5
11	52	29	1.0	10.0
12	49	38	0.0	11.5
13	49	40	0.0	12.5
14	52	29	1.0	10.0
15	50	31	0.0	9.0
16	58	35	4.0	14.5
17	58	40	4.0	17.0
18	71	35	10.5	21.0
19	68	33	9.0	18.5
20	65	33	7.5	17.0
21	65	47	7.5	24.0
22	77	39	13.5	26.0
23	68	39	9.0	21.5
24	68	25	9.0	18.0
25	51	23	0.5	9.5
26	51	22	0.5	9.5
27	54	28	2.0	11.0
28	58	37	4.0	15.5
29	53	32	1.5	10.5
30	33	24	0.0	0.5
31	28	8	0.0	0.0

AV MAX	AV MIN	AV GDD Base 50	AV GDD Base 32
60.4	32.3	181.5	484.5

WEED AND SMALL GRAIN MANAGEMENT FOR WESTERN MONTANA

754

The Weed and Small Grain Management Project (754) includes research related to all types of weeds and small grains from seeding to data collection to publications.

Project Title: Agronomic Performance Evaluation of Intrastate Winter Wheat Cultivars

Project Leader: Bob Stougaard

Project Personnel: Phil Bruckner, Jim Berg, Fernando Guillen, and Qingwu Xue

Objectives:

To evaluate new and existing winter wheat cultivars for agronomic performance and disease resistance in environments and cropping systems representative of northwestern Montana.

Results:

Winter wheat had only reached the 1.5 leaf stage when cold temperatures occurred, which resulted in some winter-kill in the 2002-03 winter wheat growing season. The winter survival in most entries was in the range of 80-90% except Rampart with 78%. Disease symptoms were minimal and no disease evaluations were recorded. Grain yield ranged from 43 (Jerry) to 70 Bu/A (MT00159), with an average of 57Bu/A. Less tillers and a short grain filling contributed to this response. Grain test weight was good in all entries with an average of 62 Lb/Bu, and only one entry (Pryer) was lower than 60 Lb/Bu. Heading date was about one week earlier as compared to normal due to low precipitation in May and June. The average heading date was 154 and ranged from 150 to 159. Plant height was also lower than normal with an average of 26 inches. However, the grain protein was higher due to dry conditions during grain filling. The average protein content was 13.3%. Three entries (Golden Spike, Gary and NuFrontier) had very low protein (11.5-12.1%), while other three entries (MTW01146, MTI01158 and Erhardt) had very high protein content (>14.5%).

Summary:

Winter-kill, fewer tillers and dry conditions during grain filling resulted in lower than average yields in the 2002-03 season. However, entries had good test weight and high protein in this season. MT00159, Pryer, Elkhorn, Wahoo, MT0097 and Neeley were among the higher yield entries (>64.6 Bu/A) this season.

Future Plans:

Continue winter wheat evaluations for the purpose of identifying those cultivars best suited for production in northwestern Montana.

Table 1. Agronomic data from the Intrastate Winter Wheat Nursery Grown at the Northwestern Agricultural Research Center, Kalispell MT in 2002-03 season.

Planted: September 27, 2002 Harvested: July 29, 2003

Entry	Cultivar	Yield	Test weight	Grain moist	Heading date	Plant height	Winter survival	Protein
		Bu/A	Lb/Bu	%	Julian	in	%	%
31	MT00159	70.3	61.7	9.7	155.0	25.5	90.0	12.9
23	Pryor	66.0	59.3	9.1	157.0	26.0	90.0	13.0
12	Elkhorn	65.7	60.3	9.2	157.7	34.5	88.3	13.8
33	Wahoo	64.8	60.6	9.3	151.3	24.7	90.0	13.3
30	MT0097	64.6	61.5	9.6	152.7	25.5	88.3	12.9
1	Neeley	64.6	61.7	10.0	156.0	29.4	90.0	13.5
18	Golden Spike (HWW)	64.3	62.0	9.8	157.0	25.6	88.3	11.7
21	Gary (HWW)	64.2	61.1	10.3	153.3	28.3	86.7	11.5
10	Norstar	63.9	60.9	10.3	159.0	35.2	90.0	13.1
28	MT9989	62.4	60.6	9.8	154.0	25.1	88.3	13.0
25	Jagalene	62.0	64.2	10.2	150.3	23.4	90.0	13.9
14	NuSky (HWW)	61.7	62.6	10.4	156.3	28.1	88.3	12.6
41	MT0177	61.0	61.6	9.9	152.3	25.1	90.0	13.0
9	NuWest (HWW)	60.9	61.1	9.5	154.7	26.2	86.7	12.3
4	Rocky	60.8	63.0	10.0	152.3	27.2	90.0	13.1
5	Vanguard	60.7	61.9	9.4	152.0	28.0	88.3	13.4
24	BZ9W96-788	60.5	63.2	9.8	151.0	23.2	88.3	13.9
29	MTR9997	59.4	62.0	10.1	154.7	26.8	90.0	14.1
11	Promontory	59.1	63.0	10.0	151.7	24.3	90.0	13.7
15	Paul	58.9	60.9	9.0	154.7	23.4	86.7	12.5
32	MTS0031	58.7	62.8	9.9	154.7	28.5	88.3	13.0
45	MTW01143	58.6	61.7	9.4	159.0	28.5	90.0	13.7
37	Millenium	57.8	62.5	9.8	152.0	26.0	90.0	14.3
42	MTR01108	57.6	62.4	10.1	156.7	23.2	88.3	14.1
27	MT9982	57.0	62.4	10.1	155.0	23.5	83.3	12.3
20	Prowers 99	56.4	63.3	10.0	152.0	29.4	86.7	13.7
35	Expedition	55.9	64.0	9.8	150.0	23.1	90.0	13.4
39	MTS0125	55.9	61.4	9.5	156.7	27.3	86.7	14.1
19	GM10004 (HWW)	55.7	61.7	10.0	153.3	27.4	88.3	12.8
34	Above (IMI)	55.5	62.7	9.8	150.3	21.8	88.3	13.1
6	Morgan	54.7	60.8	9.9	156.0	26.5	88.3	13.0
48	Judith	54.4	59.7	9.4	152.0	25.5	86.7	13.9
7	Bighorn	53.8	62.9	9.8	153.3	23.1	90.0	12.6
47	MT01148	53.6	60.8	9.9	158.3	26.6	86.7	13.5
26	AP 502CL (IMI)	53.1	61.8	9.1	149.7	21.0	88.3	13.2

(Continued in next page)

Table 1(continued). Agronomic data from the Intrastate Winter Wheat Nursery Grown at the Northwestern Agricultural Research Center, Kalispell MT in 2002-03 season.

Planted: September 27, 2002 Harvested: July 29, 2003

Entry	Cultivar	Yield	Test weight	Grain moist	Heading date	Plant height	Winter survival	Protein
		Bu/A	Lb/Bu	%	Julian	in	%	%
46	MTW01146	52.6	60.6	9.3	158.7	28.0	90.0	14.5
13	BigSky	52.5	61.9	10.0	156.0	30.4	90.0	13.8
38	MTI01158 (IMI)	51.7	63.3	10.5	154.3	26.5	88.3	14.8
8	Quantum 542	51.6	62.9	9.8	151.7	28.1	86.7	13.6
49	Erhardt	51.2	62.0	10.0	153.3	25.5	86.7	14.6
3	Tiber	51.1	61.9	9.7	157.0	32.5	86.7	14.1
22	CDC Falcon	50.1	60.4	9.4	152.0	22.0	88.3	12.6
43	MTW01132	48.9	61.6	9.6	154.3	25.5	88.3	14.1
2	Rampart	48.4	61.9	10.1	156.3	26.2	78.3	14.1
40	MTS0131	48.0	62.2	9.7	156.0	26.6	86.7	13.9
17	NuHorizon (HWW)	45.4	63.7	9.9	151.0	21.0	88.3	12.8
16	NuFrontier (HWW)	44.7	64.0	10.3	151.7	22.6	83.3	12.1
44	MTW01133	44.2	60.6	9.7	152.0	23.0	90.0	13.1
36	Jerry	42.7	60.6	9.6	154.3	26.1	83.3	13.8
	Mean	56.7	61.9	9.8	154.1	26.1	88.0	13.3
	LSD (0.05)	14.23		0.72	1.54	3.32	4.31	
	C.V. (%)	15.40		4.52	0.62	7.84	3.02	

Project Title: Agronomic Performance Evaluation of Soft White Winter Wheat Cultivars.

Project Leader: Bob Stougaard

Project Personnel: Phil Bruckner, Jim Berg, Fernando Guillen, and Qingwu Xue

Objectives: To evaluate the agronomic performance of soft white winter wheat cultivars in environments and cropping systems representative of northwestern Montana.

Results:

Winter wheat had only reached the 1.5 leaf stage when cold temperatures occurred. As a result, winter injury was evident, and stand reductions occurred for all entries. In some cases stand reductions were as high as 25 percent. Daws demonstrated the best winter survival and was comparable to the hard red winter wheat control, Neeley. This juvenile growth stage also resulted in a lack of tillering and yields were much lower than normal. For example, the yield average in 2002 was 123 bu/A compared to 67 bu/A in 2003. The poor yields resulted in minor differences among cultivars; Malcolm had the greatest yield at 73 bu/A, whereas Cashup and KW960195p7005 had yields slightly less than 60 bu/A. Test weights averaged 56 lbs/bu, which is slightly lower than the 59 lb/bu average of 2002. Proteins were a percentage point greater than 2002.

Summary:

Although the poor yields prevented a rigorous assessment of yield potential among the cultivars evaluated in this study, the results did provide new insights into the winter hardiness of soft whites, with Daws demonstrating the best winter survival.

Future Plans:

Continue to evaluate soft white winter wheat cultivars for adaptation in District 1.

Table 1. Agronomic data from the Soft White Winter Wheat Nursery grown at the Northwestern Agricultural Research Center Kalispell, MT.

Planted: Spetember 27, 2002 Harvested: July 29, 2003

Entry	Cutivar	Yield	Test weight	Grain moist	Heading date	Plant height	Winter survival	Protein
		Bu/A	Lb/Bu	%	Julian	in	%	%
2	Neeley (HRW)	76.3	60.1	10.1	154.3	31.5	90.0	13.5
11	Malcolm	73.1	55.6	9.3	156.0	26.5	83.3	13.1
3	Eltan	71.3	55.2	10.7	162.3	26.8	86.7	13.0
6	MAC-1	70.8	57.5	10.7	156.3	28.3	85.0	12.7
10	Stephens	70.4	57.1	10.5	157.3	26.0	88.3	11.7
8	MacVicar	70.2	57.6	9.0	156.7	26.4	85.0	11.7
5	Rod	70.2	51.9	8.3	160.0	25.7	86.7	12.4
15	Daws	69.1	58.0	9.7	154.0	25.2	90.0	12.3
12	Lewjain	67.5	56.4	10.0	162.3	25.1	83.3	12.1
9	Madsen	65.7	57.0	10.1	157.3	24.9	83.3	12.8
7	Kmor	65.2	53.3	9.0	158.7	26.4	80.0	13.4
14	Hill 81	65.0	56.0	10.1	159.7	27.4	85.0	13.8
4	Bruehl (SWW Club)	60.1	54.5	11.9	162.7	25.3	75.0	12.3
16	Lambert	60.1	58.6	10.9	155.0	27.6	78.3	13.0
1	KW960195p 7005	59.8	59.4	9.5	153.3	24.0	86.7	13.2
13	Cashup	58.3	58.1	8.9	156.7	25.6	86.7	12.5
	Mean	67.1	56.6	9.9	157.7	26.4	84.6	12.7
	LSD (0.05)	10.92	1.27	1.56	2.44	7.50		
	C.V. (%)	9.79	7.72	0.59	5.55	5.33		

Project Title: Evaluation of Clearfield Winter Wheat Lines for Herbicide Tolerance.

Project Leader: Bob Stougaard

Project Personnel: Phil Bruckner, Jim Berg, Qingwu Xue, and Fernando Guillen

Objectives: Evaluate crop tolerance, yield potential and agronomic attributes of experimental herbicide resistant winter wheat lines.

Results:

Herbicide resistant winter wheat varieties are being developed in cooperation with Dr. Phil Bruckner, MSU winter wheat breeder, and BASF. BASF (formally American Cyanamid) developed a line of wheat with resistance to one of their proprietary herbicides – Beyond (imazamox). Beyond controls several troublesome weeds including downy brome, jointed goatgrass, wild oat, mustards, buckwheat and bedstraw. We have incorporated the resistant trait into several locally adapted hard red, hard white and soft white winter wheat varieties. A 36-entry nursery was established at Kalispell this past year to evaluate the level of herbicide resistance as well as agronomic and end-use quality attributes in these breeding lines. These experimental lines were either treated with the herbicide Beyond or not treated on April 29 when the winter wheat was 4 inches tall and had 5 leaves.

Winter wheat had only reached the 1.5 leaf stage when cold temperatures occurred. As a result, winter injury was evident, and stand reductions occurred for all entries. In some cases stand reductions were as high as 35 percent. However, the degree of winter injury was unrelated to the resistant trait since several control varieties (Rampart in particular) demonstrated similar levels of winter injury. This juvenile growth stage also resulted in a lack of tillering and yields were much lower than normal. Most lines demonstrated excellent herbicide tolerance. Crop injury varied from 0 to 22 percent depending on the breeding line. Yields ranged from 64 to 38 bu/acre. On average, those lines treated with the herbicide yielded 96 percent of the non-treated materials.

Summary:

Although some entries did exhibit herbicide injury symptoms, several line were comparable to ‘Above’, a commercially available herbicide resistant variety. On average, the differences between treated verses untreated were minor for all of the response variables evaluated. While these results are preliminary, it appears that there are several promising herbicide resistant lines under development.

Future Plans:

Continue to evaluate herbicide resistant winter wheat materials for herbicide tolerance and agronomic attributes

IMI winter wheat 2003, Kalispell. Planted: September 27, 2002; Harvested: July 29, 2003

Entry	ID	Yield Bu/A treated	Yield Bu/A untreated	Treated as % untreated	Test weight Lb/Bu treated	Test weight Lb/Bu untreated	Treated as % untreated	Grain moisture % treated	Grain moisture % untreated	Treated as % untreated	Winter survival % treated	Winter survival % untreated	Treated as % untreated
1	MTCL0301	43.5	43.6	99.9	60.0	60.9	98.5	9.9	10.2	97.1	90.0	90.0	100.0
2	MTCL0302	48.2	46.0	104.7	60.4	60.2	100.3	12.0	13.2	90.9	80.0	85.0	94.1
3	MTCL0303	63.0	55.8	112.9	61.7	61.8	99.8	10.6	11.1	95.5	90.0	87.5	102.9
4	MTCL0304	58.9	60.3	97.8	62.3	61.7	101.0	10.4	11.4	91.2	90.0	90.0	100.0
5	MTCL0305	53.0	63.2	83.8	62.4	62.3	100.2	10.5	11.0	95.5	90.0	90.0	100.0
6	MTCL0306	53.4	57.9	92.2	62.0	61.9	100.2	11.0	11.1	99.1	87.5	87.5	100.0
7	MTCL0307	56.2	67.8	83.0	60.2	60.6	99.3	10.5	11.7	89.7	90.0	90.0	100.0
8	MTCL0308	49.9	56.9	87.7	60.8	60.5	100.5	10.6	11.0	96.4	90.0	85.0	105.9
9	MTCL0309	63.8	61.0	104.7	60.7	61.1	99.3	10.4	10.7	97.2	90.0	90.0	100.0
10	MTCL0310	57.4	69.8	82.3	58.8	60.7	96.9	11.4	11.0	103.6	90.0	90.0	100.0
11	MTCL0311	57.0	58.5	97.4	61.2	59.8	102.3	10.6	11.4	93.0	90.0	87.5	102.9
12	MTCL0312	47.9	54.8	87.4	61.3	62.3	98.4	12.8	12.0	106.7	80.0	80.0	100.0
13	MTCL0313	56.4	64.9	86.9	62.8	62.9	99.8	10.4	10.8	96.3	90.0	90.0	100.0
14	MTCL0314	58.1	53.2	109.2	65.9	62.6	105.3	11.1	11.5	96.5	90.0	85.0	105.9
15	MTCL0315	56.3	53.8	104.6	61.9	63.9	96.9	11.9	12.2	97.5	87.5	90.0	97.2
16	MTCL0316	56.1	52.2	107.6	67.3	63.1	106.7	10.3	10.9	94.5	90.0	87.5	102.9
17	MTCL0317	46.9	45.9	102.2	58.7	59.7	98.3	10.6	10.4	101.9	80.0	72.5	110.3
18	MTCL0318	45.8	46.2	99.1	62.7	62.2	100.8	10.1	10.6	95.3	82.5	70.0	117.9
19	MTCL0319	39.4	36.4	108.1	66.8	61.6	108.4	10.2	10.3	99.0	75.0	72.5	103.4
20	MTCL0320	45.9	57.1	80.5	61.4	61.1	100.5	10.6	11.0	96.4	77.5	77.5	100.0
21	MTCL0321	41.8	42.3	98.9	60.7	60.8	99.8	11.8	11.8	100.0	77.5	75.0	103.3
22	MTCL0322	40.5	40.4	100.2	64.6	62.4	103.5	10.0	10.3	97.1	82.5	67.5	122.2
23	MTCL0323	40.6	45.7	88.9	61.6	61.7	99.8	10.6	11.1	95.5	75.0	82.5	90.9
24	MTCL0324	38.3	43.1	88.7	60.6	62.4	97.1	10.5	10.3	101.9	72.5	65.0	111.5
25	MTCL0325	43.6	43.2	100.9	61.2	61.1	100.2	11.0	12.4	88.7	82.5	70.0	117.9
26	MTCL0326	38.4	38.1	100.9	69.3	60.9	113.8	10.5	10.4	101.0	80.0	80.0	100.0
27	MTCL0327	53.7	58.5	91.9	59.7	59.6	100.2	10.2	10.2	100.0	90.0	87.5	102.9
28	MTCL0328	61.2	67.8	90.2	58.6	57.1	102.6	12.2	12.5	97.6	85.0	85.0	100.0
29	MTCL0329	53.0	64.0	82.8	59.7	59.5	100.3	11.5	11.5	100.0	80.0	87.5	91.4
30	MTCL0330	51.0	53.1	96.0	56.8	55.5	102.3	14.3	15.0	95.3	80.0	72.5	110.3
31	MTI01158	53.7	56.2	95.5	61.9	62.2	99.5	12.1	12.0	100.8	85.0	85.0	100.0
32	Above	61.5	58.9	104.4	62.2	62.1	100.2	9.8	10.1	97.0	90.0	87.5	102.9
	Mean	**51.1**	**53.6**	**96.0**	**61.8**	**61.1**	**101.0**	**11.0**	**11.3**	**97.1**	**84.7**	**82.6**	**103.0**
33	Rampart	0.0	45.0	0.0	0.0	61.0	0.0	0.0	10.6	0.0	72.5	65.0	111.5
34	Eltan	0.0	65.5	0.0	0.0	55.8	0.0	0.0	13.2	0.0	85.0	85.0	100.0
35	NuWest	0.0	59.5	0.0	0.0	60.6	0.0	0.0	11.9	0.0	90.0	90.0	100.0
36	Neeley	0.0	60.8	0.0	0.0	61.9	0.0	0.0	11.1	0.0	90.0	87.5	102.9

IMI winter wheat 2003, Kalispell. Planted: September 27, 2002; Harvested: July 29, 2003

Entry	ID	Heading date Julian treated	Heading date Julian untreated	Treated as % untreated	Plant height in treated	Plant height in untreated	Treated as % untreated	Protein % treated	Protein % untreated	Treated as % untreated	Crop injury % treated	Crop injury % untreated
1	MTCL0301	152.0	152.0	100.0	20.7	20.7	100.0	12.7	13.0	97.7	0.0	0
2	MTCL0302	158.0	157.0	100.6	22.6	22.6	100.0	13.8	13.6	101.5	12.5	0
3	MTCL0303	152.5	152.5	100.0	26.0	26.6	97.8	13.1	13.9	94.2	0.0	0
4	MTCL0304	152.5	153.5	99.3	26.2	26.0	100.8	13.3	13.5	98.5	0.0	0
5	MTCL0305	152.0	152.0	100.0	24.6	24.6	100.0	13.6	13.6	100.0	2.5	0
6	MTCL0306	153.0	153.5	99.7	22.8	23.0	99.1	13.8	13.9	99.3	10.0	0
7	MTCL0307	157.0	156.0	100.6	26.8	27.6	97.1	13.4	13.7	97.8	2.5	0
8	MTCL0308	155.0	155.0	100.0	25.2	25.8	97.7	14.4	14.0	102.9	0.0	0
9	MTCL0309	152.5	153.5	99.3	25.2	27.2	92.8	14.3	14.5	98.6	0.0	0
10	MTCL0310	155.0	157.5	98.4	27.0	29.7	90.7	12.9	13.0	99.2	0.0	0
11	MTCL0311	157.0	157.0	100.0	26.2	27.2	96.4	13.3	13.4	99.3	5.0	0
12	MTCL0312	156.5	155.5	100.6	22.0	24.6	89.6	14.1	14.1	100.0	7.5	0
13	MTCL0313	151.5	151.5	100.0	23.8	25.4	93.8	13.0	13.1	99.2	7.5	0
14	MTCL0314	152.0	153.5	99.0	25.8	26.0	99.2	14.1	14.2	99.3	0.0	0
15	MTCL0315	152.0	152.5	99.7	24.4	27.2	89.9	14.7	14.8	99.3	12.5	0
16	MTCL0316	151.0	152.0	99.3	22.8	22.4	101.8	13.4	13.1	102.3	0.0	0
17	MTCL0317	157.5	158.5	99.4	26.4	29.1	90.5	14.7	14.4	102.1	10.0	0
18	MTCL0318	153.0	154.0	99.4	26.4	27.0	97.8	14.3	14.1	101.4	17.5	0
19	MTCL0319	153.0	152.0	100.7	24.6	23.4	105.0	15.3	15.3	100.0	10.0	0
20	MTCL0320	153.5	154.5	99.4	24.2	27.8	87.2	14.2	13.9	102.2	12.5	0
21	MTCL0321	157.0	156.5	100.3	23.4	24.6	95.2	14.0	14.2	98.6	22.5	0
22	MTCL0322	151.5	152.5	99.3	23.4	24.0	97.5	14.4	14.6	98.6	7.5	0
23	MTCL0323	155.5	155.5	100.0	24.8	24.8	100.0	13.9	14.1	98.6	7.5	0
24	MTCL0324	153.5	153.0	100.3	22.8	25.8	88.5	15.2	14.9	102.0	15.0	0
25	MTCL0325	154.5	156.5	98.7	25.2	28.0	90.1	13.9	13.7	101.5	5.0	0
26	MTCL0326	153.0	153.5	99.7	25.6	25.0	102.4	15.3	15.9	96.2	7.5	0
27	MTCL0327	156.0	156.5	99.7	24.2	24.8	97.6	11.8	12.0	98.3	7.5	0
28	MTCL0328	156.0	157.0	99.4	25.6	27.6	92.9	12.0	12.3	97.6	0.0	0
29	MTCL0329	159.0	158.5	100.3	22.6	24.8	91.3	12.3	11.8	104.2	5.0	0
30	MTCL0330	159.0	160.5	99.1	23.8	23.4	101.7	12.2	12.6	96.8	0.0	0
31	MTI01158	152.5	155.5	98.1	23.2	25.2	92.2	14.2	14.2	100.0	10.0	0
32	Above	149.5	150.0	99.7	21.3	23.0	92.3	12.5	12.5	100.0	2.5	0
	Mean	**154.2**	**154.7**	**99.7**	**24.4**	**25.5**	**95.9**	**13.7**	**13.7**	**99.6**	**6.0**	**0.0**
33	Rampart	0.0	157.0	0.0	0.0	25.0	0.0	0.0	14.1	0.0	100.0	0
34	Eltan	0.0	161.0	0.0	0.0	23.8	0.0	0.0	13.1	0.0	100.0	0
35	NuWest	0.0	156.0	0.0	0.0	26.4	0.0	0.0	12.8	0.0	100.0	0
36	Neeley	0.0	155.5	0.0	0.0	27.0	0.0	0.0	13.3	0.0	100.0	0

Project Title: Agronomic Performance Evaluation of Advanced Spring Wheat Experimental Lines.

Project Leader: Bob Stougaard

Project Personnel: Luther Talbert, Susan Lanning, Qingwu Xue, and Fernando Guillen

Objectives:

To evaluate advanced spring wheat experimental lines for agronomic performance and disease resistance in environments and cropping systems representative of northwestern Montana.

Results:

Precipitation from May to July was only 50% of the normal, which reduced the length of grain filling and resulted in lower yields than previous years. The yield average was 78 Bu/A and ranged from 52 Bu/A in MT 0253 to 91 Bu/A in MT0261 and MT 0245. However, nearly half of the entries yielded more than McNeal (79 Bu/A). Grain test weight ranged from 51 Lb/Bu (SX1501B) to 62 Lb/Bu (MT 0202), with an average of 58 Lb/Bu. Heading date was 10 days earlier than previous year and ranged from 167 to 177 (averaged 172). Plant height ranged from 27 inches in GM40020 and SX1501B to 44 inches in Thatcher, with an average of 33 inches. Due to dry conditions during grain filling, grain protein was very high and ranged from 14 to 17% and averaged 15.8%. No lodging and disease were found in the 2003 nursery.

Summary:

Low precipitation after heading reduced yields and test weights in 2003 spring wheat nursery. However, grain protein was very high in this season. MT 0261, MT 0245, MT 0248, MTHW0202 and BZ998447 were the top yielding entries (about 90 Bu/A) at Kalispell.

Future Plans:

Continue spring wheat evaluations for the purpose of identifying cultivars best suited for District 1.

Table 1. Agronomic data from the Advanced Spring Wheat Nursery grown at the Northwestern Agricultural Research Center Kalispell, MT.

Planted: April 21, 2003 Harvested: August 7, 2003

ID	Cultivar	Yield	Test weight	Heading date	Plant Height	Protein
		Bu/A	Lb/Bu	Julian	in	%
MT 0261	ND695/MT9653	91.2	58.1	171.3	37.3	16.4
MT 0245	MT9433/ND695	91.1	58.6	173.4	33.6	14.3
MT 0248	ND695/MT9433	89.2	59.4	172.7	34.4	15.3
MTHW0202	ID377S/MTHW9701	88.8	60.2	166.6	32.3	15.0
BZ998447	SPILLMAN/906R	88.7	54.4	169.1	32.7	15.8
ND 695	Reeder	87.5	59.0	173.0	35.2	16.0
MT 0266	ND695/MT9755	87.4	55.0	169.3	33.7	16.1
GM40004	BR 7030	87.2	59.0	169.7	30.7	14.4
MT 0237	GRANDIN/WA7802	87.0	59.4	170.0	32.2	16.2
MT 0249	ND695/MT9433	86.3	58.4	170.0	30.1	16.1
GM40020	BLANCA GRANDE	86.3	60.9	167.0	27.2	14.8
MT 0265	ND695/MT9755	85.9	55.0	170.7	35.5	16.9
MT 0205	MCNEAL/MT8808	85.8	57.0	172.7	31.2	16.8
MTHW0203	ID377S/MTHW9701	85.6	59.0	170.3	31.9	15.1
MT 0255	MT9755/WA7802	85.3	56.1	171.6	34.8	15.9
MT 0247	MT9433/ND695	85.2	61.0	169.9	33.9	15.8
GM40019	PLATA	84.8	59.4	173.0	27.7	14.2
AGRIPRO2	KNUDSON	84.6	60.0	173.0	32.7	15.5
MT 0225	ND695/MCNEAL	83.8	56.3	174.0	31.4	15.3
CI 17430	NEWANA	83.7	57.9	175.6	31.7	14.7
AGRIPRO1	NORPRO	82.2	58.9	173.3	31.3	15.7
MT 0212	MCNEAL/MT8808	81.3	57.1	171.4	30.9	16.5
PI607557	SCHOLAR	81.1	60.3	174.3	37.3	16.3
MTHW0002	MTHW9520/MTHW9427	80.6	57.4	171.7	31.6	14.4
MTHW9901	MT9311/MTHW9417	80.6	60.3	172.7	38.1	15.4
BZ992588	Conan	80.5	58.7	171.4	32.2	15.7
MTHW0204	MTHW9427/MT9410	79.9	54.9	172.6	32.0	15.6
BZ996472	BZ992-634/GOLDEN86	79.8	61.7	167.0	31.0	14.3
MT 0228	MCNEAL/WA7802	79.8	55.8	171.7	33.3	16.3
MT 0013	MCNEAL/MT9410	79.4	56.0	170.0	31.0	15.7
MT 0244	MT8808/WA7802	79.2	56.8	172.9	31.5	16.5
PI574642	MCNEAL	79.1	55.5	173.1	31.8	15.5
MT 9918	MT9328/MT9419	79.0	58.0	171.4	37.3	15.0
MT 0134	MT9410/ERNEST	78.8	59.5	174.3	37.4	15.3
PI527682	AMIDON	78.5	58.2	173.0	39.7	16.0
MT 0260	MT9653/REEDER	78.4	59.0	175.0	33.7	14.9
MTHW0201	ID377S/MTHW9701	77.8	57.2	169.3	30.7	15.4

(Continued on next page)

Table 1 (Continued). Agronomic data from the Advanced Spring Wheat Nursery grown at the Northwestern Agricultural Research Center Kalispell, MT.

Planted: April 21, 2003 Harvested: August 7, 2003

ID	Cultivar	Yield	Test weight	Heading date	Plant Height	Protein
		Bu/A	Lb/Bu	Julian	in	%
MT 0238	MT8808/MT9653	76.8	58.6	167.4	35.5	16.5
PI549275	HI-LINE	76.5	54.0	169.7	30.6	17.0
MT 9929	MT9401/MT9328	76.2	57.2	172.0	31.4	17.2
BZ996434	BORDER/CONAN	76.2	60.5	170.3	31.9	15.4
MCNB	MCNEAL LARGE SEED	75.9	56.6	173.7	33.6	15.8
MT 9955	MCNEAL/KS27//MCNEAL	75.8	55.5	172.4	30.4	16.7
MT 0009	MCNEAL/MT9410	75.7	60.4	169.9	32.0	14.6
MT 0103	BZ992632/MCNEAL	75.1	58.1	173.7	32.1	15.8
WB 926	WESTBRED 926	74.9	57.8	169.6	32.0	15.9
PI592761	ERNEST	74.5	58.9	173.7	39.1	17.0
MT 0112	ERNEST/MT9410	74.4	58.3	171.4	36.6	16.6
CI 13596	FORTUNA	74.3	60.0	173.3	39.8	15.9
MT 0220	MCNEAL/ND695	73.9	56.2	170.0	31.4	16.9
MT 0252	ND695/MT9433	73.6	58.8	171.6	32.6	15.8
MT 0118	ERNEST/MT9410	73.1	56.7	173.0	34.8	16.5
BZ992322	HANK	72.9	55.0	170.3	31.0	15.9
MT 0202	MCNEAL/GRANDIN	72.8	62.3	169.0	32.7	16.2
MT 0147	MT9565/ERNEST	72.5	61.0	169.4	30.7	16.6
PI612605	MTHW9420	72.1	55.2	171.7	31.4	15.9
CI 10003	THATCHER	71.8	56.2	177.0	44.6	17.0
SX1502B	SEEDEX SX1502B	71.2	56.5	175.7	30.1	15.9
PI619086	EXPLORER	69.5	58.1	168.3	31.0	15.3
MT 9874	OUTLOOK	69.0	53.9	175.4	32.9	16.8
MT 0148	MT9565/ERNEST	66.3	59.3	172.3	32.9	16.0
SX1501B	SEEDEX SX1501B	58.3	51.1	177.4	27.0	16.2
MT 0234	ERNEST/ND695	52.6	58.5	169.4	33.1	16.2
MT 0253	MT9542/ND695	52.0	56.5	173.7	36.5	16.4
Mean		78.4	57.8	171.7	33.1	15.8
LSD (0.05)		17.6		1.5	2.2	

Project Title:	Evaluation of Spring Wheat Variety Performance in Off-Stations Trials
Project Leader:	Bob Stougaard
Project Personnel:	Luther Talbert, Susan Lanning, Qingwu Xue, and Fernando Guillen

Objectives:

To evaluate the performance of spring wheat varieties in different environments across Montana

Results:

Precipitation from May to July was only 50% of normal, which reduced the length of the grain filling period and resulted in lower yield. Yield ranged from 44 Bu/A for Rambo to 63 Bu/A for Outlook with an average of 52 Bu/A. Grain test weight was near normal and averaged 60 Lb/Bu. Although drought stress occurred during grain filling, grain 1000 kernel weight still was high and averaged 34 g. WB 936, WB 926, Hank and Fortuna had very high 1000 kernel weight (>38 g). Heading date was earlier than normal and averaged 169. Plant height ranged from 23 to 32 inches. All entries had high grain protein (15.7-17.9%). No lodging or diseases were observed.

Summary:

Low precipitation after heading reduced yields. However, grain test weight was normal and protein was very high in this season.

Future Plans:

Spring wheat off-station trial will be continued in Northwestern Montana.

Table 1. Agronomic data from the Off-station Spring Wheat Nursery Grown at the Northwestern Agricultural Research Center, Kalispell, MT.

Planted: April 22, 2003 Harvested: August 1, 2003

Entry	Cultivar	Yield	Test weight	Grain moisture	1000 kernel weight	Heading date	Plant height	Protein
		Bu/A	Lb/Bu	%	g	Julian	in	%
17	OUTLOOK	63.2	57.7	10.8	29.6	172.0	29.8	16.7
10	WB 936	59.5	59.4	10.9	43.0	167.3	23.2	17.9
15	MTHW9420	59.2	58.9	10.9	33.9	168.3	26.8	15.7
14	Reeder	58.5	60.3	11.1	31.8	168.3	27.8	16.3
16	EXPLORER	57.3	59.9	10.4	29.8	167.0	26.6	16.3
3	LEW	54.7	60.0	10.9	32.8	171.7	31.1	16.2
8	ERNEST	53.8	61.4	11.4	33.2	169.0	29.8	17.3
20	MT 9918	53.5	60.0	10.5	30.9	168.0	28.1	17.2
13	SCHOLAR	53.5	61.1	11.0	34.0	169.3	28.1	17.1
18	MT 9929	53.0	60.1	10.8	31.7	169.0	27.2	17.9
5	MCNEAL	52.2	58.4	11.0	32.3	171.0	27.4	16.3
6	AMIDON	50.9	60.6	11.2	33.2	168.0	29.0	16.5
19	HANK	50.4	58.7	11.7	41.8	168.0	24.1	17.4
4	HI-LINE	49.0	58.8	10.4	31.8	168.0	23.2	16.2
9	WB 926	47.8	59.0	10.7	38.7	167.3	25.3	17.5
12	Conan	47.2	60.6	11.5	35.1	169.0	24.5	16.1
2	FORTUNA	47.0	60.6	10.7	38.7	168.3	32.3	16.2
1	NEWANA	46.6	59.8	12.5	32.3	171.3	23.2	15.9
11	WBEXPRES	46.4	59.3	11.2	34.1	169.0	23.0	16.4
7	RAMBO	44.4	60.7	11.7	34.7	171.7	24.5	16.7
	Mean	52.4	59.8	11.1	34.2	169.1	26.8	16.7
	LSD (0.05)	13.59	0.88		2.07	1.44	2.69	
	C.V. (%)	15.68	0.89		3.67	0.51	6.09	

Project Title: Evaluation of Durum Wheat Variety Performance in Off-Stations Trials

Project Leader: Bob Stougaard

Project Personnel: Luther Talbert, Susan Lanning, Qingwu Xue, and Fernando Guillen

Objectives:

To evaluate the performance of durum wheat varieties in different environments across Montana

Results:

Precipitation from May to July was only 50% of the normal for the 2003 spring wheat growing season. Yields averaged 41 Bu/A. All the durum entries yielded less than McNeal (55 Bu/A). Only 3 entries (Laker, Sceptre and AC Avonlea) had yields higher than Mountrail (check). Grain test weight was good and averaged 60 Lb/Bu. All entries headed within 4 days of each other and the mean heading date was 171. Plant height averaged 27 inches. Grain protein was very high (averaged 17.2%), with Laker having the lowest protein content (15.6%).

Summary:

Low precipitation after heading reduced yield in 2003 off-station durum wheat nursery. However, grain test weight was normal and protein was very high in this season.

Future Plans:

Durum wheat off-station trial will be continued in Northwestern Montana.

Table 1. Agronomic data from the Off Station Durum Wheat Grown at the Northwestern Agricultural Research Center, Kalispell, MT.

Planted: April 22, 2003 Harvested: August 1, 2003

ENTRY	Cultivar	Yield	Test weight	Grain moisture	Heading date	Plant height	Protein
		Bu/A	Lb/Bu	%	Julian		
15	MCNEAL	55.0	57.5	9.0	171.0	25.9	16.5
2	LAKER	43.9	60.5	13.8	171.7	24.8	15.6
9	SCEPTRE	43.5	59.4	9.8	170.7	26.0	17.9
14	AC AVONLEA	43.2	59.7	10.6	171.3	28.9	18.0
10	MOUNTRAIL	42.5	59.0	10.4	172.3	26.4	16.9
5	RENVILLE	41.5	60.1	12.4	171.3	28.1	17.1
3	MEDORA	41.0	61.1	12.8	170.0	28.6	17.9
11	MAIER	40.8	60.1	11.4	172.0	25.7	17.4
13	LEBSOCK	40.8	60.3	10.6	171.0	27.2	17.1
6	KYLE	39.5	59.7	13.8	172.7	29.5	17.6
7	Munich	39.5	60.6	10.0	170.7	24.5	17.6
4	MONROE	38.8	61.1	11.6	169.0	27.7	17.0
1	VIC	38.0	60.6	13.4	171.3	28.0	17.2
8	BEN	35.9	60.6	12.2	170.3	26.0	18.0
12	PLAZA	34.3	59.7	11.8	173.0	23.6	16.9
	Mean	41.2	60.0	11.6	171.2	26.7	17.2
	LSD (0.05)	4.67			1.26	2.19	
	C.V. (%)	6.77			0.44	4.89	

Project Title: Agronomic Performance Evaluation of Intrastate Spring Barley Cultivars.

Project Leader: Bob Stougaard

Project Personnel: Suzanne Mickelson, Pat Hensleigh, Qingwu Xue, and Fernando Guillen

Objectives:

To evaluate spring barley cultivars and experimental lines for agronomic performance in environments and cropping systems representative of northwestern Montana.

Results:

Although low precipitation during June and July shortened the grain filling period, barley entries still had high yields in 2003 season. The yield averaged 116 Bu/A and ranged from 98 (Haybet) to 128 Bu/A (B99AL-621 and MT981030). Only 2 entries (B99AL-621 and MT981030) yielded more than Gallatin (127 Bu/A). However, 27 entries yielded more than Baronesse (117 Bu/A). Grain test weight ranged from 43 (Legacy) to 52 Lb/Bu (MT970116 and MT000138), with an average of 49 Lb/Bu. Among the 64 entries, 23 entries had a test weight higher than 50 Lb/Bu and only 13 entries had a test weight lower than 48 Lb/Bu. Heading date ranged from 168 (Conlon) to 179 (MT010093), with an average of 174. Due to the dry conditions during grain filling, entries with early heading tended to have higher yield. The average plant height among entries (32 inches) was similar to previous year (31 inches) and ranged from 27 inches in Calgary to 36 inches in 6B952482 and Haybet. Percent plump averaged 72% and ranged from 34 to 93%. However, only Calgary, Haybet, Legacy and MT010095 had percent plumps lower than 50%. There were 22 entries with percent plumps higher than Baronesse (80%). Grain protein content was also high this season and ranged from 13.9% in MT000092 and B99AL-621 to 17.5% in Valier. About 75% of entries had protein contents higher than 15%. No lodging and disease were found in the 2003 nursery because of dry conditions during grain filling period.

Summary:

Although limited precipitation shortened the grain filling period, high yield, test weight, grain protein were still obtained in 2003 barley growing season.

Future Plans:

Continue barley evaluations for the purpose of identifying cultivars best suited for District 1.

Table 1. Agronomic data from the Intrastate Spring Barley Nursery grown at the Northwestern Agricultural Research Center Kalispell, MT.

Planted: April 21, 2003 Harvested: August 8, 2003

Entry	Cultivar	Yield	Test weight	Grain moisture	Heading date	Plant height	Lodging index	Plump	Protein
		Bu/A	Lb/Bu	%	Julian	in	0-9	%	%
12	B99AL-621	127.8	49.5	11.5	175.0	30.5	0.0	75.0	13.9
26	MT981030	127.7	49.6	11.8	177.0	33.3	0.0	70.0	15.4
1	Gallatin	127.2	50.3	11.2	170.3	34.8	0.0	81.8	14.7
50	MT010095	126.7	44.0	11.0	173.0	33.6	0.0	32.5	16.2
42	MT000156	126.7	50.2	10.0	170.0	32.9	0.0	81.0	15.6
14	MT910189	124.9	49.7	12.0	170.0	32.9	0.0	88.9	14.8
18	MT960228	124.9	48.2	12.0	173.7	33.1	0.0	71.3	14.4
23	MT970229	124.8	51.2	11.9	174.3	32.2	0.0	81.1	15.4
24	MT981004	124.2	47.7	11.2	174.0	32.1	0.0	59.6	14.9
33	MT000040	123.9	49.8	11.0	173.3	32.2	0.0	63.3	15.7
53	MT010155	123.3	50.3	10.9	171.3	35.0	0.0	86.5	15.9
45	MT010001	122.8	51.1	12.0	172.7	33.0	0.0	90.5	14.2
20	MT970116	122.8	51.9	11.8	171.7	35.0	0.0	88.1	14.2
51	MT010097	122.5	48.1	10.5	173.7	33.0	0.0	71.3	15.0
28	MT981091	122.3	46.6	11.6	171.3	31.2	0.0	65.7	15.8
21	MT970148	122.2	48.2	11.2	171.3	28.5	0.0	84.1	15.0
37	MT000092	122.1	50.9	10.5	172.0	31.8	0.0	86.2	13.9
6	Harrington	122.0	47.3	11.0	175.0	32.6	0.0	70.1	15.5
43	MT000180	121.2	49.3	11.2	174.3	34.4	0.0	76.6	15.6
54	MT010156	121.1	49.3	11.0	171.3	34.3	0.0	82.6	16.4
30	MT981212	120.9	50.7	12.0	171.3	33.9	0.0	79.7	15.3
32	MT990106	120.8	48.1	11.5	175.3	31.8	0.0	77.9	16.7
29	MT981210	120.0	48.6	12.0	174.3	34.4	0.0	73.9	16.6
62	MT010212	119.9	48.7	12.0	174.0	33.0	0.0	83.1	14.5
60	MT010198	119.9	49.9	11.6	171.0	34.5	0.0	81.3	15.4
41	MT000153	119.1	49.8	11.2	173.0	30.2	0.0	88.1	14.8
34	MT000045	118.4	50.2	11.5	174.3	32.7	0.0	83.6	15.2
2	Baronesse	117.4	51.4	12.0	175.3	33.3	0.0	80.3	14.2
48	MT010081	117.1	48.5	12.0	173.7	34.4	0.0	75.6	15.0
15	Haxby	116.9	51.7	11.9	172.7	34.0	0.0	62.7	15.6
11	6B952482	116.8	47.3	10.0	171.3	35.9	0.0	73.0	14.8
55	MT010158	116.5	50.2	11.8	173.3	32.0	0.0	79.4	15.8
58	MT010183	116.5	51.2	12.0	176.0	33.9	0.0	72.1	15.0
8	Garnet	115.8	48.3	11.8	175.3	34.7	0.0	88.1	14.0
59	MT010191	115.0	47.8	10.7	178.3	30.3	0.0	60.6	16.1

Table 1 (Continued). Agronomic data from the Intrastate Spring Barley Nursery grown at the Northwestern Agricultural Research Center Kalispell, MT.

Planted: April 21, 2003 Harvested: August 8, 2003

Entry	Cultivar	Yield	Test weight	Grain moisture	Heading date	Plant height	Lodging index	Plump	Protein
		Bu/A	Lb/Bu	%	Julian	in	0-9	%	%
36	MT000063	114.8	51.1	12.0	176.3	33.2	0.0	68.1	16.5
35	MT000047	114.8	50.1	11.4	172.3	32.0	0.0	71.8	15.7
57	MT010162	114.7	47.9	11.0	177.3	30.4	0.0	58.1	16.5
3	Conlon	114.6	50.2	9.4	167.7	34.1	0.0	92.6	14.5
5	Valier	114.2	48.5	11.0	176.7	31.6	0.0	49.6	17.5
56	MT010160	114.2	48.0	12.0	175.3	32.6	0.0	58.6	16.2
52	MT010133	114.2	49.8	12.0	177.3	30.5	0.0	61.5	14.1
39	MT000130	113.0	50.4	12.0	172.7	35.1	0.0	84.8	14.7
19	MT970026	112.9	48.5	9.0	173.7	32.0	0.0	54.5	16.1
47	MT010080	112.3	50.4	11.8	172.0	32.7	0.0	81.3	15.7
40	MT000138	111.9	51.9	12.0	171.7	34.1	0.0	92.3	15.6
22	MT970155	111.3	47.8	11.5	176.3	32.7	0.0	78.6	16.2
25	MT981006	110.9	47.5	11.2	174.3	31.0	0.0	66.3	16.5
63	MT010213	110.4	50.8	12.0	175.3	29.3	0.0	75.3	16.3
16	MT960099	110.4	46.7	11.2	175.7	27.7	0.0	55.0	15.8
31	MT981238	109.7	51.4	12.2	171.7	31.8	0.0	88.4	15.7
49	MT010093	109.3	45.9	10.2	179.0	30.7	0.0	50.2	16.4
4	Xena	109.2	49.3	11.8	175.0	32.0	0.0	65.7	15.6
9	Merit	108.9	44.7	11.0	175.7	31.8	0.0	63.1	15.6
17	MT960101	108.9	48.9	9.2	175.7	29.7	0.0	52.7	16.1
64	MT010219	108.5	47.3	11.8	174.3	34.3	0.0	82.6	16.2
38	MT000125	107.7	49.5	11.2	175.0	33.3	0.0	85.1	15.8
46	MT010061	107.2	48.1	10.6	175.3	31.5	0.0	62.9	16.9
61	MT010205	106.5	48.3	11.8	178.3	30.5	0.0	73.6	16.2
27	Hays	105.8	45.9	11.0	175.0	31.1	0.0	58.2	16.1
44	MT000239	105.0	47.5	11.5	177.0	33.4	0.0	60.5	16.5
10	Legacy	101.6	43.1	10.2	175.3	34.4	0.0	37.1	15.5
13	Calgary	100.1	45.3	11.8	176.7	27.3	0.0	46.3	17.0
7	Haybet	98.0	50.1	11.0	174.0	35.9	0.0	42.2	16.4
	Mean	115.9	48.9	11.3	174.0	32.6	0.0	71.5	15.6
	LSD(0.05)	15.5			1.8	2.2			

Project Title: Montana Statewide Spring Oat Variety Performance.

Project Leader: Bob Stougaard

Project Personnel: Suzanne Mickelson, Pat Hensleigh, Qingwu Xue, and Fernando Guillen

Objectives:

To evaluate the agronomic performance of oat varieties and experimental lines in environments and cropping systems representative of northwestern Montana.

Results:

Dry conditions during June and July shortened the grain filling period and resulted in lower yields in 2003 as compared to previous year. The average yield was 102 Bu/A, only half of the average yield in the previous year. Yields ranged from 85 Bu/A in Ajay to 115 Bu/A in CDC Pacer. However, more than half of the entries yielded more than 100 Bu/A. Plant height was also reduced as compared to previous year and averaged only 25 inches. However, grain test weight and protein content were high this season in the absence of disease and lodging. Test weight averaged 36 Lb/Bu and ranged from 34.0 (Maverick) to 38.5 Lb/Bu (Monico). Only three entries (87AB5632, ABSP14-6 and Monida) had a protein content lower than 15%. The protein in Killdeer was as high as 18.5%. Heading date ranged from 170 to 178, with an average of 174.

Summary:

Low precipitation during grain filling resulted in lower yield in 2003. However, test weight and protein content remained at high levels. CDC Pacer, 87AB5632, Celsia, 95A10854 and CDC Dancer were top yielding entries this season.

Future Plans:

Cultivars will continue to be evaluated at Kalispell in an attempt to identify those cultivars best adapted to District 1.

Table 1. Agronomic data from the State Oat Nursery grown at the Northwestern Agricultural Research Center Kalispell, MT.

Planted: April 22, 2003 Harvested: August 13, 2003

ENTRY	Cultivar	Yield	Test weight	Grain moisture	Heading date	Plant height	Grain protein
		Bu/A	Lb/Bu	%	Julian	in	%
7	CDC Pacer	114.6	36.9	9.4	173.7	29.5	15.3
12	87AB5632	112.6	35.3	9.2	174.0	24.0	14.5
5	Celsia	108.2	33.8	9.0	177.3	28.3	17.3
13	95A10854	108.1	35.2	8.8	178.3	25.5	16.1
11	CDC Dancer	108.0	38.4	9.4	172.7	30.3	17.5
15	ABSP14-6	106.7	36.4	9.9	172.0	25.6	14.7
10	ABSP19-9	106.1	35.4	9.0	176.0	22.7	15.4
3	Rio Grande	102.0	36.8	9.2	169.7	23.5	17.8
14	95AB5543	101.2	35.9	9.8	176.3	24.0	15.5
2	Monida	101.1	34.6	9.4	176.7	26.8	14.6
1	Otana	98.1	36.8	9.2	175.7	29.9	17.0
8	Maverick	96.8	34.0	9.2	172.0	20.3	16.9
9	Monico	96.2	38.5	9.8	172.3	23.6	17.8
16	98AB6646	93.8	35.4	9.5	174.7	21.9	15.1
6	Killdeer	93.4	37.6	9.6	171.0	24.7	18.5
4	Ajay	84.5	36.4	9.0	172.7	18.0	16.8
	Mean	102.0	36.1	9.3	174.1	24.9	16.3
	LSD (0.05)	10.85			1.29	2.16	
	C.V.	6.4			0.44	5.2	

Project Title: Plant Growth Regulator (PGR) Effects on Spring Wheat Growth and Yield

Project Leader: Bob Stougaard

Project Personnel: Qingwu Xue and Fernando Guillen

Objective:

To evaluate the effect of Apogee on spring wheat growth and yield.

Results:

Apogee is an experimental plant growth regulator (PGR), which may reduce plant height and prevent lodging. As such, this material may provide some yield benefits under the high rainfall conditions of northwestern Montana. Twenty spring wheat entries were planted on April 21, 2003. The PGR was sprayed prior to heading (June 12, 2003) at a rate of 0.24 lb ai/ac. Nontreated controls were also included for each entry.

Low precipitation reduced plant height compared to the long-term average. As a result, lodging was not observed with any of the entries. Apogee reduced plant height about 25%. PGR effects on plant height varied, depending on whether the material was standard height or semidwarf. Specifically, effects on plant height were non-uniform in the standard height cultivars Fortuna, Lew, Amidon and Ernest, suggesting that standard height cultivars may require repeated application. Although genotype by PGR interactions for yield were evident, the yield response to PGR application generally was not significant (Table 1). Application of Apogee did not affect grain test weight or 1000 kernel weight, but did delay heading by 1 to 3 days.

Summary:

Low precipitation reduced plant height and prevented lodging. Therefore, PGR applications did not provide any yield benefit in this growing season.

Table 1. Effect of plant growth regulator (Apogee) on spring wheat heading date, height and grain yield in 2003 at Kalispell, MT.

ENTRY	ID	PEDIGREE	Heading date (doy)			Plant height (cm)			Yield (bu/ac)		
			Untreated	Treated	Treated as % of untreated	Untreated	Treated	Treated as % of untreated	Untreated	Treated	Treated as % of untreated
1	CI 17430	NEWANA	176.0	176.5	100.3	70.0	60.5	86.4	69.7	92.6	132.8
2	CI 13596	FORTUNA	172.5	176.0	102.0	89.0	59.0	66.3	84.5	77.7	91.9
3	CI 17429	LEW	174.5	179.0	102.6	88.0	69.0	78.4	72.0	78.1	108.5
4	PI549275	HI-LINE	170.0	173.5	102.1	73.5	60.0	81.6	78.0	80.4	103.1
5	PI574642	MCNEAL	173.0	176.5	102.0	77.0	59.0	76.6	74.6	77.2	103.5
6	PI527682	AMIDON	173.5	177.0	102.0	91.0	65.0	71.4	74.3	70.2	94.4
7	C982-324	RAMBO	174.0	177.5	102.0	74.5	54.0	72.5	77.2	76.2	98.7
8	PI592761	ERNEST	174.5	175.0	100.3	92.0	65.0	70.7	75.9	81.2	107.0
9	WB 926	WESTBRED 926	169.5	170.5	100.6	66.5	54.0	81.2	66.6	77.6	116.6
10	WB 936	WESTBRED 936	169.0	170.5	100.9	64.5	55.5	86.0	70.7	70.9	100.3
11	WBEXPRES	WESTBRED EXPRESS	171.5	175.5	102.3	65.5	51.5	78.6	69.6	70.0	100.5
12	BZ992588	Conan	171.5	176.5	102.9	85.0	52.0	61.2	81.7	70.5	86.3
13	PI607557	SCHOLAR	174.5	178.0	102.0	88.5	69.0	78.0	79.2	79.5	100.3
14	ND 695	Reeder	173.0	175.0	101.2	77.0	63.0	81.8	76.2	72.6	95.2
15	MTHW9420	MT8182/MT8289	171.0	173.5	101.5	72.0	56.0	77.8	69.1	69.4	100.3
16	PI619086	EXPLORER	169.0	169.5	100.3	76.5	57.0	74.5	75.6	63.5	84.0
17	MT 9874	OUTLOOK	175.5	176.5	100.6	76.5	59.0	77.1	83.0	83.3	100.5
18	MT 9929	MT9401/MT9328	173.0	175.5	101.4	78.5	56.0	71.3	78.1	69.9	89.6
19	BZ992322	HANK	171.0	173.0	101.2	71.5	54.5	76.2	78.8	82.0	104.0
20	MT 9918	MT9328/MT9419	173.0	175.0	101.2	86.5	59.0	68.2	73.8	78.1	105.8
Mean			172.5	175.0	101.5	78.2	58.9	75.8	75.4	76.0	101.2

Table 2. Effect of plant growth regulator (Apogee) on spring wheat test weight, 1000 kernel weight and stand uniformity in 2003 at Kalispell, MT.

ENTRY	ID	PEDIGREE	Test weight (lb/bu)			Thousand kernel weight (g)			Uniformity (1-3)		
			Untreated	Treated	Treated as % of untreated	Untreated	Treated	Treated as % of untreated	Untreated	Treated	Treated as % of untreated
1	CI 17430	NEWANA	58.2	60.7	104.4	31.3	34.4	110.0	1.00	1.00	100.0
2	CI 13596	FORTUNA	61.6	60.2	97.9	41.5	39.3	94.7	1.00	3.00	300.0
3	CI 17429	LEW	60.4	59.4	98.4	34.7	33.9	97.8	1.00	2.25	225.0
4	PI549275	HI-LINE	59.0	60.0	101.7	31.7	34.5	108.9	1.00	1.25	125.0
5	PI574642	MCNEAL	57.5	57.5	100.1	33.0	33.8	102.3	1.00	1.00	100.0
6	PI527682	AMIDON	59.7	59.3	99.4	35.4	33.6	95.2	1.00	2.50	250.0
7	C982-324	RAMBO	60.1	59.9	99.7	35.3	33.2	94.3	1.00	1.25	125.0
8	PI592761	ERNEST	61.3	59.8	97.7	34.5	34.4	99.8	1.00	2.75	275.0
9	WB 926	WESTBRED 926	59.7	59.4	99.5	42.0	40.8	97.2	1.00	1.00	100.0
10	WB 936	WESTBRED 936	58.3	59.2	101.5	41.3	40.2	97.3	1.00	1.00	100.0
11	WBEXPRES	WESTBRED EXPRESS	57.6	57.5	99.7	33.4	33.0	98.8	1.00	1.00	100.0
12	BZ992588	Conan	60.6	60.2	99.3	38.9	36.6	94.0	1.00	1.00	100.0
13	PI607557	SCHOLAR	61.2	60.0	98.1	35.8	35.8	99.9	1.00	1.75	175.0
14	ND 695	Reeder	60.4	59.4	98.3	35.1	33.2	94.8	1.00	1.25	125.0
15	MTHW9420	MT8182/MT8289	57.9	58.2	100.7	33.8	33.0	97.8	1.00	1.00	100.0
16	PI619086	EXPLORER	59.7	58.6	98.2	30.5	28.9	94.7	1.00	1.25	125.0
17	MT 9874	OUTLOOK	58.3	57.5	98.7	33.4	32.3	96.7	1.00	1.00	100.0
18	MT 9929	MT9401/MT9328	60.5	59.4	98.2	35.1	34.5	98.4	1.00	1.00	100.0
19	BZ992322	HANK	58.5	58.5	100.0	41.2	41.3	100.1	1.00	1.00	100.0
20	MT 9918	MT9328/MT9419	59.5	58.6	98.6	32.6	32.3	99.0	1.00	2.00	200.0
Mean			59.5	59.2	99.5	35.5	35.0	98.6	1.0	1.5	146.3

Project Title: Spring Wheat Tolerance to Assure II, Fusilade, Poast and Select Herbicides

Project Leader: Bob Stougaard

Project Personnel: Qingwu Xue and Fernando Guillen

Objective: Evaluate spring wheat crop tolerance to four herbicides for controlling grass weeds.

Results:

The soil residual activity of Assure II, Fusilade, Poast and Select were evaluated in two separate fields (R5 and Y7) representing a sandy and silty clay loam soil, respectively. The herbicides were applied at 14, 7 and 0 days prior to spring wheat planting. The herbicides were applied using a CO_2 backpack sprayer in 20 GPA of water with Teejet XR11002 nozzle. Assure II was applied at 3 rates (0.034, 0.048 and 0.096 lb ai/ac). Fusilade, Poast and Select were applied at 0.375, 0.75 and 0.25 lb ai/ac, respectively. McNeal spring wheat was planted 1.5 inches deep on April 30, 2003 at 65 lb/ac using a double disk press drill with 6 inch row-spacings.

Assure II did not injure wheat, regardless of the soil type, use rate, or application timing (Tables 1-2). Fusilade, Poast and Select resulted in very significant injury in the sandy soil and increased in severity as application neared planting date (82-98%). Crop injury from Fusilade was less than from Poast and Select (Table 1). Crop injury was only observed with the latest applications of Poast and Select in silty clay loam soil (Table 2).

Summary:

No significant crop injury was found with applications of Assure II in spring wheat. However, applications of Fusilade, Poast and Select within 2 weeks before planting resulted in significant crop injury in sandy loam soil. Applications of Poast and Select also resulted in crop injury in silty clay soil when applied immediately before planting.

Future Plan:

Crop tolerance to herbicide will continuously conducted in Northwestern Agricultural Research Center.

Table 1. Spring wheat crop tolerance to Assure II, Fusilade, Poast and Select in R5 field (sandy soil) at Northwestern Agricultural Research Center, Kalispell, MT.

Trt No.	Treatment Name	Rate lb ai/ac	Appl Code	Emergence plants per quadrat	Stand reduce (%)	Crop injury (%)	Yield bu/ac
1	Assure II	0.034	A	14.0	10.0	6.7	44.9
2	Assure II	0.048	A	21.7	0.0	0.0	44.3
3	Assure II	0.096	A	13.3	0.0	0.0	45.4
4	Fusilade	0.375	A	8.0	28.3	20.0	38.5
5	Poast	0.75	A	14.3	3.3	10.0	42.6
6	Select	0.25	A	14.3	13.3	15.0	43.9
7	Assure II	0.034	B	14.0	0.0	0.0	44.3
8	Assure II	0.048	B	13.0	5.0	4.0	47.1
9	Assure II	0.096	B	13.0	5.0	0.0	45.4
10	Fusilade	0.375	B	6.3	40.0	38.3	32.7
11	Poast	0.75	B	7.7	65.0	70.0	26.1
12	Select	0.25	B	6.3	65.0	58.3	29.8
13	Assure II	0.034	C	12.7	10.0	3.3	39.7
14	Assure II	0.048	C	11.0	3.3	5.0	42.5
15	Assure II	0.096	C	13.7	21.7	7.3	40.9
16	Fusilade	0.375	C	2.0	88.3	81.7	19.1
17	Poast	0.75	C	4.3	97.0	95.3	7.6
18	Select	0.25	C	1.7	97.0	98.0	6.1
19	Untreated		A	19.0	0.0	5.0	47.8
LSD (P=.05)				6.76	13.67	10.23	5.88
CV				37.02	28.5	22.73	9.83
Treatment F				5.136	54.25	95.086	39.058
Treatment Prob(F)				0.0001	0.0001	0.0001	0.0001

A = 14 days prior to planting; B = 7 days prior to planting; C = 0 days prior to planting.

Table 2. Spring wheat crop tolerance to Assure II, Fusilade, Poast and Select in Y7 field (silty clay soil) at Northwestern Agricultural Research Center, Kalispell, MT.

Trt No.	Treatment	Rate lb ai/ac	Appl Code	Emergence plants per quadrat	Stand reduce (%)	Crop injury (%)	Yield bu/ac
1	Assure II	0.034	A	6.0	3.3	3.3	42.8
2	Assure II	0.048	A	9.7	1.7	0.0	47.9
3	Assure II	0.096	A	11.3	0.0	0.0	46.8
4	Fusilade	0.375	A	7.0	3.3	3.3	44.3
5	Poast	0.75	A	18.3	0.0	0.0	41.7
6	Select	0.25	A	18.3	0.0	0.0	45.4
7	Assure II	0.034	B	14.7	0.0	0.0	45.6
8	Assure II	0.048	B	16.0	0.0	0.0	44.3
9	Assure II	0.096	B	10.3	0.0	0.0	44.7
10	Fusilade	0.375	B	14.7	13.3	3.3	42.3
11	Poast	0.75	B	17.7	6.7	5.0	41.6
12	Select	0.25	B	7.3	3.3	0.0	42.9
13	Assure II	0.034	C	9.7	0.0	0.0	44.5
14	Assure II	0.048	C	10.0	10.0	3.3	44.1
15	Assure II	0.096	C	10.7	5.0	3.3	43.0
16	Fusilade	0.375	C	7.0	6.7	5.0	48.4
17	Poast	0.75	C	6.0	58.3	60.0	30.0
18	Select	0.25	C	4.0	81.7	78.3	29.8
19	Untreated		A	29.7	0.0	0.0	42.9
LSD (P=.05)				12	13.77	9.06	7.45
CV				60.5	82.01	63.19	10.56
Treatment F				2.151	20.421	46.534	3.563
Treatment Prob(F)				0.0248	0.0001	0.0001	0.0006

A = 14 days prior to planting; B = 7 days prior to planting; C = 0 days prior to planting.

Project Title: Evaluation of Reduced Herbicide Rates for Wild Oat Control in Spring Wheat.

Project Leader: Bob Stougaard

Project personnel: Qingwu Xue and Fernando Guillen

Objectives: Determine the effect of reduced rates of Beyond applied alone or in combination with MCPA for wild oat control and crop injury potential in Clearfield spring wheat.

Results:

A herbicide resistant (Clearfield) spring wheat cultivar was planted on April 22 at 65 lb/A using a double disk press drill set to a planting depth of 1.5 inches. Wild oat seed was then planted in the center of each plot to assure a uniform weed density throughout the study site. Beyond was applied at 0.03 and 0.04 lb ai/A alone or in combination with two rates of MCPA. A experimental prepackaged combination of Beyond plus MCPA (BAS 777) also was included in the study and was similarly applied at two rates. A non-treated check and Puma plus Harmony Extra plus 2,4-D were also included as controls. Herbicides were applied in 20 GPA on May 21 using teejet XR11002 nozzles. Wild oat emergence was variable and ranged from the 2 leaf to 2 tiller stage of development and height varied from 1 to 4 inches at the time of application. Clearfield spring wheat stands were unifrom and plants were 4 inches tall at application.

In general, crop injury was slight and never exceeded 18 percent. Crop injury was variable and no trends were evident with respect to use rates or tankmix combinations. All herbicide treatments that included Beyond or BAS 777 provided 100 percent control of wild oat. This is in contrast to the Puma treatment, where wild oat control was comparable to the nontreated check. Concurrently, wheat yields were lowest in the Puma and nontreated plots, but there were no yield differences among the Beyond and BAS 777 treatments.

Summary:

Although this represents a single year and location, it appears that the level of herbicide resistance in this Clearfiled cultivar was adequate and that MCPA does not result in enhanced crop injury when applied with Beyond. Further, the additions of MCPA do not appear to results in antagonism since all treatments provided complete control of wild oat. This response was consistant regardless of whether Beyong was applied at the low or high rate, suggesting that low rates of Beyond in combination with MCPA will provide excellent control of wild oat.

Future Plans:

Continue to evaluate crop saftey and wild oat control with the Clearfield system.

Evaluation of reduced herbicide rates for wild oat control in spring wheat.

Treatment Name	Rate (lb ai/A)	Crop injury % 5/30/03	Crop injury % 6/6/03	Crop injury % 7/17/03	WO control % 5/30/03	WO control % 6/6/03	WO control % 7/17/03	Yield 13%m bu/ac 8/1/03
Check		0	0	0	0	0	0	36.5
Beyond	0.0312	0	10	12	20	100	100	47.6
NIS	0.25							
UAN 28%	1							
Beyond	0.0469	0	13	8	25	100	100	50.5
NIS	0.25							
UAN 28%	1							
BAS 777	0.2812	0	0	5	27	100	100	52.2
NIS	0.25							
UAN 28%	1							
BAS 777	0.422	0	10	18	30	100	100	51.5
NIS	0.25							
UAN 28%	1							
Beyond	0.0312	0	17	13	23	100	100	52.6
MCPA Ester	0.25							
NIS	0.25							
UAN 28%	1							
Beyond	0.0469	0	13	12	35	100	100	50.8
MCPA Ester	0.375							
NIS	0.25							
UAN 28%	1							
Beyond	0.0312	0	7	8	22	100	100	50.3
MCPA Ester	0.165							
NIS	0.25							
UAN 28%	1							
Beyond	0.0469	0	13	12	27	100	100	49.7
MCPA Ester	0.25							
NIS	0.25							
UAN 28%	1							
Puma	0.0825	0	0	10	5	20	13	39.1
HarmonyExtra	0.0188							
2, 4-D Ester	0.25							
NIS	0.25							
LSD (P=.05)		0	14.727	11.892	11.401	0.313	6.264	4.35
CV		0	103.02	70.5	31.15	0.22	4.49	5.26

Project Title: Evaluation of Wild Oat Herbicides in Spring Wheat

Project Leader: Bob Stougaard

Project Personnel: Qingwu Xue and Fernando Guillen

Objective: Assess new and established wild oat herbicides for efficacy and crop tolerance.

Results:

McNeal spring wheat was planted on April 22 at 65 lb/A using a double disk press drill set to a planting depth of 1.5 inches. Wild oat seed was then planted in the center of each plot to assure a uniform weed density throughout the study site. Discover was applied at 0.05 and 0.06 lb ai/A alone or in combination with Bronate. Puma at 0.08 lb ai/A and Everest at 0.02 lb ai/A also were applied alone or in combination with Bronate. A non-treated check was included as a control. Herbicides were applied in 20 GPA on May 22 using teejet XR11002 nozzles. Wild oat and spring wheat ranged from the 1 to 2 tiller stage of development at the time of application.

Crop injury was minimal with all herbicide treatments with the exception of Everest. Crop injury with Everest initialy ranged from 23 to 30 percent, with the greater injury being associated when tankmixed with Bronate. This trend continued throughout the season, but the degree of injury decreased with time. Initially, the addition of Bronate resulted in reduced wild oat control. This was especially evident with Puma and the low rate of Discover. However, this antagonistic effect was transiate and all treatments provided excellent control of wild oat by seasons' end. Although the Everst treatments did afford complete control of wild oat, these same treatments had some of the lowest yields and this is probably attributed to the early-season crop injury.

Summary:

All treatments provided excellent control of wild oat. Everest treatments resulted in early-season crop injury which negatively affected yields.

Future Plans:

Continue to evaluate wild oat herbicides in order to determine the consistancy of control and crop injury potential over years.

Evaluation of Wild Oat herbicides in Spring Wheat.

Treatment Name	Rate (lb ai/A)	Crop Inury % 5/30/2003	Crop Injury % 6/16/2003	Crop Injury % 7/17/2003	WO Control % 6/10/2003	WO Control % 7/17/2003	Yield 13%m bu/ac 8/1/2003
Untreated		0	0	0	0	0	42.9
Discover	0.05	0	0	0	96	96	62.2
Discover	0.0625	0	0	0	98	98	60.6
Discover Bronate	0.05 0.75	0	0	0	71	94	59.5
Discover Bronate	0.0625 0.75	0	7	0	96	98	57.9
Puma	0.082	5	7	0	95	96	52.9
Puma Bronate	0.082 0.75	0	0	0	30	94	54.2
Everest NIS	0.0268 0.25	23	17	8	93	100	51.2
Everest NIS Bronate	0.0268 0.25 0.75	30	28	12	87	100	49.2
LSD (P=0.5)		4.637	9.274	4.562	20.94	3.664	5.44
CV		41.33	82.66	118.59	16.36	2.45	5.77

Project Title: Spring Wheat Seed Size and Cultivar Effects on Wild Oat Interference

Project Leader: Bob Stougaard

Project Personnel: Qingwu Xue and Fernando Guillen

Objective:

To investigate spring wheat seed size and cultivar effects on wheat yield, yield components and wild oat seeds production under wild oat interference.

Results:

This field experiment consisted of three cultivars (McNeal, Penewawa and Explorer), three seed size classes and two wild oat densities. Seed size classes in each cultivar were obtained by passing bulk seeds over 7/64, 6/64 and 5/64 inch sieves. The seed size-cultivar treatments were grown under two wild oat densities (0 and 16 plants/ft^2). Spring wheat yield components and wild oat parameters were determined by harvesting two 1.46 square feet quadrats near wild oat shattering. Spring wheat yield, test weight and wild oat dockage were determined by combine harvest.

Wild oat interference significantly reduced spring wheat yield and resulted in 24-44% yield loss. Yield did not differ among the three cultivars under both monoculture and wild oat interference. However, seed size had a significant effect on yield under wild oat interference. As seed size increased, yield loss and dockage were significantly reduced (Table 1). Wild oat interference had little effect on grain test weight but significantly reduced 1000 kernel weight. The yield loss under wild oat interference was mainly attributed to a reduction in the number of spikes per square meter and per plant. Spring wheat plants grown from large seeds had significantly more spikes than those grown from small seeds under wild oat interference (Table 1).

Spring wheat cultivar had no effect on wild oat parameters. However, seed size effect on wild oat parameters was very significant. As seed size increased, wild oat biomass and seeds production were reduced (Table 2).

Summary:

Seed size had a significant effect on spring wheat yield and wild oat seed production under wild oat interference. Plants established from large seeds provides significant benefits to crop competitiveness, reducing yield loss and wild oat seed production.

Table 1. Effects of wild oat interference, spring wheat cultivar and seed size on spring wheat yield and yield components in 2003 at Kalispell, MT.

Wild oat density	Cultivar	Seed size	Yield	Yield loss	Dockage	Test weight	Spikes per m^2	Spikes $plant^{-1}$	Seeds $spike^{-1}$	TKW
No./ft^2			Bu/A	%	%	Lb/Bu				g
0	McNeal	Large	62.1	0.0	0.0	57.8	431.5	2.8	29.3	33.3
0	McNeal	Medium	61.3	0.0	0.0	57.8	443.7	2.8	28.3	33.0
0	McNeal	Small	62.9	0.0	0.0	58.0	378.1	2.9	34.8	32.7
0	Penewawa	Large	57.2	0.0	0.0	58.4	474.9	3.0	27.2	29.7
0	Penewawa	Medium	64.3	0.0	0.0	58.9	473.8	3.0	30.4	30.3
0	Penewawa	Small	58.7	0.0	0.0	58.6	476.0	2.7	27.7	30.1
0	Explorer	Large	60.3	0.0	0.0	59.5	480.4	2.8	27.1	31.1
0	Explorer	Medium	60.3	0.0	0.0	60.0	447.1	2.9	28.4	31.9
0	Explorer	Small	62.3	0.0	0.0	59.5	433.7	3.4	31.6	30.8
16	McNeal	Large	45.7	26.0	5.1	57.9	314.7	2.3	30.1	33.3
16	McNeal	Medium	46.3	23.5	5.7	57.9	309.2	1.9	31.5	32.7
16	McNeal	Small	35.2	43.9	9.3	57.4	286.9	1.9	25.9	32.0
16	Penewawa	Large	46.7	26.7	4.2	58.7	372.6	2.3	27.7	30.6
16	Penewawa	Medium	40.6	36.8	5.8	58.2	344.8	2.2	26.8	29.7
16	Penewawa	Small	37.7	35.1	7.4	57.6	347.0	2.2	25.5	30.0
16	Explorer	Large	44.8	25.3	3.7	59.5	378.1	2.4	26.0	30.9
16	Explorer	Medium	43.0	28.6	5.5	59.3	363.7	2.3	27.3	29.9
16	Explorer	Small	37.2	40.3	9.0	59.5	331.4	2.1	25.5	29.6
	LSD (0.05)		**2.8**	**6.1**	**1.1**	**0.4**	**28.2**	**0.2**	**2.4**	**2.0**

TKW: 1000 kernel weight.

Table 2. Effects of spring wheat cultivar and seed size on the number of wild oat plants, panicles, biomass and seed production in 2003 at Kalispell, MT.

Cultivar	Seed size (SS)	Plants per m^2	Panicles per m^2	Biomass g/m^2	Seeds per m^2
McNeal	Large	95.0	130.0	194.5	3307.0
McNeal	Medium	88.5	117.1	181.9	2571.9
McNeal	Small	121.7	159.5	295.5	3370.1
Penewawa	Large	111.5	130.0	181.5	2517.8
Penewawa	Medium	105.1	139.2	208.6	3220.4
Penewawa	Small	95.9	132.7	226.3	3246.8
Explorer	Large	96.8	116.1	163.5	2176.5
Explorer	Medium	151.2	176.1	289.1	3980.9
Explorer	Small	100.5	149.3	267.7	3698.3
Contrast (SS)			**NS**	**	*

NS: Not significant, P>0.05; *: P<0.05; **: P<0.01.

Project Title: Spring Wheat Seed Size and Seeding Rate Effects on Wild Oat Interference

Project Leader: Bob Stougaard

Project Personnel: Qingwu Xue and Fernando Guillen

Objective:

To investigate spring wheat seed size and seeding rate effects on wheat yield and wild oat seed production.

Results:

This experiment consisted of 3 spring wheat seed size classes (large, medium and small), 2 seeding rates (low and high) and 2 seeding rate strategies (population or weight basis) in the presence of 2 wild oat densities (0 and 16 plants/ft^2). The three seed size classes were obtained by passing commercial bulk seeds of McNeal spring wheat through 7/64, 6/64 and 5/64 inches sieves. When determining seeding rate based on a population basis (POP), low and high seeding rates were 16 and 26 plants/ft^2. When establishing seeding rate based on weight (WT), low and high seeding rates were 60 and 120 lb/ac.

Wild oat interference significantly reduced spring wheat yield, biomass and number of spikes under both seeding rate strategies (POP and WT). The effect of seeding rate on yield, biomass and number of spikes was consistent under both strategies, with all parameters increasing as seeding rate increased under wild oat interference. Seed size effects on spring wheat yield, biomass and spikes was very significant under the POP basis, with all parameters increasing as seed size increased. When established on a weight basis (WT), seed size effects were not significant since seed size was confounded with seeding rate. For example, wheat plant population varied from 246 to 459 plants/m^2 (23-43 plants/ft^2) at a seeding rate of 120 lb/ac, depending on seed size. In general, using large seeds still increased yield when plant populations were lower than 250 plants/m^2 (23 plants/ft^2). On a POP basis, increasing seeding rate slightly increased grain test weight and 1000 kernel weight (TKW). However, plants grown from large seeds had lower TKW than those grown from small seeds. Seed size and seeding rate had little effect on test weight and TKW under WT basis (Table 1).

Increased seeding rate significantly reduced wild oat biomass and seeds production under both the POP and WT basis. The seed size effect on wild oat biomass and seeds production was only found under POP basis, and increasing seed size reduced wild oat biomass and seed production. Seed size effects on wild oat biomass and seed production were not evident when established on a WT basis because of the confounding effect with seeding ratė (Table 2). Overall, the use of higher seeding rates and the use of large seed size both contribute to improved suppression of wild oat, and higher seeding rates on a weight basis compensates for small seed size.

Future Plans: Continue to evaluate seed size and seeding rate arrangement effects on yield and wild oat interference.

Table 1. Spring wheat seed size and seeding rate effects on wheat yield, biomass, number of spikes, test weight, dockage, 1000 kernel weight (TKW) and protein content under two seeding rate strategies (POP and WT).

Planting type	Wild oat (WD)	Seeding rate (SR)	Seed size (SS)	Plants	Spikes	Biomass	Yield	Test weight	Dockage	TKW	Protein
	No./ft^2			No./m^2	No./m^2	g/m^2	bu/ac	lb/bu	%	g	%
POP	0	Low	Large	163.5	448.2	872.8	67.2	56.6	1.3	31.0	16.3
POP	0	Low	Medium	175.7	519.4	1004.0	68.6	55.6	1.0	30.3	16.8
POP	0	Low	Small	169.1	448.2	866.8	61.5	56.6	2.0	32.1	16.2
POP	0	High	Large	255.8	501.6	940.2	65.7	55.8	1.3	30.2	16.8
POP	0	High	Medium	272.5	516.0	1012.8	71.0	57.2	1.2	32.4	16.7
POP	0	High	Small	258.0	520.5	954.1	64.4	56.8	1.2	30.7	16.3
POP	16	Low	Large	201.3	452.7	812.5	46.7	55.4	6.5	29.4	17.0
POP	16	Low	Medium	167.9	320.3	603.3	42.4	57.1	9.6	32.7	16.1
POP	16	Low	Small	154.6	310.3	559.4	36.6	56.8	12.9	31.3	16.4
POP	16	High	Large	241.3	368.1	706.4	52.6	57.3	5.5	32.2	16.2
POP	16	High	Medium	241.3	387.0	739.9	51.1	57.3	5.5	33.2	16.4
POP	16	High	Small	199.1	316.9	616.6	45.9	57.7	7.7	33.0	16.1
	LSD (0.05) (WD & SR)			**18.7**	**40.7**	**67.3**	**2.1**	**0.6**	**0.8**	**0.9**	
	LSD (0.05) (SS)			**22.9**	**49.9**	**82.4**	**2.6**	**0.8**	**1.0**	**1.1**	
WT	0	Low	Large	151.3	440.4	867.9	62.6	57.1	1.6	31.9	16.2
WT	0	Low	Medium	193.5	418.2	1055.2	69.1	57.2	1.0	32.4	15.3
WT	0	Low	Small	250.2	487.1	871.8	63.4	56.7	1.7	31.6	16.1
WT	0	High	Large	250.3	496.0	947.8	66.9	57.3	1.2	31.9	15.9
WT	0	High	Medium	322.5	446.0	865.3	62.7	57.7	1.8	32.2	15.8
WT	0	High	Small	364.8	580.5	1017.7	70.7	56.6	1.1	31.1	16.4
WT	16	Low	Large	131.3	359.2	591.8	44.1	57.0	10.9	31.7	16.2
WT	16	Low	Medium	176.8	373.7	668.4	44.8	56.9	9.0	32.2	16.0
WT	16	Low	Small	245.8	388.1	710.1	50.1	58.0	6.7	33.0	15.2
WT	16	High	Large	245.8	423.7	795.2	59.5	57.9	4.8	32.9	15.9
WT	16	High	Medium	307.0	407.0	751.2	56.5	58.3	4.5	33.4	15.2
WT	16	High	Small	459.3	518.2	816.6	56.6	56.9	4.0	31.5	16.3
	LSD (0.05) (WD & SR)			**32.2**	**46.3**	**49.3**	**2.6**	**0.6**	**0.7**	**0.7**	
	LSD (0.05) (SS)			**39.4**	**56.7**	**60.4**	**3.2**	**0.7**	**0.9**	**0.8**	

Table 2. Spring wheat seed size and seeding rate effects on the number of wild oat plants, panicles, biomass and seed production under two seeding rate strategies (POP and WT).

Planting type	Seeding rate (SR)	Seed size (SS)	Plants	Panicles	Biomass	Seeds
			No./m^2	No./m^2	g/m^2	No./m^2
POP	Low	Large	115.2	146.6	218.1	2543.1
POP	Low	Medium	130.0	160.4	285.9	3656.3
POP	Low	Small	141.0	189.9	336.7	4400.3
POP	High	Large	137.4	150.3	181.6	2495.0
POP	High	Medium	118.9	131.8	184.8	2272.8
POP	High	Small	109.7	153.0	197.7	2886.8
	LSD (0.05) (SR)				**49.9**	**826.9**
	LSD(0.05) (SS)				**61.1**	**1013.8**
WT	Low	Large	137.4	155.8	256.2	3051.9
WT	Low	Medium	118.9	148.4	235.2	3159.8
WT	Low	Small	128.1	157.6	236.9	3306.0
WT	High	Large	120.8	130.0	159.0	1983.7
WT	High	Medium	106.9	120.8	156.6	1938.6
WT	High	Small	100.5	101.4	118.5	1410.6
	LSD (0.05) (SR)			**24.6**	**32.3**	**931.8**
	LSD(0.05) (SS)			**30.1**	**39.5**	**1142.4**

Project Title: Bedstraw Control by Starane in Peppermint

Project Leader: Bob Stougaard

Project Personnel: Qingwu Xue and Fernando Guillen

Objective: Evaluate the bedstraw control in peppermint with Starane.

Results:

Starane was applied at 2 crop growth stages (dormancy and 3 inches tall) and at 2 rates (0.125 and 0.25 lb ai/ac) with and without the surfactant MSO. Treatments were applied using a CO_2 backpack sprayer in 20 GPA of water with Teejet XR11002 nozzles. The bedstraw was about 1 inch tall at mint dormancy (4/10/2003) and about 6 inches tall when mint was about 3 inches tall (5/22/2003).

Application of Starane at the 3" stage resulted in some crop injury early in the season, but no crop injury was observed near harvest. Starane applied at both rates resulted in excellent bedstraw control regardless of whether a surfactant was included. Although dormant applications of Starane did not result in crop injury, bedstraw control was slightly lower (80%) especially when applied at the lower rate (0.125 lb ai/ac). This was likely due to additional weed germination and emergence following the initial herbicide application.

Summary:

Starane applied at the higher rate resulted in excellent bedstraw control, regardless of application timing. Although application of Starane at 3" stage caused some initial crop injury, oil yield was not affected. Application of Starane provided an effective way to control bedstraw in peppermint.

Table 1. Effect of Starane application on bedstraw control, mint injury, and oil yields, 2003.

Trt No.	Treatment Name	Rate Rate Unit	Appl Code	Weed control % 6/3/2003	Crop injury % 6/3/2003	Weed Control % 6/10/2003	Crop injury % 6/10/2003	Weed Control % 7/17/2003	Crop injury % 7/17/2003	Crop yield tons/ac	Weed biomass tons/ac	Mint oil lbs/ac
1	Starane	0.125 LB A/A	A	91 a	0 c	92 b	0 b	84 bc	0 a	2.9 a	0.5 ab	50.0 a
2	Starane	0.125 LB A/A	A	92 a	0 c	91 b	7 b	81 c	0 a	2.5 ab	0.9 ab	65.7 a
	MSO	0.625 % V/V	A									
3	Starane	0.25 LB A/A	A	98 a	0 c	100 a	0 b	91 ab	0 a	3.1 a	0.1 b	54.7 a
4	Starane	0.25 LB A/A	A	98 a	0 c	98 a	0 b	99 a	0 a	3.2 a	0.0 b	73.7 a
	MSO	0.625 % V/V	A									
5	Starane	0.125 LB A/A	B	63 d	25 b	100 a	27 ab	100 a	8 a	2.5 ab	0.1 b	63.2 a
6	Starane	0.125 LB A/A	B	73 c	30 ab	100 a	13 ab	100 a	0 a	2.9 a	0.0 b	61.3 a
	MSO	0.625 % V/V	B									
7	Starane	0.25 LB A/A	B	83 b	33 ab	100 a	35 ab	100 a	0 a	2.8 a	0.0 b	71.2 a
8	Starane	0.25 LB A/A	B	78 bc	42 a	100 a	43 a	100 a	0 a	3.1 a	0.0 b	67.1 a
	MSO	0.625 % V/V	B									
9	Untreated			0 e	0 c	0 c	0 b	0 d	0 a	1.6 b	1.2 a	48.4 a
LSD (P=.05)				6.77	11.94	2.81	22.6	8.21	8.33	0.83	0.638	17.703
CV				5.2	47.75	1.87	94.01	5.65	519.62	17.45	121.92	16.49
Treatment F				182.686	19.664	1222.359	5.059	139.468	1	3.165	4.603	2.329
Treatment Prob(F)				0.0001	0.0001	0.0001	0.0029	0.0001	0.4726	0.0238	0.0046	0.0753

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

A = dormant application; B = 3 inch application.

FORAGE INVESTIGATION

759

Forage investigation is part of Project 759 and includes research related to all types of forage from seeding to data collection to publications

PROJECT TITLE: Sulfur Recommendations for Irrigated Alfalfa

PROJECT COOPERATORS: Duane Johnson and Louise Strang, NWARC
Dennis Cash, MSU Bozeman

OBJECTIVE:

Test variable rates of S fertilization on irrigated alfalfa to:

- determine optimum plant S tissue levels for optimum economic yield and safe feeding,
- determine specific plant tissues (leaves vs. whole plants) for monitoring purposes, and
- begin to develop S fertilizer rate recommendations.

METHODS:

On 5/2/02 'Shaw' alfalfa was planted at 23 lbs/a in nine 5' x 20' plots with 4 replicates. The plots were harvested 7/31 and 10/3/02. Dried forage samples were analyzed for CP, ADF, NDF, S, Cu, and Zn. On 4/19/02 soil was sampled from 3 depths to determine these background levels: pH 7.6, 9ppm N, 15 ppm P, 94 ppm K, 7 ppm S, 0.56 salt. Fertilizer treatment levels for 2003 were estimated from these data.

On 4/30/03 N fertilizer containing from 0 to 35 lbs N/a was applied with and without S fertilizer containing 0 to 40 lbs S/a. The plots were harvested 6/16, 7/24, and 9/29/03. Plant samples were taken and analyzed for CP,ADF, NDF, S, Cu, and Zn. There were no significant differences in forage yield among the fertilizer treatments in 2003 at Kalispell (Table 1).

Table 1. Forage yields (tons/acre) of alfalfa fertilized with various N and S fertilizer rates at Kalispell MT in 2003.

SULFUR RECOMMENDATIONS FOR IRRIGATED ALFALFA					
Kalispell, 2003					
		6/16	*7/24*	*9/29*	
		Harv-1:	Harv-2:	Harv-3:	Total
N lb/a	S lb/a	*t/a*	*t/a*	*t/a*	*t/a*
0	0	2.96	2.14	2.03	7.13
8.8	10	2.99	2.01	1.97	6.97
17.5	20	2.48	2.10	2.09	6.46
26.3	30	2.65	2.25	1.95	6.86
35.0	40	2.76	2.03	1.96	6.75
8.8	0	2.93	2.13	1.97	7.53
17.5	0	2.75	2.12	2.14	7.00
26.3	0	2.74	2.03	1.93	6.70
35.0	0	2.64	2.11	1.95	6.70
	mean	2.77	2.10	2.00	6.90
	LSD(0.05)	ns	ns	ns	ns

PROJECT TITLE: Barley Forage Fertility Trial

PROJECT COOPERATORS: Mal Westcott – MSU-WARC
Duane Johnson – MSU-NWARC
Louise Strang – MSU-NWARC

OBJECTIVE: Determine the effects of nitrogen and sulfur fertilizer on 'Haybet' forage barley yield and quality.

METHODS: 'Haybet' barley (*Hordeum vulgare* L.) was seeded in 5'by 20' plots consisting of 7 rows spaced 6" apart. Seeding rate was 77 lbs/acre pure live seed, and seeding depth was 1.5 in. Monoammonium phosphate fertilizer *(11-52-0)* was applied preplant at a rate of 120 lbs/acre. The experimental design was a randomized complete block with 3 N fertilizer rates (applied as ammonium nitrate) and 2 S rates (applied as gypsum) and four replications. Weeds were controlled by hand.

No irrigation was used. Crop year precipitation (Sept.- Aug.) was 14.91 inches. Average monthly temperatures were 50.5, 60.1, and 69.1^{o} F from May to July, respectively.

The barley was harvested at anthesis with a research plot forage harvester on 7/11/03. Harvest area was 100 ft^2. After recording the fresh harvest weight, a subsample of approximately 500 g was taken, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content. The samples were ground in a Wiley mill to pass through a 1-mm screen. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined for each sample. Nitrogen content was determined and multiplied by 6.25 for CP concentration.

Analysis of variance was calculated by the ANCOVA procedure of XLSTAT Version 7.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

DISCUSSION: Unlike the 2002 trial, the barley forage yield did not respond to either N or S fertilizer (Table 1). Both fertilizers affected tissue nitrate levels, however (Table 2). Nitrate levels increased with increased N, and also with the addition of S. The latter was the opposite of the 2002 reaction to S fertilization.

The fertilizers seemed to affect the fiber levels in the forage. The addition of N increased both NDF and ADF over the 0-N treatment (Tables 3 & 4). The addition of 20 lbs S/acre increased both NDF and ADF when less than 120 lbs/acre N fertilizer was added. Phosphorus concentration in the forage was decreased by the addition of sulfur (Table 5). Potassium level was increased by the addition of 60 lbs N/acre over the 0-N control (Table 6). Addition of 20 lbs S/acre had no effect on K concentration.
As expected, the addition of N or S fertilizer increased the total amount of each element in the forage (Tables 7 & 8). Since crude protein (CP) is a direct function of N, CP concentration showed the same trend (Table 9).

Table 1. Total dry matter yield (tons/acre) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	3.46	3.52	3.49
60	3.76	3.62	3.69
120	3.36	3.39	3.37
mean	3.53	3.51	
			LSD (0.05): NS

Table 2. Nitrate concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	0.281	0.404	0.342
60	0.256	0.634	**0.445**
120	0.515	0.674	**0.595**
mean	0.351	**0.571**	
		LSD (0.05) N-rate: 0.171	
		LSD (0.05) S-rate: 0.139	

Table 3. NDF concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	45.9	**48.2**	47.1
60	**48.5**	**47.0**	47.8
120	**46.5**	45.7	46.1
mean	47.0	47.0	
		LSD (0.05) N x S: 2.3	

Table 4. ADF concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	23.1	**24.8**	23.9
60	**24.5**	**23.9**	24.2
120	**23.7**	23.0	23.4
mean	23.8	23.9	
		LSD (0.05) N x S: 1.6 (P=0.7)	

Table 5. P concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	0.230	0.217	0.223
60	0.226	0.219	0.223
120	0.232	0.219	0.225
mean	**0.229**	0.218	
		LSD(0.05) S-rate: 0.010.	

Table 6. K concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	1.129	1.216	1.173
60	1.418	1.437	1.428
120	1.286	1.206	1.246
mean	**1.278**	1.286	
		LSD (0.05) N-rate: 0.197.	

Table 7. Total N concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	1.988	1.948	1.968
60	1.911	2.119	2.015
120	2.225	2.331	**2.278**
mean	2.041	2.133	
		LSD (0.05) N-rate: 0.141.	

Table 8. Total S concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	0.200	0.215	0.208
60	0.196	0.225	**0.211**
120	0.214	0.234	**0.224**
mean	0.203	**0.225**	
		LSD (0.05) N-rate: 0.016 (P=0.10).	
		LSD (0.05) S-rate: 0.013	

Table 9. Crude protein concentration (% dry matter) of Haybet barley forage under different N and S fertilizer treatments at Kalispell in 2003.

	S-rate (*lbs/a*)		
N-rate *lbs/a*	0	20	mean
0	12.4	12.2	12.3
60	11.9	13.2	12.6
120	13.9	14.6	**14.2**
mean	12.8	13.3	
		LSD (0.05) N-rate: 0.9	

PROJECT TITLE: SPRING CEREAL FORAGE

PROJECT COOPERATORS: Dave Wichman, MSU - CARC
Duane Johnson, MSU – NWARC
Louise Strang, MSU - NWARC

OBJECTIVE:

To compare the yield and feeding quality of different species and cultivars of spring cereal crops as to their suitability as annual forage crops.

METHODS:

Fertilizer was applied preplant at the following rates: 100 lbs/acre N, 28 lbs/a P_2O_5, 60 lbs/a K_2O, 48 lbs/a SO_2. Pursuit and Prowl were preplant incorporated for weed control. Eighteen small grain selections were seeded 4/24/03 in a randomized complete block design with 4 replicates. Seeding rate was 21 seeds/ft^2. Plots were 5' wide x 16' long with 6" row spacing.

Crop year precipitation was 14.91 inches. Average monthly temperatures were 44.5, 50.5, 60.1,69.1, and 66.9 degrees F from April to August, respectively. No irrigation was applied.

The forage was harvested when the heads had reached anthesis, 68 to 76 days after seeding, depending on species. Data collected included dry matter production, % nitrate, protein, ADF, and NDF.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT Ver.7.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

RESULTS:

There were no significant yield differences among species and varieties in 2003 (Table 1). The barleys, as a species, produced the most forage, followed by the oats, then triticale and spelt. The wheat x spelt hybrid and the emmer yielded the least. Although quality data is not yet available, past studies have shown barley to have the most stable nitrate concentrations, an important safety factor for livestock forage.

Table 1. Total dry matter yield (t/acre) for 3 N rates and 2 S rates at Kalispell in 2003.

SPRING CEREAL FORAGE
Kalispell, 2003

Variety	Species	Head day	Anthesis day	Plant Height inches	Yield t/a
Logan	barley	60.0	72.5	25.8	**3.31**
Hays	barley	63.8	72.5	22.8	2.83
Valier	barley	65.3	72.5	26.3	2.68
Sarah	barley	59.0	72.5	28.8	**3.25**
BZ 598-227	barley	63.0	72.5	26.3	**3.01**
Haybet	barley	61.3	72.5	28.5	**3.17**
Westford	barley	64.0	72.5	31.5	**3.08**
Bestford	barley	63.5	72.5	32.0	**3.43**
Bz 598-257	barley	62.8	72.5	24.5	2.63
Harrington	barley	64.8	71.8	25.8	**3.01**
Maverick	oat	62.8	72.5	23.8	2.23
Otana	oat	63.0	**76.0**	36.0	2.82
Paul	oat	64.5	**76.0**	35.0	2.54
Red 1	triticale	62.5	68.8	**38.5**	2.33
91002005	triticale	61.8	68.5	36.3	2.27
93ST59	wht X splt	64.0	68.5	37.5	1.75
SK3P	spelt	64.0	68.3	**42.3**	2.10
Lucille	emmer	**67.5**	69.3	32.8	1.46
	mean	63.2	71.8	30.8	2.66
	LSD(0.05)	1.9	1.2	4.1	0.59

PROJECT TITLE: Hulless Oats Cultivar Trial

PROJECT COOPERATORS: Duane Johnson and Louise Strang, NWARC

OBJECTIVE: Evaluate hulless oat cultivars and breeding lines for yield potential in a Northwestern Montana environment.

RESULTS: Nineteen experimental selections of hulless oat were compared to 4 currently available hulless cultivars. The hulled cultivars 'AJ' and 'Monida' were included as checks. The trial was seeded on April 28, 2003 at 60 lbs/a seeding rate.

Experimental design was a randomized complete block with 4 replicates. Plots were fertilized with 13 lbs N/a and 62 lbs P_2O_5/a on 4/21/03. Good stands were obtained. Grain yields of the selection lines ranged from 38.2 bu/a to 65.9 bu/a compared to 51.1 bu/a for 'Paul' and 77.9 bu/a for 'Monida' (Table 1).

Table 1. Heading (days after seeding), height, grain yield, and test weight of oats at Kalispell in 2003

Line	Heading *day*	Height *in*	Test Wt *lbs/bu*	Yield *bu/a*	% of mean
Monida	65.3	34.6	23.5	**77.9**	147
AJ	63.0	26.2	22.7	**67.5**	128
94Ab6965	61.3	33.5	31.6	**65.9**	125
95Ab12970	64.0	36.4	28.4	60.3	114
99Ab12635	65.5	**38.5**	27.0	58.6	111
94Ab6860	63.8	32.2	28.6	56.8	108
99Ab12631	66.3	**40.8**	28.6	56.9	108
MF9714-136	**58.0**	32.2	**33.8**	53.9	102
95Ab13061	63.3	**37.3**	27.1	52.7	100
98Ab7351	62.3	29.4	30.9	52.8	100
99Ab12621	67.0	**37.4**	29.0	51.5	98
Paul	66.5	**40.6**	32.3	51.1	97
95Ab11633	67.3	32.5	23.9	50.4	95
Pennuda	**57.0**	30.6	**33.7**	49.5	94
Lamont	68.0	35.8	26.7	47.6	90
97Ab8390	68.0	31.2	27.5	47.3	89
98Ab7523	62.5	30.8	28.1	47.2	89
99Ab12379	68.3	31.3	27.4	47.2	89
99Ab12443	61.5	29.8	29.2	46.4	88
99Ab12428	68.0	28.8	29.2	44.8	85
96Ab8858	66.5	31.9	28.8	44.5	84
99Ab12423	67.7	31.0	30.6	43.8	83
99Ab12356	66.5	29.2	29.5	43.3	82
Provena	68.3	31.3	32.1	42.9	81
98Ab6384	69.8	28.7	25.9	38.2	72
mean	64.8	32.2	28.1	52.8	
LSD(0.05)	1.9	3.8	1.3	12.1	

PROJECT TITLE: 2000 DRYLAND INTRASTATE ALFALFA YIELD TRIAL

PROJECT COOPERATORS: Dennis Cash, MSU – Bozeman
Duane Johnson, MSU – NWARC
Louise Strang, MSU – NWARC

On the web: http://animalrangeextension.montana.edu/forage/forage.htm

OBJECTIVE:

Compare yield potential of new releases and experimental lines with older, established cultivars.

METHODS:

The experiment was established on 4/25/00. Eighteen cultivars were seeded in 5-ft by 15-ft plots consisting of 4 rows spaced 12-inches apart. Seeding rate was 5 lbs/acre pure live seed, and seeding depth was 0.5 in. Monoammonium phosphate fertilizer *(*11-52-0*)* was applied preplant at a rate of 400 lbs/acre and at 120 lbs/acre each spring following. The experimental design was a randomized complete block with 18 cultivars and four replications. Weeds were controlled by Poast (1-qt/a) + 2,4-D amine (0.75 lb/a) in 2000.

Crop year precipitation was 14.91 inches. Average monthly temperatures were 44.5, 50.5, 60.1,69.1, and 66.9 degrees F from April to August, respectively.

Forage yield harvest dates were 6/9/03 and 7/21/03. The trial was terminated following the second harvest.

Plots were harvested with a sickle-bar research plot swather. Harvest area was 70 ft^2. After recording the fresh harvest weight, a subsample of approximately 500 g was taken, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT Ver.6.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

RESULTS:

Due to extensive variability within replicates, differences among varieties were not significant. Over the 4 years of the study, 'Cooper' was most productive (17.46 t/a), and 'Innovator + Z' was least productive (11.88 t/a).

Table 1. 2003 Summary of the 2000 DRYLAND INTRASTATE ALFALFA YIELD TRIAL at Kalispell 2003

Cultivar	Harvest-1	Harvest-2	2003 Total	2002 Total	2001 Total	Total 2001-2003	%Mean
	t/a	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*	
Cooper	2.62	1.49	4.12	**6.58**	5.85	16.55	120
Plumas	2.68	1.45	4.13	**6.43**	5.75	16.31	118
Select	2.38	1.30	3.69	**6.06**	5.78	15.53	112
Ultra Eureka	2.67	1.48	4.15	**5.85**	5.52	15.51	112
5246	2.36	1.38	3.75	**6.02**	5.45	15.21	110
Wrangler	2.58	1.23	3.81	**5.73**	5.62	15.16	110
Ladak 65	2.63	1.30	3.93	**5.63**	5.22	14.78	107
Masterpiece	2.79	1.76	4.55	**4.15**	5.68	14.38	104
53V08	2.72	1.43	4.15	**4.75**	5.28	14.17	102
Shaw	2.21	0.96	3.17	**4.89**	5.52	13.58	98
ZX9450A	2.18	1.06	3.24	**4.64**	5.48	13.36	97
Riley	2.34	1.11	3.45	**4.57**	5.18	13.20	95
4200	2.38	1.39	3.77	**4.36**	4.90	13.03	94
631	2.13	0.97	3.10	**4.26**	4.94	12.30	89
WinterCrown	2.47	1.18	3.65	3.04	5.08	11.77	85
AmeriGraze 401+Z	2.47	1.37	3.84	2.72	5.20	11.75	85
Millennia	2.23	1.09	3.31	2.95	5.30	11.56	84
Innovator +Z	2.42	1.15	3.57	2.61	4.86	11.04	80
mean	2.46	1.28	3.74	4.74	5.37	13.84	
LSD(0.05)	NS	NS	NS	2.77	NS	NS	

Yield values in **bold** are not significantly different (P=0.05) from the highest yield in the same column.

PROJECT TITLE: 2002 DRYLAND INTRASTATE ALFALFA YIELD TRIAL

PROJECT COOPERATORS:
Dennis Cash, MSU – Bozeman
Duane Johnson, MSU – NWARC
Louise Strang, MSU – NWARC

OBJECTIVE:

Compare yield potential of new releases and experimental lines with older, established cultivars.

METHODS:

The experiment was established on 5/8/02. Fourteen cultivars were seeded in 5-ft by 15-ft plots consisting of 7 rows spaced 6-inches apart. Seeding rate was 5 lbs/acre pure live seed, and seeding depth was 0.5 in. Monoammonium phosphate fertilizer *(11-52-0)* was applied preplant at a rate of 400 lbs/acre and at 120 lbs/acre each spring following. The experimental design was a randomized complete block with 14 cultivars and four replications.

Crop year precipitation was 14.91 inches. Average monthly temperatures were 44.5, 50.5, 60.1,69.1, and 66.9 degrees F from April to August, respectively.

Forage yield harvest dates were 6/11/03 and 7/21/03. The trial was not fall-harvested due to insufficient regrowth.

Plots were harvested with a sickle-bar research plot swather. Harvest area was 100 ft^2. After recording the fresh harvest weight, a subsample of approximately 500 g was taken, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT Ver.6.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

RESULTS:

Due to extensive variability within replicates, differences among varieties were not significant (Table 1). Over the 2 years of the study, 'HybriForce 400' was most productive (5.92 t/a), and 'Ameristand 403T' was least productive (3.43 t/a).

Table 1. 2003 Summary of the 2002 DRYLAND INTRASTATE ALFALFA YIELD TRIAL at Kalispell

Cultivar	Harvest-1	Harvest-2	2003 Total	Total 2002-2003	%Mean
	t/a	t/a	t/a	t/a	
HybriForce 400	2.26	1.26	3.52	5.92	125
Wrangler	2.07	1.18	3.25	5.32	113
WL 319HQ	2.16	0.95	3.12	5.10	108
Rugged	2.16	0.91	3.07	5.09	108
HybriForce-420/Wet	2.07	1.01	3.07	5.06	107
Ladak DL	1.98	1.10	3.08	4.91	104
6420	2.00	1.00	3.00	4.82	102
Shaw	2.05	0.98	3.03	4.78	101
Plumas	2.13	1.01	3.14	4.74	100
Cooper	2.05	0.89	2.94	4.52	96
Rebel	2.00	0.93	2.93	4.34	92
XTRA-3	1.94	0.91	2.85	4.25	90
Ladak 65	1.86	0.78	2.65	3.81	81
Ameristand 403T	1.73	0.65	2.38	3.43	73
mean	2.03	0.97	3.00	4.72	
LSD(0.05)	NS	NS	NS	NS	

PROJECT TITLE: 2000 IRRIGATED INTRASTATE ALFALFA YIELD TRIAL

PROJECT COOPERATORS:

Dennis Cash, MSU – Bozeman
Duane Johnson, MSU – NWARC
Louise Strang, MSU – NWARC

OBJECTIVE:

Compare yield potential of new releases and experimental lines with older, established cultivars in an irrigated/high rainfall environment.

METHODS:

The experiment was established on 4/25/00. Eighteen cultivars were seeded in 5-ft by 15-ft plots consisting of 4 rows spaced 12-inches apart. Seeding rate was 7 lbs/acre pure live seed, and seeding depth was 0.5 in. Monoammonium phosphate fertilizer *(*11-52-0*)* was applied preplant at a rate of 400 lbs/acre and at 120 lbs/acre each spring following. The experimental design was a randomized complete block with 18 cultivars and four replications.

Crop year precipitation was 14.91 inches. Average monthly temperatures were 44.5, 50.5, 60.1,69.1, and 66.9 degrees F from April to August, respectively.

Forage yield harvest dates were 6/11/03 and 7/22/03. The trial was terminated following the second harvest.

Plots were harvested with a sickle-bar research plot swather. Harvest area was 70 ft^2. After recording the fresh harvest weight, a subsample of approximately 500 g was taken, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT Ver.6.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

RESULTS:

Significant differences in total dry matter yield were found among varieties (Table 1). Over the 4 years of the study, 'ZX9450A' was most productive (25.43 t/a), and '5246', Wrangler', and 'Riley' were least productive (19.82-20.02 t/a).

Table 1. 2003 Summary of the 2000 IRRIGATED INTRASTATE ALFALFA YIELD TRIAL at Kalispell.

Cultivar	Harv.-1	Harv.-2	*2003* Total	2002 Total	2001 Total	2001-03 Total	% of Mean
	t/a	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*	
ZX9450A	**2.71**	**2.14**	**4.86**	**10.63**	**8.15**	**23.63**	111
Millennia	2.59	2.09	4.68	**10.31**	**7.63**	**22.61**	106
Ultra	**2.75**	**2.33**	**5.08**	9.80	**7.60**	**22.48**	105
Masterpiece	**2.69**	**2.18**	**4.87**	**9.99**	**7.52**	**22.38**	105
Plumas	2.49	1.96	4.45	9.93	**7.77**	**22.15**	104
WinterCrown	2.60	**2.23**	**4.84**	9.69	**7.61**	**22.14**	104
53V08	**2.88**	**2.22**	**5.11**	9.62	7.30	**22.02**	103
631	**2.72**	2.12	**4.83**	9.51	**7.58**	21.92	103
Shaw	2.54	2.05	4.60	9.76	7.42	21.77	102
Select	2.52	2.04	4.57	9.60	**7.60**	21.77	102
AmeriGraze 401+Z	**2.81**	2.09	**4.89**	9.12	**7.56**	21.57	101
Innovator +Z	**2.82**	2.03	**4.85**	9.56	7.08	21.50	101
4200	**2.78**	2.01	**4.79**	9.48	7.18	21.45	100
Cooper	2.61	1.93	4.54	9.16	7.31	21.01	98
5246	2.39	1.65	4.04	9.39	6.69	20.12	94
Ladak 65	2.61	1.85	4.46	8.54	5.98	18.98	89
Riley	2.41	1.79	4.19	8.16	6.29	18.64	87
Wrangler	2.30	1.68	3.99	8.32	6.33	18.63	87
mean	2.62	2.02	4.65	9.48	7.25	21.38	
LSD(0.05)	0.26	0.20	0.39	0.69	0.69	1.69	

Yield values in **bold** are not significantly different (P=0.05) from the highest yield in the same column.

PROJECT TITLE: 2001 IRRIGATED INTRASTATE ALFALFA YIELD TRIAL

PROJECT COOPERATORS: Dennis Cash, MSU – Bozeman
Duane Johnson, MSU – NWARC
Louise Strang, MSU – NWARC

OBJECTIVE:

Compare yield potential of new releases and experimental lines with older, established cultivars in an irrigated/high rainfall environment.

METHODS:

The experiment was established on 5/3/01. Nineteen cultivars were seeded in 5-ft by 15-ft plots consisting of 4 rows spaced 12-inches apart. Seeding rate was 8 lbs/acre pure live seed, and seeding depth was 0.5 in. Monoammonium phosphate fertilizer (11-52-0) was applied preplant at a rate of 400 lbs/acre and at 120 lbs/acre each spring following. The experimental design was a randomized complete block with 19 cultivars and four replications.

Crop year precipitation was 14.91 inches. Average monthly temperatures were 44.5, 50.5, 60.1,69.1, and 66.9 degrees F from April to August, respectively.

Forage yield harvest dates were 6/12/03, 7/22/03, and 9/26/03. Plots were harvested with a sickle-bar research plot swather. Harvest area was 75 ft^2. After recording the fresh harvest weight, a subsample of approximately 500 g was taken, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT Ver.6.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

RESULTS:

Significant differences in total dry matter yield were found among varieties (Table 1). Over the 3 years of the study, 'DK A42-15' was most productive (17.12 t/a), and 'A 30-06', Wrangler', and 'Ladak 65' were least productive (14.51-15.31 t/a).

Table 1. 2003 Summary of the 2001 IRRIGATED INTRASTATE ALFALFA YIELD TRIAL at Kalispell.

Cultivar	Harv.-1	Harv.-2	Harv.-3	2003 Total	2002 Total	2002-03 Total	% of Mean
	t/a	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*	
DK A42-15	2.81	2.23	**1.81**	6.85	**10.27**	**17.12**	108
Alliant	**3.13**	**2.55**	**2.02**	**7.69**	9.30	**16.99**	107
Cooper	**3.19**	2.18	**1.90**	**7.27**	9.33	**16.60**	104
Mariner II	**2.87**	**2.37**	**1.77**	**7.02**	**9.46**	**16.47**	104
WBRR	**3.10**	2.19	**1.87**	**7.16**	9.13	**16.29**	102
Goliath	**2.99**	**2.31**	**1.92**	**7.23**	9.03	**16.25**	102
WL 327	2.69	**2.40**	**1.80**	6.88	9.28	**16.17**	102
Reliance	**2.96**	2.20	**1.78**	6.94	9.11	**16.05**	101
Monument II	**2.87**	**2.35**	**1.99**	**7.22**	8.82	**16.04**	101
Ascend 552	**2.94**	**2.32**	**1.82**	**7.34**	8.63	**15.97**	100
Shaw	2.68	1.95	1.67	6.30	**9.61**	**15.91**	100
DAK 9901	**2.99**	**2.29**	**1.81**	**7.09**	8.68	**15.77**	99
Plumas	2.78	2.12	**1.79**	6.70	9.00	**15.70**	99
Amerstand 403T	**2.86**	2.00	**1.79**	6.65	8.97	**15.62**	98
Abound	**2.88**	2.19	**1.79**	6.85	8.75	**15.60**	98
Riley	**3.18**	**2.28**	**2.01**	**7.47**	7.92	**15.39**	97
A 30-06	2.68	2.17	**1.77**	6.68	8.63	15.31	96
Ladak 65	2.66	1.85	1.62	6.13	8.39	14.52	91
Wrangler	**2.86**	1.82	1.72	6.40	8.11	14.51	91
mean	2.90	2.20	1.82	6.94	8.97	15.91	
LSD(0.05)	0.35	0.28	0.26	0.72	0.90	1.79	

Yield values in **bold** are not significantly different (P=0.05) from the highest yield in the same column.

PROJECT TITLE: 2002 IRRIGATED INTRASTATE ALFALFA YIELD TRIAL

PROJECT COOPERATORS: Dennis Cash, MSU – Bozeman
Duane Johnson, MSU – NWARC
Louise Strang, MSU – NWARC

OBJECTIVE:

Compare yield potential of new releases and experimental lines with older, established cultivars in an irrigated/high rainfall environment.

METHODS:

The experiment was established on 5/8/02. Fourteen cultivars were seeded in 5-ft by 15-ft plots consisting of 7 rows spaced 6-inches apart. Seeding rate was 8 lbs/acre pure live seed, and seeding depth was 0.5 in. Monoammonium phosphate fertilizer (11-52-0) was applied preplant at a rate of 400 lbs/acre and at 120 lbs/acre each spring following. The experimental design was a randomized complete block with 14 cultivars and four replications.

Crop year precipitation was 14.91 inches. Average monthly temperatures were 44.5, 50.5, 60.1,69.1, and 66.9 degrees F from April to August, respectively.

Forage yield harvest dates were 6/13/03, 7/24/03, and 9/29/03. Plots were harvested with a sickle-bar research plot swather. Harvest area was 100 ft^2. After recording the fresh harvest weight, a subsample of approximately 500 g was taken, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT Ver.6.0 (2003). Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant.

RESULTS:

Yield data was so variable that significant differences among varieties were not determined (Table 1). Over the 2 years of the study, 'Plumas', 'HybriForce 420/Wet', and '6420' were the most productive (5.91-5.99 t/a), and 'Wrangler' was least productive (5.28 t/a).

Table 1. 2003 Summary of the 2002 IRRIGATED INTRASTATE ALFALFA YIELD TRIAL at Kalispell

Cultivar	Harvest-1	Harvest-2	Harvest-3	2003 Total	%Mean	%Mean
	t/a	t/a	t/a	t/a		
Plumas	2.56	1.75	**1.69**	5.99	105	100
HybriForce-420/Wet	2.41	1.85	**1.70**	5.96	105	107
6420	2.48	1.80	**1.64**	5.91	104	102
Shaw	2.42	1.72	**1.68**	5.82	102	101
Cooper	2.39	1.70	**1.73**	5.82	102	96
XTRA-3	2.29	1.79	**1.71**	5.79	102	90
Rebel	2.43	1.68	**1.62**	5.73	101	92
WL 319HQ	2.38	1.79	1.52	5.69	100	
Ameristand 403T	2.31	1.71	**1.60**	5.61	99	73
HybriForce 400	2.11	1.82	**1.66**	5.59	98	
Rugged	2.31	1.73	1.54	5.58	98	
Ladak DL	2.15	1.72	1.53	5.39	95	
Ladak 65	2.34	1.53	1.45	5.32	94	81
Wrangler	2.18	1.59	1.50	5.28	93	
mean	2.34	1.73	1.61	5.68		
LSD(0.05)	NS	NS	0.18	NS		

Yield values in **bold** are not significantly different (P=0.05) from the highest yield in the same column.

PROJECT TITLE: Irrigated Forage Grasses

PROJECT COOPERATORS: Dennis Cash, MSU-Bozeman
Duane Johnson, MSU-NWARC
Louise Strang, MSU-NWARC

OBJECTIVE:

Compare yield potential and stand persistence of different species and varieties of cool-season forage grasses in a northwestern Montana high moisture environment.

METHODS:

The experiment was established at the Northwestern Agricultural Research Center, Kalispell, MT. The soil at this site is a Creston silt loam (coarse silty, mixed Pachic Haploxeroll, 37 g/kg organic C, pH 7.9). Thirty-two cultivars from 14 species of perennial grasses were seeded in 5' by 15' plots consisting of 4 rows spaced 12" apart. The plots were fertilized with 29 lbs N/a + 40 lbs P_2O_5/a + 10 lbs S/a on 4/21/03. The experimental design was a randomized complete with block four replications. Spot spraying with 2,4-D controlled broadleaf weeds.

Respective irrigation and precipitation amounts were 8" and 14.9". Average monthly temperatures were 44.5, 50.5, 60.1, 69.1, and 66.9 degrees F from April to August, respectively.

Harvest dates were 6/17 and 10/6/03. Plots were harvested with a sickle-bar research plot swather. Harvest area was 75 ft^2. After recording the fresh harvest weight, a sub sample of approximately 500 g was taken from 2 plots of each species, weighed, dried at 60°C in a forced air oven for 48 to 72 h, and reweighed to determine DM content.

Analysis of variance was calculated by the ANOVA procedure of XLSTAT, Version 7.0. Critical value for a significant F-test was tested at P=0.05. Forage yield differences were compared by protected LSD when the F test for cultivars was significant.

DISCUSSION:

The hot, dry weather was beneficial for the early season production, but late season regrowth was retarded. The second cutting, therefore, was postponed until after frost. Only the bluestems produced more second cutting forage than in their first harvest.

The tall fescues (*Festuca arundinacea*) and meadow bromegrasses (*Bromus biebersteinii*) *were* the best producers in 2003 (Table 1). 'Fleet' meadow brome, 'Fawn', 'Forager', and 'Martin 2' tall fescue yielded over 4.5 tons/acre. Over the past 2 years, those tall fescues and 'Hykor' Festulolium (a perennial rye X meadow fescue hybrid) produced 11-12 tons of forage/acre. The least productive species were the bluegrasses (*Poa* spp.), the perennial ryegrasses (*Lolium perenne* L.), and Big Bluestem (*Andropogon geradii* Vitman) and Little Bluestem (*Schizachyrium scopanium*).

Table 1. Total dry matter yields of irrigated forage grasses at Kalispell, MT in 2003.

Cultivar	Species	Harv-1	Harv-2	2003 Total	2002 Total	2002-03 Total	% of Mean
				tons/acre			
Hykor	Festulolium	3.08	0.97	4.05	**8.27**	**12.32**	171.6
Fawn	Tall fescue	**3.88**	**1.16**	**5.05**	**7.17**	**12.22**	170.1
Forager	Tall fescue	**4.00**	**1.04**	**5.04**	6.49	**11.53**	160.6
Martin 2	Tall fescue	**3.63**	0.95	**4.59**	6.09	**10.68**	148.7
Fleet	Meadow bromegrass	**3.87**	0.67	**4.54**	5.27	9.81	136.6
Paddock	Meadow bromegrass	**3.59**	0.63	4.22	5.56	9.79	136.3
Mb-2*	Meadow bromegrass	**3.34**	0.66	3.99	5.43	9.43	131.3
Mb-1	Meadow bromegrass	3.27	0.73	4.00	5.35	9.35	130.2
Regar	Meadow bromegrass	2.80	0.60	3.41	5.53	8.94	124.5
Mustang	Perennial ryegrass	0.95	0.42	1.37	6.31	7.67	106.8
Hakari	Alaska brome	1.91	0.72	2.63	4.85	7.48	104.2
Vega	Timothy	2.80	0.16	2.96	4.38	7.35	102.3
Manchar	Smooth brome	2.62	0.20	2.82	4.48	7.30	101.7
Intensiv	Orchardgrass	2.29	0.82	3.11	3.92	7.03	97.9
Fure	Meadow fescue	1.93	0.47	2.41	4.62	7.02	97.8
Magna	Smooth brome	2.66	0.21	2.87	3.99	6.86	95.5
Climax	Timothy	2.70	0.28	2.99	3.70	6.69	93.1
Joliette	Timothy	2.44	0.35	2.79	3.89	6.68	93.0
OG 9204	Orchardgrass	2.16	0.67	2.83	3.84	6.67	92.8
Bilbo	Timothy	2.53	0.32	2.85	3.76	6.61	92.1
Laura	Meadow fescue	1.84	0.47	2.32	4.28	6.59	91.8
TM 9501	Timothy	2.31	0.39	2.71	3.86	6.57	91.5
Pauite	Orchardgrass	1.93	0.79	2.72	3.47	6.19	86.2
Linn	Perennial ryegrass	0.90	0.29	1.19	5.00	6.18	86.1
Profile	Orchardgrass	1.88	0.71	2.59	3.17	5.77	80.3
Blizzard	Alaska brome	1.66	0.97	2.63	2.99	5.62	78.3
Potomac	Orchardgrass	2.03	0.60	2.63	2.86	5.49	76.4
Park	Kentucky bluegrass	1.52	0.42	1.94	1.90	3.84	53.5
Platini	Forage bluegrass	1.02	0.22	1.24	1.89	3.13	43.6
Sherman	Big bluegrass	1.03	0.47	1.52	1.56	3.07	42.8
	Little bluestem	0.71	**1.41**	2.12	0.04	2.16	30.1
	Big bluestem	0.88	0.95	1.83	0.28	2.11	29.4
	Mean	2.33	0.62	2.95	4.26	7.13	
	LSD(0.05)	0.68	0.41	0.80	1.25	1.73	

*Released as 'Macbeth' meadow bromegrass.

Nutritional Comparison of 6 Hays Grown at Kalispell, MT in 2003.

Hay	ADF[1/]	NDF[2/]	RFV[3/]
Sainfoin	29.9	38.7	157.6
Timothy/Alfalfa	28.3	40.4	154.1
Timothy/Sainfoin	29.4	42.5	144.4
Orchardgrass/Alfalfa	31.0	45.6	132.0
Orchardgrass/Sainfoin	32.9	50.3	117.0
Indian Ricegrass	42.6	78.8	65.8

[1/] *acid detergent fiber*
[2/] *neutral detergent fiber*
[3/] *relative feed value*

SPECIALTY CROP EVALUATION

759

Specialty crop evaluation is part of Project 759 and includes research related to a wide variety of unique crops from seeding to data collection to publications.

Alternative Crop Research And Product Development

Alternative crops represent a challenge and an opportunity to Northwest Montana. The alternative crops project was designed around the concept that markets must first be identified and then agricultural crops developed to fill that market niche. Along that idea, we began looking at what growth markets are developing in this area? What we found were growth opportunities in the green industries (trees, shrubs and turf), new opportunities in the equine industries (horse care products), environmentally friendly fluids (motor oils, hydraulic oils, bar oils, etc) and dietary needs ("gluten-free" and "diabetic friendly").

Some surprises came from the research. For example, we began looking at a bergamot mint (lavender mint) as a digestive aid for horses. After analyzing the oil profile, we found we had a cosmetic grade mint oil. Likewise we began looking at fenugreek to stimulate eating in athletic horses. We found fenugreek does quite well in dryland production and it also contains essentially non-digestible soluble fiber ("vegetable gum) rather than starch. All of this led us to looking at the gum for use in diabetic food products. The return per acre appears far better than peas or lentils and it's easy to grow.

Along those same lines, we began to look at timothy as a gluten-free cereal to supplement Indian Ricegrass. The flavor is closer to wheat than IRG. We grew out the world collection of 308 lines in 2003 and found some interesting types. Some only grew 2-3 inches tall and could be looked at as a new turf that gets mowed once or twice yearly. Others are robust forage types and some may have interesting seed traits for the gluten-free project. We also initiated a dwarf bluegrass study, which also has potential as a "mow once grass".

We led a commercialization effort with our growers to produce hybrid canola seed. Given the harshness of the 2003 summer, our yields were not as high as we had hoped but we met seed quality standards and successfully grew hybrid canola seed. As a part of the targeted horse market, we have been evaluating new hay formulations that have significant improvements in digestibility. To set this formula up as a Montana product, we have been working with a private company to develop a feed supplement specifically for that hay. The supplements are geared to geriatric horses and athletic horses. Next year we hope to expand the types of supplements we produce for this market into other classes of horse.

In 2003, the NWARC product development project patented the use of timothy as a gluten-free cereal and patented biobased greases made from canola and safflower oils. Some of these products are under development with farmer-owned co-operatives.

In 2004, we will be looking at vegetable crops as well as field crops. There is potential for expanding markets in western Montana and we need to identify the better varieties of some of the major vegetables this market requires. We will also look at some minor vegetables with unique market opportunities. Attached is a summary of work and the impacts we expect from the alternative and product development project at NWARC.

'Specialty Crops Evaluation and Product Development'

Activity: Research has developed new applications for oilseed crops such as canola, safflower and sunflower. Using high oleic types, lubrication applications such as four cycle engine oils, bar-chain oils, hydraulic oils and greases have been developed and are currently in commercialization. Patents have been obtained for the greases.

Impact/Accomplishment: Commercialization will help stabilize production and develop new industries in Montana. Using 50,000 acres of land for production, the value at the farmgate will be $7 million. Value-added products derived from production and byproduct sales will add an estimated $15 million for a value of $22 million per annum to the state economy. Market growth is expected to remain steady at 7.2% per year barring large increases in competitive petroleum costs. A farmer-owned cooperative has been established to develop these products. Market contacts are through US Federal agencies. Currently, we are designing lubricants for the U.S. Navy, U.S. Army and the National Park system.

Source of Funds: State grant, Hatch and Federal grant

Scope of Impact: Integrated research, extension and private collaboration will lead to new industry within a year.

Activity: Research has developed new applications for non-glutinous cereals. Cereals such as Indian ricegrass, timothy and hulless oats are in co-development with two newly formed cooperatives. Research includes determining gluten content of new cereal grains, best management practices, and formulating products (bread mixes, dry cereals and snack foods).

Impact/Accomplishment: Commercialization will help stabilize production and develop new industries in Montana. Using 10,000 acres of land for production, the value at the farmgate will be $7.5 million. Value-added products derived from production and byproduct sales will add an estimated $18.9 million per annum. A farmer-owned cooperative has been established to develop these products. Market contacts are through organic and natural food sales and Internet sales.

Source of Funds: State grant, private, Hatch and Federal grant

Scope of Impact: Integrated research, extension and private collaboration will lead to expanded product line for the farm co-op within 18 months.

Activity: Research has developed new applications for hulless oats and legumes. Hulless oats are being selected for protein content of 28-30%, a high amylose:amylopectin ratio and yields within norms for cereal oats. Selection is based on less than 20% amylopectin as acceptable. These oats and legumes will be used to focus on applications in diabetic cereals as dry cereals and snack foods.

Impact/Accomplishment: Commercialization will help stabilize production and develop new industries in Montana. Using 40,000 acres of land for production, the value at the farmgate will be $10.3 million. Value-added products derived from production and byproduct sales will add an estimated $20.6 million per annum. A farmer-owned cooperative has been established to develop these products. Market contacts are through locally owned cereal manufacturers.

Source of Funds: Hatch and Federal grants, private funding.

Scope of Impact: Integrated research and private collaboration will require 2-3 years for commercialization.

Activity: Development of products for the equine industry has been ongoing for three years. New products include a identity-preserved hay blend specific for horses and a supplement designed to be compatible with this hay. Other products include a hoof moisturizer and protectant, and a dust control system for enclosed arenas.
Impact/Accomplishment: The equine industry is increasing in the western United States by 6 percent per year. All growth is essentially in non-working or traditional horses. Development of feeds specific for horse classes (athletic, geriatric and brood mare, as examples) are new markets for Montana producers. The new hay developed has a relative feed value of 150 (alfalfa has an RFV of 100). The equine industry, as a whole, in the United States has an economic value comparable to the U.S. petroleum industry.

Source of Funds: Hatch and Federal grant

Scope of Impact: Integrated research and private collaboration will require extension development to assist in organizing producers and marketing new products before commercialization.

Activity: Development has been initiated on providing natural protection to crops from applications of glyphosate. Glyphosate, N-(phosphonomethyl) glycine, inhibits aromatic amino acid synthesis. Seed treatments are made which provide aromatic amino acids to seedlings, bypassing their need for manufacture.

Impact/Accomplishment: The impact of this research will provide an alternative to genetically modified crops using the same herbicide system. Currently, 90+ % of the corn, soybeans and cotton, and 80+% of the canola grown in North America are genetically modified crops. By providing a seed treatment, other crops can be used in a glyphosate herbicide management system. In addition, the use of GMO-derived resistance could be made obsolete, providing an environmentally friendly alternative with no genetic resistance transfer to non-GMO crops or weeds.

Source of Funds: Hatch and Federal grant

Scope of Impact: Integrated research will lead to new seed industries within Montana and improved broad spectrum weed control.

PROJECT TITLE: Evaluation of Fungicides in Fall Mint Plantings

PROJECT COOPERATORS: Duane Johnson, MSU-NWARC
Louise Strang, MSU-NWARC

OBJECTIVE:

Determine which chemical fungicides can enhance the initial stand of fall planted peppermint and spearmint and increase oil production the following year.

METHODS:

The experiment was established at the Northwestern Agricultural Research Center, Kalispell, MT, on 8 November 2001. Stolon segments of 'Black Mitcham' and 'Murray Mitcham' peppermint (*Mentha piperita)* and 'Scotch 213' spearmint (*Mentha cardiaca)* were laid in plots consisting of 8-3" deep furrows, 10 ft long with 1-foot row spacing and 2-ft between plots. Planting rate was 1.3 lbs of root material/plot (566 lbs/acre). The experimental design was a two factor randomized split plot, with 3 cultivars and 5 fungicide treatments as main plots. Each plot was split into treated and untreated subplots. Fungicides were sprayed over the roots in 4 of the 8 rows and all furrows covered with soil. Each cultivar/fungicide treatment was randomized in four replications.

On 5/22/03 the trial was fertilized with 32 lbs/a N, 24 lbs/a P_2O_5, 37 lbs/a K_2O, and 7 lbs/a S. Early weeds were controlled with 1-lb/a Sinbar (terbacil) and by hand for the remainder of the season.

Respective irrigation and precipitation amounts were 8" and 14.9". Average monthly temperatures were 44.5, 50.5, 60.1, 69.1, and 66.9 degrees F from April to August, respectively.

Stand counts (emerged shoots) of each plot were taken on 13 May 2003. Biomass was harvested 5 August 2003. Plots were harvested with a sickle-bar research plot swather. Harvest area was 100 ft^2. Approximately 20 lbs of the hay in each plot was put in onion sacks and hung to air dry for 6 weeks. Oil was steam distilled and collected by a research still at the NWARC. Oil samples were analyzed for quality by gas chromatography with a Shimadzu GC-17A.

Data were analyzed with cultivars as main plots and fungicide treatments as subplots split into treated and untreated pairs. Analysis of variance was calculated by the ANOVA procedure of XLSTAT 7.0. Critical value for a significant F-test was tested at P=0.05. Treatment effects were compared by protected LSD when the F test for treatment was significant. Paired comparisons between treated and untreated subplots were made using the Wilcoxon signed-ranks 2-tailed test at P=0.05.

DISCUSSION:

In comparing the paired treated and untreated plots for spring stand establishment, Black Mitcham shows significantly better emergence in the treated plots (Table 1). Tops MZ had the strongest effect of the 5 fungicide treatments (51% better stand than the untreated), and Quadris had the weakest.

In comparing total dry matter (hay) yields, Tops MZ treated mints had significantly higher yields than those treated with Quadris or Maxim (Table 2). Paired comparisons showed that the treated Murray Mitcham plots produced significantly more hay than their untreated partners.

Post establishment year oil yields indicate the true advantage, and allow us to calculate the economic return (or cost) of establishing mint with fungicides. The fungicide treated Black Mitcham peppermint yielded 17% more oil than the untreated peppermint (Table 3). Tops MZ and Quadris had the biggest effect on Black Mitcham, while Prevail and Maxim had essentially no positive effect. If the cost of the fungicides is less than the selling price of the additional oil a producer will realize a profit in the first production year.

Table 1. Mint shoot emergence for 3 varieties and 5 fungicide root treatments at Kalispell in 2003.

Spring Stand (emerged shoots/sqft)

	Fungicide										
Cultivar	Maxim	NF[1/]	Quadris	NF	Prevail	NF	Tops MZ	NF	Tops MZ +*Gaucho*	NF	mean
Black Mitcham	**24.6**	**16.4**	**18.5**	**17.5**	**22.8**	**15.0**	**24.2**	**10.9**	**27.7**	**21.3**	**23.5**
Murray Mitcham	8.1	4.9	11.2	6.3	16.3	17.9	14.4	15.7	10.3	6.6	12.0
Scotch 213	18.3	14.8	8.8	20.3	25.8	19.3	23.2	25.1	23.8	12.6	**20.0**
mean	17.0	12.0	12.8	14.7	21.6	17.4	20.6	17.2	20.6	13.5	

LSD (0.05) - Variety means = 8.0
LSD (0.05) - Fungicide means -NS
LSD (0.05) - Var x Fung - NS

****Black Mitcham paired samples significantly different**

1/ Untreated (control) rows

Table 2. 2003 total dry matter yield of 3 varieties of mint receiving 5 fungicide root treatments at Kalispell in fall 2001.

Hay Yield (t/a)

				Fungicide						
Cultivar	Maxim	NF	Quadris	NF	Prevail	NF	Tops MZ	NF	Tops MZ *+Gaucho*	NF	mean
Black Mitcham	2.06	1.98	2.39	2.21	2.06	2.23	2.57	1.70	2.44	2.13	2.18
Murray Mitcham	**0.74**	**0.47**	**0.39**	**0.55**	**1.34**	**0.83**	**1.56**	**1.09**	**0.74**	**0.37**	0.86
Scotch 213	2.36	2.62	3.00	2.93	2.99	3.14	3.48	2.74	3.74	3.13	**3.00**
mean	1.72	1.69	1.92	1.89	**2.13**	2.07	**2.54**	1.84	**2.31**	1.88	2.01

LSD(0.05) - Variety means = 0.44
LSD(0.05) - Fungicide means = 0.57

****Murray Mitcham paired samples significantly different**

Table 3. 2003 oil yield of 3 varieties of mint receiving 5 fungicide root treatments at Kalispell in fall 2001.

Oil Yield (lbs/a)

					Fungicide					
Cultivar	Maxim	NF	Quadris	NF	Prevail	NF	Tops MZ	NF	Tops MZ *+Gaucho*	NF	mean
Black Mitcham	63.1	62.1	92.2	69.0	78.0	82.4	88.8	58.8	82.0	70.3	75.1
Murray Mitcham	27.0	20.0	10.2	14.3	32.9	19.5	66.1	38.1	23.2	7.2	27.9
Scotch 213	133.1	144.8	194.4	164.6	162.1	189.0	181.0	101.6	185.9	153.9	**161.8**
mean	74.4	75.6	98.9	82.6	91.0	96.96	111.9	66.1	97.0	77.1	88.3

LSD(0.05) - Variety means = 24.1

****Black Mitcham paired samples significantly different**

2003 Pacific Northwest Regional Pea and Lentil Trials

Northwestern Agricultural Research Center
Kalispell, Montana

Principal Investigator: Fred Muehlbauer, USDA-ARS, Pullman, WA

Cooperators: Duane Johnson, NWARC, Kalispell, MT
Louise Strang, NWARC, Kalispell, MT

Materials & Methods

Twelve dry pea and 12 lentil cultivars were seeded at 8.3 seeds/ft^2 in 7-row plots, 15 feet long with 6-inch row spacing. Experimental design was a randomized complete block with 4 replicates. The lentils were seeded April 23, 2003, and the peas were seeded April 24 into a Creston silt loam soil (pH 7.9).

The plot area was fertilized with 100 lbs N, 28 lbs P_2O_5, 60 lbs K_2O, and 48 lbs SO_2/acre on April 9. Pursuit (imazethapyr) at 0.063 lb ae/A and Prowl (pendimethalin) at 1.0 lb. ai/A were pre-plant incorporated on April 22 for weed control.

Plants in each plot were pulled and left to dry when 90% had turned yellow. When totally dry each plot was thrashed and the seeds weighed to determine yield.

Results

Following abundant precipitation in March and April, the weather turned hot and dry (Table 1). The legumes established well, but the heat and lack of moisture during the pod filling stage resulted in low yields.

The peas averaged 1305 lbs/A and 2287 seeds/lb (Table 1). 'PS810162' and 'PS9910346' were the earliest blooming varieties (48 days Post Plant), and 'PS810240' and 'PS9910140' were the latest (57 days post plant). 'PS610152', PS810162, and 'PS9910346' had the fewest nodes before the first flower (hence, the longest internode spacing), and 'PS810191', PS810240, and 'PS9910188' had the most. The earliest maturing varieties were PS810162 and PS9910346 (80-81 days PP), and the latest were 'PS710909' and 'PS99101364' (86-88 days PP).

PS810240 had the tallest canopy height (21.5"), and PS810191 and 'PS9910592' were the shortest (15"). Pea yields ranged from 895 lbs/A ('PS99101381') to 1761 lbs/A (PS9910140). 'PS99101364' and PS99101381 had the largest seeds (1700/lb), and PS810191 had the smallest (2757/lb).

The mean yield of the 12 lentil varieties was 529 lbs/A. This is only 48% of the average yield for the years 1993-2002. We assume the unusually hot, dry weather in June and July hindered seed set, resulting in the low yields (Table 2).

'Merrit', 'LC99602712T', and 'LC99602427P' were the first varieties to flower (53 days PP), and 'LC00600854E' was the latest (63 days PP). 'LC99602724T' and LC99602427P were the earliest maturing (86 days PP), and 'LC860359L' was the latest (95 days PP). The tallest plants were those of 'LC9960273L' (13.5"), and the shortest were LC99602724T, LC99602724T, and 'LC00600812P' (9.3-9.5").

Table 1. Agronomic data from the 2003 Western Regional Dry Pea Yield Trial at Kalispell MT in 2003.

Cultivar	Color	Leaf Type	Days to first bloom	Nodes to first bloom	Days to Maturity	Height *inches*	Yield *lbs/a*	SeedWt *#/lb*
PS9910140	yellow	afila	57.0	13.0	**80.8**	17.5	**1761**	2617
PS9910188	yellow	afila	54.5	**13.9**	**81.3**	17.3	**1678**	1928
PS810240	green	afila	56.5	**15.1**	84.3	**21.5**	**1615**	2447
PS9910592	green	afila	53.8	12.2	**81.8**	15.3	**1506**	2497
PS810162	green	afila	**48.0**	9.2	**79.8**	16.3	**1404**	2300
PS810191	green	afila	54.3	**14.6**	**81.7**	14.7	**1386**	2757
PS9910346	green	afila	**48.0**	10.7	**80.5**	17.3	1319	2549
PS610152	green	afila	51.8	9.8	83.0	16.5	1202	2597
PS710048	green	afila	54.5	12.8	82.8	16.0	1037	2427
PS710909	green	vine	55.0	12.9	87.5	16.0	961	1907
PS99101364	green	vine	52.8	12.4	86.3	**19.0**	900	**1694**
PS99101381	green	vine	51.3	12.3	84.0	17.8	895	**1728**
mean			53.1	12.4	82.8	17.1	1305	2287
LSD(0.05)			0.9	2.0	2.2	3.2	407	130

Table 2. Agronomic data from the 2003 Western Regional Lentil Yield Trial at Kalispell MT in 2003

Cultivar	Type	Cotyledon *color*	Days to First bloom	Days to Maturity	Height *in*	Yield *lbs/a*	Seed Size *#/lb*
Pennell	Laird	yellow	54.8	93.0	10.3	311.0	**6716**
LC860359L	Laird	yellow	58.8	95.3	12.0	432.2	7482
LC9960273L	Laird	yellow	60.8	94.8	**13.5**	458.7	**6929**
LC99602075L	Laird	yellow	55.5	94.3	**12.8**	404.0	**6211**
Merrit	Brewer	yellow	**52.0**	89.5	12.0	384.8	7294
LC760209C	Crimson	red	**53.8**	88.3	11.8	528.9	**6610**
LC99602712T	Turkish	red	**52.5**	**86.8**	9.5	**668.0**	12330
LC99602724T	Turkish	red	**53.0**	**85.5**	9.5	**742.6**	12786
LC00600831E	Eston	yellow	55.3	**87.0**	11.0	**686.6**	11318
LC00600854E	Eston	yellow	63.0	93.3	11.0	378.8	13165
LC99602427P	Pardina	yellow	**52.5**	**86.3**	10.5	**702.4**	9707
LC00600812P	Pardina	yellow	**53.0**	**86.5**	9.3	**654.6**	10857
mean			55.4	90.0	11.1	529.4	9284
LSD(0.05)			2.3	2.0	1.3	115.0	773

PROJECT TITLE: Pacific Northwest Canola Variety Trial

PROJECT COOPERATORS: Duane Johnson, Louise Strang at MSU–NWARC
Jack Brown, Jim Davis at University of Idaho

OBJECTIVE: Compare yield potential of experimental canola cultivars with established varieties.

METHODS:
Eighteen canola cultivars were planted at 5 lbs/acre on 4/29/03 on a dryland site underconventional tillage. The soil was fertilized pre-plant with 79 lbs N + 28 lbs P_2O_5 + 124 lbs K_2O + 24 lbs S/acre. Each plot consisted of 4-20' long rows spaced 1-foot apart. Number of emerged plants was counted in each plot on 5/28/03. The date on which 50% of the plants in each plot had bloomed was recorded. The canola was swathed on 8/5/03, when most of the plants had turned light brown. The seed was thrashed on 8/15/03.

RESULTS:
The check variety 'Goldrush', 'VISH.03.2', and 'HyClass.2061RR' had the best early stands (Table 1). Goldrush was the earliest to flower (43 days after planting). 'Clearwater CF' was the highest yielding variety (1298 lbs/a) and Goldrush was the lowest (132 lbs/a).

See Table 1 on the next page.

Table 1. Agronomic data from the Pacific Northwest Canola Variety Trial at Kalispell MT in 2003.

Variety	**Stand**	**Flowering**	**Yield**	**Test Weight**
	plants/sqft	*day after planting*	*lbs/acre*	*lbs/bu*
CHN.501	1.2	51.0	739.6	40.1
CHN.503	1.9	50.8	**997.7**	40.5
Clearwater CF	2.5	50.7	**1297.8**	39.7
Garnet	3.2	49.5	**1139.2**	40.3
Goldrush	**4.2**	**43.3**	131.7	NS
Hero	0.7	51.0	536.2	40.1
HyClass.2061RR	**3.8**	51.0	**1091.2**	39.8
Hyola.357MagnRR	1.3	48.0	**1004.2**	40.2
Hyola.401	1.9	48.5	**930.8**	**41.0**
IMC.109RR	0.8	50.3	**962.1**	**40.7**
IMC.110RR	0.5	51.8	519.9	**40.9**
IMC.208RR	1.3	50.3	728.8	39.2
IMC.304RR	1.0	50.7	**812.0**	39.8
Impress CF	1.1	51.7	370.7	39.9
Kab.36 CF	2.0	51.3	667.8	39.5
Variety	**Stand**	**Flowering**	**Yield**	**Test Weight**
Premier	0.7	50.5	603.0	40.5
Profit	2.3	50.0	**910.7**	39.9
Sterling	2.3	48.8	**877.5**	39.8
Sunrise	1.7	50.5	**1238.0**	40.3
VISC.00.1.3.12	1.6	50.8	**800.5**	39.8
VISC.00.1.3.5	2.2	50.3	**916.2**	40.3
VISC.00.3.1.17	3.5	48.5	**1110.3**	40.4
VISC.00.3.1.7	1.6	48.0	**1027.0**	40.0
VISC.00.3.13.12	1.2	51.0	**833.4**	40.0
VISH.00.3.8.DE	1.8	49.3	781.9	40.2
VISC.02.3.14	3.6	51.0	**859.4**	40.3
VISC.02.4.18	3.0	50.3	716.4	40.1
VISH.00.3.13.19	2.1	49.5	**1108.9**	40.6
VISH.00.3.13.25	2.9	49.0	**903.6**	40.6
VISH.00.3.19.23	2.2	50.5	670.2	40.5
VISH.00.3.19.7	2.4	49.8	**905.5**	**40.7**
VISH.03.1	2.3	50.8	**800.7**	40.2
VISH.03.2	**4.9**	49.0	**1055.4**	**40.7**
VISH.03.3	2.9	49.5	**967.7**	**40.8**
VISH.03.4	2.8	50.5	724.9	40.4
Westar	1.3	51.0	**837.0**	40.6
Mean	2.1	49.9	849.4	40.2
LSD(0.05)	1.3	1.1	507.0	0.4