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

ANNUAL REPORT
2010 CROP YEAR

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NORTHWESTERN AGRICULTURAL RESEARCH CENTER
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CLIMATOLOGY

Weather information as recorded at the

Northwestern Agricultural Research Center, Kalispell, Montana

CLIMATOLOGICAL OVERVIEW 2010

NORTHWESTERN AGRICULTURAL RESEARCH CENTER

Kalispell, MT

The precipitation for the 2009-2010 crop year at 21.14 inches was approximately 1.0 inches less than the long-term average in this area. April, June and December had above normal precipitation, while September, November 2009 and February and March 2010 were considerably less than normal. Average temperatures were lower than normal from April through June 2009 and October and December 2010. Average temperatures were higher than normal during September and November 2009 and January through March 2010.

Summary of Climatic Data by Months for the 2010 Crop Year: September 2009 - August 2010
and Averages for the Years 1980-2010 at the
Northwestern Agricultural Research Center, Kalispell, Montana

	Sept. 2009	Oct. 2009	Nov. 2009	Dec. 2009	Jan. 2010	Feb. 2010	Mar. 2010	Apr. 2010	May 2010	June 2010	July 2010	Aug. 2010	Total or Average
Precipitation (inches)													
Current Year	0.04	1.72	0.37	2.66	1.42	0.66	0.72	3.47	2.45	5.03	1.25	1.35	21.14
1980-2010	1.61	1.29	1.56	1.53	1.37	1.17	1.30	1.83	2.42	3.22	1.70	1.18	20.18
Average Temperature (F°)													
Current Year	60.1	38.9	35.3	18.0	26.4	31.4	37.9	30.0	47.1	56.0	61.9	61.4	42.0
1980-2010	53.7	42.1	32.6	24.0	24.5	27.3	34.8	31.6	51.4	57.6	64.3	63.4	43.2

Last killing frost[1] in spring		
Spring 2010	May 22	31°F
Median for 1980-2010	May 20	
First killing frost[1] in fall		
Fall 2010	September 23	32°F
Median for 1980-2010	September 24	
Frost Free Period		
Avg. 1980-2010	123	
Growing Degree Days April - August 2010		
Base 50	1295.5	
Base 40	2312.0	
Base 32	3353.0	
Maximum summer temperature	92	Aug. 27, 2010
Minimum winter temperature	-16	Dec. 8, 9, 2009

1. In this summary 32 degrees is considered a killing frost.

MAXIMUM / MINIMUM TEMPERATURES BY MONTH & DAY
JANUARY 2010- DECEMBER 2010

2010

YR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	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	39	32	32	23	50	25	49	25	51	32	58	47	73	40	79	54	59	46	72	40	48	36	30	21
2	40	34	37	25	50	25	45	27	51	32	64	47	70	48	71	49	62	34	73	38	57	41	34	26
3	38	29	37	25	45	28	44	31	54	37	58	48	61	46	75	47	67	35	72	38	58	27	33	28
4	40	29	34	29	51	30	44	26	54	35	60	40	59	48	78	51	75	40	70	43	53	25	34	13
5	33	31	34	23	50	25	47	19	37	31	55	44	64	47	78	49	75	49	58	48	49	25	29	18
6	32	1	30	24	49	24	50	22	44	26	63	35	65	42	84	55	55	41	62	36	43	26	21	12
7	18	-12	36	29	52	23	41	33	47	28	64	43	68	42	82	50	51	41	61	40	62	34	19	8
8	10	-12	34	30	52	25	45	33	52	31	65	49	76	46	81	52	65	44	56	45	46	38	23	16
9	10	-1	34	30	48	28	44	24	49	37	67	46	83	48	81	45	69	46	62	45	46	33	39	21
10	21	10	34	30	34	27	37	24	49	28	59	46	82	50	80	51	50	49	62 m		41	22	40	32
11	31	20	36	31	36	23	47	21	61	28	59	43	83	55	77	51	59	37	62	46	38	24	37	31
12	29	19	37	31	42	25	46	29	58	29	65	36	79	61	74	49	65	34	54	29	38	31	37	28
13	38	19	44	34	57	37	49	32	61	31	70	41	76	41	73	49	71	36	54	28	38	22	43	31
14	38	28	42	24	47	21	36	32	66	38	74	48	65	46	68	46	73	40	59	25	36	33	43	36
15	40	32	39	27	49	22	47	30	71	37	72	45	70	46	74	41	73	40	59	25	38	33	41	29
16	46	32	38	31	52	23	61	31	70	38	69	48	79	47	79	46	72	41	56	23	45	33	35	24
17	41	30	38	27	56	26	69	32	77	40	51	42	85	46	82	46	59	41	51	20	36	25	34	11
18	39	30	42	23	52	30	63	33	80	50	45	39	82	47	84	48	49	41	53	21	39	25	25	4
19	41	21	37	21	47	20	59	31	74	49	61	37	80	47	85	54	51	43	53	22	38	29	17	5
20	37	25	39	20	44	20	69	31	65	40	70	42	73	43	82	55	61	45	58	24	35	16	20	9
21	37	25	36	13	52	21	77	39	53	36	75	52	76	50	80	42	59	48	58	25	22	11	22	13
22	32	19	33	13	53	30	76	42	54	31	54	50	78	46	82	47	56	33	58	25	22	8	29	9
23	35	21	38	17	47	34	56	34	58	38	67	46	76	49	64	46	57	32	54	28	11	1	21	13
24	31	18	45	17	50	25	59	37	57	34	72	51	71	47	70	38	57	33	50	29	6	-11	26	18
25	28	16	36	26	53	24	54	31	55	39	77	52	77	48	74	40	60	35	47	38	4	-11	21	14
26	28	21	44	26	54	27	53	25	61	35	74	52	82	50	84	44	73	34	43	34	14	4	18	10
27	33	20	47	26	46	36	56	31	71	45	76	46	85	54	92	48	70	42	38	35	25	14	31	15
28	31	16	44	26	54	25	55	36	61	40	76	48	79	57	65	36	75	43	45	26	32	24	36	22
29	31	22			58	25	55	32	51	39	82	48	83	58	61	41	77	43	43	26	28	23	39	29
30	36	23			53	34	39	27	48	41	83	60	83	49	53	40	73	38	42	29	30	21	30	12
31	30	23			49	29			58	46			78	50	63	41			43	30			16	-6
AVG	32.7	20.0	37.8	25.0	49.4	26.4	52.4	30.0	58.0	36.2	66.2	45.7	75.5	48.2	76.0	46.8	63.9	40.1	55.7	31.0	35.9	22.1	29.8	17.8

MAXIMUM TEMPERATURE 92°F | MINIMUM TEMPERATURE -12°F "M": missing data

Summary of Precipitation at the Northwestern Agricultural Research Center On a Crop Year Basis

Total Precipitation in Inches by Year and Month

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL
1980-81	1.20	0.83	0.78	2.58	1.81	1.85	2.17	1.75	3.86	4.70	1.17	0.96	23.66
1981-82	0.77	0.56	1.49	1.91	2.38	1.48	1.16	1.60	1.25	2.41	2.06	1.17	18.24
1982-83	2.37	0.75	1.39	1.60	0.93	0.85	1.71	2.41	1.20	2.96	3.66	1.16	20.99
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
2003-04	2.56	1.29	0.59	1.04	2.02	0.42	0.57	2.23	1.97	1.31	1.24	3.60	18.84
2004-05	1.89	1.62	0.84	1.49	1.38	0.01	1.41	2.21	1.73	8.44	0.26	1.35	22.63
2005-06	2.28	2.20	1.45	1.42	3.04	1.14	0.55	2.12	2.89	5.50	0.51	0.24	23.34
2006-07	1.95	1.10	2.28	0.95	0.39	2.26	0.54	1.62	3.29	1.35	0.75	0.23	16.71
2007-08	1.28	1.11	1.02	1.13	1.31	0.76	0.61	0.90	2.33	3.65	3.80	1.15	19.05
2008-09	1.57	0.61	1.71	2.37	1.72	1.59	1.43	0.98	1.62	1.98	2.44	0.99	19.01
2009-10	0.04	1.72	0.37	2.66	1.42	0.66	0.72	3.47	2.45	5.03	1.25	1.35	21.14
MEAN	1.61	1.29	1.56	1.53	1.37	1.17	1.30	1.83	2.42	3.22	1.70	1.18	20.18

Mean precipitation for all crop years = 20.14

Precipitation by Day for Crop Year September 2009- August 2010
Northwest Agriculture Research Center, Kalispell Montana

DAY	SEPT. 2009	OCT. 2009	NOV. 2009	DEC. 2009	JAN. 2009	FEB. 2010	MAR. 2010	APR. 2010	MAY 2010	JUNE 2010	JULY 2010	AUG. 2010	Year to Date
1		0.21	0.11	0.02		0.11			0.04	0.29	0.04	0.26	1.08
2						0.02			0.09	0.05	0.23	0.01	0.40
3		0.02	0.02			0.01			0.15	0.33	0.18	0.07	0.78
4					0.17		0.07			0.01	0.11		0.36
5				0.06	0.67		0.01		0.13	0.25	0.05		1.17
6			0.02		0.09	0.09		0.09			0.06	0.02	0.37
7		0.05						0.1		0.07		0.03	0.25
8		0.04								0.02			0.06
9		0.07		0.01			0.20	0.02	0.09		0.02		0.41
10				0.01			0.11		0.04	0.14			0.30
11			0.02	1.01	0.04	0.03				0.01			1.11
12						0.09						0.05	0.14
13				0.30	0.14	0.04	0.01					0.35	0.84
14	0.04	0.10		0.07	T			1.07				0.05	1.33
15		0.26		0.08		0.11		0.02					0.47
16		0.03		0.20		0.01				0.22			0.46
17				0.01	0.03	0.04				1.09			1.17
18		0.01		M						1.26			1.27
19					0.08			0.01	0.29				0.38
20		0.04		0.19					0.41		0.12		0.76
21		0.05		0.47					0.02	0.95			1.49
22		0.03	0.03	0.01						0.24			0.31
23				0.02	T		0.05		0.02		0.30	0.10	0.49
24		0.51	0.03										0.54
25					0.02				0.04				0.06
26		0.03			0.03	0.04	0.03			0.09			0.22
27			0.07			0.07							0.14
28		0.08	0.06					0.36	0.37		0.08		0.95
29		0.02		0.02			0.01	1.41	0.55		0.01	0.08	2.10
30		0.12	0.01	0.03	0.15		0.02	0.39	0.18	0.01		0.26	1.17
31		0.05		0.15			0.21		0.03			0.07	0.51
											0.05		0.05
TOTAL	0.04	1.72	0.37	2.66	1.42	0.66	0.72	3.47	2.45	5.03	1.25	1.35	21.14

YEAR 2010 - GROWING DEGREE DAYS JANUARY THROUGH OCTOBER
CALCULATED AT BASE 50, BASE 40, AND BASE 32
Page 1: January - May

JANUARY

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	39	32	0.0	0.0	3.5
2	40	34	0.0	0.0	5.0
3	38	29	0.0	0.0	3.0
4	40	29	0.0	0.0	4.0
5	33	31	0.0	0.0	0.5
6	32	1	0.0	0.0	0.0
7	18	-12	0.0	0.0	0.0
8	10	-12	0.0	0.0	0.0
9	10	-1	0.0	0.0	0.0
10	21	10	0.0	0.0	0.0
11	31	20	0.0	0.0	0.0
12	29	19	0.0	0.0	0.0
13	38	19	0.0	0.0	3.0
14	38	28	0.0	0.0	3.0
15	40	32	0.0	0.0	4.0
16	46	32	0.0	3.0	7.0
17	41	30	0.0	0.5	4.5
18	39	30	0.0	0.0	3.5
19	41	21	0.0	0.5	4.5
20	37	25	0.0	0.0	2.5
21	37	25	0.0	0.0	2.5
22	32	19	0.0	0.0	0.0
23	35	21	0.0	0.0	1.5
24	31	18	0.0	0.0	0.0
25	28	16	0.0	0.0	0.0
26	28	21	0.0	0.0	0.0
27	33	20	0.0	0.0	0.5
28	31	16	0.0	0.0	0.0
29	31	22	0.0	0.0	0.0
30	36	23	0.0	0.0	2.0
31	30	23	0.0	0.0	0.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
32.8	20.7	0.0	4.0	54.5

February

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	32	23	0.0	0.0	0.0
2	37	25	0.0	0.0	2.5
3	37	25	0.0	0.0	2.5
4	34	29	0.0	0.0	1.0
5	34	23	0.0	0.0	1.0
6	30	24	0.0	0.0	0.0
7	36	29	0.0	0.0	2.0
8	34	30	0.0	0.0	1.0
9	34	30	0.0	0.0	1.0
10	34	30	0.0	0.0	1.0
11	36	31	0.0	0.0	2.0
12	37	31	0.0	0.0	2.5
13	44	34	0.0	2.0	7.0
14	42	24	0.0	1.0	5.0
15	39	27	0.0	0.0	3.5
16	38	31	0.0	0.0	3.0
17	38	27	0.0	0.0	3.0
18	42	23	0.0	1.0	5.0
19	37	21	0.0	0.0	2.5
20	39	20	0.0	0.0	3.5
21	36	13	0.0	0.0	2.0
22	33	13	0.0	0.0	0.5
23	38	17	0.0	0.0	3.0
24	45	17	0.0	2.5	6.5
25	36	26	0.0	0.0	2.0
26	44	26	0.0	2.0	6.0
27	47	26	0.0	3.5	7.5
28	44	26	0.0	2.0	6.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
35.2	23.4	0.0	14.0	82.5

March

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	50	25	0.0	5.0	9.0
2	50	25	0.0	5.0	9.0
3	45	28	0.0	2.5	6.5
4	51	30	0.5	5.5	9.5
5	50	25	0.0	5.0	9.0
6	49	24	0.0	4.5	8.5
7	52	23	1.0	6.0	10.0
8	52	25	1.0	6.0	10.0
9	48	28	0.0	4.0	8.0
10	34	27	0.0	0.0	1.0
11	36	23	0.0	0.0	2.0
12	42	25	0.0	1.0	5.0
13	57	37	3.5	8.5	15.0
14	47	21	0.0	3.5	7.5
15	49	22	0.0	4.5	8.5
16	52	23	1.0	6.0	10.0
17	56	26	3.0	8.0	12.0
18	52	30	1.0	6.0	10.0
19	47	20	0.0	3.5	7.5
20	44	20	0.0	2.0	6.0
21	52	21	1.0	6.0	10.0
22	53	30	1.5	6.5	10.5
23	47	34	0.0	3.5	8.5
24	50	25	0.0	5.0	9.0
25	53	24	1.5	6.5	10.5
26	54	27	2.0	7.0	11.0
27	46	36	0.0	3.0	9.0
28	54	25	2.0	7.0	11.0
29	58	25	4.0	9.0	13.0
30	53	34	1.5	6.5	11.5
31	49	29	0.0	4.5	8.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
49.4	26.4	24.5	151.0	276.5

April

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	49	25	0.0	4.5	8.5
2	45	27	0.0	2.5	6.5
3	44	31	0.0	2.0	6.0
4	44	26	0.0	2.0	6.0
5	47	19	0.0	3.5	7.5
6	50	22	0.0	5.0	9.0
7	41	33	0.0	0.5	5.0
8	45	33	0.0	2.5	7.0
9	44	24	0.0	2.0	6.0
10	37	24	0.0	0.0	2.5
11	47	21	0.0	3.5	7.5
12	46	29	0.0	3.0	7.0
13	49	32	0.0	4.5	8.5
14	36	32	0.0	0.0	2.0
15	47	30	0.0	3.5	7.5
16	61	31	5.5	10.5	14.5
17	69	32	9.5	14.5	18.5
18	63	33	6.5	11.5	16.0
19	59	31	4.5	9.5	13.5
20	69	31	9.5	14.5	18.5
21	77	39	13.5	18.5	26.0
22	76	42	13.0	19.0	27.0
23	56	34	3.0	8.0	13.0
24	59	37	4.5	9.5	16.0
25	54	31	2.0	7.0	11.0
26	53	25	1.5	6.5	10.5
27	56	31	3.0	8.0	12.0
28	55	36	2.5	7.5	13.5
29	55	32	2.5	7.5	11.5
30	39	27	0.0	0.0	3.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
52.4	30.0	81.0	191.0	321.5

May

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	51	32	0.5	5.5	9.5
2	51	32	0.5	5.5	9.5
3	54	37	2.0	7.0	13.5
4	54	35	2.0	7.0	12.5
5	37	31	0.0	0.0	2.5
6	44	26	0.0	2.0	6.0
7	47	28	0.0	3.5	7.5
8	52	31	1.0	6.0	10.0
9	49	37	0.0	4.5	11.0
10	49	28	0.0	4.5	8.5
11	61	28	5.5	10.5	14.5
12	58	29	4.0	9.0	13.0
13	61	31	5.5	10.5	14.5
14	66	38	8.0	13.0	20.0
15	71	37	10.5	15.5	22.0
16	70	38	10.0	15.0	22.0
17	77	40	13.5	18.5	26.5
18	80	50	15.0	25.0	33.0
19	74	49	12.0	21.5	29.5
20	65	40	7.5	12.5	20.5
21	53	36	1.5	6.5	12.5
22	54	31	2.0	7.0	11.0
23	58	38	4.0	9.0	16.0
24	57	34	3.5	8.5	13.5
25	55	39	2.5	7.5	15.0
26	61	35	5.5	10.5	16.0
27	71	45	10.5	18.0	26.0
28	61	40	5.5	10.5	18.5
29	51	39	0.5	5.5	13.0
30	48	41	0.0	4.5	12.5
31	58	46	4.0	12.0	20.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
58.0	36.2	137.0	296.0	480.0

YEAR 2010 - GROWING DEGREE DAYS JANUARY THROUGH OCTOBER 2010
CALCULATED AT BASE 50, BASE 40, AND BASE 32
Page 2: June - October

JUNE

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	58	47	4.0	12.5	20.5
2	64	47	7.0	15.5	23.5
3	58	48	4.0	13.0	21.0
4	60	40	5.0	10.0	18.0
5	55	44	2.5	9.5	17.5
6	63	35	6.5	11.5	17.0
7	64	43	7.0	13.5	21.5
8	65	49	7.5	17.0	25.0
9	67	46	8.5	16.5	24.5
10	59	46	4.5	12.5	20.5
11	59	43	4.5	11.0	19.0
12	65	36	7.5	12.5	18.5
13	70	41	10.0	15.5	23.5
14	74	48	12.0	21.0	29.0
15	72	45	11.0	18.5	26.5
16	69	48	9.5	18.5	26.5
17	51	42	0.5	6.5	14.5
18	45	39	0.0	2.5	10.0
19	61	37	5.5	10.5	17.0
20	70	42	10.0	16.0	24.0
21	75	52	13.5	23.5	31.5
22	54	50	2.0	12.0	20.0
23	67	46	8.5	16.5	24.5
24	72	51	11.5	21.5	29.5
25	77	52	14.5	24.5	32.5
26	74	52	13.0	23.0	31.0
27	76	46	13.0	21.0	29.0
28	76	48	13.0	22.0	30.0
29	82	48	16.0	25.0	33.0
30	83	60	21.5	31.5	39.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
66.2	45.7	253.5	484.5	718.0

JULY

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	73	40	11.5	16.5	24.5
2	70	48	10.0	19.0	27.0
3	61	46	5.5	13.5	21.5
4	59	48	4.5	13.5	21.5
5	64	47	7.0	15.5	23.5
6	65	42	7.5	13.5	21.5
7	68	42	9.0	15.0	23.0
8	76	46	13.0	21.0	29.0
9	83	48	16.5	25.5	33.5
10	82	50	16.0	26.0	34.0
11	83	55	19.0	29.0	37.0
12	79	61	20.0	30.0	38.0
13	76	41	13.0	18.5	26.5
14	65	46	7.5	15.5	23.5
15	70	46	10.0	18.0	26.0
16	79	47	14.5	23.0	31.0
17	85	46	17.5	25.5	33.5
18	82	47	16.0	24.5	32.5
19	80	47	15.0	23.5	31.5
20	73	43	11.5	18.0	26.0
21	76	50	13.0	23.0	31.0
22	78	46	14.0	22.0	30.0
23	76	49	13.0	22.5	30.5
24	71	47	10.5	19.0	27.0
25	77	48	13.5	22.5	30.5
26	82	50	16.0	26.0	34.0
27	85	54	19.5	29.5	37.5
28	79	57	18.0	28.0	36.0
29	83	58	20.5	30.5	38.5
30	83	49	16.5	26.0	34.0
31	78	50	14.0	24.0	32.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
75.5	48.2	413.0	677.5	925.5

AUGUST

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	79	54	16.5	26.5	34.5
2	71	49	10.5	20.0	28.0
3	75	47	12.5	21.0	29.0
4	78	51	14.5	24.5	32.5
5	78	49	14.0	23.5	31.5
6	84	55	19.5	29.5	37.5
7	82	50	16.0	26.0	34.0
8	81	52	16.5	26.5	34.5
9	81	45	15.5	23.0	31.0
10	80	51	15.5	25.5	33.5
11	77	51	14.0	24.0	32.0
12	74	49	12.0	21.5	29.5
13	73	49	11.5	21.0	29.0
14	68	46	9.0	17.0	25.0
15	74	41	12.0	17.5	25.5
16	79	46	14.5	22.5	30.5
17	82	46	16.0	24.0	32.0
18	84	48	17.0	26.0	34.0
19	85	54	19.5	29.5	37.5
20	82	55	18.5	28.5	36.5
21	80	42	15.0	21.0	29.0
22	82	47	16.0	24.5	32.5
23	64	46	7.0	15.0	23.0
24	70	38	10.0	15.0	22.0
25	74	40	12.0	17.0	25.0
26	84	44	17.0	24.0	32.0
27	92	48	18.0	27.0	35.0
28	65	36	7.5	12.5	18.5
29	61	41	5.5	11.0	19.0
30	53	40	1.5	6.5	14.5
31	63	41	6.5	12.0	20.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
76.0	46.8	411.0	663.0	908.0

SEPTEMBER

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	59	46	4.5	12.5	20.5
2	62	34	6.0	11.0	16.0
3	67	35	8.5	13.5	19.0
4	75	40	12.5	17.5	25.5
5	75	49	12.5	22.0	30.0
6	55	41	2.5	8.0	16.0
7	51	41	0.5	6.0	14.0
8	65	44	7.5	14.5	22.5
9	69	46	9.5	17.5	25.5
10	50	49	0.0	9.5	17.5
11	59	37	4.5	9.5	16.0
12	65	34	7.5	12.5	17.5
13	71	36	10.5	15.5	21.5
14	73	40	11.5	16.5	24.5
15	73	40	11.5	16.5	24.5
16	72	41	11.0	16.5	24.5
17	59	41	4.5	10.0	18.0
18	49	41	0.0	5.0	13.0
19	51	43	0.5	7.0	15.0
20	61	45	5.5	13.0	21.0
21	59	48	4.5	13.5	21.5
22	56	33	3.0	8.0	12.5
23	57	32	3.5	8.5	12.5
24	57	33	3.5	8.5	13.0
25	60	35	5.0	10.0	15.5
26	73	34	11.5	16.5	21.5
27	70	42	10.0	16.0	24.0
28	75	43	12.5	19.0	27.0
29	77	43	13.5	20.0	28.0
30	73	38	11.5	16.5	23.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
63.9	40.1	209.5	390.5	601.0

OCTOBER

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Growing Degree Days Base 40	Growing Degree Days Base 32
1	72	40	11.0	16.0	24.0
2	73	38	11.5	16.5	23.5
3	72	38	11.0	16.0	23.0
4	70	43	10.0	16.5	24.5
5	58	48	4.0	13.0	21.0
6	62	36	6.0	11.0	17.0
7	61	40	5.5	10.5	18.5
8	56	45	3.0	10.5	18.5
9	62	45	6.0	13.5	21.5
10	62		6.0	11.0	15.0
11	62	46	6.0	14.0	22.0
12	54	29	2.0	7.0	11.0
13	54	28	2.0	7.0	11.0
14	59	25	4.5	9.5	13.5
15	59	25	4.5	9.5	13.5
16	56	23	3.0	8.0	12.0
17	51	20	0.5	5.5	9.5
18	53	21	1.5	6.5	10.5
19	53	22	1.5	6.5	10.5
20	58	24	4.0	9.0	13.0
21	58	25	4.0	9.0	13.0
22	58	25	4.0	9.0	13.0
23	54	28	2.0	7.0	11.0
24	50	29	0.0	5.0	9.0
25	47	38	0.0	3.5	10.5
26	43	34	0.0	1.5	6.5
27	38	35	0.0	0.0	4.5
28	45	26	0.0	2.5	6.5
29	43	26	0.0	1.5	5.5
30	42	29	0.0	1.0	5.0
31	43	30	0.0	1.5	5.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
56.2	32.0	113.5	258.5	423.0

CEREALS

Project Title: Barley Variety Performance – Off Station

Objectives: To evaluate barley varieties for agronomic performance in environments and cropping systems representative of northwestern Montana.

Materials and Methods:

Treatments were seeded 1.5 inches deep on April 19, 2010. Individual plots consisted of seven, 6-in wide rows, 15 feet in length with each variety replicated 3 times in a randomized complete block design. A preplant application of 27-30-120-24 was applied on April 2, 2010. Wolverine was applied at 1.7 pt/A on May 25, 2010 for weed control. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Height measurements were recorded near maturity. The study was harvested August 18. Grain yield, test weight, grain moisture, and percent plump were then determined.

Results:

The average Julian heading date for the nursery was 183 (July 2). Goldeneye and Geraldine had the earliest (177) and latest (191) heading dates, respectively (Table 1). Plant heights averaged 33.2 inches. Gallatin was the tallest (36.2 inches) and BZ596117 was the shortest (28.6 inches). Lodging was not detected. Yields averaged 95.9 Bu/A, and ranged from a high of 132 Bu/A for Goldeneye to a low of 76 Bu/A for BZ596117. Test weights averaged 52 lb/Bu and ranged from a low of 50 lb/Bu (Goldeneye and Metcalf) and a high of 55 lb/Bu for Hockett. Percent plump averaged 92 percent.

Table 1. Agronomic data from the barley off-station nursery. Kalispell, MT 2010.

Cultivar	Yield Bu/A	TWT lb/A	Grain Moisture %	Plump %	Heading Julian	Height inches
Goldeneye	132.1	50.9	12.0	89.7	177.7	35.3
MT050030	106.7	52.7	12.7	97.6	187.7	32.7
MT010158	106.5	53.4	12.9	95.0	181.7	33.3
Conrad	103.4	51.9	12.4	91.9	184.7	32.2
Hockett	102.6	55.1	13.1	94.0	182.3	34.8
MT030042	97.8	53.1	12.7	85.7	184.0	32.0
Champion	97.3	53.8	13.1	97.2	180.3	34.5
Harrington	95.5	52.3	12.2	95.0	183.3	34.1
Haxby	95.1	53.5	12.3	92.8	179.3	32.0
MT020155	94.1	52.8	12.1	94.5	179.3	35.2
MT010160	92.6	52.2	12.4	93.2	185.7	34.0
Gallatin	85.2	52.8	12.7	94.2	179.7	36.2
Pinnacle	83.8	51.9	13.1	98.2	179.3	32.2
Geraldine	83.7	51.6	12.2	83.4	191.3	31.1
Metcalfe	82.2	50.8	12.1	88.5	183.3	33.5
BZ596117	76.4	53.1	12.0	93.2	190.7	28.6
MIN	76.4	50.8	12.0	83.4	177.7	28.6
MAX	132.1	55.1	13.1	98.2	191.3	36.2
MEAN	95.9	52.6	12.5	92.8	183.1	33.2
LSD (P=.05)	26.58	1.74	0.63	4.04	3.06	10.06
CV	16.61	1.98	3.03	2.61	1.00	7.15
Trt (Pr > F)	0.0432	0.0024	0.0025	<.0001	<.0001	0.0639

Project Title: Agronomic Evaluation of Advanced Spring Wheat Experimental lines

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

Materials and Methods:

The previous crop was alfalfa and the field was fertilized with 27-30-120-24 lb/A of N-P-K-S, respectively. The soil type was a Creston silt loam (25-50-25) with an organic matter content of 4%, a pH of 7.5, and a CEC of 20 meq/100g. Treatments were seeded 1.5 inches deep on April 23, 2010. Individual plots consisted of seven, 6-in wide rows, 15 feet in length with each variety replicated 3 times in a randomized complete block design. Wolverine was applied at 1.7 pt/A on May 25, 2010 for weed control. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Three wheat heads were collected from each plot in the first replication to determine midge larval numbers. Height measurements were recorded near maturity. The study was harvested September 29, 2010. Grain yield, test weight, protein and grain moisture were then determined.

Results:

The average Julian heading date was 181 (June 30). Heading dates ranged from 178 (June 27) for AGRIPR13 to 186 (July 5) for Jedd (Table1). Plant height was taller than the previous year, averaging 37.5 inches in 2010 as compared to 31.5 inches in 2009. Thatcher was the tallest (49.6-in) and Jedd was the shortest (30.8-in). Lodging was not detected. Stripe rust was detected in the nursery with MTHW0867 (98.3%), AP604CL (95.6%), Hank (90%), and Jedd (90%) being the most susceptible. Septoria was also detected, with AGRIPR11 (48.3%) and BZ903461W (45%) being the most susceptible. Midge densities were low, averaging 10 larvae per spike. Midge densities were highest in MT0941 at 68 larvae per spike, while AGRIPR12, MT0747, Fortuna, and Mott had no infestation. Despite disease and insect pressures, growing conditions were favorable for spring wheat, with 16 varieties producing 99 Bu/A or more. Yields averaged 89 Bu/A and ranged from a high of 110 Bu/A for AGRIPR12, to a low of 61 Bu/A for Thatcher. Test weights averaged 58.6 lb/Bu and ranged from a low of 52.1 lb/Bu for MTHW0867 and a high of 60.7 lb/Bu for Volt. Protein levels were good and averaged 14.8% for the nursery. Protein ranged from a high of 16.5% for MT0909 to a low of 13.3% for BZ903461W.

Table 1. Agronomic data from the Spring Wheat Advanced Yield Trial. 2010, Kalispell, MT.

Variety	Yield bu/A	Protein %	Test weight lb/bu	owbm no/spike	Heading Julian	Height inches	Stripe rust %	Septoria %	Green leaf area %
AGRIPR12	110.8	13.6	59.6	0.0	182.0	32.4	15.0	21.7	65.0
MT 0827	109.4	15.1	59.8	5.5	179.7	38.8	1.7	8.3	86.7
MT 0747	109.3	15.2	59.2	0.0	180.0	38.1	6.7	5.0	91.7
VOLT	108.9	13.5	60.7	0.3	182.3	36.2	0.0	6.7	91.7
BZ903461W	107.6	13.3	59.5	9.3	180.0	36.9	1.7	45.0	51.7
JENNA	107.1	14.1	58.3	24.3	184.0	36.2	15.0	13.3	80.0
MT 0755	105.9	16.0	58.8	2.3	179.0	39.6	0.0	15.0	78.3
MT 0855	104.9	15.4	57.9	1.3	180.7	37.8	0.0	23.3	73.3
REEDER	103.8	15.2	60.4	3.3	180.3	39.4	11.7	10.0	86.7
MT 0832	101.4	14.9	59.0	2.7	180.0	36.5	0.0	25.0	73.3
MT 0968	101.2	14.5	60.3	1.7	181.3	39.5	11.7	10.0	78.3
BRENNAN	100.8	14.7	59.3	1.0	179.7	32.3	1.7	13.3	86.7
AGRIPR11	100.0	14.3	58.5	5.3	183.0	35.2	20.0	48.3	35.0
AP604 CL	99.5	13.7	59.4	1.0	180.0	39.0	95.7	0.0	5.0
KELBY	99.3	15.1	59.4	0.7	179.3	33.2	5.0	15.0	81.7
VIDA	99.2	15.0	59.4	11.3	181.3	38.7	13.3	8.3	83.3
MT 0975	98.9	14.9	57.9	6.0	181.3	38.1	6.7	10.0	83.3
MT 0869	97.5	15.0	59.0	9.7	180.3	36.5	15.0	11.7	78.3
MT 0750	97.4	15.0	58.7	3.0	181.7	40.9	25.0	18.3	58.3
MT 0928	96.8	15.1	58.6	19.7	182.3	37.3	1.7	8.3	91.7
CORBIN	96.2	14.2	59.3	23.7	180.3	37.5	33.3	26.7	53.3
MT 0802	94.6	15.3	59.5	6.3	183.0	39.6	26.7	8.3	78.3
CHOTEAU	94.2	15.0	59.0	14.0	181.3	36.2	0.0	5.0	90.0
FREYR	94.1	14.7	59.7	6.7	180.7	39.2	3.3	10.0	88.3
KUNTZ	93.9	14.5	59.4	4.0	181.3	34.1	5.0	8.3	85.0
MT 0801	93.6	14.2	58.0	10.3	179.7	39.2	71.7	18.3	23.3
MT 0861	93.5	15.0	58.0	6.0	182.3	35.3	18.3	13.3	71.7
MT 0930	93.4	14.8	57.4	8.3	183.0	35.4	0.0	8.3	81.7
MT 0944	91.9	14.3	59.2	29.3	181.0	36.4	65.0	20.0	30.0
MT 0967	91.2	15.3	58.9	2.0	180.0	38.2	0.0	8.3	91.7
MT 0847	90.9	15.2	58.1	3.3	181.3	36.2	51.7	18.3	36.7
MT 0943	90.8	14.0	56.4	1.0	181.0	35.8	18.3	26.7	36.7
AGRIPR13	90.3	15.4	60.6	3.0	178.7	40.7	26.7	15.0	63.3
HANK	90.2	13.7	56.2	41.7	180.3	35.2	90.0	5.0	6.7
MT 0923	88.5	15.5	59.3	8.0	182.0	35.4	1.7	6.7	91.7
MT 0852	88.1	14.8	59.3	11.7	182.3	37.9	50.0	18.3	36.7

Table 1. Continued

Variety	Yield bu/A	Protein %	Test weight lb/bu	owbm no/spike	Heading Julian	Height inches	Stripe rust %	Septoria %	Green leaf area %
IMICHT79	87.3	15.1	58.5	3.7	182.0	35.6	3.3	6.7	91.7
OUTLOOK	87.0	15.2	58.1	12.3	184.0	39.2	1.7	8.3	90.7
MT 0953	86.7	15.4	59.2	5.0	181.7	40.3	6.7	10.0	86.7
MT 0959	86.4	14.7	60.6	1.3	180.0	36.0	65.0	35.0	15.0
MT 0912	85.7	15.4	59.3	7.7	182.3	36.2	3.3	16.7	78.3
MT 0921	85.5	14.9	58.1	0.7	182.3	36.1	3.3	13.3	84.0
MT 0927	85.2	15.5	57.2	2.7	183.3	35.7	0.0	10.0	90.0
MCNEAL	85.1	15.2	59.4	19.7	184.0	41.1	18.3	8.3	81.7
FORTUNA	85.1	14.4	59.1	0.0	181.7	45.1	1.7	25.0	66.7
MT 0914	84.8	14.3	56.7	8.0	181.0	36.4	86.7	0.0	10.0
BZ902413R	84.5	14.2	60.2	8.3	181.0	36.5	6.7	20.0	73.3
MT 0950	84.4	14.4	56.8	3.3	183.7	41.1	85.0	13.3	10.0
MT 0974	84.3	15.0	59.1	4.0	182.0	38.6	35.0	6.7	56.7
MOTT	83.8	14.5	58.8	0.0	186.3	42.7	63.3	18.3	25.0
MT 0969	82.0	15.1	60.0	2.7	182.7	38.6	13.3	6.7	81.7
MT 0940	81.2	14.8	59.1	3.3	183.0	37.4	80.0	16.7	13.3
MT 0814	80.4	15.0	58.5	11.3	180.3	35.8	86.7	18.3	10.0
MT 0972	78.3	15.6	59.4	2.7	181.3	37.7	13.3	8.3	81.7
CONAN	74.5	14.4	59.3	16.3	181.0	36.7	48.3	11.7	50.0
JEDD	73.2	13.7	57.2	41.3	180.3	30.8	90.0	16.7	8.3
BZ902413W	72.9	14.6	59.7	19.3	180.3	35.7	10.0	20.0	51.7
ONEAL	71.5	14.8	57.8	2.0	182.7	36.7	85.0	11.7	11.7
MTHW0867	71.0	13.4	52.1	15.3	181.0	38.8	98.3	0.0	1.7
MT 0909	69.5	16.5	59.0	12.0	185.7	38.1	5.0	10.0	81.7
MT 0964	69.1	14.9	56.6	28.3	184.3	34.5	76.7	16.7	6.7
MT 0965	64.2	14.8	57.4	20.7	186.0	39.0	83.3	10.0	11.7
MT 0941	63.8	15.7	55.6	68.3	184.7	35.8	66.7	23.3	25.0
THATCHER	61.3	14.8	58.4	41.3	186.3	49.6	50.0	16.7	40.0
MIN	61.3	13.3	52.1	0.0	178.7	30.8	0.0	0.0	1.7
MAX	110.8	16.5	60.7	68.3	186.3	49.6	98.3	48.3	91.7
MEAN	89.7	14.8	58.6	10.1	181.7	37.5	29.6	14.2	58.7
LSD (p=.05)	11.33	NA	0.68	NA	1.33	2.11	14.39	12.36	16.53
CV	7.81	NA	0.72	NA	0.45	3.49	30.08	53.71	17.41
TRT (Pr>F)	0.0001	NA	0.0001	NA	0.0001	0.0001	0.0001	0.0001	0.0001

Project Title: Agronomic Evaluation of Private Spring Wheat Varieties – Site 1.

Objectives: To evaluate private spring wheat varieties

Materials and Methods:

Treatments were seeded 1.5 inches deep on April 17, 2010. Individual plots consisted of seven, 6-in wide rows, 15 feet in length with each variety replicated 3 times in a randomized complete block design. A preplant application of 27-30-120-24 was applied on April 2, 2010. Wolverine was applied at 1.7 pt/A on May 25 for weed control. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Height measurements were recorded near maturity. The study was harvested August 26. Grain yield, test weight, moisture, and protein content were then determined.

Results:

Heading occurred over a period of 6 days with the average heading date of 177 (June 26). Kelby had the earliest (174) and Faller had the latest (180) heading dates (Table1). Plant heights averaged 34.31 inches. Hollis was the tallest variety (43.18 inches) and Solano was the shortest (27.95 inches). Lodging was not detected. Yields were high, averaging 101 Bu/A, and ranged from a high of 109 Bu/A for Knudson to a low of 89 Bu/A for Kelby. Test weights averaged 62.26 lb/Bu, and range from 60.60 lb/Bu for Traverse to 63.77 lb/Bu for Bullseye. Protein content averaged 13.1 percent. RB07 had the highest protein (14.37) and Jerome had the lowest protein (11.53). Similar to the previous year, Kelby had the lowest yield (89.05) and had higher protein content (14.27).

Table 1. CHS-1. Agronomic performance of spring wheat varieties. Kalispell, MT 2010

Variety	Yield bu/A	Protein %	TWT lb/bu	Heading Julian	Height inches
Knudson	109.26	12.23	62.60	177	35.30
Bullseye	106.78	12.13	63.77	178	31.89
McNeal	106.71	13.03	62.37	179	36.48
Reeder	105.85	13.60	63.13	178	38.85
Choteau	105.64	13.60	62.00	177	32.94
Vida	104.77	13.23	61.53	179	38.06
Jerome	104.19	11.53	61.77	175	32.81
Kuntz	101.87	12.53	63.30	178	32.81
Traverse	101.46	12.67	60.60	176	40.29
Cabernet	101.08	12.77	61.10	176	28.61
RB07	100.02	14.37	62.30	175	33.60
Hollis	98.69	13.50	61.60	177	43.18
Expresso	98.01	13.93	62.33	178	29.27
Solano	97.18	13.47	62.37	177	27.95
Faller	94.04	12.07	61.80	180	36.09
Kelby	89.05	14.27	63.53	174	30.84
MIN	89.05	11.53	60.60	174	27.95
MAX	109.26	14.37	63.77	180	43.18
MEAN	101.54	13.06	62.26	177	34.31
LSD (P=.05)	8.88	0.54	0.95	0.83	1.90
CV	5.25	2.50	0.91	0.28	3.33
Trt (Pr>F)	0.0054	0.0001	0.0001	0.0001	0.0001

Planted April 17, harvested August 26, 2010.

Project Title: Agronomic Evaluation of Private Spring Wheat Varieties – Site 2.

Objectives: To evaluate private spring wheat varieties

Materials and Methods:

Treatments were seeded 1.5 inches deep on May 6, 2010. Individual plots consisted of seven, 6-in wide rows, 15 feet in length with each variety replicated 3 times in a randomized complete block design. Wolverine was applied at 1.7 pt/A on May 25, 2010 for weed control. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Height measurements were recorded near maturity. The study was harvested September 13. Grain yield, test weight, moisture, and protein content were then determined.

Results:

Heading occurred over a period of 6 days with the average heading date of 186 (July 5). Jerome had the earliest (183), while Cabernet, Solano, and Expresso had the latest (189) heading dates (Table 1). Plant heights averaged 37.43 inches. Hollis was the tallest variety (46.85 inches) and Cabernet was the shortest (31.89 inches). Lodging was greatest in Faller (48.3%) and Knudson (33.3%). Stripe rust was detected in the nursery, with Faller (21.7%) and McNeal (18.3%) being the most susceptible. Septoria was also detected, with Jerome (43.3%) being the most susceptible. Yields averaged 81 Bu/A, with Travers, RB07 and Reeder producing 95 bu/A or greater. In contrast, Cabernet, Solano and Expresso were the three lowest yielding entries. The low yields were primarily due to orange wheat blossom midge (OWBM) damage as Cabernet, Solano and Expresso had the highest midge densities. As yields declined, protein increased. Protein content averaged 14.18 percent. Solano had the highest protein (16%) and Traverse had the lowest protein (12.63%). Test weights averaged 57.88 lb/Bu, and range from a low of 55.53 lb/Bu for Solano to a high of 59.93 lb/Bu for Reeder.

Table. Agronomic performance of spring wheat varieties grown in a silt loam soil. Kalispell, 2010.

	Heading	Height	Stripe rust	Septoria	GLA	Lodging	Yield	TWT	Protein	OWBM
Variety	Julian	inches	%	%	%	%	bu/A	lb/bu	%	no/spike
Traverse	183	42.91	1.70	28.30	43.30	0.00	98.80	56.47	12.63	1.22
RB07	183	34.65	3.30	26.70	53.30	0.00	96.60	58.43	13.80	1.44
Reeder	185	39.10	10.00	15.00	81.70	0.00	95.70	59.93	14.13	3.22
Choteau	184	38.84	0.00	23.30	41.70	0.00	88.50	58.20	14.40	13.44
Knudson	188	37.01	13.30	21.70	58.30	33.30	86.40	58.07	13.27	3.89
Kelby	184	34.52	3.30	25.00	63.30	0.00	85.70	59.00	14.43	2.22
Jerome	183	34.64	10.00	43.30	40.00	0.00	83.80	57.97	13.17	17.33
Faller	188	38.85	21.70	25.00	53.30	48.30	83.70	56.80	13.17	4.44
Bullseye	186	34.65	1.70	23.30	71.70	0.00	83.60	58.50	13.60	12.11
Hollis	187	46.85	1.70	25.00	63.30	13.30	82.50	58.73	14.83	31.44
McNeal	187	39.89	18.30	16.70	73.30	3.30	79.00	58.43	14.93	22.11
Kuntz	188	37.40	11.70	16.70	70.00	0.00	78.30	59.23	13.80	21.55
Vida	185	39.50	10.00	25.00	68.30	0.00	74.80	57.97	14.47	9.45
Cabernet	189	31.89	3.30	18.30	76.70	1.70	71.70	56.60	14.63	35.44
Solano	189	33.99	1.70	8.30	88.30	0.00	62.60	55.53	16.00	58.55
Expresso	189	34.25	0.00	6.70	78.30	0.00	60.20	56.23	15.67	40.67
MIN	183	31.89	0.00	6.70	40.00	0.00	60.20	55.53	12.63	1.22
MAX	189	46.85	21.70	43.30	88.30	48.30	98.80	59.93	16.00	58.55
MEAN	186	37.43	6.98	21.77	64.05	6.24	81.99	57.88	14.18	17.41
LSD (P=.05)	1.62	2.8913	7.93	14.95	28.35	21.35	10.95	1.486	1.085	24.56
CV	0.52	4.63	68.17	41.2	26.54	204.85	8.01	1.54	4.59	84.63
TRT Prob>F	0.0001	0.0001	0.0001	0.0094	0.0295	0.0012	0.0001	0.0001	0.0001	0.0008

Project Title: Agronomic Evaluation of Soft White Spring Wheat Varieties

Objectives: To evaluate soft white spring wheat varieties and experimental lines for agronomic performance in environments and cropping systems representative of northwestern Montana.

Materials and Methods:

Treatments were seeded 1.5 inches deep on April 17, 2010. Individual plots consisted of seven, 6-in wide rows, 15 feet in length with each variety replicated 3 times in a randomized complete block design. A preplant application of 27-30-120-24 was applied on April 2, 2010. Wolverine was applied at 1.7 pt/A on May 25 for weed control. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Height measurements were recorded near maturity. The study was harvested August 27, 2010. Grain yield, test weight, and grain moisture were then determined.

Results:

The average Julian heading date for the nursery was 178 (June 27). Varieties Pettit and Treasure had the earliest (173) and latest (182) heading dates, respectively. Plant heights averaged 33.4 inches, with Pettit being the shortest (29.1) and Zak being the tallest (37.4). Yields averaged 104 Bu/A, and ranged from a high of 112 Bu/A for WA008039 to a low of 95.5 Bu/A for Calorwa. Test weights averaged 62.4 lb/Bu, and ranged from 60.5 lb/Bu for Calorwa to 63.5 lb/Bu for WA008039 and Alpowa.

Table 1. Agronomic data from the soft white spring wheat nursery grown at Kalispell, MT.

Cultivar	Yield Bu/A	TWT lb/Bu	Heading Julian	Height in
WA008039	112.2	63.5	179	33.4
Alturas	112.1	62.1	178	33.7
Treasure	111.8	61.6	182	34.0
Eden	109.4	63.2	177	32.7
Zak	108.9	61.2	179	37.4
Louise	107.6	62.7	179	36.1
Jubilee	107.4	63.1	179	36.0
Vida	106.8	62.8	178	35.3
Wakanz	106.7	61.8	180	33.4
Alpowa	106.1	63.5	179	33.5
Pettit	106.1	62.7	173	29.1
Centennial	105.3	62.7	177	32.8
BZ604-026	102.9	63.4	178	31.5
WA008008	102.4	62.0	176	33.9
Choteau	101.3	62.2	177	33.9
BZ604-002	101.1	62.6	176	32.6
Nick	98.0	62.4	177	32.7
Whitebird	97.7	63.2	180	34.7
Cataldo	96.8	61.4	175	32.2
Calorwa	95.5	60.5	177	29.4
MIN	95.5	60.5	173	29.1
MAX	112.2	63.5	182	37.4
MEAN	104.8	62.4	178	33.4
LSD (P=.05)	9.35	0.52	1.10	2.08
CV	5.41	0.50	0.37	3.77
TRT (Pr > F)	0.0089	0.0001	0.0001	0.0001

Project Title: Effect of Methoprene on Orange Wheat Blossom Midge Densities

Objective: To determine if methoprene would prevent larval development

Materials and Methods:

This study was established in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. Hank hard red spring wheat was seeded at a rate of 75 lb/A in seven inch wide rows, to a depth of two inches on May 11, 2010.

Methoprene was applied at seven rates ranging from 0.06 to 4.0 lb ai/A (Table 1). Treatments included a non-ionic surfactant (NIS) at 0.25 % v/v and were applied in 20 GPA of water using a backpack sprayer equipped with 11002 Tee Jet nozzles. The experimental design was a randomized complete block with three replications with each plot measuring 10 by 15 feet. Treatments were applied on July 16 at 9:00 pm when the crop growth ranged from 80% anthesis to the watery ripe stage. Three spikes were sampled from each plot on August 6. Each spike was dissected and the number of larvae and seeds counted. Plots were harvested on September 13 to measure grain yield and quality.

Results:

Methoprene had no effect on larval populations (Table 1). Similarly, methoprene had no effect on grain yield or quality. Perhaps the most important observation from this study is that methoprene did not cause any damage to spring wheat, even at rates as high as 4.0 lb/A.

Table 1. Effect of methoprene rate on orange wheat blossom midge densities and grain yield

Treatment	Rate lb ai/a	Yield Bu/A	TWT lb/Bu	Protein %	PPO	FN sec	OWBM no/spike
Check		50.1	56.7	15.1	0.7918	320.0	76.44
Methoprene	0.06	51.0	56.9	15.2	0.6323	326.7	46.33
Methoprene	0.12	50.8	57.6	14.3	0.7628	339.3	35.66
Methoprene	0.25	47.7	57.2	14.1	0.7582	329.0	43.00
Methoprene	0.50	45.4	57.0	14.5	0.8987	322.0	56.66
Methoprene	1.00	49.5	56.8	15.0	0.8192	349.7	52.77
Methoprene	2.00	44.7	56.9	13.7	0.8002	334.7	74.00
Methoprene	4.00	54.8	57.5	14.2	0.8958	351.0	33.33
MIN		44.7	56.7	13.7	0.6323	320.0	33.33
MAX		54.8	57.6	15.2	0.8987	351.0	76.44
MEAN		49.3	57.1	14.5	0.7949	334.1	52.27
LSD (P=.05)		NA	NA	NA	NA	NA	NA
CV		10.83	0.90	5.37	15.71	9.9	38.42
Trt (Pr>F)		0.4002	0.4086	0.2530	0.2877	0.8961	0.1370

Project Title: Effect of seed color on spring wheat resistance to the orange wheat blossom midge

Objective: Determine if spring wheat resistance to the orange wheat blossom midge varies by market class

Materials and Methods:

Ten hard red and ten soft white spring wheat varieties were evaluated for resistance to the owbm as well as for agronomic performance. This study was established in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. Treatments were seeded at a rate of 75 lb/A in six inch wide rows, to a depth of two inches on May 7, 2010. Individual treatments consisted of seven, 15 foot long rows, with each treatment replicated three times in a randomized complete block design.

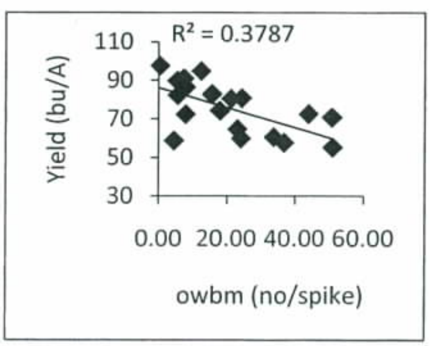
Heading was recorded when 50 percent of the plants in a plot had half the spike exposed. Plant height measurements were taken the first week of August. Three spikes were sampled from each plot on August 9. Each spike was dissected and the number of larvae and seeds counted. Plots were harvested on September 13 to determine grain yield, protein, test weight, thousand kernel weight, falling numbers, and polyphenol oxidase (PPO).

Results:

Midge densities varied depending on variety, ranging from a low of 0.44/spike for Treasure, to a high of 51.11/spike for Eden (Table 1). Nonetheless, market class did not influence infestation levels. Larval densities were lower than normal and averaged 20.6/spike among the soft white varieties and 23.67/spike with the hard reds. The lack of adequate insect pressure may have negated any meaningful effect attributed to market class.

Midge densities were low, but still had a negatively affect on yield (Figure 1). Midge densities did not differ between market classes, but yields did. The soft white class averaged 80.47 bu/A as compared to 67.96 for the hard red class. Treasure and Eden were the highest and lowest yielding soft white wheats, while Faller and Solano were the highest and lowest yielding hard red wheats.

Figure 1. Effect of owbm density on yield.



Not surprisingly, protein also varied between market classes since yield is inversely related to protein. The soft white and hard red varieties averaged 11.34 and 14.06 percent protein, respectively. The range in protein levels was greater with the hard reds, which varied from a high of 15.97 for Solano to a low of 12.43 for Faller. In contrast, soft whites varied from a high of 12.37 for Eden to a low of 10.53 for Treasure.

Polyphenol oxidase content was the only other trait that varied by market class, with the hard red varieties averaging 1.0293 compared to 0.5790 for the soft white varieties. This study was predicated on the fact that hard red varieties would have higher phenolic levels then soft white varieties. As such, it's not surprising that hard reds would have higher PPO levels. Polyphenol oxidase levels increased as thousand kernel weight increased, as protein increased, and as plant height increased (r^2= 0.49, 0.48, and 0.45, respectively).

There were no significant differences between market classes for any of the other response variables. Test weights were low and averaged 57.86 lb/bu. Reeder had the highest test weight while Solano had the lowest. Solano was also the shortest variety in the experiment, while Fortuna was the tallest. Heading occurred over seven days, with the average being 187 (July 6). Choteau was the earliest while Volt was the latest.

Overall, the results demonstrate that while midge densities vary among varieties, there are no differences in oviposition preference between hard red and soft white varieties.

Table 1. Agronomic performance among hard red and soft white spring wheats.

	Yield	Protein	TWT	TKW	Heading	Height	owbm	PPO	FN
Variety	bu/A	%	lb/bu	g	Julian	inches	no/spike		sec.
					soft white				
Treasure	97.60	10.53	57.53	36.68	190.00	37.40	0.44	0.4376	335
Nick	94.80	11.10	58.53	44.71	185.30	38.45	12.44	0.5354	344
Cataldo	89.80	10.90	57.70	44.35	184.70	38.85	5.44	0.4069	327
Calorwa	86.40	11.03	56.73	39.00	186.70	36.09	7.89	0.3747	409
Pettit	82.70	11.07	57.77	38.52	184.70	32.81	15.67	0.3755	269
Alturas	80.70	11.07	58.00	45.19	188.30	38.85	24.55	0.5113	316
Louise	80.40	10.83	57.93	51.77	188.70	41.21	21.33	1.0150	254
Jubilee	72.50	12.27	58.90	38.39	191.30	40.94	44.00	0.3493	335
Alpowa	64.60	12.27	57.93	45.40	189.00	40.55	23.11	1.2916	262
Eden	55.20	12.37	57.90	39.11	189.00	37.93	51.11	0.4926	261
					hard red				
Faller	90.90	12.43	57.97	42.30	188.30	41.08	7.33	1.1559	447
Reeder	82.20	13.50	60.33	41.40	186.00	40.68	5.56	1.2520	392
Amidon	74.10	12.87	58.60	40.33	185.00	47.11	18.00	1.0369	442
Choteau	72.20	13.87	58.17	39.51	184.00	36.22	7.89	0.8029	418
Hank	70.70	13.27	56.97	46.59	185.70	37.80	50.89	1.1784	331
McNeal	60.50	14.57	57.60	40.11	188.30	38.58	33.78	0.7781	456
Vida	59.80	14.33	58.73	41.74	188.70	40.03	24.22	1.4159	253
Fortuna	58.70	15.37	57.20	45.53	187.30	47.51	4.45	1.4795	336
Volt	57.70	14.37	57.20	29.85	191.70	37.66	36.89	0.4666	309
Solano	52.80	15.97	55.47	39.32	190.00	31.50	47.67	0.7272	267
					white vs red				
LSD (P=.05)	7.17	0.60	NA	NA	NA	NA	NA	0.17	37.30
CV	18.69	9.17	2.03	11.18	1.32	10.04	104.56	42.28	21.30
TRT Pr>F	0.0009	0.0001	0.8183	0.1753	0.6799	0.1417	0.6097	0.0001	0.0054
					among varieites				
MIN	52.80	10.53	55.47	29.85	184.00	31.50	0.44	0.3493	253
MAX	97.60	15.97	60.33	51.77	191.70	47.51	51.11	1.4795	456
MEAN	74.22	12.70	57.86	41.49	187.64	39.06	22.13	0.8042	338
LSD (P=.05)	12.13	1.49	1.30	2.00	1.91	2.23	32.02	0.2532	70.56
CV	9.90	7.11	1.36	2.91	0.62	3.47	87.67	19.08	12.61
TRT Pr>F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0183	0.0001	0.0001

Planted May 7, harvested September 13.

Project Title: Evaluation of hard and soft NILs for resistance to the Orange Wheat Blossom Midge

Objectives: To determine if midge populations would be affected by differences in grain hardness

Materials and Methods:

Grain hardness has been shown to impact resistance to certain fungal diseases. This study evaluated the effect of grain hardness for resistance to the owbm by comparing experimental white wheat lines that varied in grain texture. This experiment was established in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. The nursery was plant on May 17 as a randomized complete block design with three replications. Plots consisted of 10 seeds per entry planted in individual hills. Heading was recorded when 50 percent of the plants in a plot had half the spike exposed. Plant height measurements and stripe rust disease ratings were taken the first week of August. Three spikes were sampled from each plot on August 9. Each spike was dissected and the number of larvae and seeds counted.

Results:

Midge densities varied from approximately 300 to112 larvae per spike (Table 1). While midge densities varied statistically among entries, grain hardness had no effect on OWBM populations. Likewise, differences among varieties were noted for stripe rust infection, but grain hardness had no effect on disease susceptibility.

Table 1. Effect of seed texture on OWBM densities. Kalispell, MT 2010.

entry	Pedigree	Texture	Heading	Height	Stripe rust	owbm No/spike	owbm No/seed
23	WQL2GAM329S	soft	199.33	29.92	11.67	143.11	3.18
24	WQL2GAM503S	soft	196.67	33.86	11.67	299.89	6.57
29	WQL3H-F077S	soft	197.67	33.86	20.00	153.78	3.43
30	WQL3H-F254S	soft	200.00	32.02	13.33	111.45	2.42
25	WQL2GAM329H	hard	197.67	30.05	6.67	132.11	2.65
26	WQL2GAM909H	hard	198.00	34.38	10.00	121.22	2.44
27	WQL3H-F254H	hard	199.00	30.84	10.00	232.44	4.62
28	WQL3H-F077H	hard	197.00	33.99	18.33	146.78	2.81
	Entry	TRT Pr>F	0.1836	0.3818	0.0113	0.0184	0.0008
		CV	0.77	9.36	29.74	35.03	25.83
		LSD	NA	NA	6.62	102.81	1.59
	Texture	TRT Pr>F	NS	NS	NS	NS	NS
		soft	198.41	32.41	14.16	177.06	3.89
		hard	197.91	32.31	11.25	158.14	3.13

Project Title: Evaluation of hard red and hard white NILs for resistance to the Orange Wheat Blossom Midge

Objectives: To determine if midge populations would be affected by differences in phenolic content attributed to seed color

Materials and Methods:

Experimental materials derived from crosses between the hard red variety Vida and the hard white variety MTHW0471 were evaluated for resistance to the owbm. This study was established in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. The nursery was plant on May 17 as a randomized complete block design with three replications. Plots consisted of 10 seeds per entry planted in individual hills. Heading was recorded when 50 percent of the plants in a plot had half the spike exposed. Plant height measurements and stripe rust disease ratings were taken the first week of August. Three spikes were sampled from each plot on August 9. Each spike was dissected and the number of larvae and seeds counted.

Results:

Differences between red and white seeded entries were noted for plant height and stripe rust. Red seeded entries were slightly taller and also had a lower incidence of stripe rust. However, seed color had no effect on midge populations. This is in contrast to the previous growing season where midge densities were twice as great in the white seeded entries as compared with red seeded entries. Midge densities averaged 43 larvae per spike in 2009 as compared to 163 per spike in 2010. The effect of seed color may be density dependent where benefits are only realized at low to moderate midge populations. This study should be repeated to better assess the potential interaction between midge density and seed color.

Table 1. Effect of seed color on OWBM densities. Kalispell, MT 2010.

entry	Pedigree	color	Heading	Height	Stripe rust	owbm No/spike	owbm No/seed
10	VIDA/MTHW0471 white	white	196.00	33.07	6.67	223.45	4.29
11	VIDA/MTHW0471 white	white	198.67	28.48	8.33	212.83	3.44
12	VIDA/MTHW0471 white	white	198.33	36.75	0.00	147.22	2.69
13	VIDA/MTHW0471 white	white	192.67	34.38	0.00	112.67	2.00
14	VIDA/MTHW0471 white	white	202.00	35.43	1.67	97.67	1.55
15	VIDA/MTHW0471 red	red	198.67	41.21	0.00	219.56	3.98
16	VIDA/MTHW0471 red	red	199.00	29.79	0.00	196.22	4.95
17	VIDA/MTHW0471 red	red	198.33	40.16	0.00	135.67	2.57
18	VIDA/MTHW0471 red	red	199.67	38.85	0.00	116.17	2.20
19	VIDA/MTHW0471 red	red	198.67	39.90	3.33	175.78	3.42
	Entry	TRT Pr>F	0.0001	0.0001	0.0001	0.2110	0.0696
		CV	0.36	4.94	92.54	40.89	40.60
		LSD	1.23	3.03	3.17	NA	2.16
	Color	TRT Pr>F	0.1645	0.0099	0.0395	0.7150	0.2653
		LSD	NA	3.21	2.52	NA	NA
		white	197.53	33.62	3.33	158.77	2.79
		red	198.86	37.97	0.66	168.68	3.42

Project Title:	Evaluation of polyphenol oxidase (PPO) content for resistance to the Orange Wheat Blossom Midge
Objectives:	To determine if midge populations would be affected by differences in PPO content

Materials and Methods:

Near isogenic lines that varied in polyphenol oxidase content were evaluated for resistance to the OWBM. Experimental materials were derived from crosses between the low PPO variety Clear White and the high PPO varieties Choteau and Hank. The treatment design consisted of two recurrent parents, Hank and Choteau, and two PPO levels, high and low, for a total of eight treatments. The experiment was established as a randomized complete block design with three replications in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. The nursery was plant on May 17 where individual hill plots consisted of 10 seeds per entry. Heading was recorded when 50 percent of the plants in a plot had half the spike exposed. Plant height measurements and stripe rust disease ratings were taken the first week of August. Three spikes were sampled from each plot on August 9. Each spike was dissected and the number of larvae and seeds counted.

Results:

Midge pressures were high for the nursery and averaged about 160 larvae per spike (Table 1). However, polyphenol oxidase content had no effect on any of the parameters measured. Although no differences were detected with regard to PPO content, treatment effects were observed for two recurrent parents. Experimental lines that were derived from Hank had a higher incidence of stripe rust and greater midge densities as compared to materials derived from Choteau.

Table 1. Effect of ploypenol oxidase (PPO) content on OWBM density. Kalispell, MT 2010.

Pedigree	ppo	Heading	Height	Stripe rust	owbm No/spike	owbm No/seed
Choteau/CW	high	193.00	32.28	0.00	149.67	3.09
Choteau/CW	high	193.00	28.61	0.00	140.00	2.38
Choteau/CW	low	192.00	33.60	0.00	83.67	1.75
Choteau/CW	low	195.00	32.81	1.67	176.44	2.94
Hank/CW	high	192.00	32.02	20.00	195.55	3.12
Hank/CW	high	193.67	29.92	23.33	185.11	3.09
Hank/CW	low	193.67	31.89	21.67	145.89	2.44
Hank/CW	low	192.33	29.79	20.00	207.11	3.46
Entry	TRT Pr>F	0.4569	0.1927	0.0001	0.0879	0.1073
n=8	LSD	NA	NA	4.25	79.04	1.14
PPO	TRT Pr>F	0.6058	0.2091	0.8095	0.5467	0.4174
n=8	LSD	NA	NA	NA	NA	NA
	High	192.91	30.71	11.81	167.58	2.91
	Low	193.25	32.02	10.83	153.28	2.64
CV	TRT Pr>F	0.6665	0.4077	0.0001	0.0236	0.1046
n=8	LSD	NA	NA	1.97	39.05	0.60
	Choteau	193.25	31.82	0.45	137.45	2.53
	Hank	192.91	30.90	21.25	183.42	3.02

Project Title: Evaluation of spring wheat varieties for resistance to the Orange Wheat Blossom Midge (OWBM)

Objective: To evaluate spring wheat varieties for agronomic performance and resistance to the OWBM.

Materials and Methods:

Twenty commercially available spring wheat varieties were evaluated as a subset within the Advanced Yield Trial to assess resistance to the OWBM. The study was analyzed as a randomized complete block with three replications. The previous crop was alfalfa and the field was fertilized with 27-30-120-24 lb/A of N-P-K-S, respectively. The soil type was a Creston silt loam (25-50-25) with an organic matter content of 4%, a pH of 7.5, and a CEC of 20 meq/100g. The spring wheat varieties were planted on April 23, 2010 at a rate of 75 lb/A to a depth of 1.5 inches. Each plot was 15 foot long and consisted of 7 rows, spaced 6 inches apart. Wolverine was applied at 1.7 pt/A on May 25, 2010 for weed control.

Heading was recorded when 50 percent of the plants in a plot had half of the spike exposed. Three randomly selected spikes were collected on August 6. Each spike was dissected and the number of larvae and kernels were determined. Height measurements were recorded near maturity. Plots were harvested on September 29 to determine grain yield and quality parameters from each plot. Protein was determined from plots in the first replication.

Results:

Plant heights were taller than normal and averaged about 38 inches (Table 1). The tallest variety was Thatcher (49.6 inches) and the shortest was Jedd (30.84 inches). Heading occurred over a span of seven days. The average heading date for the nursery was approximately 182 (July 1). Kelby had the earliest heading date at 179, while Mott and Thatcher had the latest date (186.33). Unlike previous years, there was no relationship between heading date and midge infestations. Midge populations were low, averaging about 10 larvae per spike. As a result, the relationship between grain yield and larval numbers was weak (Figure 1). Nevertheless, certain trends among the varieties were evident. Reeder again had one of the lowest infestation levels with only 1.3 larvae/spike, while Thatcher had the highest density with 20 larvae/spike.

While midge densities were low, foliar disease pressures were substantial. Stripe rust was the most prevalent, and averaged an infection level of 31 percent. Stripe rust infection ranged from a high of 95 percent for AP604 CL to a low of 0 for Volt and Choteau. Not surprisingly, there was a very strong association between stripe rust infection and percent green leaf area (R^2=0.96). While stripe rust infection levels were high, the association between the disease and yield was not strong (R^2=0.25). However, the effect of the disease on test weight was more apparent (Figure 2). Septoria also was present, but was less evident, averaging only about a 12 percent infection level. Septoria infection ranged from a low of 0 in AP604 CL to a high of 26 percent in Corbin.

Figure 1. Yield response to owbm.

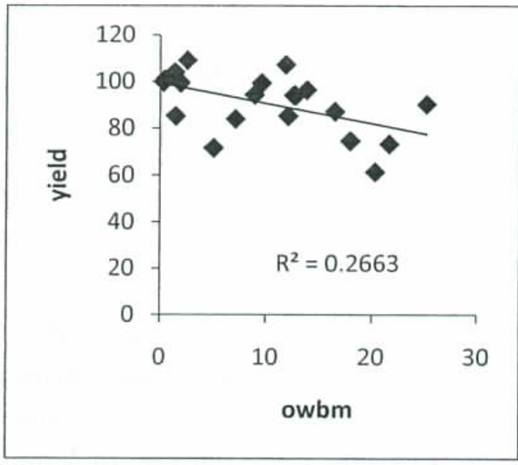
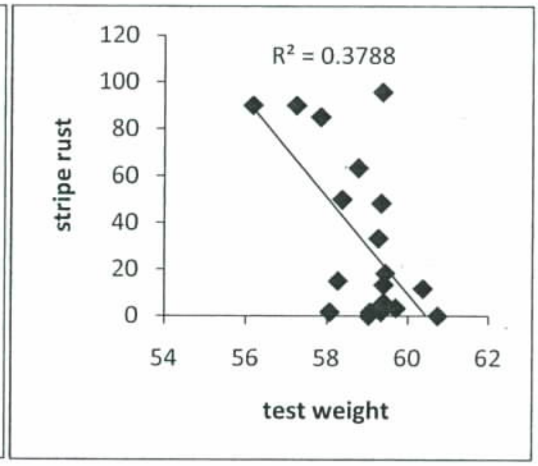


Figure 2. Effect of stripe rust on test weight.



Yields were exceptional and averaged 90 bu/A. Yields ranged from a high of 108 bu/A for Volt to a low of 61 bu/A for Thatcher. Yield potential was affected, to varying degrees, by damage attributed to the midge, stripe rust, and septoria. As such there was no clear association between any of these pests and yield. Test weights were lower than normal and averaged 58.93 lb/bu. Test weights ranged from a high of 60.73 lb/bu for Volt to a low of 56.17 lb/bu for Hank. As previously mentioned, test weights were most strongly associated with percent green leaf area and stripe rust infection. Protein averaged 14.59 percent and ranged from a high of 15.2 for Reeder, Outlook, and McNeal, to a low of 13.5 percent for Volt.

Table 1. Agronomic data from the spring wheat AYT off-station subset. Kalispell, MT. 2010

Variety	Yield	Test weight	Protein	owbm[1]	Heading	Height	Stripe rust	Septoria	Green leaf area
	bu/A	lb/bu	%	No/spike	Julian	inches	%	%	%
Volt	108.92	60.73	13.50	2.56	182.33	36.22	0.00	6.67	91.67
Jenna	107.11	58.27	14.10	11.89	184.00	36.22	15.00	13.33	80.00
Reeder	103.81	60.37	15.20	1.33	180.33	39.37	11.67	10.00	86.67
Brennan	100.79	59.33	14.70	0.44	179.67	32.28	1.67	13.33	86.67
AP604 CL	99.51	59.37	13.70	0.33	180.00	38.98	95.67	0.00	5.00
Kelby	99.27	59.37	15.10	1.89	179.33	33.20	5.00	15.00	81.67
Vida	99.20	59.40	15.00	9.56	181.33	38.71	13.33	8.33	83.33
Corbin	96.23	59.27	14.20	13.89	180.33	37.53	33.33	26.67	53.33
Choteau	94.24	59.03	15.00	8.89	181.33	36.22	0.00	5.00	90.00
Freyr	94.13	59.70	14.70	12.67	180.67	39.24	3.33	10.00	88.33
Kuntz	93.93	59.43	14.50	12.78	181.33	34.12	5.00	8.33	85.00
Hank	90.16	56.17	15.10	25.22	180.33	35.17	90.00	5.00	6.67
Outlook	87.02	58.07	15.20	16.55	184.00	39.24	1.67	8.33	90.67
McNeal	85.09	59.43	15.20	12.11	184.00	41.08	18.33	8.33	81.67
Fortuna	85.08	59.07	14.40	1.44	181.67	45.14	1.67	25.00	66.67
Mott	83.79	58.77	14.50	7.11	186.33	42.65	63.33	18.33	25.00
Conan	74.47	59.33	14.40	18.00	181.00	36.75	48.33	11.67	50.00
Jedd	73.17	57.23	13.70	21.67	180.33	30.84	90.00	16.67	8.33
Oneal	71.51	57.83	14.80	5.00	182.67	36.75	85.00	11.67	11.67
Thatcher	61.30	58.37	14.80	20.33	186.33	49.61	50.00	16.67	40.00
MIN	61.30	56.17	13.50	0.33	179.33	30.84	0.00	0.00	5.00
MAX	108.92	60.73	15.20	25.22	186.33	49.61	95.67	26.67	91.67
MEAN	90.44	58.93	14.59	10.18	181.87	37.97	31.62	11.92	60.62
LSD (P=.05)	10.79	0.66	NA	14.96	1.42	2.21	12.2	9.96	14.02
CV	7.21	0.68	NA	88.89	0.47	3.52	23.35	50.58	13.99
TRT (Pr >F)	0.0001	0.0001	NA	0.0230	0.0001	0.0001	0.0001	0.0005	0.0001

[1] owbm: orange wheat blossom midge. Planted April 23, harvested September 29.

Project Title: Evaluation of experimental lines containing the Sm1 gene for antibiosis against the Orange Wheat Blossom Midge (owbm)

Objectives: To verify the presence of the Sm1 gene and to evaluate the agronomic performance of experimental lines of spring wheat

Materials and Methods:

Experimental materials derived from crosses between a Sm1 line from North Dakota and several Montana spring wheat varieties and advanced lines were evaluated for resistance to the owbm as well as for agronomic performance. Several commercial varieties also were included for comparison.

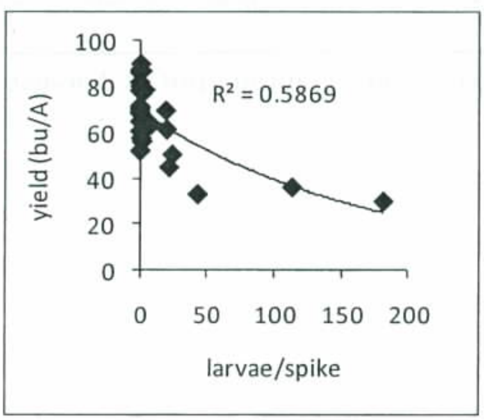
This study was established in a field which had been in spring wheat for the previous five years and had a history of moderate to high midge densities. The study was conducted using conventional tillage and was fertilized with 97-30-120-24 lb/A of N-P-K-S. Treatments were seeded at a rate of 75 lb/A in six inch wide rows, to a depth of two inches on May 7, 2010. Individual treatments consisted of seven, 15 foot long rows, with each treatment replicated three times in a randomized complete block design.

Heading was recorded when 50 percent of the plants in a plot had half the spike exposed. Plant height measurements and foliar disease ratings were taken the first week of August. The latter included stripe rust and septoria. Percent green leaf area was also recorded at this time. Three spikes were sampled from each plot on August 9. Each spike was dissected and the number of larvae and seeds counted. Stem samples also were taken to assess stem solidness on a scale of 5 (hollow) to 25 (solid). Plots were harvested on September 14 to determine grain yield, protein, test weight, and polyphenol oxidase (PPO).

Results:

Yields averaged 66 bu/A, and ranged from a high of 89 bu/A for CAP339-1 to a low of 30 bu/A for Hank (Table 1). Wheat yields were affected by midge densities, with yields declining exponentially as larvae numbers increased (Figure 1). The highest larvae densities, and the lowest grain yields, were observed

Figure 1. Effect of owbm density on yield.



with the commercial varieties Choteau, Vida and Hank. In contrast, incorporation of the Sm1 gene greatly reduced owbm densities, benefiting yields in the process. While the non-attractive spring wheat Reeder had larval numbers typical of this variety, the relative yield ranking was lower than normal. At a minimum this response demonstrates that several experimental lines not only have a much lower incidence of midge as compared to Reeder, but have superior yield potential as well.

Yields were also negatively affected by the foliar diseases, stripe rust and septoria. Septoria was wide spread throughout the nursery. Infection levels averaged 23 percent and ranged from a low of 10 to a high of 38 percent. Stripe rust was less of a problem and most entries expressed high levels of resistance. Infection levels averaged 13 percent and ranged from 0 to 65 percent. CAP82-3, CAP577-1, and Hank had the highest incidence of stripe rust. While foliar diseases were prevalent, the impact on yield was less relative to the owbm.

As yields increased, protein levels decreased, but test weights increased. Protein averaged 13.91 percent, ranging from a low of 11.87 for CAP 197-1 to a high of 16.20 for Vida. Protein content tended to increase as midge numbers increased. Test weights were lower than normal, and averaged 58.40 lb/bu. CAP523-3 had the lowest test weight at 54.63 lb/bu, while CAP289-2 had the highest test weight at 60.40 lb/bu. Polyphenol oxidase levels ranged from a low of 0.7041 to a high of 1.1485.

The average heading date for the nursery was 186 (July 5), with the earliest and latest dates being 184 and 189 respectively. Yields tended to decrease as heading was delayed, but the effect was minimal. Plant height averaged 38 inches and ranged from a low of 35.43 for CAP151-3 to a high of 40.94 for Vida. Stem solidness varied greatly among the entries ranging from a low of 7.27 for CAP281-2 to a high of 22.87 for CAP73-1. Plant height and stem solidness were marginally correlated to PPO levels. As plant height increased, so too did PPO levels. In contrast, stem solidness decreased as PPO levels increased.

Overall, these preliminary results demonstrate that there are several high yielding experimental lines that have resistance to the midge as well as stripe rust and septoria, while also possessing excellent quality attributes. In particular, CAP151-3 is a short, early heading, solid stem line that has excellent insect and disease resistance, high protein, and very good yield potential.

Table 1. Evaluation of experimental spring wheat lines for resistance to the orange wheat blossom midge. Kalispell, 2010.

entry	ID	Yield Bu/A	Protein %	Test weight lb/bu	PPO	OWBM no/spike	Stripe rust %	Septoria %	Green leaf area %	Heading Julian	Height inches	Stem solidness 5 to 25
22	CAP339-1	89.60	14.33	59.10	1.0549	0.78	15.00	20.00	78.33	184.33	39.89	11.67
13	CAP201-2	86.86	13.20	59.33	1.0406	0.11	13.33	31.67	66.67	185.00	39.76	16.93
15	CAP219-2	86.49	12.40	59.23	1.0227	1.67	11.67	21.67	65.00	185.33	38.32	16.73
11	CAP197-3	85.99	12.07	59.17	0.9287	0.00	3.33	18.33	76.67	188.33	39.24	14.87
8	CAP151-3	81.67	14.77	59.30	0.8756	0.00	0.00	10.00	86.67	185.00	35.43	19.53
5	CAP84-1	79.92	13.93	58.97	1.0082	0.33	21.67	26.67	60.00	184.67	40.55	16.73
14	CAP219-1	78.36	12.70	59.23	1.0066	1.56	15.00	23.33	66.67	185.33	39.63	13.53
10	CAP197-1	78.25	11.87	59.83	1.0699	3.89	5.00	18.33	70.00	187.67	39.63	14.20
1	CAP34-1	78.08	12.93	59.13	0.7896	0.00	0.00	18.33	78.33	186.33	36.48	22.47
16	CAP219-3	76.85	12.57	59.33	0.8563	1.89	8.33	23.33	61.67	186.33	37.80	13.00
18	CAP281-2	71.32	13.30	59.00	1.1032	0.00	13.33	21.67	53.33	185.00	37.80	7.27
21	CAP311-2	70.75	14.97	58.20	0.8834	0.33	6.67	30.00	61.67	185.67	38.71	16.20
17	CAP277-1	70.02	14.20	59.50	1.0812	0.00	1.67	23.33	65.00	187.33	40.16	13.07
24	CAP401-2	69.25	13.70	59.47	0.8379	19.44	0.00	20.00	61.67	184.67	35.70	8.65
7	CAP108-3	68.97	13.43	58.43	0.7768	0.22	0.00	33.33	58.33	186.67	38.06	22.33
12	CAP201-1	68.21	12.20	59.47	1.1485	0.00	16.67	38.33	51.67	185.67	40.68	16.87
6	CAP84-2	68.17	12.90	59.37	0.8515	0.22	10.00	18.33	53.33	185.00	38.58	17.73
23	CAP400-1	65.56	14.33	57.83	0.9075	4.22	0.00	23.33	60.00	189.00	38.06	8.13
25	CAP523-3	64.59	16.00	54.63	0.8320	0.22	0.00	21.67	60.00	187.67	36.75	20.47
20	CAP289-2	63.13	14.90	60.40	1.0615	8.34	26.67	26.67	66.67	185.00	40.03	12.13
27	CAP577-1	62.14	13.57	55.63	0.9542	4.33	63.33	21.67	33.33	185.67	37.14	13.80
28	REEDER	61.10	14.87	59.70	0.9414	19.89	3.33	13.33	86.67	186.67	40.16	8.40
9	CAP172-2	60.53	13.20	58.40	0.9840	0.11	0.00	35.00	58.33	185.67	37.80	20.47
2	CAP73-1	57.48	13.83	59.23	0.7041	1.00	0.00	23.33	78.33	186.00	38.58	22.87
26	CAP548-2	55.96	13.17	57.20	0.8032	1.67	46.67	33.33	30.00	188.33	38.85	9.07
3	CAP82-3	51.95	13.47	59.00	0.7356	0.33	65.00	25.00	23.33	186.33	37.80	21.53
4	CAP83-3	50.32	15.40	56.07	0.8481	24.33	3.33	15.00	71.67	185.67	38.45	20.40
19	CAP284-1	44.80	16.13	56.60	1.1254	21.78	13.33	20.00	71.67	186.00	38.32	9.53

Table 1. Continued.

entry	ID	Yield Bu/A	Protein %	Test weight lb/bu	PPO	OWBM no/spike	Stripe rust %	Septoria %	Green leaf area %	Heading Julian	Height inches	Stem solidness 5 to 25
29	CHOTEAU	36.15	16.10	56.20	0.8713	113.22	0.00	21.67	68.33	186.00	38.45	21.80
31	VIDA	33.14	16.20	57.53	1.0955	43.11	3.33	11.67	91.67	188.33	40.94	12.13
30	HANK	30.06	14.53	55.77	1.0520	181.11	50.00	31.67	23.33	187.00	35.56	10.33
	MIN	30.06	11.87	54.63	0.7041	0.00	0.00	10.00	23.33	184.33	35.43	7.27
	MAX	89.60	16.20	60.40	1.1485	181.11	65.00	38.33	91.67	189.00	40.94	22.87
	MEAN	65.99	13.91	58.40	0.9436	14.65	13.44	23.23	62.53	186.18	38.49	15.25
	LSD (P=0.5)	14.50	1.20	0.58	0.2500	41.48	9.95	12.91	21.74	1.27	2.04	2.24
	CV	13.45	5.29	0.61	16.15	173.40	45.36	34.05	21.29	0.42	3.20	9.01
	TRT (P>F)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0040	0.0001	0.0001	0.0001	0.0001

Project Title: Orange Wheat Blossom Midge Insecticide Trials.

Objective: To evaluate new and established insecticide products for the control of the Orange Wheat Blossom Midge (OWBM).

Material and Methods:

The study was established using conventional tillage practices, in a field with a history of moderate to high midge densities. The previous crop was spring wheat and the site was fertilized with 97-30-120-24 pounds per acre of N-P-K-S. 'Hank' hard red spring wheat was planted in seven inch row spacing's to a depth of 2 inches at 70 lb/A on May 11. Treatments were applied on July 8 when the crop was 85% headed. Treatments were applied to 10 by 15 foot plots with a CO_2 backpack sprayer in 20 GPA using Teejet XR11002 nozzles. Three spikes per plot were randomly collected on August 6. The spikes were dissected in order to determine the number of larvae per spike and the number of larvae per seed. The study was harvested on September 13.

Results:

Midge densities were moderate in this experiment, with the nontreated check averaging 75 larvae per spike and 0.7 larvae per seed (Table 1). All insecticide treatments significantly reduced midge densities relative to the check. However, there were no differences among insecticide treatments. Although midge populations were moderate, the impact on yield was noticeable. Yields ranged from a low of 59 bu/A in the check to a high of 90 bu/A for Warrior II. All insecticide treatments improved yield relative to the check. In addition, Warrior II produced higher yields than Lorsban. Seed protein levels were highest in the check, owing to the feeding damage caused by the midge and the associated reduction in starch content. Likewise, feeding damage impacted falling numbers (FN) and sprout damage. The check had the lowest falling numbers and the highest percent sprout. All insecticide treatments improved falling number values and percent sprout relative to the check plot, but there were no statistical difference among the insecticide treatments.

Table 1. Control of the Orange Wheat Blossom Midge with insecticides. Kalispell, MT 2010.

Treatment	Rate		OWBM no/spike	OWBM no/seed	TWT lb/bu	Yield bu/A	Protein %	FN sec.	Sprout %
Check			75.22	0.70	57.30	59.30	14.60	320.30	1.50
Endigo	4.5	oz/a	14.78	0.15	58.10	85.20	12.17	418.30	0.27
COC	1.0	% v/v							
Warrior II	1.9	oz/a	31.22	0.29	58.27	90.70	12.63	403.00	0.37
COC	1.0	% v/v							
Cobalt	13.0	oz/a	18.56	0.18	58.77	87.00	11.83	401.00	0.63
COC	1.0	% v/v							
Lorsban	16.0	oz/a	20.44	0.19	58.13	79.30	11.73	382.70	0.43
Endigo	3.5	oz/a	40.67	0.37	58.63	88.20	12.53	416.00	0.63
COC	1.0	% v/v							
MIN			14.78	0.15	57.30	59.30	11.73	320.30	0.27
MAX			75.22	0.70	58.77	90.70	14.60	418.30	1.50
MEAN			33.48	0.31	58.20	81.62	12.58	390.22	0.64
LSD (P=.05)			31.67	0.28	0.92	11.21	1.82	40.99	0.44
CV			52.00	48.93	0.87	7.55	7.92	5.77	37.88
Treatment Prob(F)			0.0146	0.0119	0.0572	0.001	0.0494	0.0030	0.0011

Project Title: Evaluation of Herbicides for Broadleaf Weed Control in Spring Wheat

Objective: To evaluate the effects of herbicides and rates on broadleaf weed control and spring wheat tolerance and yield.

Materials and Methods:

Several new products have recently been introduced for the control of broadleaf weeds. The purpose of this study was to evaluate newly release herbicides and standard products for the control of common broadleaf weeds and for crop tolerance. The experiment consisted of 10 different herbicides applied in various combinations for a total of 14 herbicide treatments. Two non-treated checks were also included. The experimental design was a randomized complete block with three replications.

The field had previously been in peas and was fertilized with 97-30-120-24. Volt spring wheat was planted on April 22 at 70 lb/A, to a depth of two inches on seven inch row spacing's. Herbicide treatments were applied on May 25 when the majority of weeds were 1 to 2 inches tall. Treatments were applied in 20 GPA with a CO_2 backpack sprayer equipped with Teejet XR11002 nozzles. Weed pressure was extensive, with the dominate species consisting of common lambsquarters, wild buckwheat, common chickweed, and white cockle. Discover was applied on June 2 for the control of wild oats. Treatments were evaluated for crop injury at one and three weeks after application, while weed control was assessed at three and seven weeks after application. Spring wheat test weight and yield were determined on September 15.

Results

Wolverine caused some minor crop injury, otherwise crop tolerance was excellent (Table 1). Most treatments did an excellent job of controlling lambsquarters and wild buckwheat. All treatments provided greater than 90 percent control of lambsquarters, except for Pulsar and Goldsky. Chickweed and white cockle were more difficult to control (Table 2). This was especially true for the plant growth regulator products Widematch and Pulsar. The remaining products did an excellent job controlling the entire weed complex. Yields were phenomenal and ranged from a low of 62 bu/A to a high of 113 bu/A. There were no significant yield differences among the herbicide treatments.

Table 1. Effect of broadleaf herbicides on crop injury and weed control. Kalispell, MT 2010.

Treatment	Rate		Heading	Percent Crop Injury		Percent Control			
						Lambsquarters		Wild Buckwheat	
			Julian	1-Jun	18-Jun	18-Jun	13-Jul	18-Jun	13-Jul
Untreated			184	0	0	0	0	0	0
Untreated			187	0	0	0	0	0	0
Widematch	0.75	PT/A	186	0	0	99	99	98	99
MCPA Ester	0.50	PT/A							
Widematch	1.00	PT/A	187	0	0	99	99	99	99
MCPA Ester	0.50	PT/A							
Pulsar	8.30	OZ/A	187	3	0	99	99	99	98
MCPA Ester	0.50	PT/A							
NIS	0.25	% V/V							
Pulsar	12.50	OZ/A	186	0	0	86	93	98	99
Goldsky	16.00	OZ/A	187	0	0	79	88	98	99
NIS	0.25	% V/V							
Orion	17.00	OZ/A	187	0	0	98	99	98	99
Orion	17.00	OZ/A	187	0	0	99	99	99	99
Starane	0.33	PT/A							
Wolverine	27.40	OZ/A	187	12	0	99	99	99	99
Huskie	11.00	OZ/A	187	0	0	99	99	98	98
Axial XL	16.00	OZ/A							
Huskie	11.00	OZ/A	186	0	0	99	99	98	99
AMS	0.50	LB/A							
Huskie	13.50	OZ/A	187	0	0	99	99	98	99
AMS	0.50	LB/A							
Huskie	15.00	OZ/A	187	0	0	99	99	98	99
AMS	0.50	LB/A							

Table 1. Continued

Treatment	Rate		Heading	Percent Crop Injury		Percent Control			
						Lambsquarters		Wild Buckwheat	
			Julian	1-Jun	18-Jun	18-Jun	13-Jul	18-Jun	13-Jul
Huskie	13.50	OZ/A	187	0	0	99	99	99	99
AMS	0.50	LB/A							
NIS	0.25	% V/V							
Huskie	11.00	OZ/A	188	0	0	99	99	98	99
AMS	0.50	LB/A							
MCPA	0.50	PT/A							
Affinity TM	0.60	OZ /A	189	0	0	98	99	98	99
Starane	0.33	PT/A							
NIS	0.25	% V/V							
MIN			184.3	0	0	0	0	0	0
MAX			188.7	12	0	99	99	99	99
MEAN			186.86	1	0	85	86	87	87
LSD (P=.05)			1.67	4.72	0.00	9.32	5.44	1.87	1.28
CV			0.53	321.00	0.00	6.55	3.77	1.29	0.88
Treatment Prob(F)			0.0097	0.0029	1.0000	0.0001	0.0001	0.0001	0.0001

Table 2. Effect of broadleaf herbicides on weed control and yield. Kalispell, MT 2010.

			Percent Control				Test	
			Chickweed		White Cockle		weight	Yield
Treatment	Rate		18-Jun	13-Jul	18-Jun	13-Jul	lb/Bu	Bu/A
Untreated			0	0	0	0	57.2	73.2
Untreated			0	0	0	0	60.5	62.1
Widematch	0.75	PT/A	42	62	58	53	61.8	113.2
MCPA Ester	0.50	PT/A						
Widematch	1.00	PT/A	50	66	50	53	62.0	112.7
MCPA Ester	0.50	PT/A						
Pulsar	8.30	OZ/A	47	60	50	27	61.3	108.6
MCPA Ester	0.50	PT/A						
NIS	0.25	% V/V						
Pulsar	12.50	OZ/A	33	43	33	66	61.9	111.5
Goldsky	16.00	OZ/A	99	99	99	99	62.0	110.0
NIS	0.25	% V/V						
Orion	17.00	OZ/A	99	99	99	99	62.3	110.8
Orion	17.00	OZ/A	99	99	97	99	61.9	95.5
Starane	0.33	PT/A						
Wolverine	27.40	OZ/A	90	86	90	86	61.8	110.0
Huskie	11.00	OZ/A	88	65	96	99	61.8	110.5
Axial	16.00	OZ/A						
Huskie	11.00	OZ/A	93	99	97	99	61.5	105.2
AMS	0.50	LB/A						
Huskie	13.50	OZ/A	94	96	97	96	61.7	106.7
AMS	0.50	LB/A						
Huskie	15.00	OZ/A	87	83	96	96	61.6	104.0
AMS	0.50	LB/A						

Table 2. Continued

Treatment	Rate		Percent Control: Chickweed 18-Jun	Percent Control: Chickweed 13-Jul	Percent Control: White Cockle 18-Jun	Percent Control: White Cockle 13-Jul	Test Weight lb/Bu	Yield Bu/A
Huskie	13.50	OZ/A	95	99	98	99	61.6	101.9
AMS	0.50	LB/A						
NIS	0.25	% V/V						
Huskie	11.00	OZ/A	91	83	95	94	62.3	110.3
AMS	0.50	LB/A						
MCPA	0.50	PT/A						
Affinity TM	0.60	OZ /A	99	99	98	99	61.5	100.4
Starane	0.33	PT/A						
NIS	0.25	% V/V						
MIN			0	0	0	0	57.23	62.053
MAX			99	99	99	99	62.27	113.2
MEAN			71	73	74	74	61.452	102.74
LSD (P=.05)			21.07	50.04	14.41	29.57	1.80	20.50
CV			17.82	41.22	11.73	23.83	1.76	11.97
Treatment Prob(F)			0.0001	0.0012	0.0001	0.0001	0.0016	0.0004

Project Title: Wild Oat Herbicide Screening Trial

Objective: To evaluate the effects of herbicides and application rates on wild oat control and spring wheat yield.

Materials and Methods:

Eight herbicides were applied at their respective 1X and 1/3X rates to evaluate the consistency of wild oat control in spring wheat. In addition, Rimfire Max plus Huskie was applied to compare adjuvant effects on crop tolerance and efficacy. The experimental design was a randomized complete block with three replications. 'Volt' hard red spring wheat was planted on seven inch row spacing's, to a depth of two inches on April 22, at a rate of 70 lb/A. Wild oat was seeded in the center of each plot at a density of 16 seeds per square foot on April 26. Broadleaf weeds were controlled with 11 oz/A of Huskie applied post emergence on May 26. The herbicide treatments were applied on June 1, using a CO_2 backpack sprayer with Teejet XR11002 nozzles in 20 GPA of water. Spring wheat and wild oat plants were at the 5- and 3-leaf stage, respectively, at the time of application. Crop injury was evaluated at one, three, and seven week after application, while wild oat control was determined at three and seven weeks after application. Spring wheat yield and test weight were determined on August 27.

Results:

Minor crop injury was observed with Silverado and Rimfire regardless of the rate applied. Crop injury also was observed with Goldsky applied at the 1Xrate. However, symptoms diminished by three weeks after application (table 1). All herbicides evaluated provided 90% wild oat control or greater when applied at their respective 1X rates. Further, all herbicides also provided commercially acceptable wild oat control (>80%) when applied at 1/3X rates. Indeed, Axial, Everest, Goldsky, Silverado and Rimfire afforded greater than 90% control when applied at 1/3X rates. Abundant rainfall benefited spring wheat and minimized wild oat competitive effects on crop yield.

Summary:

Overall, herbicide performance during 2010 was excellent with all herbicides when applied at labeled rates.

Table 1. Effects of wild oat herbicides and use rates on crop injury, wild oat control, and yield.

Treatment	Rate		Percent Crop Injury			Percent Wild Oat Control		Test Weight	Yield
			9-Jun	25-Jun	20-Jul	25-Jun	20-Jul	lb/bu	bu/A
Untreated			0	0	0	0	0	62.9	83.9
Untreated			0	0	0	0	0	63.9	79.5
Achieve Supercharge	6.9	oz/a	0	0	0	98	99	64.4	103.6
Achieve Supercharge	2.3	oz/a	0	0	0	96	88	64.3	102.3
Axial XL	16.2	oz/a	0	0	0	99	99	64.4	97.2
Axial XL	5.4	oz/a	0	0	0	98	94	64.7	106.4
Discover NG	12.8	oz/a	0	3	0	96	99	64.6	95.9
Discover NG	4.28	oz/a	3	0	0	98	86	64.6	109.0
Everest NIS	0.6	oz/a	0	7	0	93	92	64.5	99.0
Everest NIS	0.2	oz/a	0	0	0	96	94	64.7	93.4
Goldsky AMS NIS	1 1.5	pt/a lb/a	12	3	0	95	95	64.4	93.7
Goldsky AMS NIS	0.33 1.5	pt/a lb/a	8	0	0	95	92	64.5	105.1
Hoelon COC	2 1.5	pt/a pt/a	7	0	0	98	93	64.5	94.2
Hoelon COC	0.67 1.5	pt/a pt/a	7	0	0	93	81	64.4	99.5

Table 1. Continued

Treatment	Rate		Percent Crop Injury 9-Jun	Percent Crop Injury 25-Jun	Percent Crop Injury 20-Jul	Percent Wild Oat Control 25-Jun	Percent Wild Oat Control 20-Jul	Test Weight lb/bu	Yield bu/A
Puma	10.6	oz/a	3	3	0	98	99	64.4	96.2
Puma	3.53	oz/a	7	0	0	97	86	64.5	98.4
Silverado	2.25	oz/a	10	2	0	98	99	64.4	103.1
MSO	1.5	pt/a							
UAN	1	qt/a							
Silverado	0.75	oz/a	10	0	0	96	95	64.5	95.3
MSO	1.5	pt/a							
UAN	1	qt/a							
Wolverine	27.4	oz/a	0	0	0	99	96	64.6	102.4
Wolverine	9.13	oz/a	3	0	0	98	85	64.8	101.3
Rimfire Max	3	oz /a	12	2	0	96	96	64.5	98.6
Huskie	11	oz/a							
Quad 7	1	% v/v							
Rimfire Max	3	oz a	12	0	0	93	96	64.3	98.5
Huskie	11	oz/a							
MSO	1.3	% v/v							
MIN			0	0	0	0	0	62.9	79.5
MAX			11.7	6.7	0	99	99	64.8	109.0
MEAN			4.2	0.9	0	87.7	84.8	64.4	98.0
LSD (0.05)			4.61	5.03	0	5.11	8.2	0.6	14.5
CV			65.8	335.59	0	3.53	5.86	0.5	9.0
Treatment Prob (F)			0.0001	0.4832	1	0.0001	0.0001	0.0001	0.0557

Project Title:	Plant Growth Regulator Effects on Spring Wheat Height and Agronomic Performance.
Objective:	To determine the effect of spring wheat growth stage on the activity of Cerone and Palisade plant growth regulators.

Materials and Methods:

This study was conducted in a field which had been in alfalfa for the past four years and was fertilized with 27-30-120-24 lb/A of N-P-K-S. 'Scholar' spring wheat was planted into a conventionally tilled seed bed on April 19. The seed was planted two inches deep, on six inch row spacing's, at a rate of 75 lb/A.

The factorial experiment consisted of two plant growth regulators (PGR's) applied at four growth stages. Cerone and Palisade plant growth regulators were applied at 0.109 lb ai/A and 0.250 lb ai/A , respectively, in 20 GPA using a backpack sprayer equipped with Teejet XR11002 nozzles. Applications were made to spring wheat at jointing, flag leaf, booting, and heading stages of development (Table 1). The experimental design was a randomized complete block, with three replications.

Table 1. Application information.

Growth stage	Jointing	Flag leaf	Booting	Heading
Zadoks scale	31	39	45	55
Application date	7-Jun	22-Jun	26-Jun	28-Jun
Air temperature (F)	72	78	57	89
Soil temperature (F)	64	72	60	81
Relative humidity (%)	47	65	90	30

Results:

Both compounds reduced wheat height when applied at flag leaf and boot growth stages, with the greatest height reduction being observed with applications made at the flag leaf stage. At the same time, there was a delay in heading when either product was applied at flag leaf. In addition, Palisade caused a slight delay in heading when applied at jointing. Yield was not affect by either product, regardless of application timing. Similar results were observed for thousand kernel weights (TKW). There was a trend ($p=0.064$) for increased test weights when Palisade was applied at the last two stages of growth. Overall, both compounds reduced wheat height without adversely impacting grain yield or quality in the absence of lodging pressuer.

Table 2. Spring wheat response to plant growth regulators. Kalispell, MT 2010.

Treatment	Timing	Heading (Jualian)	Height (inches)	Yield (bu/A)	TWT (lb/bu)	TKW (g)
check		178.70	36.60	75.30	62.70	39.28
Palisade	Jointing	180.00	36.60	71.10	63.07	39.03
Palisade	Flag leaf	181.00	30.60	70.60	62.97	37.77
Palisade	Booting	179.00	33.10	76.60	63.20	39.29
Palisade	Heading	178.30	34.80	80.70	63.33	40.11
check		179.00	37.40	75.00	62.73	38.86
Cerone	Jointing	179.30	37.90	71.40	62.63	38.82
Cerone	Flag leaf	180.00	33.30	81.20	62.93	39.84
Cerone	Booting	179.30	34.10	79.90	63.00	39.15
Cerone	Heading	178.30	36.00	80.10	62.93	40.34
MIN		178.30	30.60	70.60	62.63	37.77
MAX		181.00	37.90	81.20	63.33	40.34
MEAN		179.29	35.04	76.19	62.95	39.25
LSD (P=.05)		1.18	2.14	9.08	0.43	1.82
CV		0.38	3.56	6.95	0.40	2.70
TRT Prob>F		0.0035	0.0001	0.127	0.0643	0.2429

Palisade was applied at 7 oz/A. Cerone was applied at 8 oz/A.

Project Title: Evaluation of Clearfield Winter Wheat Cultivars for Herbicide Tolerance

Objectives: To evaluate experimental lines for herbicide tolerance and agronomic performance in environments and cropping systems representative of northwestern Montana.

Materials and Methods:

A preplant application of 30-30-60 was applied on September 23, 2009. Treatments were seeded 1.5 inches deep on September 24 at a rate of 80 lb/A. Individual plots consisted of seven, 6-inch wide rows, 15 feet in length, with each variety replicated 3 times in a randomized complete block design. A topdress application of nitrogen was applied as urea at 70 lb/A on April 12, 2010. Beyond was applied at the 2X rate (12 oz/A) with MSO in 20 GPA of water on April 21 using a tractor mounted sprayer equipped with Tee Jet 11022 nozzles. Herbicide injury ratings were recorded at 3 and 4 weeks after treatment. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Height measurements and lodging were recorded near maturity. Varieties were evaluated for stripe rust on July 15. The study was harvested August 25. Grain yield, test weight, moisture, and grain protein were then determined.

Results:

All entries demonstrated excellent tolerance to Beyond when applied at the 2X rate (Table 1). Initial injury ratings ranged from 0 to 10 percent. However, these symptoms had completely dissipated by 4 weeks after treatment. The average heading date for the nursery was 161 (June 10). Varieties BZ9WM07-1527 and BZ9WM07-1555 had the earliest (157) and MTCL1002 had the latest (167) heading dates. Plant heights averaged 36.9 inches and ranged from a low of 30 inches for BZ9WMO7-1516 to a high of 40.9 inches for BZ9WM07-1546. Lodging was minor, with MTCL1076 (30%) being the most adversely affected. Stripe rust was detected in the nursery with BZ9WM07-1516 (72%), MTCL1073 (58%), MTCL1074 (58%) being highly susceptible. Yields averaged 127 Bu/A, and ranged from a high of 162 Bu/A for AP503CL2 to a low of 89 Bu/A for BZ9WM07-1516. Protein content averaged 13 % and ranged from a high of 14.4 % for BZ9WM07-1553 to a low of 11.8 % for MTCL1073. Test weights averaged 61.1 lb/Bu, and range from 59.5 lb/Bu for MTCL1074 to 63.6 lb/Bu for AP503CL2.

Table 1. Agronomic data from the clearfield winter wheat nursery grown at Kalispell, MT 2010.

	Yield	Protein	TWT	Heading	Height	Lodging	Crop Injury 12-May	Crop Injury 18-May	Stripe Rust
Cultivar	Bu/A	%	lb/Bu	Julian	Inches	%	%	%	%
AP503CL2	162.4	13.2	63.6	162.5	36.4	3	0	0	0
MTCL1077	157.1	12.5	61.0	159.3	38.2	17	3	0	0
MTCL1076	147.9	11.9	61.2	163.3	40.7	30	3	0	0
BZ9WM07-1515	145.4	13.1	61.8	163.3	37.3	0	3	0	2
MTCL1075	141.4	12.4	61.6	165.3	39.4	0	10	0	2
BZ9WM07-1563	137.3	13.7	61.9	159.0	39.0	0	0	0	0
MTCL1071	137.0	13.0	60.1	166.3	34.6	17	3	0	20
MTCL1002	133.6	12.6	61.5	167.3	34.8	5	0	0	35
MTCL1072	131.7	11.9	60.5	163.0	39.2	0	0	0	35
BZ9WM07-1546	129.8	12.9	61.3	160.7	40.9	0	3	0	5
BZ9WM07-1527	124.8	14.0	61.5	157.3	37.4	22	0	0	18
BZ9WM07-1555	121.8	14.4	61.6	157.3	36.0	0	0	0	2
BZ9WM07-1545	120.8	13.2	61.2	161.5	38.6	0	0	0	5
MTCL1005	120.2	13.4	60.7	161.0	38.2	3	7	0	0
BZ9WM07-1526	118.2	13.8	61.9	160.7	37.9	0	0	0	23
MTCL1073	117.0	11.8	60.3	162.3	31.6	0	0	0	58
MTCL1074	113.0	11.9	59.5	160.3	34.3	0	0	0	58
BZ9WM07-1513	110.5	13.9	60.4	159.7	37.4	0	0	0	38
BZ9WM07-1538	108.3	12.6	61.1	158.3	34.4	0	5	0	40
BZ9WM07-1553	99.1	14.4	61.1	159.3	37.8	0	3	0	2
BZ9WM07-1516	89.2	12.7	59.7	158.0	30.0	0	0	0	72
MIN	89.2	11.8	59.5	157.3	30.0	0	0	0	0
MAX	162.4	14.4	63.6	167.3	40.9	30	10	0	72
MEAN	127.0	13.0	61.1	161.2	36.9	5	2	0	20
LSD (P=.05)	19.41	NA	1.06	3.39	2.32	30.20	6.78	0.00	32.01
CV	8.97	NA	1.01	1.23	3.68	371.31	190.11	NA	90.46
Trt (Pr>F)	<.0001	NA	<.0001	<.0001	<.0001	0.7653	0.1850	NA	<.0001

Project Title: Intrastate Winter Wheat Variety Performance

Objectives: To evaluate winter wheat varieties and experimental lines for agronomic performance and disease resistance in environments and cropping systems representative of northwestern Montana.

Materials and Methods:

A preplant application of 30-30-60 was applied on September 23, 2009. Treatments were seeded 1.5 inches deep on September 24 at a rate of 80 lb/A. Individual plots consisted of seven, 6-inch wide rows, 15 feet in length, with each entry replicated 3 times in a 7 by 7 lattice experimental design. A topdress application of nitrogen was applied at 70 lb/A on April 12, 2010. A mixture of Discover plus Harmony Extra was applied April 22 for weed control. Heading was recorded when 50 percent of the plants in a plot had half the head exposed. Height measurements were recorded near maturity. Varieties were evaluated for stripe rust on July 15. The study was harvested August 25. Grain yield, test weight, moisture, and grain protein were then determined.

Results:

The average Julian heading date for the nursery was 164 (June 13). Varieties Art and MTS0832 had the earliest (160) and latest (169) heading dates, respectively. Plant heights averaged 42.2 inches, with Carter being the shortest (36.5) and Peregrine being the tallest (42.2). Lodging was severe with several varieties, with the greatest lodging being observed with MTS0705 (60%) and Yellowstone (55%). Stripe rust was detected in 85% of the varieties. MT0890, MT0861, Curlew, Promontory, MTS0808, NI04421 (Robidoux), and MT06103 were resistant, while Decade (75%), MTS0832 (68%), Pryor (68%), Norris (65%), and Rocky (62%) were very susceptible to stripe rust. Yields averaged 142 Bu/A as compared to 86 Bu/A in 2009 and 127 Bu/A in 2008. Yields ranged from a high of 162 Bu/A for MT0871 to a low of 113 Bu/A for Pryor. Test weights averaged 61.9 lb/Bu, and ranged from 57.3 lb/Bu for Pryor to 64 lb/Bu for MT0866. Protein content was normal and averaged 12.3% for the nursery. Protein levels were highest for Bynum (CL) (14.2%) and lowest for MTS0832 (11.2%).

Table 1. Agronomic data from the intrastate winter wheat nursery grown at Kalispell, MT.

Planted: September 24, 2009 Field D2 Harvested: August 25, 2010

Entry	Cultivar	Yield bu/ac	Protein %	Test weight lb/bu	Stripe rust %	Plant height in	Lodging %	Heading date Julian
47	MT0871	162.4	12.1	61.6	7	42.5	0	165.7
2	Yellowstone	162.2	11.7	61.5	2	41.1	55	166.3
39	BZ9W05-2043	161.8	12.1	62.3	5	41.6	0	166.3
48	MT0890	161.2	12.6	62.5	0	42.1	2	164.7
31	MT0861	161.1	12.7	63.1	0	43.3	1	164.7
32	Curlew	158.4	12.5	61.7	0	45.7	8	164.3
9	Promontory	155.7	11.4	63.8	0	39.5	3	164.0
20	Peregrine	155.1	12.0	62.8	3	52.0	0	165.3
42	MTS0819	155.0	12.5	62.2	2	37.4	3	163.0
6	Jagalene	153.4	12.4	63.2	20	40.0	1	162.3
49	MTS0808	153.1	12.6	62.4	0	41.5	2	166.3
30	MTS0721	151.3	12.5	62.6	12	40.7	52	164.6
29	NI04421 (Robidoux)	150.2	11.8	62.1	0	42.5	17	160.7
23	MT06103	149.1	13.5	63.3	0	41.2	0	162.7
28	Settler CL	148.2	12.2	62.9	28	39.5	0	161.7
25	MTS0713	147.8	12.7	62.0	2	39.1	0	164.7
44	MTS0827	146.8	12.8	61.9	13	44.1	0	169.3
26	Radiant	146.6	11.8	62.2	2	43.7	1	166.3
17	MTS04114 (HWW)	145.8	12.8	62.5	3	40.3	15	164.0
34	Art	145.8	12.0	61.7	10	39.5	20	160.0
43	MTS0826	145.3	13.2	61.6	5	45.3	0	169.3
22	AP 503 CL2	144.4	12.5	62.7	2	39.0	1	164.3
27	Overland	143.9	12.2	62.0	35	42.7	3	162.7
16	Hyalite (CL, HWW)	143.3	12.3	63.3	9	43.0	0	162.7
41	MTS0532L	142.5	12.7	62.4	2	39.0	0	164.0
40	MTS04114L	141.9	13.0	62.6	2	42.4	0	165.3
12	Rocky	140.5	11.7	62.4	62	46.3	0	163.0
4	Ledger	139.8	11.4	61.7	23	40.6	7	163.0
3	CDC Falcon	139.5	11.6	62.0	5	40.0	0	164.7
1	Genou	139.5	12.5	62.6	30	44.0	0	165.7
21	Accipiter	138.1	11.7	61.0	10	43.0	0	168.3
11	Norris (CL)	138.0	12.3	63.7	65	44.9	2	162.7
13	Bynum (CL)	136.9	14.2	62.0	5	44.8	0	163.3
46	MT0866	136.5	12.7	64.0	12	43.6	3	165.3
14	Carter	135.5	11.9	61.0	10	36.5	0	164.7
5	Rampart	135.3	13.9	62.2	7	45.1	3	164.0

Table 1. Continued

Planted: September 24, 2009 Field D2 Harvested: August 25, 2010

Entry	Cultivar	Yield bu/ac	Protein %	Test weight lb/bu	Stripe rust %	Plant height in	Lodging %	Heading date Julian
15	Wahoo	135.2	11.7	59.7	32	40.7	0	161.3
38	BZ9W05-2039	133.4	12.6	61.2	47	42.0	22	162.0
24	MTS0705	133.4	13.2	62.4	8	43.8	60	168.3
18	MTS0532 (HWW)	133.1	12.6	61.5	3	40.6	7	165.3
33	Broadview	132.6	11.6	61.0	33	41.2	3	165.0
45	MTS0832	129.4	11.2	59.9	68	45.4	0	169.7
37	CA9W07-817	129.0	12.0	61.6	45	43.6	0	167.0
35	Boomer	128.2	11.7	60.0	25	41.1	3	165.7
19	Decade	127.7	12.1	58.6	75	40.3	0	162.3
10	Neeley	127.7	11.3	61.5	37	46.3	7	166.0
36	Striker	119.2	11.9	61.5	43	37.8	0	165.0
7	Jerry	116.7	11.9	60.6	38	47.6	0	167.0
8	Pryor	113.2	12.4	57.3	68	40.0	10	165.3
	MIN	113.2	11.2	57.3	0.0	36.5	0.0	160.0
	MAX	162.4	14.2	64.0	75.0	52.0	60.0	169.7
	MEAN	142.3	12.3	61.9	19.0	42.2	6.0	164.7
	LSD (0.05)	14.80	NA	1.10	17.00	2.40	25.00	1.60
	CV	6.20	NA	1.00	55.00	3.40	237.00	0.60
	Trt (Pr >F)	0.0001	NA	0.0001	0.0001	0.0001	0.0002	0.0001

Project Title: Downy Brome Control

Objective: To evaluate herbicides for the control of downy brome in winter wheat.

Material and Methods:

Yellowstone hard red winter wheat was planted 2 inches deep, on 7 inch row spacing's, at a rate of 80 lb/A on September 24, 2009. The study was established under dry-land conditions, using conventional tillage, with the land being fallowed during the 2009 growing season. Downy brome was planted in the center of each plot on October 5. Herbicide treatments were applied on April 21, 2010 with a CO_2 backpack sprayer in 20 GPA of water using 11002 flat fan nozzles. Winter wheat and downy brome were 4 and 2 inches tall, respectively. The experiment was established as a completely randomized design with three replications, with each plot measuring 10 by 15 feet.

Results:

All treatments resulted in minor crop injury symptoms which dissipated by 4 weeks after application (Table 1). There were no statistical differences in downy brome control among the herbicides evaluated. That is, Atlantis provided downy brome control comparable to Osprey, Olympus and Powerflex.

Table 1. Effect of downy brome herbicides on crop tolerance and efficacy.

Treatment	Rate		Crop Injury 5/2/2010	Crop Injury 5/18/2010	Downy Brome Control 5/18/2010	Downy Brome Control 6/1/2010
Untreated			0	0	0	0
Atlantis	52.5	g ai/ha	10	0	73	77
MSO	1.17	l/ha				
Atlantis	52.5	g ai/ha	10	0	78	83
MSO	1.754	l/ha				
Atlantis	52.5	g ai/ha	10	0	72	75
NIS	0.5	% v/v				
UAN	4.68	l/ha				
Atlantis	61.8	g ai/ha	10	0	85	92
NIS	0.5	% v/v				
UAN	4.68	l/ha				
Atlantis	52.5	g ai/ha	10	0	73	86
MSO	1.17	l/ha				
Huskie	206.5	g ai/ha				
Osprey	45	g ai/ha	10	0	78	82
NIS	0.5	% v/v				
UAN	4.68	l/ha				
Powerflex	18.39	g ai/ha	10	0	83	83
NIS	0.25	% v/v				
Olympus Flex	49.65	g ai/ha	8	0	83	90
MSO	1.52	l/ha				
MIN			0	0	0	0
MAX			10	0	85	92
MEAN			9	0	70	74
LSD (P=.05)			1.65	0	16.51	18.2
CV			11.06	0	13.82	14.31
Treatment Prob(F)			0.0001	1	0.0001	0.0001

ESSENTIAL OILS

Project Title: Dill tolerance to soil and foliar applied herbicides

Objectives: To evaluate the response of dill to preemergence and postemergence herbicides.

Materials and Methods:

The study was conducted under dryland conditions, using conventional tillage practices, with the previous crop being alfalfa. The soil type was Kalispell very fine sandy loam with a sand, silt, and clay content of 60, 25, and 15 percent, respectively. The soil had a CEC of 15, an organic matter content of 3 percent, and a pH of 7.0. The field was fertilized with 27-30-120-24 lb/A of N-P-K-S on April 2. Dill was seeded 0.25 inches deep on April 20, at a rate of 4 lb/A in six inch wide rows. Preemergence herbicide treatments were applied on April 21. Postemergence treatments were applied on June 7 when the dill seedlings were 1 to 3.5 inches tall. All herbicides were applied with a CO_2 backpack sprayer in 20 GPA of water using 11002 flat fan nozzles. The experiment was established as a randomized complete block with three replications, with each plot measuring 10 by 15 feet.

Treatments were visually rated for percent crop injury on June 25 and July 3, using a scale of 0 (no injury) to 100 (complete injury). Plant density and biomass were determined in each plot by collecting the above ground plant material from two, 1.5 ft^2quadrates on July 27. Plant height and days to flowering also were evaluated in order to further assess crop injury potential. Plots were harvested on August 24. Plots were hand-weeded to prevent weed competition from confounding yield results.

Results:

Crop injury varied from 0 to 67 percent, and generally occurred in the form of plant density reductions and delayed heading (Figures 1 and 2). Prowl, Lorox and Caparol showed the least amount of injury, while Cinch and Facet treatments resulted in more severe injury (Table 1).

Figure 1. Crop injury and plant density.

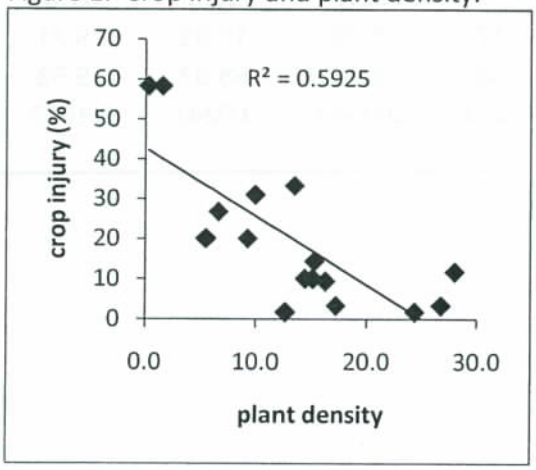
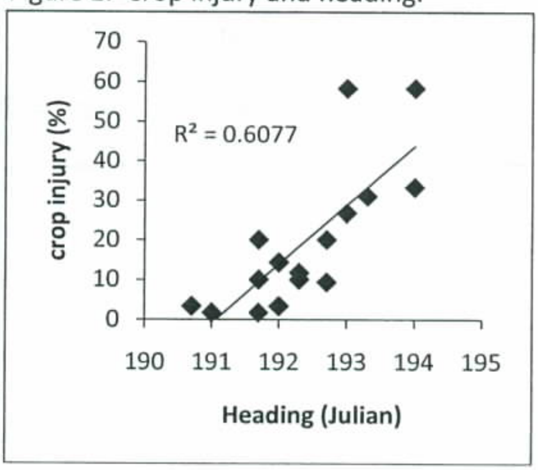


Figure 2. Crop injury and heading.



Herbicide treatment had no significant effect on yield. However, yields tended to decline as the rates of Caparol increased. In sum, all of the herbicides evaluated would appear to have potential for use in dill, especially with respect to the yields obtained. This study should be repeated over a range of different soil types in order to better assess the potential crop tolerance of these materials.

Table 1. Effect of herbicide and rate on dill yield, Kalispell, MT2010.

Herbicide	Rate lb ai/A	Crop Injury (%)		Heading Julian	Height (in)	Density (No./ft2)	Biomass (g/ft2)	Yield lb/A
		25-Jun	3-Jul		2-Aug	27-Jul	27-Jul	24-Aug
check		0	2	191	34.0	24.4	48.3	1970.6
Prowl	0.95	15	10	192	32.7	14.4	29.6	2657.6
Prowl	1.90	18	14	192	34.4	15.3	27.1	2826.3
Prowl	3.80	7	12	192	34.0	28.0	44.1	3069.0
Cinch	0.95	22	27	193	33.2	6.6	32.8	2365.6
Cinch	1.91	30	20	192	34.8	5.5	26.5	2945.6
Cinch	2.86	37	31	193	32.8	9.9	35.9	2501.3
Facet	0.25	32	33	194	33.7	13.4	41.0	2336.8
Facet	0.50	65	58	194	38.7	1.5	14.5	1752.6
Facet	0.75	67	58	193	37.8	0.3	0.7	1888.3
Lorox	0.25	7	2	192	31.9	12.6	34.7	2920.9
Lorox	0.50	10	10	192	33.7	15.1	25.6	3344.7
Lorox	1.00	8	20	193	29.1	9.2	24.6	2361.4
Caparol	0.50	3	3	191	34.0	17.2	43.2	3032.0
Caparol	1.00	0	3	192	30.9	26.7	47.2	2702.9
Caparol	2.00	8	9	193	32.7	16.2	29.1	1489.3
MIN		0	2	191	29.1	0.3	0.7	1489.3
MAX		67	58	194	38.7	28.0	48.3	3344.7
MEAN		21	20	192	33.7	13.5	31.6	2510.3
LSD (P=.05)		15.06	17.74	2.17	4.70	15.42	29.21	1198.66
CV		44.01	54.39	0.68	8.38	68.37	55.53	28.64
TRT (Pr > F)		0.0001	0.0001	0.1242	0.0540	0.0241	0.1638	0.1295

FORAGES

Project Title: 2010 Intrastate Alfalfa Variety Evaluation – Dryland

Project Leader: Heather Mason

Project Personnel: James Thompson

Objective: To evaluate the yield performance of alfalfa varieties in a northwestern Montana dryland environment

Results:

Nine alfalfa cultivars were planted at a rate of 5 lb/ac on May 9, 2008 in a randomized complete block design with four replications. The site was not irrigated and was further characterized as a 'dryland' site due to its sandy loam soil texture. Prior to planting, fertilizer at a rate of 44 lb N/ac, 104 lb P/ac, 120 lb K/ac and 20 lb S/ac was broadcast and incorporated.

In the spring of 2010, stands were well established. All harvests were taken at the full bloom stage of the alfalfa crop. Yields at first harvest (June 29, 2010) were below average at 2.85 t/ac (DM basis). The growing season was wetter than normal, with precipitation from April through July totaling 12.2 inches compared to the 30-year average of 9.2 inches. Growth was slowed due to slightly cooler-than-average (2-4° F lower) temperatures, but DM yield at the second cutting (August 17, 2010) was adequate at 2.07 t/ac. The third and final cutting on November 8, 2010 yielded below average at 0.76 t/ac. Overall 2010 yield averaged 5.69 t/ac, less than the 5.81 t/ac yield seen in 2009.

Since the start of this evaluation in 2008, none of the nine varieties tested have yielded differently from one another, and the same effect was observed in 2010.

Table 1. Stand and yield data from the dryland Intrastate Alfalfa Variety Evaluation, 2010.

Cultivar	MT-ID#	Stand	Harv-1	Harv-2	Harv-3	2010 Total	2009 Total	Total 09-10
		% plot	*t/ac*	*t/ac*	*t/ac*	*t/ac*	*t/ac*	*t/ac*
Rebound 5.0	MT-398	81	2.96	2.24	1.05	6.23	5.99	12.22
DKA43-13	MT-413	95	3.15	2.32	0.95	6.42	5.98	12.40
54V09	MT-414	70	2.63	1.87	0.69	5.19	5.61	10.81
FSG 229CR	MT-415	93	3.34	2.09	0.77	6.20	6.20	12.40
FSG 429SN	MT-416	80	2.66	2.00	0.72	5.38	5.72	11.10
FSG 408DP	MT-417	79	2.75	1.94	0.72	5.41	5.92	11.32
Ladak-65	MT-2	84	2.53	1.88	0.44	4.88	5.16	10.04
Melton	MT-338	84	2.95	2.28	0.76	5.99	6.18	12.17
Shaw	MT-328	75	2.66	2.07	0.76	5.49	5.54	11.03
mean		82	2.85	2.07	0.76	5.69	5.81	11.50
P<F		ns	ns	ns	ns	ns	ns	ns
LSD(0.05)		11.2	0.390	0.244	0.161	0.754	0.690	1.259
CV		19	19.40	16.60	29.70	18.7	16.80	15.49

Future plans: The final year of this evaluation will be in 2011.

Project Title: 2010 Intrastate Alfalfa Variety Evaluation – Irrigated

Project Leader: Heather Mason

Project Personnel: James Thompson

Objective: To evaluate the yield performance of alfalfa varieties in a high-rainfall northwestern Montana environment

Results:

Nine alfalfa cultivars were planted at a rate of 5 lb/ac on May 9, 2008 in a randomized complete block design with four replications. The site was chosen for its clay loam soil with a high water holding capacity, but was not irrigated. Prior to planting, fertilizer at a rate of 44 lb N/ac, 104 lb P/ac, 120 lb K/ac and 20 lb S/ac was broadcast and incorporated.

In the spring of 2010, stands were well established. All harvests were taken at the full bloom stage of the alfalfa crop. Yields at first harvest (June 29, 2010) were below average at 2.81 t/ac (DM basis). The growing season was wetter than normal, with precipitation from April through July totaling 12.2 inches compared to the 30-year average of 9.2 inches. Growth was slowed due to slightly cooler-than-average (2-4° F lower) temperatures, but DM yield at the second cutting (August 17, 2010) was close to average at 2.84 t/ac. The third and final cutting on November 5, 2010 yielded below average at 0.70 t/ac. Overall 2010 yield averaged 6.37 t/ac, higher than the 5.54 t/ac yield seen in 2009.

Since the start of this evaluation in 2008, none of the nine varieties tested have yielded differently from one another, and the same effect was observed in 2010.

Table 1. Stand and yield data from the irrigated Intrastate Alfalfa Variety Evaluation, 2010.

Cultivar	MT-ID#	Stand	Harv-1	Harv-2	Harv-3	2010 Total	2009 Total	Total 09-10
		% plot	*t/ac*	*t/ac*	*t/ac*	*t/ac*	*t/ac*	*t/ac*
Rebound 5.0	MT-398	94	2.70	3.00	0.63	6.27	5.39	11.82
DKA43-13	MT-413	90	2.69	2.47	0.63	5.79	5.40	11.15
54V09	MT-414	91	2.82	2.95	0.72	6.70	5.95	12.57
FSG 229CR	MT-415	93	2.83	3.05	0.82	6.89	5.51	12.43
FSG 429SN	MT-416	89	2.86	3.00	0.73	6.69	5.55	12.25
FSG 408DP	MT-417	94	2.71	2.89	0.76	6.78	5.35	12.19
Ladak-65	MT-2	85	3.10	2.71	0.66	6.46	5.00	11.46
Melton	MT-338	91	2.71	2.80	0.62	6.12	5.68	11.79
Shaw	MT-328	94	2.87	2.98	0.76	6.60	6.02	12.62
mean		91	2.81	2.84	0.70	6.37	5.54	11.87
P<F		ns	ns	ns	ns	ns	ns	ns
LSD(0.05)		7.4	0.683	0.512	0.238	1.273	1.637	1.598

Future plans: The final year of this evaluation will be in 2011.

Project Title: Spring barley-winter wheat relay cropping for forage production in western Montana

Project Leaders: Heather Mason, Northwestern Agricultural Research Center, Kalispell, MT; Malvern Westcott, Western Agricultural Research Center, Corvallis, MT.

Project Personnel: Martha Knox, James Thompson, Brooke Bohannon

Objectives:

i. Compare the forage yield and quality of a spring barley-winter wheat relay intercropping system with spring barley and winter wheat monocrop systems.

ii. Investigate the effect of N fertilizer source (ESN® vs. conventional urea), N rate, and their interactions on forage productivity in intercropping and monocrop systems.

Materials and Methods:

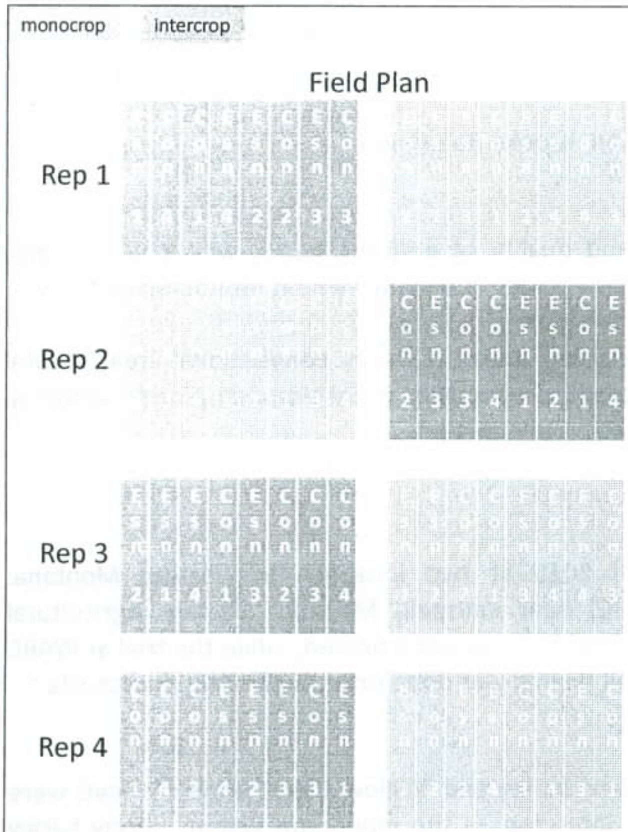
Field experiments were planted in the spring of 2010 at two locations in western Montana: Northwestern Agricultural Research Center (NWARC) near Kalispell, MT and Western Agricultural Research Center (WARC) in Corvallis, MT. The trial at NWARC was not irrigated, while the trial at WARC received irrigation throughout the growing season. Soil testing was done prior to planting at each site.

Northwestern Agricultural Research Center
Two Montana-released cereal forage varieties ('Haybet' barley and 'Willow Creek' winter wheat) were grown separately as monocrops and together as an intercrop. In the monocrop system, spring barley was seeded on May 10, 2010 at a rate of 76 lb/ac and was harvested for estimates of forage yield and quality at the late dough stage (July 27, 2010). Fields were cultivated and winter wheat was planted in late fall (Sept. 29, 2010), at a rate of 52 lb/ac. In 2011, winter wheat will be harvested for hay and tested for forage yield and quality at early dough.

In the intercrop system, spring barley and winter wheat were planted perpendicular to one another in the spring of 2010 (May 10, 2010) at rates of 76 and 52 lb/ac, respectively. The intercrop was harvested for estimates of forage biomass and quality on the same dates as the monocrop was harvested. The remaining winter wheat crop was left in the field to resume growth. There was a chance that the winter wheat would put on enough late season growth to take a second cutting of hay in 2010, but in late September, it was decided that re-growth was not sufficient to justify a second cutting and the winter wheat was left to overwinter. In 2011, the winter wheat will be harvested at the early dough stage and tested for forage yield and quality.

The second objective of this trial was to investigate the effect of N fertilizer source and N rate on the productivity of winter wheat grown in either a monocrop or intercropped situation. On Oct. 1, 2010, half of the winter wheat plots were fertilized with a polymer-coated urea product (ESN® 44-0-0) at four different N levels (0, 75, 150 and 225 lb N/ac total applied N). In the spring of 2011, winter wheat plots that did not receive fall ESN will receive treatments of conventional urea (46-0-0) at the same N levels.

The experimental design is a split-plot with 4 replications, where cropping system (monocrop vs. intercrop) is the main plot factor and N source x N rate are the subplot factors. Data has been subjected to analysis of variance to assess the effect of cropping system on forage productivity. Yield and forage quality parameters will be regressed against N rate to establish fertilizer guidelines for each system.



Field Operations

Season	Monocrop	Intercrop
Spring 2010	• Preplant fert • Plant barley	• Preplant fert • Plant wheat and barley together
Summer 2010	• Cut barley	• Cut barley
Fall 2010	• Plant winter wheat • Broadcast ESN (at rate 1,2,3 or 4) in subplots marked 'esn'	• Allow established winter wheat to continue growing • Broadcast ESN (at rate 1,2,3 or 4) in subplots marked 'esn'
Spring 2011	• Broadcast conventional urea (at rate 1,2,3 or 4) in subplots marked 'con'	• Broadcast conventional urea (at rate 1,2,3 or 4) in subplots marked 'con'
Summer 2011	• Harvest wheat hay	• Harvest wheat hay

Legend
ESN=environmentally smart N (44-0-0)
CON=conventional urea (46-0-0)
Numbers 1,2,3,4 denote fertilizer levels (0, 75, 150 and 225 lb N/ac total applied N)

Figure 1. Experimental design and protocol for the Forage Relay Trial.

Western Agricultural Research Center

As at NWARC, two Montana-released cereal forage varieties ('Haybet' barley and 'Willow Creek' winter wheat) were grown separately as monocrops and together as an intercrop. In the monocrop system, spring barley was sown in May 4, 2010 at a rate of 76 lb/ac and was harvested for estimates of forage yield and quality at the late dough stage (July 23, 2010). Fields were cultivated and winter wheat was planted in early fall at a rate of 52 lb/ac. In 2011, winter wheat will be harvested for hay and tested for forage yield and quality at early dough.

In the intercrop system, spring barley and winter wheat were planted perpendicular to one another on May 4, 2010, at rates of 76 and 52 lb/ac, respectively. The intercrop was harvested for estimates of forage biomass and quality on the same dates as the monocrop was harvested. The remaining winter wheat crop was left in the field to resume growth. As was the case at NWARC, winter wheat re-growth was not sufficient to justify a second cutting and the winter wheat was left to overwinter.

An error was made at WARC with respect to the fertilizer treatments. Rather than applying the conventional urea fertilizer treatments in the spring of *2011*, urea treatments were applied immediately after planting in the spring of *2010* (May 18, 2010). The four urea treatments (0, 75, 150 and 225 lb N/ac) were applied to plots at rates corresponding to the intended fall fertilizer treatment (Figure 1). For example, all boxes in Figure 1 labelled with a '2' received urea fertilizer in the spring of 2010 at a rate of 75 lb N/ac. In the fall, ESN fertilizer treatments were applied as planned. That experiment has yielded some valuable information and will continue, but cannot be used in conjunction with the data from the current evaluation. The trial will be conducted again at this site in 2011-12.

Results:

Northwestern Agricultural Research Center

The site was non-irrigated and received 8" rainfall during the growing season (May-September). At the start of the season, soil N levels measured 72 lb N/ac in the top 24", and an additional 100 lb of 6-30-40 was broadcast and incorporated prior to planting.

Although barley plants in the monocrop and intercrop systems were seeded at the same rate, mid-season barley density was higher in the monocrop system compared to barley density in the intercrop system, indicating strong competitive pressure from the winter wheat (Table 1). In the intercrop system barley averaged 4.8 plants/ft^2 while winter wheat averaged 16.4 plants/ft^2, for a total of 21.2 plants/ ft^2. This overall plant density was similar to that found in the monocrop system, where barley plants averaged 21.6 plants/ ft^2 (Table 1). This indicates that each system had a similar capacity but that winter wheat competed with barley in such a manner that significantly reduced the barley population. However, the vigorous spring habit of the barley outcompeted the winter wheat during the growing season, resulting in comparatively little winter wheat growth (<5" tall).

Competition in the intercrop system resulted in decreased forage yields. Monocropped forage barley yielded 7,243 lb DM/ac, which was significantly more than the 3,328 lb DM/ac harvested from the intercropped forage barley and winter wheat (Table 2). Most quality parameters, however, indicated higher quality in the intercropped forage compared to the monocropped barley. Crude protein was 1% higher in the intercropping arrangement, at 9.7% compared to 8.7% in the monocrop. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were significantly higher in the monocropped barley (Table 2). Correspondingly, total dietary fiber (TDF) and relative feed value (RFV) were higher when the barley forage was augmented with winter wheat forage (Table 2).

Relatively mild incidences of barley scald and net blotch were identified on barley plants in both the intercrop and monocrop systems. Diseases will continue to be monitored carefully as the trial continues.

Table 1. Density of monocrop and intercrop barley and winter wheat grown in 2010 at Kalispell, MT.

	Barley density	Winter wheat density	Total plant density
	#/ft^2	#/ft^2	#/ft^2
Monocrop	21.6	0	21.6
Intercrop	4.8	16.4	21.2
CV (%)	27.0	33.8	18.9
P>F	**	**	ns
LSD (0.05)	1.78	1.38	2.02

*, ** denote significance at α=0.05 and 0.01, respectively; ns indicates P value>0.05

Table 2. Forage yield and quality of monocropped 'Haybet' barley and intercropped 'Haybet' barley and 'Willow Creek' winter wheat grown in 2010 at Kalispell, MT.

	First cut forage yield	Forage crude protein	ADF	NDF	TDF	RFV
	lb DM/ac	%	%	%	%	%
Monocrop	7243	8.7	25.9	46.5	61.8	118.4
Intercrop	3328	9.7	23.1	43.5	64.2	129.5
CV (%)	19.4	9.6	7.2	4.4	3.5	5.9
P>F	**	**	**	**	**	**
LSD (0.05)	513.0	0.44	0.89	0.99	1.10	3.70

*, ** denote significance at α=0.05 and 0.01, respectively; ns indicates P value>0.05

Western Agricultural Research Center

The site was irrigated and received 17" of water (7" rainfall + 10" irrigation) during the growing season (May-September). At the start of the season, soil N levels measured 23 lb in the top 36" of soil, thus an additional 100 lb of 11-52-40 was broadcast and incorporated prior to planting.

Unlike the Kalispell site, forage yield did not differ between the monocropped (5320 lb DM/ac) and intercropped (5101 lb DM/ac) systems (Table 3). Forage quality was only slightly higher in the intercropped system at Corvallis, with no differences in crude protein or TDF, lower ADF and NDF and higher RFV in the intercrop (Table 3).

Forage yield and protein levels increased with increasing N applications, suggesting that optimal levels of N fertilizer were not supplied to the crop at planting (Table 3). Further, there were no significant N fertilizer x System interaction effects, suggesting that both systems used N fertilizer to a similar degree. This knowledge will allow us to set better fertilizer N guidelines and can be used to improve this study at all sites in subsequent years.

Table 3. Forage yield and quality of monocropped 'Haybet' barley and intercropped 'Haybet' barley and 'Willow Creek' winter wheat grown at four N rates in 2010 at Corvallis, MT.

	First cut forage yield	Forage crude protein	ADF	NDF	TDF	RFV
	lb DM/ac	%	%	%	%	%
System						
Monocrop	5320	10.4	28.7	49.6	58.4	106.4
Intercrop	5101	10.2	27.8	48.5	59.0	109.5
P>F	ns	ns	*	**	ns	*
LSD (0.05)	342.5	0.54	0.88	0.84	0.92	2.80
N Fertilizer						
0N	3323	7.1	27.1	48.0	60.3	112.4
75N	5533	8.6	28.3	48.9	58.7	108.3
150N	6248	11.7	29.0	49.8	57.4	104.9
225N	5738	13.8	28.7	49.7	58.5	106.3
P>F	**	**	*	**	**	**
LSD (0.05)	484.3	0.78	1.24	1.18	1.31	3.97
CV (%)	19.4	9.6	7.2	4.4	3.5	5.9

*, ** denote significance at α=0.05 and 0.01, respectively; ns indicates P value>0.05

Differences between the two systems were more apparent at the dryland site (NWARC) compared to the irrigated site (WARC), which may be related to interspecific competition for moisture and/or nitrogen. The preliminary results of this trial indicate that the intercropping of spring forage barley and winter forage wheat has the potential to be a suitable cropping system in Montana, but that some adjustments to the system may be beneficial. From the results obtained at WARC, it is probable that our initial N fertilizer levels at both sites were too low to produce optimal forage yields. Thus, we plan to increase initial levels of soil N in subsequent studies. Forage quality in the intercrop system was comparable to or better than forage quality in the monocrop system, increasing the viability of the relay cropping scheme for Montana producers.

Future Plans:

The second phase of this experiment (Conventional urea vs. ESN) is still underway at Northwestern Agricultural Research Center, and we will initiate the study for a second year at that non-irrigated site. We also plan to initiate the originally planned experiment again at WARC under irrigation. Results of this phase will assist Montana forage growers in selecting the most effective and economic fertilizer products.

GENERAL CROPPING SYSTEMS

Project Title: Quantifying the nitrogen benefit of legumes in a crop rotation

Project Leader: Heather Mason

Project Personnel: James Thompson, Brooke Bohannon

Objective: To quantify the amount of nitrogen supplied by legumes to subsequent spring wheat and canola crops

Materials and Methods:

A three-year crop sequence study was initiated in 2009 at Northwestern Agricultural Research Center in Creston, MT. In 2010, another site was initiated and the crop sequence was continued at the 2009 site. The table below outlines the timeline of the proposed crop sequence at the two sites.

Table 1. Project years, crops and sites to be used in the evaluation of crop sequence on wheat and canola in northwestern Montana.

Project Year	Crop Sequence	Site 1	Site 2
0	Alfalfa	2006	2007
0	Alfalfa	2007	2008
0	Barley	2008	2009
1	Initial Crops	2009	2010
2	Spring Canola/Spring Wheat	2010	2011
3	Wheat	2011	2012

Site 1

In 2009, Initial Crops included pea ('Universal', 'Aragorn'), lentil ('Richlea', 'Brewer'), and wheat ('Jedd') , as well as a fallow treatment. Following the production of the Initial Crops in Year 1 of the study, Year 2 of the crop sequence was initiated. Vertical fertilizer treatments were broadcast and incorporated prior to planting, at rates of 0, 40, 80 and 120 lb N/ac. On May 7, 2010, spring wheat ('Jedd') and canola ('Python 2') were seeded into sub-plots at 80 and 5 lb/ac, respectively. Soil N and moisture content (24" depth) were collected in the 0 and 80 lb N/ac plots to 24" depth just after planting, and again at harvest. Time to flowering and maturity, plant stand, weed biomass, disease and insect incidence, seed yield, test weight, moisture content were collected. Grain protein, seed oil content and plant tissue N analysis is presently being conducted.

Site 2

Initial Crops pea ('Universal', 'Aragorn'), lentil ('Richlea', 'Merritt'), and wheat ('Jedd') were planted on April 27, 2010. Time to flowering and maturity, plant height, canopy height, grain yield, test weight and moisture content were recorded. Peas were harvested August 19, lentils were harvested August 27, and wheat was harvested Sept 8, 2010.

Results:

Initial findings indicate that canola yields were highest following fallow (2215 lb/ac) and pea (1985 lb/ac), and were lowest following wheat (1630 lb/ac) (Table 2). Spring wheat yield did not differ according to previous crop, except in the case of continuous wheat, which resulted in a yield reduction. Spring wheat and canola yields correspond closely with spring soil N, which was highest following fallow (130 lb N/ac) and pea (100 lb N/ac) (Table 3).

Table 1. Effect of previous crop on canola and wheat yield.[1]

2009 Crop	Canola yield (lb/ac)	Canola yield (bu/ac)		Wheat yield (lb/ac)	Wheat yield (bu/ac)	
Fallow	2215	44.4	a	3604	63.5	a
Pea	1985	40.4	ab	3721	65.1	a
Lentil	1797	36.5	bc	3702	64.8	a
Wheat	1630	33.5	c	3256	57.1	b
Mean	1908	38.7		3571	62.6	
P>F	0.03	0.04		0.05	0.03	
LSD (0.05)	344.5	6.84		329.0	5.23	

[1]within crops, canola and wheat yields with the same letter do not differ at the α=0.05 level.

Table 3. Effect of previous crop of spring soil nitrogen levels.[1]

Previous Crop (2009)	**Spring 2010 soil N (lb/ac)**	
Fallow	129.8	a
Pea	99.8	ab
Lentil	95.5	b
Wheat	70.0	b
P>F	0.05	
LSD (0.05)	30.9	

[1]spring soil N levels with the same letter do not differ at the α=0.05 level.

Data from this site also suggest that pea variety may impact the yield of a subsequent canola crop. Canola yields were higher following 'Aragorn' pea (2323 lb/ac) compared to when canola followed 'Universal' pea (1648 lb/ac), however there was no significant difference in the concentration of soil N or moisture in 'Aragorn' or 'Universal' pea plots prior to the planting of the canola crops in the spring of 2010. 'Universal' peas were higher yielding in 2009 than 'Aragorn' at 3987 lb/ac compared to 3532 lb/ac. Further study is required to determine if this trend continues in other location-years.

Future plans:

The third year of the study at Site 1 will continue in 2011, with wheat planted into all plots. At Site 2, spring wheat and canola will be planted into plots where pea, lentil, wheat, and fallow treatments stood in 2010. Nitrogen fertilizer treatments will be applied at 0, 40, 80 and 120 lb N/ac, and data on yield, and soil and plant N status will be collected.

OIL SEEDS

Project Title: Statewide Camelina Variety Evaluation

Project Leader: Heather Mason

Project Personnel: James Thompson, Brooke Bohannon

Objective: To evaluate seed yield and agronomic performance of 18 camelina varieties in northwestern Montana.

Results:

Eighteen camelina varieties were included in the 2010 statewide evaluations; four commercially available varieties, six varieties developed by Sustainable Oils (SO) and five varieties developed by Great Plains-The Camelina Company (GP) (Table 1). Camelina was seeded on May 6, 2010 into Creston sandy loam at a rate of 5 lb/a and at a depth of 0.5 in under conventional tillage and dryland conditions. Fertilizer (27-30-120-24) was broadcast and incorporated prior to planting. The plots were direct combine harvested on September 7, 2010.

Good camelina stand establishment was obtained with an average of 28 plants/ft^2. The time to flowering for camelina varieties averaged 50 days after planting (June 26), with the crop reaching average harvest maturity approximately 48 days later (August 12), a total of 98 days after planting. Plant height averaged 37.5 in, ranging from 35.0 to 39.3 in. Lodging and shatter were moderate, yet higher than in previous years due to above average in-season precipitation. Lodging averaged 5.8 (on a scale of 0-9) and shatter 21.9% (Table 1).

Differences in seed yield and test weight were significant among varieties included in this year's evaluation. On average, camelina yielded 2,313 lb/ac, and test weights were 52.5 lb/bu. The three highest yielding varieties were SO-9 (49.7 bu/ac), Ligena (48.4 bu/ac), and SO-5 (48.2 bu/ac). Differences in oil yield and content among varieties were also significant. Average oil yield among all varieties was 754 lb/ac. The three highest oil yielding varieties were SO-9 (858 lb/ac), SO-5 (827 lb/ac), and GP-10 (819 lb/ac). Oil content of camelina seed averaged 32.6%, ranging from 31.8% to 33.7%.

Fatty acid composition of varieties differed for all variables (Table 2). Overall, camelina oil was comprised of approximately 46% polyunsaturated fat, 42% monounsaturated fat and 7% saturated fat.

Summary:

Camelina seed yields were slightly higher than in 2009 (2,106 lb/a) despite an increase in lodging and shatter. Above average precipitation and cooler temperatures may have helped to increase the length of the seed-filing period, resulting in higher camelina seed yield.

Future Plans:

With continued variety development and release, evaluations will be conducted in order to identify varieties best suited to this growing region.

Table 1. Seed yield and agronomic characteristics of varieties grown in the 2010 Statewide Camelina Variety Evaluation at Northwestern Agricultural Research Center, Kalispell, MT.

Variety	Seed Yield	Seed Yield	Oil Yield	Test Weight	Protein	Oil	Moisture	Shatter	Plant Height	Lodging	Plant Count	Days to Flower	Harvest Maturity
	bu/ac	*lb/ac*	*lb/ac*	*lb/bu*	*%*	*%*	*%*	*%*	*in*	*0-9*	*per ft²*	*days after planting*	*days after planting*
SO-9	**49.7** ++	2629	858	52.94	27.08	32.6	9.0	23.8	38.8	5.5	24	51	99
Ligena	**48.4** +	2509	806	51.88	27.58	32.2	9.2	17.5	38.3	6.3	25	52	102
SO-5	**48.2** +	2562	827	53.18	27.26	32.3	9.2	21.3	38.8	5.8	29	51	98
SO-7	**47.3** +	2445	795	51.74	26.97	32.5	9.6	16.3	39.0	5.5	18	51	101
SO-8	**47.1** +	2453	792	52.06	27.19	32.3	9.5	27.5	37.0	5.5	26	50	100
GP-10	**46.6** +	2479	819	53.24	27.21	33.1	9.1	25.0	37.8	6.0	31	51	98
Blaine Creek	**44.9** +	2372	777	52.85	27.20	32.9	9.6	21.3	37.5	4.8	28	51	96
Calena	**44.9** +	2374	755	52.90	27.36	32.0	9.2	18.8	37.3	5.8	33	51	100
GP-07	44.0	2286	769	51.93	28.05	33.7	8.7	11.3	35.0	4.5	29	44	94
GP-43	43.7	2333	770	53.36	27.18	33.0	9.1	23.8	37.8	6.3	32	51	96
GP-69	43.1	2253	724	52.23	27.32	32.1	9.7	25.0	36.8	6.0	27	50	95
GP-12	43.0	2274	730	52.87	27.70	32.1	9.2	28.8	36.5	5.8	25	52	97
GP-42	42.8	2274	746	53.07	27.13	32.8	9.0	21.3	39.3	6.0	29	50	99
Suneson	41.4	2216	703	53.55	27.57	31.8	9.4	21.3	38.5	6.3	29	51	98
SO12	40.8	2133	699	52.33	27.05	32.7	9.3	22.5	38.8	6.0	35	53	103
SO-11	40.5	2078	687	51.34	27.02	33.1	9.1	25.0	36.5	6.3	25	50	96
GP-68	39.4	2056	669	52.13	27.55	32.6	9.2	23.8	37.0	5.8	27	50	96
GP-73	36.8	1909	641	51.93	26.90	33.6	9.0	21.3	35.5	5.8	30	44	95
Average	44.0	2313	754	52.53	27.29	32.6	9.2	21.9	37.5	5.8	28	50	98
F test	**	**	**	**	*	**	**	**	**	*	*ns*	**	**
LSD (α=0.05)	5.12	269.1	90.8	0.413	0.584	0.98	0.40	6.07	1.83	0.99	10.6	1.5	2.9

Seed and oil yields, and test weights are adjusted to 8% moisture content. Grain protein, grain oil and oil yield are reported on a dry matter basis.
++ Indicates highest yielding variety
+ Indicates varieties yielding equal to the highest yielding variety based on Fisher's protected LSD at the 0.05 probability level.
*,** Effects are significant at $P<0.05$, $P<0.01$, respectively; *ns* denotes non-significant effects.
Lodging visually estimated on a score from 0 to 9 (0=none, 9=all plants laying flat).

Table 2. Fatty acid composition of the varieties grown in the 2010 Statewide Camelina Variety Evaluation.

Variety	Saturated	Mono-unsaturated	Poly-unsaturated	Palmitic Acid C16:0	Stearic Acid C18:0	Oleic Acid C18:1	Linoleic Acid C18:2	α- Linolenic Acid C18:3	Arachidic Acid C20:0	Gadoleic Acid C20:1	Behenic Acid C22:0	Erucic Acid C22:1	Nervonic Acid C24:1
	%	%	%	%	%	%	%	%	%	%	%	%	%
Blaine Creek	7.2	**43.3**[+]	44.4	3.2	2.0	21.5	5.2	43.1	1.9	20.3	0.5	4.4	0.5
Calena	7.3	41.2	46.2	3.5	2.0	20.1	7.4	42.4	1.9	19.9	0.4	4.3	0.5
GP-07	6.9	38.8	**48.4**[++]	3.3	2.0	17.8	8.2	43.8	1.8	19.0	0.4	4.0	0.6
GP-10	**7.6**	41.3	45.9	3.6	2.0	20.2	7.9	40.9	1.9	19.6	0.5	4.3	0.5
GP-12	7.3	41.9	45.5	3.6	2.1	21.4	7.1	42.1	1.7	19.6	0.4	4.1	0.5
GP-42	**7.8**[++]	40.6	46.5	3.7	2.0	19.7	9.4	40.2	2.0	19.3	0.5	4.2	0.5
GP-43	**7.6**[+]	41.8	45.5	3.5	2.0	20.6	7.6	41.2	2.0	19.8	0.5	4.3	0.5
GP-68	7.5	**43.2**[+]	44.4	3.4	2.0	21.6	6.1	41.7	1.9	19.9	0.5	4.5	0.5
GP-69	7.0	**43.7**[++]	44.2	3.2	2.0	22.0	4.9	43.4	1.9	20.5	0.5	4.4	0.4
GP-73	7.5	42.3	45.1	3.4	2.0	20.4	7.5	41.6	2.0	20.1	0.5	4.4	0.5
Ligena	7.4	40.7	46.5	3.6	2.0	19.8	8.3	41.5	2.0	19.6	0.4	4.3	0.5
SO-11	**7.7**[+]	41.3	46.0	3.7	2.1	20.3	9.2	40.4	1.8	19.2	0.4	4.2	0.5
SO-12	7.4	41.0	46.1	3.7	2.1	20.9	7.9	41.2	1.8	19.6	0.4	4.0	0.5
SO-5	**7.6**[+]	41.3	46.0	3.6	1.9	20.1	8.2	40.9	2.0	19.9	0.5	4.3	0.5
SO-7	7.3	42.6	45.0	3.3	1.9	20.6	7.3	41.9	2.1	20.1	0.5	4.6	0.5
SO-8	7.5	42.5	44.8	3.5	2.1	21.0	6.7	41.3	2.0	20.7	0.5	4.5	0.5
SO-9	**7.8**[++]	41.4	45.7	3.8	2.1	20.6	8.2	40.1	2.0	20.0	0.5	4.3	0.5
Suneson	7.5	41.5	45.8	3.6	2.0	20.6	7.8	41.6	2.0	19.7	0.5	4.2	0.5
Average	7.4	41.7	45.7	3.5	2.0	20.5	7.5	41.6	1.9	19.8	0.5	4.3	0.5
F test	**	**	**	**	**	**	**	**	**	**	**	**	**
LSD (α=0.05)	0.23	0.80	0.65	0.18	0.06	0.56	1.10	1.02	0.09	0.64	0.01	0.13	0.03

Fatty acid composition reported on a dry matter basis of the whole seed.

[++] Indicates highest yielding cultivar.

[+] Indicates cultivars yielding equal to the highest yielding cultivar based on Fisher's protected LSD at the 0.05 probability level.

** Effects are significant at P<0.01.

Project Title: Nitrogen and sulfur fertility for camelina in Montana

Project Leaders: Heather Mason, Northwestern Agricultural Research Center; Chengci Chen, Central Agricultural Research Center; Peggy Lamb, Northern Agricultural Research Center; Clain Jones, Land Resources and Environmental Sciences, MSU Bozeman.

Project Personnel: James Thompson, Brooke Bohannon

Objectives:

i. To determine the effect of nitrogen and sulfur fertilizer rates, and their interaction effects on camelina seed yield and agronomic performance at the Northwestern, Northern and Central Agricultural Research Centers.

ii. To investigate the effects of variety and fertilizer rate on camelina productivity in these same locations.

Materials and Methods:

Field trials were planted in 2009 and 2010 at three Montana State University agricultural experimental stations: Northwestern Ag Research Center (Kalispell, MT), Northern Ag Research Center (Havre, MT), and Central Ag Research Center (Moccasin, MT). Two camelina varieties (Blaine Creek and Suneson) were grown under rainfed conditions at each site. Nitrogen (N) fertilizer treatments and target N levels varied among locations, and were determined based on spring soil testing and suitability for the area (Table 1). Sulfur fertilizer treatments were combined with N treatments to create eight fertilizer treatment levels at each location. The experimental design at Kalispell was a split plot design with four replications and was a randomized complete block design with four replications at Havre and Moccasin.

Table 1. Soil analysis and target N levels for trials conducted at six Montana sites in 2009 and 2010.

Site Name	Location	Year	pH	OM	Pre-plant soil N (0-24")	N fertilizer treatment levels	Target N levels	Pre-plant soil S (0-24")	S fertilizer treatment levels)
				%	lb N/ac	lb N/ac	lb N/ac	lb S/ac	lb S/ac
Hav09	Havre	2009	7.8	1.6	61	0,30,60,90	61,91,121,151	50	0,20
Kal09	Kalispell	2009	7.4	5.3	26	0,40,80,120	26,66,106,146	64	0,20
Moc09	Moccasin	2009	7.1	3.7	13	0,30,60,120	13,43,73,133	na	0,20
Hav10	Havre	2010	8.0	1.4	60	0,30,60,90	60,90,120,150	38	0,20
Kal10	Kalispell	2010	7.8	1.8	38	0,40,80,120	38,78,118,158	48	0,20
Moc10	Moccasin	2010	na	3.4	72	0,30,60,120	72,102,132,192	16	0,20

In 2009 and 2010, fertilizer treatments were broadcast and incorporated prior to seeding at Kalispell and were broadcast at the time of seeding at Havre and Moccasin. In all location-years, flowering and maturity date, and plant height were recorded. Plots were direct harvested using a plot combine, and plot yield, test weight, and seed moisture content were recorded. Grain oil and grain protein percentages were determined, and in 2010, soil sampling was conducted in each plot after harvest, and analyzed for nitrate-N and sulfate-S in order to assess crop nutrient uptake.

Results:

In 2009, camelina yields averaged 2,043 lb/ac at Havre, 2,123 lb/ac at Kalispell, and 755 lb/ac at Moccasin (Table 2). The low yields at Moccasin were due to low rainfall throughout the growing season (annual precipitation was nearly 5 in. less than the long term average of 15.3 in). Camelina seed yields were not affected by N fertilizer at Kalispell or Havre, but increased linearly with N fertilizer at Moccasin. In 2010, camelina yields averaged 1,447 lb/ac at Havre, 1,222 lb/ac at Kalispell and 1,681 lb/ac at Moccasin. At all three sites, seed yield increased with N fertilizer, up to 80 lb N/ac at Kalispell and up to 60 lb N/ac at Havre and Moccasin. When taking both fertilizer N and available soil N into consideration, camelina yields reached their maximum when soil N + fertilizer N reached 120 lb N/ac (Tables 1 and 2).

Table 2. The effect of nitrogen fertilizer on camelina seed yield at three Montana locations in 2009 and 2010.

Location	Havre 2009	Havre 2010		Kalispell 2009	Kalispell 2010		Moccasin 2009	Moccasin 2010
Applied N (lb N/ac)	Seed yield (lb/ac)		Applied N (lb N/ac)	Seed yield (lb/ac)		Applied N (lb N/ac)	Seed yield (lb/ac)	
0	2010	1168	0	2033	756	0	407	1505
30	2000	1365	40	2190	1174	30	687	1694
60	2048	1582	80	2152	1592	60	840	1712
90	2114	1674	120	2116	1367	120	1087	1813
F test	ns	**		ns	**		**	**
LSD (0.05)	157	153		277	188		316	107
Mean	**2241**	**1419**		**2170**	**849**		**457**	**1569**

Sulfur fertilizer did not affect seed yield of camelina at any of the location-years, except at Kalispell in 2010, where an additional 20 lb S/ac resulted in a yield increase of 315 lb/ac (Table 3). The large response to S at the Kalispell 2010 location may be in part due to the sandy soil texture at that site.

Table 3. The effect of sulfur fertilizer on camelina seed yield at three Montana locations in 2009 and 2010.

Fertilizer (lb/ac)	Havre 2009	Havre 2010	Fertilizer (lb/ac)	Kalispell 2009	Kalispell 2010	Fertilizer (lb/ac)	Moccasin 2009	Moccasin 2010
				Sulfur				
0	2032	1460	0	2130	1060	0	832	1674
20	2054	1435	20	2114	1385	20	678	1688
P value	ns	ns		ns	**		ns	ns
LSD (0.05)	96	108		169	133		197	76
Mean	**2043**	**1447**		**2123**	**1222**		**755**	**1681**

Future Plans:

This experiment has been concluded and additional reports are forthcoming.

Project Title: Camelina tolerance to soil applied herbicides

Objective: To evaluate the response of camelina to preemergence applications of several major herbicide families.

Materials and Methods:

The study was conducted under dryland conditions, using conventional tillage practices, with the previous crop being alfalfa. The soil type was Kalispell very fine sandy loam with a sand, silt, and clay content of 60, 25, and 15 percent, respectively. The soil had a CEC of 15, an organic matter content of 3 percent, and a pH of 7.0. The field was fertilized with 27-30-120-24 lb/A of N-P-K-S on April 2. 'Ligena' camelina was seeded 0.25 inches deep, at a rate of 5 lb/A in six inch wide rows on April 19. Herbicide treatments were applied on April 20, with a CO_2 backpack sprayer in 20 GPA of water using 11002 flat fan nozzles. The experiment was established as a randomized complete block with three replications, with each plot measuring 10 by 15 feet.

Treatments included a non-treated control along with the herbicides Outlook (dimethenamid), Prowl (pendimethalin), Facet (quinclorac), Cinch (metolachlor), and KIH-485 (pyroxasulfone). Each herbicide was applied at three rates (Table 1). Treatments were visually rated for percent crop injury on July 3, using a scale of 0 (no injury) to 100 (complete injury). Plant density and biomass were determined in each plot by collecting the above ground plant material from two, 1.5 ft^2quadrates on July 27. Plant height and days to flowering also were evaluated in order to further assess crop injury potential. Plots were harvested on August 11. Plots were hand-weeded to prevent weed competition from confounding yield results.

Results:

Crop injury ranged from 0 to 81 percent, depending on the herbicide and rate applied. Crop injury was mostly expressed in the form of plant density reductions (Figure 1, R^2=0.82), but stunting also contributed to the overall response. Crop injury was more severe compared to the previous year. With the exception of Facet, all herbicides caused significant stand loss relative to the check, and this had a significant effect on yield (Figure 2). Treatment differences were also noted for days to flowering. Moreover, there was a strong relationship between flowering and yield (Figure 3, R^2=0.59) where yields declined as flowering was delayed. On average, camelina flowered within three weeks, which is similar to the previous year. Facet had no effect on flowering, while Outlook, Prowl and Cinch consistently delayed flowering. Although several treatments reduced plant densities by more than half, biomass was not affected. Similarly, height measurements were non-significant, even though stunting was initially observed. Not surprisingly, yield was not strongly associated with either of these variables. Test weights varied from a high of 48.2 to a low of 44.4, with the highest test weights being associated with Facet. Test weights were strongly associated with yield, where yields increased as test weights increased (Figure 4).

All of the herbicides evaluated have a potential fit for use in camelina when applied at the lowest rate, but Facet appears to have the greatest crop tolerance. This study should be conducted on additional soil types to better characterize camelina tolerance to these herbicides.

Figure 1.

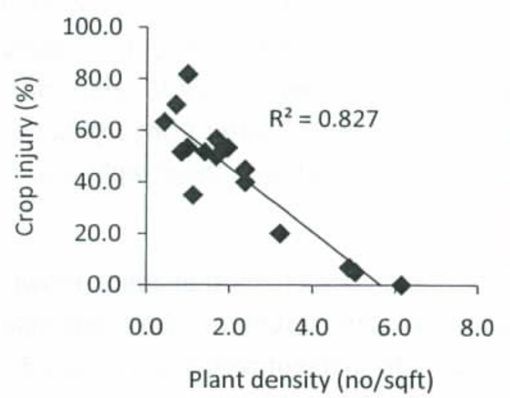


Figure 2.

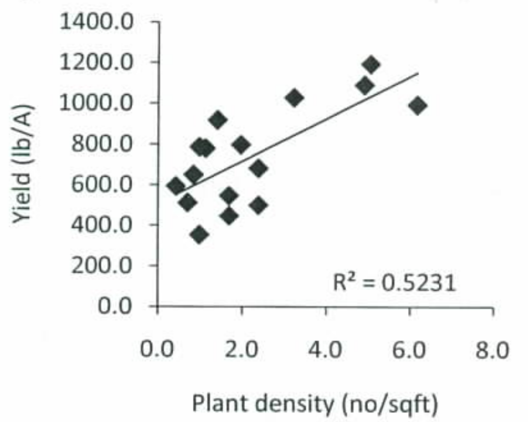


Figure 3.

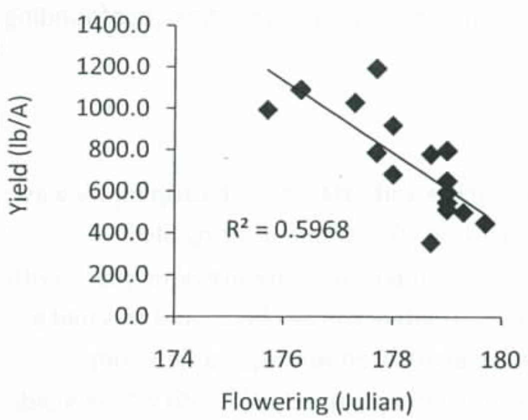


Figure 4.

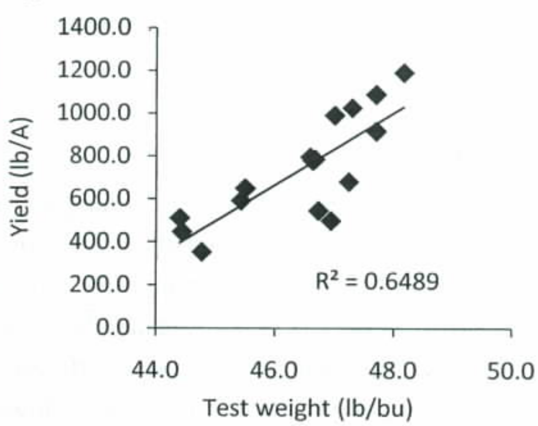


Table 1. Effect of herbicide and rate on camelina production, Kalispell, MT 2010.

Herbicide	Rate lb ai/a	Injury (%)	Flowering Julian	Density No./ft2	Biomass g/ft2	Height (in)	TWT lb/Bu	Yield lb/A
		3-Jul		27-Jul	27-Jul	2-Aug		
Check		0.0	176	6.2	63.9	37.5	47.0	991.4
Outlook	0.560	56.7	180	1.7	39.9	35.0	44.4	446.0
Outlook	0.840	51.7	179	0.8	21.9	34.0	45.5	649.6
Outlook	1.125	70.0	179	0.7	37.5	34.6	44.4	510.6
Prowl	0.950	40.0	178	2.4	57.1	35.4	47.2	680.6
Prowl	1.900	45.0	179	2.4	46.1	34.7	46.9	498.2
Prowl	3.800	50.0	179	1.7	47.8	34.7	46.7	545.3
Facet	0.250	20.0	177	3.2	86.2	36.5	47.3	1026.8
Facet	0.500	5.0	178	5.0	86.4	37.3	48.2	1191.5
Facet	0.750	6.7	176	4.9	60.5	39.3	47.7	1088.5
Cinch	0.950	35.0	179	1.1	19.1	32.8	46.6	778.5
Cinch	1.910	53.3	179	2.0	41.4	33.3	46.6	795.5
Cinch	2.860	63.3	179	0.4	14.5	32.4	45.4	592.0
KIH-485	0.056	51.7	178	1.4	26.6	36.5	47.7	917.4
KIH-485	0.111	53.3	178	1.0	48.7	35.0	46.7	785.6
KIH-485	0.223	81.7	179	1.0	59.9	36.1	44.8	352.8
MIN		0.0	176	0.4	14.5	32.4	44.4	352.8
MAX		81.7	180	6.2	86.4	39.3	48.2	1191.5
MEAN		42.7	178	2.2	47.3	35.3	46.5	740.6
LSD (P=.05)		32.54	2.16	3.36	50.86	3.87	2.33	469.96
CV		45.70	0.73	89.87	64.43	6.57	2.99	38.06
Trt (Pr>F)		0.0003	0.0339	0.0315	0.1766	0.0773	0.0375	0.0234

Project Title:	Statewide Spring Canola Variety Evaluation
Project Leader:	Heather Mason
Project Personnel:	James Thompson, Brooke Bohannon
Objective:	To evaluate seed yield and agronomic performance of twenty canola varieties in northwestern Montana.

Results:

Twenty varieties of canola (Table 1) were seeded at 5 lb/ac (0.5 in depth) to a Creston sandy loam soil under dryland conditions. Plots were seeded May 6, 2010 using a double disc plot seeder. Fertilizer (27-30-120-24) was broadcast and incorporated prior to planting. The plots were direct combine harvested on September 7, 2010.

Time to flowering for canola varieties averaged 53 days after planting (June 28), with the crop reaching harvest maturity approximately 55 days later (August 22), a total of 108 days after planting. Average plant height was 45.0 in, ranging from 40.3 in (Hyola 357 Magnum) to 49.0 in (InVigor 624). Lodging was minimal in most plots, while shatter averaged 34.5% ranging from 17.5% (InVigor 5440) to 60% (UISC0038DE).

Differences in seed yield and test weight were significant among varieties included in the evaluation. On average, canola yielded 1,607 lb/ac, and test weights were 50.6 lb/bu. The three highest yielding varieties were Hyola 357 Magnum (39.5 bu/ac), DKL30-42 (38.7 bu/ac) and DKL 72-55 (37.9 bu/ac). Differences in oil yield and content among varieties were also significant. Oil yield ranged from 506 lb/ac (UISCOO38DE) to 948 lb/ac (DKL30-42), with an average of 737 lb/ac. Average oil content was 45.7%, ranging from 43.4% (Hyola 357 Magnum) to 48.5% (HyClass 947-RR).

Varieties differed in monounsaturated fat (oleic acid) and polyunsaturated fats (linoleic and α- linolenic acid). HyClass varieties were highest in oleic acid. Most InVigor varieties were high in omega 6 fatty acids (linoleic acid). Differences in the saturated fat stearic acid were detected among varieties, while none were apparent for palmitic acid (also a saturated fat).

Summary:

Overall canola yields were down from 2009 (2,489 lb/ac). An increase in shatter and lodging, as well as above average precipitation and cooler temperatures may have been a factor in the 2010 yields. In addition diamond back moths were observed in the crop. No disease problems were noted.

Future Plans:

With continued variety development and release, further canola evaluations will be conducted in order to identify varieties best suited to our growing region.

Table 1. Seed yield and agronomic characteristics of varieties grown in the 2010 Statewide Canola Variety Evaluation, Northwestern Agricultural Research Center, Kalispell, MT

Variety	Seed Yield	Seed Yield	Oil Yield	Test Weight	Protein Content	Oil Content	Moisture	Shatter	Days to Flower	Harvest Maturity	Plant Height	Lodging
	bu/ac	*lb/ac*	*lb/ac*	*lb/bu*	*%*	*%*	*%*	*%*	*days after planting*	*days after planting*	*in*	*0 to 9*
Hyola 357 Magnum	**39.5** ++	1920	836	48.7	26.4	43.4	11.8	20.0	51	107	40.3	3
DEKALB DKL30-42	**38.7** +	1971	948	50.9	24.0	48.0	9.8	22.5	51	105	45.5	2
DKL 72-55	**37.9** +	1917	929	50.7	24.5	48.4	9.8	35.0	52	107	47.5	1
DEKALB DKL51-45	**37.9** +	1910	923	50.5	23.7	48.4	9.5	42.5	51	105	45.3	2
InVigor 624	**36.3** +	1908	860	52.7	25.9	44.9	14.2	27.5	57	112	49.0	1
HyClass 947-RR	**35.0** +	1776	863	50.8	23.4	48.5	11.3	30.0	52	106	43.8	2
UISC003117	**34.2** +	1708	799	50.0	24.5	46.7	10.5	37.5	51	110	46.3	4
HyClass 940-RR	**33.5** +	1677	777	50.2	25.2	46.2	10.4	57.5	51	105	45.8	1
InVigor 5440	**33.4** +	1752	761	52.5	25.7	43.5	15.2	17.5	56	108	48.8	0
Exp 988-RR	**32.6** +	1594	721	49.4	24.3	45.1	16.7	27.5	56	113	46.0	2
InVigor 642	**32.5** +	1650	-	50.9	-	-	15.5	25.0	56	107	45.3	0
DEKALB DKL 52-41	**31.6** +	1578	731	50.0	26.1	46.2	11.6	47.5	52	106	46.8	3
InVigor 8440	29.2	1448	654	49.7	25.3	45.1	14.0	22.5	53	110	45.0	2
InVigor 5550	28.1	1477	660	52.6	25.8	44.7	15.2	35.0	53	106	46.5	1
03IL1561	26.4	1335	600	50.5	25.3	44.4	11.8	55.0	53	110	47.0	4
USC0135	25.4	1272	564	50.2	26.3	44.3	13.3	35.0	52	107	45.3	3
HyClass 921-RR	24.6	1280	587	52.2	24.9	45.8	15.6	25.0	52	111	41.8	1
Nexera 105RR	23.9	1221	544	51.0	26.1	44.4	15.2	32.5	57	108	41.3	2
UISC0038DE	23.7	1138	506	48.1	25.5	44.2	11.8	60.0	52	106	43.5	5
Average	31.8	1607	737	50.6	25.2	45.7	12.8	34.5	53	108	45.0	2
F test	**	**	**	**	**	**	**	**	**	**	**	**
LSD (α=0.05)	8.92	441.8	197.2	1.65	0.65	1.25	2.80	17.82	0.6	3.7	4.20	1.4

Seed and oil yields, and test weights are adjusted to 8% grain moisture content.
++ Indicates highest yielding variety.
+ Indicates varieties yielding equal to the highest yielding variety based on Fisher' protected LSD at P<0.05.
** Effects are significant at p<0.01
- Information not available.

Table 2. Fatty acid composition of varieties grown in the 2010 Statewide Canola Variety Evaluation

Variety	Palmitic Acid C16:0	Stearic Acid C18:0	Oleic Acid C18:1	Linoleic Acid C18:2	α- Linolenic Acid C18:3
	%	%	%	%	%
Hyola 357 Magnum	4.4	2.3	62.6	18.1	8.9
DEKALB DKL30-42	4.4	2.3	**67.4**+	17.9	8.5
DKL 72-55	4.3	2.4	67.1	17.2	9.1
DEKALB DKL51-45	4.5	2.2	**68.7**+	**18.9**+	9.0
InVigor 624	4.4	1.8	64.2	**18.9**+	10.4
HyClass 947-RR	4.2	2.3	**69.5**++	17.7	8.5
UISC003117	4.2	2.1	61.4	17.2	9.7
HyClass 940-RR	4.2	2.6	**68.6**+	16.7	7.9
InVigor 5440	4.3	1.8	63.2	**19.3**+	10.9
Exp 988-RR	4.3	2.3	**69.1**+	17.7	8.2
InVigor 642	-	-	-	-	-
DEKALB DKL 52-41	4.4	2.0	**68.6**+	17.5	9.6
InVigor 8440	4.3	2.4	66.7	17.3	9.2
InVigor 5550	4.4	1.5	62.9	**19.5**++	11.9
03IL1561	4.2	1.9	64.1	**19.5**++	9.7
USC0135	4.4	2.2	65.4	18.1	9.4
HyClass 921-RR	4.1	1.7	**69.2**+	**19.2**+	9.8
Nexera 105RR	4.3	2.0	66.2	17.9	10.1
UISC0038DE	4.3	2.2	65.6	**19.3**+	9.2
Average	4.3	2.1	66.1	18.2	9.4
F test	*ns*	**	**	**	**
LSD (α=0.05)	0.67	0.38	2.08	0.9	0.87

Fatty Acid Composition reported on a dry matter basis of the whole seed

- Information not available.

++ Indicates highest yielding cultivar.

+ Indicates cultivars yielding equal to the highest yielding cultivar based on Fisher's protected LSD at the 0.05 probability level.

** Effects are significant at P<0.01, respectively; *ns* denotes non-significant effects.

Project Title: Nitrogen and sulfur fertility for canola in Montana

Project Leaders: Heather Mason, Northwestern Agricultural Research Center; Chengci Chen, Central Agricultural Research Center; Peggy Lamb, Northern Agricultural Research Center; Clain Jones, Land Resources and Environmental Sciences, MSU Bozeman.

Project Personnel: James Thompson, Brooke Bohannon

Objectives:

i. To determine the effect of nitrogen and sulfur fertilizer rates, and their interaction effects on canola seed yield and agronomic performance at the Northwestern, Northern and Central Agricultural Research Centers.

ii. To investigate the effects of variety and fertilizer rate on canola productivity in these same locations.

Materials and Methods:

Field trials were planted in 2009 and 2010 at three Montana State University agricultural experimental stations: Northwestern Ag Research Center (Kalispell, MT), Northern Ag Research Center (Havre, MT), and Central Ag Research Center (Moccasin, MT). Two canola varieties (Hyola 357 Magnum and InVigor 5550). Nitrogen (N) fertilizer treatments and target N levels varied among locations, and were determined based on spring soil testing and suitability for the area (Table 1). Sulfur fertilizer treatments were combined with N treatments to create eight fertilizer treatment levels at each location. The experimental design at Kalispell was a split plot design with four replications and was a randomized complete block design with four replications at Havre and Moccasin.

Table 1. Soil analysis and target N levels for trials conducted at six Montana sites in 2009 and 2010.

Site Name	Location	Year	pH	OM	Pre-plant soil N (0-24")	N fertilizer treatment levels	Target N levels	Pre-plant soil S (0-24")	S fertilizer treatment levels)
				%	lb N/ac	lb N/ac	lb N/ac	lb S/ac	lb S/ac
Hav09	Havre	2009	7.8	1.6	61	0,30,60,90	61,91,121,151	50	0,20
Kal09	Kalispell	2009	7.4	5.3	26	0,40,80,120	26,66,106,146	64	0,20
Moc09	Moccasin	2009	7.1	3.7	13	0,30,60,120	13,43,73,133	na	0,20
Hav10	Havre	2010	8.0	1.4	60	0,30,60,90	60,90,120,150	38	0,20
Kal10	Kalispell	2010	7.8	1.8	38	0,40,80,120	38,78,118,158	48	0,20
Moc10	Moccasin	2010	na	3.4	72	0,30,60,120	72,102,132,192	16	0,20

In 2009 and 2010, fertilizer treatments were broadcast and incorporated prior to seeding at Kalispell and were broadcast at the time of seeding at Havre and Moccasin. In all location-years, flowering and maturity date, and plant height were recorded. Plots were direct harvested using a plot combine, and plot yield, test weight, and seed moisture content were recorded. Grain oil and grain protein percentages were determined, and in 2010, soil sampling was conducted in each plot after harvest, and analyzed for nitrate-N and sulfate-S in order to assess crop nutrient uptake.

Results:

In 2009, canola seed yield averaged 2,170 lb/ac at Kalispell, 2,241 lb/ac at Havre and 457 lb/ac at Moccasin (Table 2). Yields at Moccasin were well below average, due to lower than average precipitation throughout the growing season. In 2010, canola seed yield averaged 1,419 lb/ac at Havre and 1,569 at Moccasin, while at Kalispell, canola yields were much lower than expected, at only 849 lb/ac. These low yields can be largely attributed to a diamond back moth outbreak just prior to flowering.

Overall, nitrogen fertilizer increased canola seed yields at all sites except for Kalispell in 2009. The lack of response at Kalispell may be explained by the high organic matter level of the silt loam soil at that site. Mineralization of organic matter may have increased the base soil N level and obscured any response to N fertilizer.

Table 2. The effect of nitrogen fertilizer on canola seed yield at three Montana locations in 2009 and 2010.

Location	Havre 2009	Havre 2010		Kalispell 2009	Kalispell 2010		Moccasin 2009	Moccasin 2010
Applied N (lb N/ac)	Seed yield (lb/ac)		Applied N (lb N/ac)	Seed yield (lb/ac)		Applied N (lb N/ac)	Seed yield (lb/ac)	
0	2129	935	0	2151	546	0	293	1391
30	2221	1462	40	2251	768	30	454	1543
60	2276	1595	80	2047	1052	60	501	1647
90	2339	1685	120	2231	1029	120	579	1696
F test	*	**		ns	**		**	**
LSD (0.05)	145	229		369	227		173	137
Mean	**2241**	**1419**		**2170**	**849**		**457**	**1569**

In both years, sulfur fertilizer increased yield at Kalispell, but did not affect seed yield at the other two locations (Table 3). In 2009, canola seed yield increased from 2, 047 lb/ac to 2,293 lb/ac with the addition of 20 lb S/ac. Despite much lower yields in 2010, sulfur fertilizer again increased canola yield by almost 200 lb/ac.

Table 3. The effect of sulfur fertilizer on canola seed yield at three Montana locations in 2009 and 2010.

Fertilizer (lb/ac)	Havre 2009	Havre 2010	Fertilizer (lb/ac)	Kalispell 2009	Kalispell 2010	Fertilizer (lb/ac)	Moccasin 2009	Moccasin 2010
				Sulfur				
0	2210	1404	0	2047	755	0	427	1601
20	2273	1434	20	2293	943	20	487	1537
P value	ns	ns		*	**		ns	ns
LSD (0.05)	92	162		228	161		103	97
Mean	**2241**	**1419**		**2170**	**849**		**457**	**1569**

Future Plans:

This experiment has been concluded and additional reports are forthcoming.

Project Title: National Winter Canola Variety Evaluation

Project Leader: Heather Mason

Project Personnel: James Thompson, Brooke Bohannon

Objective: To evaluate the winter survival, seed yield and agronomic traits of winter canola varieties in northwestern Montana.

Results:

Twenty-one winter canola varieties were planted on August 23, 2010. Stands were well established by the time of first frost established nicely and made it to the 4-6 leaf stage prior to the date of first frost, October 12, 2010. In spring of 2011, plots started to green up in early March. Winter survival scores averaged 89% across plots. Overwintering success may be attributed to early seeding, adequate fall moisture (3.25 in) from August until killing frost, and the selection of a more protected site that provided consistent snow cover over the winter months.

The trial will continue and will be harvested in the later summer of 2011. Seed yield and oilseed content will be assessed and reported in the next annual report.

Future Plans:

As interest in winter canola increases, we will continue to participate in the National Winter Canola Variety Evaluations.

Project Title:	Seeding date and potassium fertilizer effects on winter canola survival
Project Leader:	Heather Mason
Project Personnel:	James Thompson, Brooke Bohannon
Objective:	To evaluate the effects of seeding date and potassium (K) fertilizer on the overwintering ability and seed yield of winter canola in northwestern Montana.

Results:

Field trials were initiated in the fall of 2010. Two winter canola varieties were differing in winter hardiness rating (HyClass 107W and HyClass 115W) were sown at a target rate of 5 lb/ac into loam soil measured to be low in K (71 ppm soil test K). Plots were seeded on 4 seeding dates: August 23, September 2 and September 14, 2010. Three levels (0, 40, 120 lb K/ac) of K fertilizer (0-0-60) were broadcast and incorporated into the subplots prior to planting at each seeding date.

After seedling emergence, stands continued to grow until the first killing frost (October 12, 2010). At that time, winter canola plants were well established, with average plant density of 13 plants/ft^2.

In the spring of 2011, plants resumed growth, with an average of 88% winter survival (11.5 plants/ft^2). Variety, seeding date and K fertilizer level did not have a significant effect on the overwintering success of winter canola. Plots will continue to grow during the 2011 growing season and will be assessed for yield and oil content following harvest in the fall of 2011.

Future Plans:

In order to collect a second set of data, the trial will be seeded again in the fall of 2011.

PULSES

Project Title:	Statewide Lentil Variety Evaluation
Project Leader:	Heather Mason
Project Personnel:	James Thompson, Brooke Bohannon
Objective:	To evaluate seed yield and agronomic performance of fifteen lentil varieties in northwestern Montana.

Results:

Fifteen lentil varieties (Table 1) were seeded into Creston sandy loam soil on April 26, 2010. The field was previously seeded to alfalfa, and was prepared for planting using conventional tillage. Fertilizer (27-30-120-24) was broadcast and incorporated prior to planting. No pesticides were applied and the trial was not irrigated. Seeds, treated with fungicide and inoculated with *Rhizobium sp.*, were sown at a rate of 10-12 seeds/ft^2 at a depth of 1.5 in. Plots were combine harvested at physiological maturity on August 18, 2010.

Although plots were planted five days earlier than the previous year, average flowering and maturity dates were nearly the same. The average time to flowering was 65 days after planting (June 30) and plants reached grain maturity (10% moisture) an average of 106 days after planting (August 10) (Table 1). The Turkish (red) and Pardina type lentils matured the earliest and the Laird (large green) type lentils matured the latest (Table2.) Canopy height ranged from 7 to 13 in and vine length ranged from 18 to 22 in.

Lentil test weights averaged 62.0 lb/bu (Table 1). Grain yields ranged from 29.3 bu/a (1,808 lb/a) for CDC Meteor to 40.5 bu/a (2,649 lb/a) for CDC Impala CL. Overall lentil yield across varieties was 34.1 bu/a (2,120 lb/a). CDC Impala CL and CDC Redberry were the highest yielding commercially available varieties.

Summary:

The 2010 growing season was cooler and moister than average, which most likely had an adverse impact on the lentil crop. Average grain yield and test weight (2,120 lb/a and 62 lb/bu respectively) were lower than in 2009 (2,438 lb/a and 70 lb.bu respectively). Earlier planting date in 2010 did not seem to have a significant effect on time to maturity.

Future Plans:

Trials will continue to be conducted each year in order to identify varieties suitable to the region.

Table 1. Seed yield and agronomic characteristics of varieties grown in the 2010 Statewide Lentil Variety Evaluation, Northwestern Agricultural Research Center, Kalispell, MT.

Variety	Grain Yield	Grain Yield	Test Weight	Days to Flower	Days to Maturity	Canopy Height	Vine Length
	bu/a	*lb/a*	*lb/bu*	*days after planting*	*days after planting*	*in*	*in*
Large Green							
Riveland	31.1	1835	58.8	65	109	7	20
Pennell	32.0	1929	60.1	65	106	9	18
CDC Improve CL	31.8	1951	61.2	65	111	8	20
Merrit	31.3	1889	60.2	65	104	9	20
Medium Green							
Brewer	**34.4** +	2092	60.7	64	104	7	19
CDC Vantage	30.5	1810	59	65	110	8	19
CDC Richlea	**34.1** +	2078	60.9	66	109	8	21
CDC Meteor	29.3	1808	61.6	66	105	8	20
LC01602300R	**40.4** +	2538	62.6	65	108	9	22
Small Green							
LC01602307E	**37.3** +	2382	63.7	65	109	8	20
Red							
CDC Redberry	**35.7** +	2268	63.6	65	109	13	19
LC01602062T	**35.7** +	2253	63.2	65	102	8	19
Crimson	**33.8** +	2184	64.6	65	101	8	16
CDC Impala CL	**40.5** ++	2649	65.4	67	102	7	20
Pardina							
LC01602245P	33.0	2128	64.4	65	101	7	15
Average	34.1	2120	62.0	65	106	8	19
F test	*ns*	**	**	**	**	**	**
LSD (α=0.05)	7.31	452.2	2.14	0.9	3.2	2.6	3

Grain yield and test weight are adjusted to 10% grain moisture content.

++Indicates highest yielding cultivar.

+Indicates cultivars yielding equal to the highest yielding cultivar based on Fisher's Protected LSD at the 0.05 probability level.

** Effects are significant at P<0.01; *ns* denotes non-significant effects.

CL indicates varieties that are Clearfield® herbicide resistant.

Table 2. Lentil variety characteristics

Variety	Type	Seed coat	Cotyledon	Resistance	Seed Size[1]	Maturity[2]
Riveland	Laird	Green	Yellow	as	Large	Late
Pennell	Laird	Green	Yellow	PEMV/as	Large	Moderate
CDC Improve CL	Laird	Green	Yellow	-	Large	Late
Merrit	Brewer	Mottled Green	Yellow	PEMV	Med. Large	Moderate
Brewer	Brewer	Mottled Green	Yellow	-	Medium	Moderate
CDC Vantage	Richlea	Green	Yellow	as	Medium	Late
CDC Richlea	Richlea	Green	Yellow	-	Medium	Late
CDC Meteor	Richlea	Green	Yellow	-	Medium	Moderate
LC01602300R	Richlea	Green	Yellow	-	Medium	Late
LC01602307E	Eston	Green	Yellow	-	Small	Late
CDC Redberry	Turkish	Gray	Red	as/an	Small	Late
LC01602062T	Turkish	Brown	Red	-	Small	Early
Crimson	Turkish	Brown	Red	-	Small	Early
CDC Impala CL	Turkish	Brown	Red	as/an	Extra Small	Early
LC01602245P	Pardina	Brown	Yellow	-	Small	Early

[1]- Size Classes (b/1000 seeds): Large: >60-65; Medium: 50-60; Small <50

[2]- Maturity (days): Early < 103; Moderate 104-106; Late >108, based on data collected at Kalispell, MT.

an: anthracnose

as: ascochyta

PEMV: pea enation mosaic virus