FORTY-EIGHTH ANNUAL REPORT
1996

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

4570 Montana 35
Kalispell, MT 59901

Prepared by

Leon E. Welty
Professor of Agronomy & Superintendent
Robert N. Stougaard
Assistant Professor, Weed Science
Doug Holen Jr.
Research Associate
Louise S. Prestbye
Agric. Research Specialist

Compiled by Elaine M. Scott, Administrative Support

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ADMINISTRATION 750

The Administration Project at the Northwestern Agricultural Research Center includes expenses for the overall operation of the center, personnel and office equipment purchased.

Purchase of computer for Administrative Support $ 3,123.00

Full Time Staff Members **Years in Service**

Leon E. Welty - Supt. & Prof. Agronomy (Began January 1973) 23

Robert N. Stougaard - Assistant Professor, Weed Science 5
(Began November 1991)

Todd K. Keener - Ag Research Spec. II (Began March 1978-resigned March 1996)

Doug L. Holen Jr. - Research Associate (Began April 1996) . . . . . 8 mos.

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Paul P. Koch - Farm/Ranch Hand III (Began May 1995) 1

Vern R. Stewart - Professor Emeritus

Part Time Employees:

Paul Ausenhus (June 10 through August 23)

Jan Haaven (March 28 through November 22)

Sarah Gunderson (May 9 through October 24)

David Alzner (June 10 through August 16)

Student Employees:

Gail Sharp (May 14 through August 30)

Dana Wittinger (May 15 through August 16)

Jeffrey Wood (June 4 through September 13)

GENERAL FARM 751

The General Farm Project (751) supports all research projects. This includes items purchased and used in the total research program. The following were leased in 1996:

John Deere 6400 tractor	$ 2,322.10
John Deere 870 tractor	$ 1,211.86

PHYSICAL PLANT 752

The Physical Plant Project (752) includes the maintenance of buildings and grounds at the Northwestern Agricultural Research Center.

WEED AND SMALL GRAIN MANAGEMENT FOR WESTERN MONTANA 754

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

Purchase of Seed Counter	$ 3,895.00
Purchase of Balance Scales	$ 1,982.00

PROFESSIONAL & CLIENTELE PRESENTATIONS 1996

Date	Activity	Who	Where
1/11	Advisory Committee	Welty Stougaard	Missoula
1/18	Mint Industry Research Council Meeting	Welty	Las Vegas, NV
2/9	IPM Meeting	Stougaard	Bozeman
2/12	Mint Growers Association	Welty Stougaard	Kalispell
2/15	Lake's Seed, Inc.-Producers	Welty Stougaard	Ronan
2/19	Equity Agronomy Meeting-Producers	Welty Stougaard	Kalispell
3/14	Pea & Lentil - Producers	Stougaard	Kalispell
5/10	Area Business People	Welty	NWARC
6/11	MT Vo-Ag Teachers-Tour	Welty Stougaard	NWARC
6/18	Arizona Farmers - Tour	Welty	NWARC
6/21	Flaxville High School Students-Tour	Welty	NWARC
6/27	Chinese Delegates - Tour	Welty Stougaard	NWARC
7/5	Great Britain Farmers - Tour	Welty	NWARC
7/14	Massachusetts Farmers - Tour	Welty	NWARC
7/16	Mint Flavorists - Tour	Welty	NWARC
7/18	Mint Producers - Tour	Welty Stougaard	NWARC
7/22	Japanese Students - Tour	Welty Stougaard	NWARC
8/5	Japanese Students - Tour	Welty	NWARC
	Mint Oil Buyers - Tour	Welty	NWARC
8/9	Mint Oil Buyers - Tour	Welty	NWARC
8/12	Japanese Students - Tour	Welty	NWARC
8/19	Japanese Students - Tour	Welty	NWARC
8/20	Holland Mint Oil Buyers - Tour	Welty	NWARC
10/7	Producers - Tour	Welty	NWARC

CLIMATOLOGICAL DATA
NORTHWESTERN AGRICULTURAL RESEARCH CENTER
Kalispell,MT

The growing season of 1995/1996 was generally characterized by above normal precipitation and below normal temperatures. Precipitation was 23% above normal and accumulated growing degree days was 12% below normal (1670 vs 1879). Precipitation for April and May was 200% of normal. Adequate snow cover was present during December and January to protect the crops when the air temperature dipped to -32^{0}F on the 31st of January. However, abnormally high temperatures occurring from Feb. 6 through Feb. 26 melted the snow pack resulting in severe flooding and considerable soil erosion. Air temperatures then turned cold again on Feb. 26, dipped to -4^{0}F on Feb. 26 and remained cold until March 7.

Because of the cool wet spring, small grain planting was 2 to 3 weeks behind schedule. Generally, the small grains are seeded by April 20. Late seedings of barley on heavier wet soils were stunted and yellow and had to be turned under. It was very apparent that 'mudding in the crop' did not work in 1996. Wet conditions persisted until the end of June when it turned hot and dry. Evidently, the cereals had not developed normal roots because the plants were moisture stressed during July resulting in below normal yields on lighter soils. Rain and cool temperatures kicked in again in late July and early Aug. delaying harvest. All in all it was a very challenging year for growing small grains.

Alfalfa was mildly stressed by the winter. Several acres of a three-year-old stand were killed because of 'icing over'. This area was sprayed with Roundup and then reseeded 'no till' with alfalfa early in the spring with excellent results. No evidence of alfalfa toxicity was apparent. First harvest was delayed and yields were below normal because of the cool, wet spring. Second and third harvests were about normal.

The crop most affected by the unusual winter and the cool, wet spring was peppermint. The peppermint was in excellent condition in mid Feb. after the big thaw. The following cold temperatures (-4^{0}F), however, resulted in stand loss in one field. These stand losses were not as severe on the Station as they were in other parts of the Flathead valley. Winter kill of the peppermint was particularly bad northwest of the Flathead river. Growth of the peppermint was very slow in May-at least 2 to 3 weeks behind normal. We normally receive 234 growing degree days (see following table) in May, but in 1996 only received 92 growing degree days. Generally, peppermint oil yields were below normal in 1996.

This year is shaping up to be as interesting as last year. At this writing (March 11), we have received 167% of normal precipitation (14.88" as compared to the normal of 8.88"). In early March we surpassed the accumulated snow record with over 120" being recorded. The previous record occurred for the 1977/1978 winter.

Following is a list of tables giving a complete description of the weather for the crop year (September 1994 through August 1996) and 1996 (January through December).

Table 1. Summary of climatic data by months for 1995-96 crop year (September through August) and averages for the period 1949-96 at the Northwestern Agricultural Research Center, Kalispell, MT.

Table 2. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1996. (Average)

Table 3. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1996. (Maximum)

Table 4. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1996. (Minimum)

Table 5. Summary of precipitation records at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1996.

Table 6. Precipitation by day for crop year September 1, 1992 through August 31, 1996, Northwestern Agricultural Research Center, Kalispell, MT.

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 through 1996.

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950-1996.

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center, January 1950 through December 1996.

Table 10. Summary of precipitation records at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 through December 1996.

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, Kalispell, MT, May 1, 1949 through October 31, 1996.

Table 12. Summary of snow data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1996.

Table 1. Summary of climatic data by months for 1995-96 crop year (September thru August) and averages for the period 1949-96 at the Northwestern Agricultural Research Center, Kalispell, MT.

ITEM	Sept. 1995	Oct. 1995	Nov. 1995	Dec. 1995	Jan. 1996	Feb. 1996	Mar. 1996	Apr. 1996	May 1996	June 1996	July 1996	Aug. 1996	Total or Average
Precipitation (inches)													
Current Year	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
Avg. 1949 to 1995-96	1.55	1.38	1.54	1.62	1.50	1.15	1.16	1.51	2.33	2.93	1.64	1.56	19.87
Mean Temperature (F)													
Current Year	54.9	41.1	34.9	26.7	17.4	24.0	29.0	43.2	46.6	58.5	65.4	62.5	42.0
Avg. 1949 to 1995-96	53.5	43.2	32.6	25.4	22.3	27.6	33.8	43.3	51.6	58.3	63.9	62.9	43.2

Last killing frost in spring

1996	May 21 (31 degrees)
Avg. 1949-96	May 24

First killing frost in fall

1996	September 23 (27 degrees F)
Avg. 1949-96	September 14

Frost Free Period

1996	125 days
Avg. 1949-96	113 days

Growing Degree Days (base 50):

May 1-Oct. 31, 1996	1670.0 days
Avg. 1949-96	1878.8 days

Maximum summer temperature	91	degrees F on 7/19/96
Minimum winter temperature	-32	degrees F on 1/31/96

In this summary 32 degrees is considered a killing frost.

Table 2. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1996.

Average temperature by month and year
Degrees Fahrenheit

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	MEAN
1949-50	54.1	41.5	38.5	25.0	4.2	25.6	31.2	41.9	49.7	57.0	64.0	62.5	41.3
1950-51	53.8	45.9	31.5	29.5	20.2	27.7	27.0	42.1	50.0	54.2	64.7	60.4	42.3
1951-52	50.6	40.8	30.8	16.9	18.0	26.6	29.3	45.8	52.4	56.7	61.8	62.8	41.0
1952-53	56.0	45.5	30.4	27.6	36.0	32.9	37.2	41.2	49.5	54.6	64.3	63.1	44.9
1953-54	56.1	46.2	37.0	31.3	21.1	31.2	29.6	40.8	52.5	54.9	63.4	60.1	43.7
1954-55	52.9	41.5	38.8	28.8	25.7	22.1	24.5	39.1	47.7	58.8	62.7	62.2	42.1
1955-56	52.5	44.6	23.5	21.8	23.3	20.9	31.5	44.2	54.0	59.0	64.8	62.0	41.8
1956-57	55.2	44.1	30.9	28.5	10.2	23.4	33.3	43.7	55.6	59.7	65.4	62.4	42.7
1957-58	55.8	41.4	32.1	32.4	29.1	30.4	32.2	43.6	59.6	62.3	65.2	67.9	46.0
1958-59	55.5	44.6	32.8	28.2	24.7	23.1	35.3	45.2	48.1	59.9	64.5	61.0	43.6
1959-60	53.0	43.9	25.5	27.6	19.4	25.2	32.3	44.3	50.6	59.6	68.8	60.6	42.6
1960-61	55.0	45.2	34.4	24.9	27.8	37.0	38.3	42.0	52.6	64.7	66.2	67.8	46.3
1961-62	49.6	42.3	28.2	23.6	17.4	25.7	30.9	47.2	51.5	58.6	62.1	62.1	41.6
1962-63	54.7	44.7	38.0	32.5	11.8	33.1	38.7	43.2	51.4	59.4	63.0	64.9	44.6
1963-64	58.7	47.4	35.8	24.0	28.5	28.3	30.6	42.8	51.1	58.7	64.3	58.9	44.1
1964-65	51.2	43.7	33.7	22.1	30.2	28.7	28.6	45.2	50.6	57.6	64.6	63.6	43.3
1965-66	46.4	47.6	35.0	28.8	26.3	27.7	34.5	42.9	54.3	56.0	64.5	61.7	43.8
1966-67	59.3	43.4	33.4	30.2	31.0	33.2	32.9	40.6	52.2	59.4	66.1	67.2	45.7
1967-68	61.0	45.9	33.8	25.2	23.3	32.8	41.2	42.0	49.8	59.0	64.6	61.3	45.0
1968-69	53.8	42.9	33.4	19.9	13.1	24.0	29.6	47.1	53.9	58.8	62.3	63.6	41.9
1969-70	56.0	40.0	35.2	27.7	21.9	29.9	32.8	40.2	53.2	62.0	64.8	62.6	43.9
1970-71	48.7	40.1	31.3	26.2	23.6	29.9	33.2	43.6	52.5	54.9	61.9	68.2	42.8
1971-72	49.5	40.4	34.1	22.2	17.0	27.3	38.5	40.6	51.9	59.3	61.5	65.9	42.4
1972-73	50.2	40.3	33.7	19.9	20.7	27.8	37.7	42.2	51.5	57.5	65.1	64.5	42.6
1973-74	53.3	44.1	29.3	30.8	21.0	32.3	33.6	42.7	48.0	61.5	64.8	61.6	43.6
1974-75	52.8	43.6	34.8	30.1	21.5	21.5	29.9	37.6	48.6	55.9	69.1	59.8	42.1
1975-76	52.1	42.9	35.4	27.5	27.7	29.9	31.0	43.4	51.9	54.5	63.4	61.3	43.4
1976-77	55.2	42.4	33.1	28.6	20.0	30.9	34.4	45.0	49.7	61.5	62.6	62.8	43.9
1977-78	51.7	42.5	30.4	22.0	21.6	26.1	34.3	43.7	48.1	59.1	63.4	60.3	41.9
1978-79	53.7	43.7	27.2	18.8	4.1	24.9	34.7	42.3	51.5	59.4	65.0	65.4	40.9
1979-80	56.9	46.6	30.7	33.0	16.3	29.0	32.6	47.1	54.8	56.9	63.5	58.6	43.8
1980-81	54.1	45.3	35.8	32.2	30.1	31.3	38.5	44.5	52.5	53.8	62.8	66.4	45.6
1981-82	55.3	43.2	36.0	27.0	21.6	24.5	37.5	39.4	49.8	59.8	61.1	63.0	43.2
1982-83	53.4	41.0	29.1	25.9	30.3	33.8	37.9	42.4	51.9	57.6	59.6	65.4	44.0
1983-84	50.4	42.9	36.6	11.1	27.6	32.4	38.3	42.2	48.7	56.4	65.3	64.6	43.0
1984-85	49.5	40.0	32.6	20.6	19.2	19.0	30.8	44.8	53.7	57.6	68.3	60.2	41.4
1985-86	47.8	40.8	18.6	18.3	25.4	25.6	40.6	43.8	53.7	63.9	59.9	66.1	42.0
1986-87	50.2	43.0	30.3	24.9	22.2	27.9	35.0	47.8	55.6	61.6	62.9	59.8	43.4
1987-88	56.1	43.3	35.3	25.4	20.5	30.3	37.8	45.7	51.4	60.9	63.7	63.9	44.5
1988-89	53.4	43.4	36.3	23.3	27.5	12.4	28.8	44.2	49.6	59.8	65.4	61.9	42.2
1989-90	52.7	42.7	35.8	25.3	30.5	24.5	34.8	45.2	49.8	57.2	65.2	64.8	44.0
1990-91	59.1	41.9	36.1	16.5	18.3	34.6	32.8	42.4	50.3	55.1	64.0	65.2	43.0
1991-92	54.4	40.6	32.1	29.3	28.7	34.5	39.7	45.1	53.5	55.5	61.2	61.8	44.7
1992-93	51.1	44.7	33.1	19.4	14.7	18.4	33.7	43.6	56.0	56.5	56.6	59.7	40.6
1993-94	51.4	44.4	25.0	27.4	32.9	20.6	37.5	45.4	54.0	57.3	66.4	63.0	43.8
1994-95	56.3	42.8	29.7	27.1	23.6	33.7	33.1	42.6	51.6	56.3	63.1	59.5	43.3
1995-96	54.9	41.1	34.9	26.7	17.4	24.0	29.0	43.2	46.6	58.5	65.4	62.5	42.0
MEAN	53.5	43.2	32.6	25.4	22.3	27.6	33.8	43.3	51.6	58.3	63.9	62.9	43.2

Mean temperature for all years = 43.2

Table 3. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1996.

Average maximum temperature by month and year
Degrees Fahrenheit

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	MEAN
1949-50	71.4	52.4	45.7	32.1	14.4	34.6	38.4	52.3	63.1	70.1	78.6	79.5	52.7
1950-51	70.9	55.8	38.2	36.3	28.7	36.6	37.3	57.9	63.2	66.6	82.4	77.0	54.2
1951-52	64.2	47.5	37.2	23.6	25.9	35.7	39.5	61.8	65.7	70.2	79.2	79.5	52.5
1952-53	73.4	62.6	40.6	33.2	41.3	39.1	46.8	51.5	62.5	66.8	83.3	79.5	56.7
1953-54	72.3	61.0	45.6	36.7	29.1	38.4	40.0	51.0	67.2	67.0	80.1	74.4	55.2
1954-55	66.4	53.4	45.9	34.9	31.8	31.2	33.9	48.1	60.5	74.7	76.9	82.4	53.3
1955-56	67.6	55.5	30.8	29.2	30.7	30.1	39.7	57.4	67.5	73.3	81.2	77.8	53.4
1956-57	71.0	53.7	37.6	35.5	19.0	33.2	43.3	55.3	70.2	72.4	82.1	80.0	54.4
1957-58	74.3	50.5	40.1	38.5	33.7	37.9	43.5	54.4	77.5	75.7	80.8	85.5	57.7
1958-59	69.7	57.9	39.6	34.1	31.8	31.9	43.9	57.9	61.5	74.3	83.2	76.3	55.2
1959-60	64.0	53.6	33.9	33.3	27.5	34.1	43.4	56.1	63.0	74.8	88.7	74.1	53.9
1960-61	72.1	57.8	41.1	29.8	35.0	43.1	48.2	51.6	65.3	82.0	83.7	86.3	58.0
1961-62	62.3	53.3	35.1	30.4	26.0	33.4	40.5	60.7	62.7	74.2	79.2	77.5	52.9
1962-63	71.7	54.7	43.8	37.9	19.9	41.4	48.9	55.7	67.1	71.8	79.6	82.5	56.3
1963-64	74.6	59.4	43.4	30.2	35.1	37.7	39.7	53.3	63.5	71.4	80.3	72.9	55.1
1964-65	63.9	55.0	41.0	28.9	35.1	36.9	41.0	57.6	64.3	71.4	80.8	77.1	54.4
1965-66	57.5	61.1	42.6	35.4	31.8	35.3	45.4	54.8	69.8	69.1	81.2	78.4	55.2
1966-67	74.9	55.1	41.1	35.8	36.7	40.9	41.3	52.6	66.0	73.3	84.8	87.2	57.5
1967-68	78.9	55.8	41.3	30.8	31.5	40.8	52.6	54.2	63.4	72.2	82.7	75.7	56.7
1968-69	65.9	53.1	40.6	27.3	20.8	32.5	40.9	59.5	68.7	72.0	78.9	83.0	53.6
1969-70	70.4	49.7	43.0	32.8	28.5	36.2	42.5	49.7	67.9	75.5	79.1	80.9	54.7
1970-71	62.5	52.2	40.0	34.1	30.6	38.6	41.6	56.2	66.4	67.3	78.0	87.5	54.6
1971-72	64.2	53.1	41.2	30.9	27.1	35.9	47.9	51.7	64.7	72.4	76.9	83.3	54.1
1972-73	64.0	51.3	41.4	28.6	30.6	38.5	47.7	53.8	65.8	69.6	83.7	83.2	54.9
1973-74	67.6	56.3	36.8	36.5	28.5	39.6	43.5	53.1	59.2	76.2	80.3	77.6	54.6
1974-75	70.9	61.4	43.2	37.4	32.0	31.5	39.4	48.1	61.2	68.5	85.5	73.0	54.3
1975-76	69.4	52.3	40.4	35.1	36.2	37.6	40.1	54.3	66.2	66.3	79.0	74.4	54.3
1976-77	73.2	57.7	42.1	36.1	28.0	39.1	42.7	60.2	61.9	77.0	76.6	77.4	56.0
1977-78	64.7	55.4	38.5	29.4	28.8	35.5	45.5	54.3	58.1	72.6	77.5	74.2	52.9
1978-79	65.7	59.2	35.9	28.2	13.7	33.2	45.3	52.5	64.3	73.9	81.5	82.8	53.0
1979-80	74.1	59.5	37.8	39.2	25.2	35.9	40.8	60.4	66.9	69.0	77.0	73.2	54.9
1980-81	66.9	59.0	43.9	39.2	34.0	38.9	49.7	54.8	63.3	63.8	78.1	85.0	56.4
1981-82	70.8	54.1	44.9	34.2	29.7	33.3	45.8	50.5	62.5	74.3	75.0	80.6	54.6
1982-83	69.2	53.2	36.9	33.0	36.8	42.2	47.5	55.2	66.4	70.6	73.1	82.9	55.6
1983-84	65.1	56.0	43.7	19.9	34.6	40.8	46.8	54.2	60.4	69.1	82.8	83.3	54.7
1984-85	63.9	52.2	40.4	28.2	25.3	29.1	42.7	56.8	68.7	73.2	88.0	75.0	53.6
1985-86	60.4	51.3	26.7	25.2	34.0	36.6	51.6	55.1	66.1	78.5	73.0	84.1	53.6
1986-87	59.9	54.3	38.0	30.9	29.5	34.2	43.4	61.3	67.9	75.7	76.5	74.9	53.9
1987-88	73.5	59.9	43.0	32.6	29.0	39.3	46.1	58.5	63.8	74.1	79.5	82.6	56.8
1988-89	69.0	62.0	42.7	30.3	35.3	21.8	36.1	56.6	61.1	72.6	81.6	75.0	53.7
1989-90	68.5	54.0	42.4	30.5	36.4	33.9	44.8	57.3	60.5	68.9	79.7	79.5	54.7
1990-91	77.9	53.0	43.8	24.1	25.6	42.5	41.6	54.0	61.7	65.5	78.2	81.6	54.1
1991-92	70.9	56.1	38.6	33.7	35.1	42.7	52.7	57.7	67.7	67.8	73.1	78.0	56.2
1992-93	64.9	57.4	38.0	27.2	22.4	27.0	43.7	52.8	69.7	67.8	66.2	73.8	50.9
1993-94	66.6	56.8	33.5	33.3	38.9	30.2	48.9	57.4	66.7	70.5	83.0	85.0	55.9
1994-95	74.0	54.1	36.4	33.1	29.3	43.3	42.9	52.7	63.9	67.6	75.5	74.1	53.9
1995-96	70.0	50.4	43.0	32.2	25.3	33.1	38.7	54.1	55.1	70.5	81.0	78.1	52.6
MEAN	68.6	55.3	40.0	32.1	29.7	36.1	43.6	55.0	64.7	71.5	79.7	79.3	54.6

Mean temperature for all years = 54.6

Table 4. Summary of temperature data at the Northwestern Agricultural Research Center on crop year basis September 1, 1949 through August 31, 1996.

Average minimum temperature by month and year
Degrees Fahrenheit

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	MEAN
1949-50	36.7	35.0	31.2	17.8	-6.0	16.6	23.9	31.5	36.3	43.9	49.4	45.5	30.2
1959-51	36.6	36.0	24.8	22.6	11.7	18.8	16.6	26.2	36.7	41.7	46.9	43.7	30.2
1951-52	37.0	34.0	24.4	10.1	10.0	17.4	19.1	29.8	39.1	43.1	44.3	46.1	29.5
1952-53	38.6	28.3	20.2	21.9	30.6	26.7	27.5	30.9	36.5	42.3	45.3	46.7	33.0
1953-54	39.8	31.4	28.4	25.9	13.1	24.0	19.2	30.6	37.7	42.8	46.7	45.7	32.1
1954-55	39.3	29.5	31.6	22.7	19.5	13.0	15.0	30.0	34.9	42.8	48.5	42.0	30.7
1955-56	37.3	33.6	16.1	14.4	15.9	11.7	23.3	30.9	40.5	44.7	48.2	46.1	30.2
1956-57	39.4	34.4	24.2	21.5	1.4	13.6	23.2	32.0	40.9	47.0	48.7	44.8	30.9
1957-58	37.2	32.3	24.1	26.2	24.5	22.8	20.9	32.8	41.7	48.8	49.5	50.3	34.3
1958-59	41.2	31.2	26.0	22.2	17.5	14.2	26.6	32.4	34.7	45.4	45.8	45.6	31.9
1959-60	42.0	34.1	17.0	21.8	11.2	16.3	21.1	32.4	38.1	44.3	48.8	47.0	31.2
1960-61	37.9	32.5	27.6	19.9	20.6	30.9	28.4	32.3	39.8	47.4	48.7	49.2	34.6
1961-62	36.8	31.2	21.2	16.8	8.7	17.9	21.2	33.7	40.3	43.0	45.0	46.6	30.2
1962-63	37.6	34.6	32.2	27.1	3.7	24.7	28.4	30.6	35.7	47.0	46.4	46.9	32.9
1963-64	42.7	35.3	28.1	17.7	21.8	18.9	21.4	32.2	38.6	46.0	48.3	44.9	33.0
1964-65	38.4	32.3	26.4	15.3	25.3	20.4	16.2	32.7	36.9	43.8	48.4	50.0	32.2
1965-66	35.2	34.0	27.4	22.1	20.8	20.0	23.6	30.9	38.7	42.8	47.7	45.0	32.4
1966-67	43.6	31.7	25.6	24.6	25.3	25.5	24.5	28.6	38.4	45.4	47.4	47.2	34.0
1967-68	43.1	35.9	26.3	19.4	15.0	24.8	29.7	29.8	36.1	45.7	46.4	46.8	33.3
1968-69	41.7	32.6	26.1	12.5	5.4	15.4	18.2	34.6	39.0	45.5	45.7	43.5	30.0
1969-70	41.6	30.3	27.4	22.6	15.3	23.4	23.0	30.7	38.5	48.2	50.5	44.3	33.0
1970-71	34.9	27.9	22.5	18.3	16.5	21.0	24.8	31.0	38.6	42.3	45.7	48.8	31.0
1971-72	34.7	27.6	26.9	13.5	7.7	18.6	29.0	29.0	39.2	46.3	45.8	48.5	30.6
1972-73	36.4	29.2	25.9	11.1	11.0	17.4	27.8	29.6	36.4	44.4	46.5	45.8	30.1
1973-74	38.9	32.0	21.8	25.2	13.5	25.1	23.6	32.4	36.7	46.9	49.5	45.6	32.6
1974-75	34.7	25.7	26.3	22.9	10.9	11.5	20.4	27.1	36.1	43.3	52.7	46.5	29.8
1975-76	34.7	33.4	30.3	20.0	19.1	22.2	22.0	32.4	37.6	42.6	47.8	48.3	32.5
1976-77	37.2	27.2	24.1	21.1	12.0	22.6	26.1	29.9	37.4	46.0	48.5	48.2	31.7
1977-78	38.6	29.5	22.2	14.6	14.5	16.7	23.2	33.1	38.1	45.6	49.2	46.4	31.0
1978-79	41.7	28.3	18.4	9.3	-5.6	16.5	24.0	32.1	38.7	44.9	48.5	48.0	28.7
1979-80	39.7	33.7	23.6	26.8	7.5	22.1	24.5	33.7	42.7	44.7	50.0	44.0	32.8
1980-81	41.3	31.6	27.7	25.1	26.2	23.8	27.2	34.2	41.7	43.7	47.6	47.8	34.8
1981-82	39.7	32.2	27.0	19.8	13.5	15.7	29.2	28.4	37.2	45.3	47.3	45.4	31.7
1982-83	37.6	28.8	21.4	18.7	23.7	25.3	28.4	29.5	37.5	44.7	46.1	48.0	32.5
1983-84	35.6	29.7	29.5	2.4	20.6	24.0	29.9	30.2	37.1	43.6	47.8	46.0	31.4
1984-85	35.2	27.7	24.7	13.0	13.2	9.0	18.8	32.7	38.7	42.0	48.5	45.5	29.1
1985-86	35.2	30.2	10.6	11.4	16.9	14.5	29.6	32.5	41.3	49.3	46.8	48.1	30.5
1986-87	40.5	31.6	22.6	18.8	14.9	21.6	26.6	34.2	43.3	47.4	49.4	44.7	33.0
1987-88	38.7	26.5	27.6	18.1	11.5	21.3	29.5	33.0	39.0	47.7	47.9	45.2	32.2
1988-89	38.6	32.9	29.8	16.3	19.7	2.9	21.4	31.8	38.1	46.9	49.3	48.7	31.4
1989-90	36.9	31.3	29.3	20.1	24.7	15.2	24.7	33.2	39.1	45.4	50.6	50.0	33.4
1990-91	40.4	30.9	28.4	8.8	11.0	26.6	24.0	30.8	39.0	44.7	49.8	48.8	31.9
1991-92	37.9	25.1	25.6	25.0	22.4	26.3	26.8	32.6	39.2	43.2	49.3	45.7	33.3
1992-93	37.4	32.0	28.1	11.6	7.0	9.8	23.8	34.5	42.3	45.2	47.0	45.6	30.4
1993-94	36.3	32.0	16.6	21.5	27.0	11.0	26.2	33.4	41.3	44.1	49.8	48.3	32.3
1994-95	38.6	31.6	23.0	21.1	17.9	24.2	23.4	32.5	39.3	45.1	50.8	45.0	32.7
1995-96	39.9	31.9	26.9	21.3	9.5	14.9	19.3	32.4	38.1	46.6	49.8	46.9	31.5
MEAN	38.4	31.2	24.9	18.8	15.3	19.1	23.9	31.5	38.6	45.0	48.0	46.6	31.8

Mean temperature for all years = 31.8

Table 5. Summary of precipitation records at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1996.

	Total precipitation in inches by month and year												
YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	MEAN
1949-50	1.03	1.05	1.67	0.92	2.62	1.13	2.31	0.84	0.15	3.90	3.12	0.75	19.49
1950-51	0.52	2.30	1.16	2.48	0.94	1.29	0.62	2.32	3.77	2.26	1.03	2.86	21.55
1951-52	1.49	5.62	1.01	3.31	1.03	0.98	0.97	0.17	1.32	3.95	0.56	0.69	21.10
1952-53	0.13	0.05	0.60	0.98	1.84	1.14	0.98	2.07	2.00	3.31	T	1.62	14.72
1953-54	0.71	0.03	0.87	1.30	2.65	0.79	0.83	0.79	1.52	2.98	2.91	3.79	19.17
1954-55	1.09	0.54	1.00	0.43	1.00	1.31	0.44	0.82	1.18	1.86	3.08	0.00	12.75
1955-56	1.64	1.89	1.97	2.38	1.76	1.53	0.87	1.28	1.06	4.20	2.13	3.21	23.92
1956-57	1.16	1.10	0.53	0.96	1.47	1.14	0.75	1.22	1.75	2.51	0.52	0.78	13.89
1957-58	0.10	1.59	0.96	1.76	1.56	2.67	0.97	1.47	2.20	2.56	0.84	0.58	17.26
1958-59	1.99	1.16	2.90	2.77	1.95	1.33	0.75	1.62	4.10	1.75	T	0.91	21.23
1959-60	4.22	3.36	4.32	0.34	1.67	1.10	1.01	1.23	3.27	0.69	0.13	2.43	23.77
1960-61	0.55	1.44	1.72	1.24	0.65	1.46	1.96	2.26	4.02	1.45	0.76	0.64	18.15
1961-62	3.40	1.22	1.77	2.09	1.33	1.15	1.59	0.96	2.59	1.15	0.11	0.72	18.08
1962-63	0.58	1.85	1.31	0.91	1.69	1.21	0.85	1.07	0.57	5.00	1.44	2.10	18.58
1963-64	1.46	0.75	0.95	1.70	1.46	0.41	1.57	0.87	3.33	3.86	3.01	1.64	21.01
1964-65	2.27	0.85	1.62	3.62	2.25	0.64	0.24	2.55	0.81	2.30	1.15	4.74	23.04
1965-66	1.72	0.21	1.31	0.55	1.42	0.67	0.53	0.76	1.18	6.57	2.49	1.64	19.05
1966-67	0.79	1.34	3.33	1.68	1.50	0.62	1.27	0.99	1.30	2.53	0.02	0.01	15.38
1967-68	0.91	1.88	0.62	1.16	0.79	1.15	0.68	0.57	3.92	2.22	1.00	3.42	18.32
1968-69	4.51	2.39	1.59	3.12	3.05	0.75	0.69	1.39	1.19	5.21	0.70	0.09	24.68
1969-70	1.54	1.90	0.31	1.14	3.10	0.89	1.49	0.76	1.97	4.37	3.08	0.44	20.99
1970-71	1.79	1.38	1.75	0.99	1.84	0.77	0.69	0.58	2.45	4.42	1.31	1.11	19.08
1971-72	0.94	0.87	1.70	1.62	1.10	1.65	2.11	0.95	1.48	3.28	1.77	0.98	18.45
1972-73	1.38	1.84	0.80	2.19	0.52	0.56	0.70	0.45	1.13	2.14	0.01	0.63	12.35
1973-74	1.37	1.41	2.95	1.94	1.35	1.32	1.40	3.36	1.82	1.80	1.01	0.62	20.35
1974-75	0.80	0.12	1.10	1.31	1.56	1.08	1.50	1.27	1.50	1.40	1.08	4.26	16.98
1975-76	1.18	2.96	0.85	1.39	0.91	1.12	0.34	1.92	1.90	2.49	1.49	3.42	19.97
1976-77	0.96	0.62	0.73	0.86	0.83	0.71	1.40	0.41	2.90	0.52	3.60	1.50	15.04
1977-78	2.84	0.56	1.62	4.10	2.15	0.99	0.72	2.54	3.56	2.63	3.90	3.34	28.95
1978-79	1.90	0.15	0.96	0.91	1.70	1.45	0.82	2.33	2.67	1.23	0.40	1.79	16.31
1979-80	1.03	1.75	0.50	1.03	1.53	2.03	0.97	1.88	5.48	3.89	1.08	2.45	23.62
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
MEAN	1.55	1.38	1.54	1.62	1.50	1.15	1.16	1.51	2.33	2.93	1.64	1.54	19.87

Mean precipitation for all crop years = 19.87

Table 6. Precipitation by day for crop year, September 1, 1995 through August 31, 1996.
Northwestern Agricultural Research Center, Kalispell, MT.

DATE	SEPT. 1995	OCT. 1995	NOV. 1995	DEC. 1995	JAN. 1996	FEB. 1996	MAR. 1996	APR. 1996	MAY 1996	JUNE 1996	JULY 1996	AUG. 1996	YTD
1		0.16		0.02				0.66	0.18				
2				0.02	0.03			0.15	0.14				
3		0.32		0.04	0.18				0.09		0.02		
4		0.54		0.08	0.55	0.11	0.35		0.11				
5	0.59			0.01	0.02		0.55		0.23		0.03	0.34	
6	0.05		0.03	T	0.01	0.02	T					0.03	
7			0.14	T	0.13	0.49	0.05	0.04					
8			0.72		0.03	0.20	0.01		0.02				
9		0.02	0.07	0.02		T			0.11				
10				0.48	0.18			0.22	T				
11		0.02	0.28	0.34				0.60					
12		0.40	T	0.18				0.45	T				
13				0.25				0.55	0.14				
14								0.01	0.40				
15									0.40			0.08	
16			0.03						0.46	0.02			
17					0.02			0.09	0.02				
18	0.09	0.46	0.02	T		0.08			0.36		T		
19					0.06	0.11		0.20	0.02				
20					0.17	0.02			0.12				
21	0.01	0.19			0.43			T				0.25	
22		0.15	0.03		0.01	0.15	0.02	0.04	0.02	0.31			
23			0.07		0.07	T	0.09	0.08	0.90	0.18			
24			T		0.02			0.18	0.11	0.50			
25			0.04		0.03			0.03		0.55			
26		0.49	0.01		0.02					0.01			
27			0.12		0.02			T		0.04			
28	0.21		0.32		0.12			T	0.08	0.44			
29	0.04		0.43		0.12			0.02	0.48			0.10	
30	0.22		0.02	0.11			0.09		0.04		0.72		
31				0.36			0.03		0.15		0.18		
TOTAL	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

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 thru 1996.

YEAR	DATE LAST FREEZE	TEMPERATURE DEGREE F	DATE FIRST FREEZE	TEMPERATURE DEGREES F	FROST FREE SEASON
1950	June 10	32	Sept. 11	29	93
1951	June 1	29	Sept. 15	29	106
1952	June 14	32	Sept. 8	29	86
1953	May 23	32	Sept. 16	31	116
1954	May 29	31	Sept. 30	26	124
1955	May 25	28	Sept. 13	31	111
1956	May 3	26	Sept. 2	32	122
1957	May 23	30	Sept. 9	30	109
1958	May 14	31	Sept. 27	31	136
1959	June 11	32	Aug. 30	30	80
1960	June 18	32	Sept. 6	32	80
1961	May 6	32	Sept. 12	29	129
1962	May 30	32	Sept. 3	25	96
1963	May 22	28	Sept. 18	32	119
1964	May 25	26	Sept. 11	28	109
1965	June 7	30	Sept. 6	31	91
1966	May 18	26	Sept. 30	28	135
1967	May 26	28	Sept. 23	32	120
1968	May 20	32	Sept. 21	32	124
1969	June 13	28	Sept. 6	32	85
1970	May 11	32	Sept. 10	31	122
1971	July 7	32	Sept. 14	28	69
1972	May 4	32	Sept. 12	32	131
1973	May 22	31	Sept. 2	31	103
1974	May 18	31	Sept. 2	30	107
1975	May 25	32	Sept. 12	32	110
1976	May 21	30	Sept. 8	30	110
1977	May 16	29	Sept. 27	28	133
1978	May 23	31	Sept. 17	28	116
1979	May 30	31	Oct. 1	32	123
1980	June 4	32	Sept. 24	31	111
1981	May 5	28	Sept. 24	25	142
1982	May 30	31	Sept. 15	23	108
1983	May 15	31	Sept. 6	31	114
1984	June 2	32	Sept. 13	30	103
1985	May 13	26	Sept. 7	32	117
1986	May 16	31	Sept. 7	31	114
1987	May 22	28	Sept. 17	29	117
1988	May 3	30	Sept. 12	30	131
1989	May 21	32	Sept. 9	29	110
1990	May 10	31	Oct. 6	24	149
1991	May 27	32	Sept. 19	32	115
1992	May 17	30	Aug. 24	32	99
1993	May 4	32	Sept. 13	29	132
1994	April 30	31	Sept. 12	32	135
1995	May 27	32	Sept. 21	22	117
1996	May 21	31	Sept. 23	27	125
Mean for years	May 24	30	Sept. 14	30	113

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950-96.

	MINIMUM		MAXIMUM	
YEAR	DATE	TEMPERATURE DEGREES F	DATE	TEMPERATURE DEGREES F
1950	Jan. 30	-40	Aug. 31	88
1951	Jan. 28	-25	Aug. 2	92
1952	Jan. 1	-14	Aug. 31	90
1953	Jan. 6	8	July 12	97
1954	Jan. 20	-32	July 6	90
1955	Mar. 5	-20	June 22	96
1956	Feb. 16	-25	July 22	90
1957	Jan. 26	-34	July 13	91
1958	Jan. 1	2	Aug. 11	94
1959	Nov. 16	-30	July 23	96
1960	Mar. 3	-32	July 19	98
1961	Jan. 2	0	Aug. 4	100
1962	Jan. 21	-32	Aug. 16	92
1963	Jan. 30	-24	Aug. 9	94
1964	Dec. 17	-28	July 8	91
1965	Mar. 24	-10	July 31	89
1966	Mar. 4	- 7	Aug. 2,25	91
1967	Jan. 24	2	Aug. 19	95
1968	Jan. 21	-23	July 7	94
1969	Jan. 25	-13	Aug. 24	97
1970	Jan. 15	-14	Aug. 21,25	92
1971	Jan. 12	- 8	Aug. 6, 9	96
1972	Jan. 28	-24	Aug. 9,10	92
1973	Jan. 11	-22	July 11	97
1974	Jan. 5	-18	June 16,20	93
1975	Jan. 12, Feb. 9	-16	July 12	96
1976	Feb. 5	- 4	July 27	90
1977	Dec. 31	-11	June 7	97
1978	Dec. 31	-31	July 16	91
1979	Jan. 1	-31	July 20	97
1980	Jan. 29	-20	July 23	92
1981	Feb. 21	-21	Aug. 26,27	97
1982	Feb. 9,10	-23	Aug. 8	91
1983	Dec. 25	-29	Aug. 8	97
1984	Jan. 18	-14	July 27	97
1985	Jan. 30	-24	July 9,11,23	94
1986	Nov. 10	- 8	May 30	93
1987	Jan. 16, Dec. 31	- 4	July 27	95
1988	Jan. 6	-17	July 22, Aug. 6	92
1989	Feb. 4, 5	-20	Aug. 1	96
1990	Dec. 30	-33	Aug. 16	94
1991	Jan. 2, 3	-11	Aug. 10	92
1992	Jan. 20	10	Aug. 15	93
1993	Feb. 18	-19	May 13	91
1994	Feb. 8	-25	Aug. 15	97
1995	Jan. 4	-11	Aug. 6	88
1996	Jan. 31	-32	July 19	91

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center January 1950 through December 1996.

AVERAGE TEMPERATURE BY MONTH AND YEAR
DEGREES FAHRENHEIT

DATE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
1950	4.2	25.6	31.2	41.9	49.7	57.0	64.0	62.5	53.8	45.9	31.5	29.5	41.4
1951	20.2	27.7	27.0	42.1	50.0	54.2	64.7	60.4	50.6	40.8	30.8	16.9	40.5
1952	18.0	26.6	29.3	45.8	52.4	56.7	61.8	62.8	56.0	45.5	30.4	27.6	42.7
1953	36.0	32.9	37.2	41.2	49.5	54.6	64.3	63.1	56.1	46.2	37.0	31.3	45.8
1954	21.1	31.2	29.6	40.8	52.5	54.9	63.4	60.1	52.9	41.5	38.8	28.8	43.0
1955	25.7	22.1	24.5	39.1	47.7	58.8	62.7	62.2	52.5	44.6	23.5	21.8	40.4
1956	23.3	20.9	31.5	44.2	54.0	59.0	64.8	62.0	55.2	44.1	30.9	28.5	43.2
1957	10.2	23.4	33.3	43.7	55.6	59.7	65.4	62.4	55.8	41.4	32.1	32.4	43.0
1958	29.1	30.4	32.2	43.6	59.6	62.3	65.2	67.9	55.5	44.6	32.8	28.2	46.0
1959	24.7	23.1	35.3	45.2	48.1	59.9	64.5	61.0	53.0	43.9	25.5	27.6	42.7
1960	19.4	25.2	32.3	44.3	50.6	59.6	68.8	60.6	55.0	45.2	34.4	24.9	43.4
1961	27.8	37.0	38.2	42.0	52.6	64.7	66.2	67.8	49.6	42.3	28.2	23.6	45.0
1962	17.4	25.7	30.9	47.2	51.5	58.6	62.1	62.1	54.7	44.7	38.0	32.5	43.8
1963	11.8	33.1	38.7	42.3	51.4	59.4	63.0	64.9	58.7	47.4	35.8	24.0	44.2
1964	28.5	28.3	30.6	42.8	51.1	58.7	64.3	58.9	51.2	43.7	33.7	22.1	42.8
1965	30.2	28.7	28.6	45.2	50.6	57.6	64.6	63.6	46.4	47.6	35.0	28.8	43.9
1966	26.3	27.7	34.5	42.9	54.3	56.0	64.5	61.7	59.3	43.4	33.4	30.2	44.5
1967	31.0	33.2	32.9	40.6	52.2	59.4	66.1	67.2	61.0	45.9	33.8	25.1	45.7
1968	23.3	32.8	41.2	42.0	49.8	59.0	64.6	61.3	53.8	42.9	33.4	19.9	43.7
1969	13.1	24.0	29.6	47.1	53.9	58.8	62.3	63.6	56.0	40.0	35.2	27.7	42.6
1970	21.9	29.9	32.8	40.2	53.2	62.0	64.8	62.6	48.7	40.1	31.3	26.2	42.8
1971	23.6	29.9	33.2	43.6	52.5	54.9	61.9	68.2	49.5	40.4	34.1	22.0	42.8
1972	17.0	27.3	38.5	40.6	51.9	59.3	61.5	65.9	50.2	40.3	33.7	19.9	42.2
1973	20.7	27.8	37.7	42.2	51.5	57.5	65.1	64.5	53.3	44.1	29.3	30.8	43.7
1974	21.0	32.3	33.6	42.7	48.0	61.5	64.8	61.6	52.8	43.6	34.8	30.1	43.9
1975	21.5	21.5	29.9	37.6	48.6	55.9	69.1	59.8	52.1	42.9	35.4	27.5	41.8
1976	27.7	29.9	31.0	43.4	51.9	54.5	63.4	61.3	55.2	42.4	33.1	28.6	43.5
1977	20.0	30.9	34.4	45.0	49.7	61.5	62.6	62.8	51.7	42.5	30.4	22.0	42.8
1978	21.6	26.1	34.3	43.7	48.1	59.1	63.4	60.3	53.7	43.7	27.2	18.8	41.7
1979	4.1	24.9	34.7	42.3	51.5	59.4	65.0	65.4	56.9	46.6	30.7	33.0	42.9
1980	16.3	29.0	32.6	47.1	54.8	56.9	63.5	58.6	54.1	45.3	35.8	32.2	43.8
1981	30.1	31.3	38.5	44.5	52.5	53.8	62.8	66.4	55.3	43.2	36.0	27.0	45.1
1982	21.6	24.5	37.5	39.4	49.8	59.8	61.1	63.0	53.4	41.0	29.1	25.9	42.2
1983	30.3	33.8	37.9	42.4	51.9	57.6	59.6	65.4	50.4	42.9	36.6	11.1	43.3
1984	27.6	32.4	38.3	42.2	48.7	56.4	65.3	64.6	49.5	40.0	32.6	20.6	43.2
1985	19.2	19.0	30.8	44.8	53.7	57.6	68.3	60.2	47.8	40.8	18.6	18.3	39.9
1986	25.4	25.6	40.6	43.8	53.7	63.9	59.9	66.1	50.2	43.0	30.3	24.9	44.0
1987	22.2	27.9	35.0	47.8	55.6	61.6	62.9	59.8	56.1	43.2	35.3	25.4	44.4
1988	20.5	30.3	37.8	45.7	51.4	60.9	63.7	63.9	53.8	47.5	36.3	23.3	44.6
1989	27.5	12.4	28.8	44.2	49.6	59.8	65.4	61.9	52.7	42.7	35.8	25.3	42.2
1990	30.5	24.5	34.8	45.2	49.8	57.2	65.2	64.8	59.2	41.9	36.1	16.5	43.8
1991	18.3	34.6	32.8	42.4	50.3	55.1	64.0	65.2	54.4	40.6	32.1	29.3	43.3
1992	28.7	34.5	39.7	45.1	53.5	55.5	61.2	61.8	51.1	44.7	33.1	19.4	44.0
1993	14.7	18.4	33.7	43.6	56.0	56.5	56.6	59.7	51.4	44.4	25.0	25.4	40.5
1994	32.9	20.6	37.5	45.4	54.0	57.3	66.4	66.6	56.3	43.3	32.5	27.1	45.0
1995	23.6	33.7	33.1	42.6	51.6	56.3	63.1	59.5	54.9	41.1	34.9	26.7	43.4
1996	17.4	24.0	29.0	43.2	46.6	58.5	65.4	62.5	52.3	42.1	27.3	19.8	40.7
MEAN	22.3	27.6	33.8	43.3	51.6	58.3	63.9	62.9	53.5	43.3	32.4	25.3	43.2

Table 10. Summary of precipitation records at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 thru December 1996.

	Total Precipitation (inches) by Months and Years												
DATE	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1950	2.62	1.13	2.31	0.84	0.15	3.90	3.12	0.75	0.52	2.30	1.16	2.48	21.28
1951	0.94	1.29	0.62	2.32	3.77	2.26	1.03	2.86	1.49	5.62	1.01	3.31	26.52
1952	1.03	0.98	0.97	0.17	1.32	3.95	0.56	0.69	0.13	0.05	0.60	0.98	11.43
1953	1.84	1.14	0.98	2.07	2.00	3.31	T	1.62	0.71	0.03	0.87	1.30	15.87
1954	2.65	0.79	0.83	0.79	1.52	2.98	2.91	3.79	1.09	0.54	1.00	0.43	19.32
1955	1.00	1.31	0.44	0.82	1.18	1.86	3.08	--	1.64	1.89	1.97	2.38	17.57
1956	1.76	1.53	0.87	1.28	1.06	4.20	2.13	3.21	1.16	1.10	0.53	0.96	19.79
1957	1.47	1.14	0.75	1.22	1.75	2.51	0.52	0.78	0.10	1.59	0.96	1.76	14.55
1958	1.56	2.67	0.97	1.47	2.20	2.56	0.84	0.58	1.99	1.16	2.90	2.77	21.67
1959	1.95	1.33	0.75	1.62	4.10	1.75	T	0.91	4.22	3.36	4.32	0.34	24.65
1960	1.67	1.10	1.01	1.23	3.27	0.69	0.13	2.43	0.55	1.44	1.72	1.24	16.48
1961	0.65	1.46	1.96	2.26	4.02	1.45	0.76	0.64	3.40	1.22	1.77	2.09	21.68
1962	1.33	1.15	1.59	0.96	2.59	1.15	0.11	0.72	0.58	1.85	1.31	0.91	14.25
1963	1.69	1.21	0.85	1.07	0.57	5.00	1.44	2.10	1.46	0.75	0.95	1.70	18.79
1964	1.46	0.41	1.57	0.87	3.33	3.86	3.01	1.64	2.27	0.85	1.62	3.62	24.51
1965	2.25	0.64	0.24	2.55	0.81	2.30	1.15	4.74	1.72	0.21	1.31	0.55	18.47
1966	1.42	0.67	0.53	0.76	1.18	6.57	2.49	1.64	0.79	1.34	3.33	1.68	22.40
1967	1.50	0.62	1.27	0.99	1.30	2.53	0.02	0.01	0.91	1.88	0.62	1.16	12.81
1968	0.79	1.15	0.68	0.57	3.92	2.22	1.00	3.42	4.51	2.39	1.59	3.12	25.36
1969	3.05	0.75	0.69	1.39	1.19	5.21	0.70	0.09	1.54	1.90	0.31	1.14	17.96
1970	3.10	0.89	1.49	0.76	1.97	4.37	3.08	0.44	1.79	1.38	1.75	0.99	22.01
1971	1.84	0.77	0.69	0.58	2.45	4.42	1.31	1.11	0.94	0.87	1.70	1.62	18.30
1972	1.10	1.65	2.11	0.95	1.48	3.28	1.77	0.98	1.38	1.84	0.80	2.19	19.53
1973	0.52	0.56	0.70	0.45	1.13	2.14	0.01	0.63	1.37	1.41	2.95	1.94	13.81
1974	1.35	1.32	1.40	3.36	1.82	1.80	1.01	0.62	0.80	0.12	1.10	1.31	16.01
1975	1.56	1.08	1.50	1.27	1.50	1.40	1.08	4.26	1.18	2.96	0.85	1.39	20.03
1976	0.91	1.12	0.34	1.92	1.90	2.49	1.49	3.42	0.96	0.62	0.73	0.86	16.76
1977	0.83	0.71	1.40	0.41	2.90	0.52	3.60	1.50	2.84	0.56	1.62	4.10	20.99
1978	2.15	0.99	0.73	2.54	3.56	2.63	3.90	3.34	1.90	0.15	0.96	0.91	23.76
1979	1.70	1.45	0.82	2.33	2.67	1.23	0.40	1.79	1.03	1.75	0.50	1.03	16.70
1980	1.53	2.03	0.97	1.88	5.48	3.89	1.08	2.45	1.20	0.83	0.78	2.58	24.70
1981	1.81	1.85	2.17	1.75	3.86	4.70	1.17	0.96	0.77	0.56	1.49	1.91	23.00
1982	2.38	1.48	1.16	1.60	1.25	2.41	2.06	1.17	2.37	0.75	1.39	1.60	19.62
1983	0.93	0.85	1.71	2.41	1.20	2.96	3.66	1.16	1.70	1.13	1.96	2.57	22.24
1984	0.80	2.19	1.81	1.93	2.91	2.07	0.31	0.55	2.15	2.25	1.40	1.29	19.66
1985	0.31	1.28	0.90	1.31	2.81	1.89	0.35	1.62	5.35	1.55	1.61	0.51	19.49
1986	2.39	2.33	0.50	1.34	2.92	1.83	2.09	0.81	3.63	0.80	1.78	0.63	21.05
1987	0.38	0.46	3.47	1.15	1.89	1.95	4.85	0.98	0.81	0.12	0.91	1.18	18.15
1988	0.98	1.03	0.77	1.36	3.60	1.98	1.07	0.13	2.30	0.62	1.39	1.69	16.92
1989	1.39	1.48	2.29	1.09	2.70	2.05	2.70	3.69	1.50	2.29	3.75	1.92	26.85
1990	0.96	1.00	1.76	1.63	3.74	2.68	2.34	2.44	T	2.32	1.37	2.60	22.84
1991	1.41	0.41	0.72	1.21	2.72	5.36	0.77	1.15	0.80	0.75	2.26	0.58	18.14
1992	1.17	0.61	0.83	1.18	1.65	5.34	2.24	0.94	1.21	1.07	2.37	1.53	20.14
1993	1.68	0.60	0.73	3.77	2.22	4.00	7.00	1.19	1.54	0.83	1.23	1.27	26.06
1994	1.43	1.49	0.11	2.01	1.79	2.59	0.10	0.23	0.46	2.12	1.89	1.07	15.29
1995	1.17	0.90	2.33	2.25	1.44	5.63	1.91	1.47	1.21	2.75	2.33	1.91	25.30
1996	2.22	1.18	1.19	3.32	4.58	2.05	0.95	0.80	2.67	1.58	3.99	3.52	28.05
MEAN	1.50	1.15	1.16	1.51	2.33	2.93	1.64	1.54	1.59	1.39	1.59	1.67	20.02

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, May 1, 1949 through October 31, 1996. GDD = Temp Max + Temp Min÷2 - 50
Max Temp > 86F substituted with 86; Min Temp < 50F substituted with 50

Average growing degree days by month and year.							
YEAR	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	TOTAL
1949	314.0	356.5	467.0	499.5	322.0	57.5	2016.5
1950	208.0	308.0	459.5	465.0	314.0	97.5	1852.0
1951	223.0	251.5	488.5	411.5	212.5	33.0	1620.0
1952	243.5	309.0	458.5	472.5	358.0	199.0	2040.5
1953	194.5	252.5	503.5	455.5	336.0	172.0	1914.0
1954	270.5	255.0	473.5	387.0	248.0	61.5	1695.5
1955	165.0	364.5	439.5	502.5	263.0	103.5	1838.0
1956	282.0	351.5	491.0	437.5	316.5	98.0	1976.5
1957	312.5	350.5	509.5	466.0	366.0	60.0	2064.5
1958	427.5	398.0	504.5	553.0	295.0	136.0	2314.0
1959	187.0	370.0	499.5	417.5	211.0	68.0	1753.0
1960	202.5	380.5	563.0	383.0	334.0	132.5	1995.5
1961	248.0	479.5	537.5	548.5	190.0	99.5	2103.0
1962	201.0	367.5	454.0	438.0	326.0	86.5	1873.0
1963	265.0	335.0	468.0	508.5	378.0	150.0	2104.5
1964	219.5	324.5	484.5	357.0	208.0	88.0	1681.5
1965	222.0	328.5	488.5	453.5	126.0	173.0	1791.5
1966	306.5	291.0	495.0	445.5	375.0	97.0	2010.0
1967	255.0	354.5	538.0	545.0	444.0	101.5	2238.0
1968	207.5	348.0	497.0	407.0	243.0	57.5	1760.0
1969	293.5	338.5	460.5	503.5	306.5	38.0	1940.5
1970	281.5	391.0	472.5	474.5	196.5	72.5	1888.5
1971	259.0	263.0	434.0	553.5	217.0	100.0	1826.5
1972	228.5	348.5	425.0	505.5	226.0	87.0	1820.5
1973	259.5	320.5	515.0	497.0	266.5	106.5	1965.0
1974	152.5	390.5	476.0	432.5	314.0	179.0	1944.5
1975	180.0	283.5	563.0	362.5	290.5	77.5	1757.0
1976	251.0	247.0	463.0	400.0	347.5	119.5	1828.0
1977	184.0	419.0	431.5	428.0	224.5	93.0	1780.0
1978	131.0	348.0	442.0	375.0	243.5	145.0	1684.5
1979	225.5	368.5	484.5	510.5	362.0	163.0	2114.0
1980	268.0	290.0	438.5	361.0	254.0	151.0	1762.5
1981	209.0	210.5	445.5	517.0	312.5	73.0	1767.5
1982	195.0	369.5	402.5	473.0	282.0	66.5	1788.5
1983	259.5	315.5	358.5	510.5	229.0	98.5	1771.5
1984	162.0	294.5	511.0	511.0	214.0	108.5	1801.0
1985	294.5	347.0	562.0	394.5	162.0	67.0	1827.0
1986	247.5	456.5	363.0	529.0	152.0	86.0	1834.0
1987	287.5	404.0	434.5	388.5	352.5	154.0	2021.0
1988	218.5	397.0	449.0	503.0	276.5	197.5	2041.5
1989	178.5	350.5	516.0	388.5	276.5	80.0	1790.0
1990	165.5	296.0	485.0	459.0	417.5	75.0	1898.0
1991	175.0	243.0	464.0	499.5	312.5	170.5	1864.5
1992	277.0	410.5	375.0	441.5	223.0	140.0	1867.0
1993	301.5	273.5	260.0	383.0	249.5	114.0	1581.5
1994	261.5	315.0	512.5	529.5	361.0	82.0	2061.5
1995	219.5	275.0	427.5	381.5	303.5	39.0	1646.0
1996	91.5	322.0	498.0	435.5	214.5	108.5	1670.0
MEAN	233.6	334.7	468.5	456.3	280.3	105.5	1878.8

Mean growing degree days for all years = 1878.8

Table 12. Summary of snow data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1997.

Average snow accumulation by month and year

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL
1949-50	0.0	0.0	1.5	17.4	25.2	7.3	4.0	0.0	0.0	0.0	0.0	0.0	55.4
1950-51	0.0	0.0	4.0	7.0	15.1	14.8	7.8	10.0	T	0.0	0.0	0.0	58.7
1951-52	0.0	5.5	6.6	47.2	0.0	10.0	1.8	0.0	T	0.0	0.0	0.0	71.1
1952-53	0.0	0.0	1.0	7.0	8.4	13.1	0.0	0.0	0.0	0.0	0.0	0.0	29.5
1953-54	0.0	0.0	0.0	9.3	30.9	5.0	5.6	4.0	0.0	0.0	0.0	0.0	54.8
1954-55	0.0	0.0	2.0	2.5	16.3	13.1	4.5	0.0	0.0	0.0	0.0	0.0	38.4
1955-56	0.0	T	14.6	18.4	21.5	19.2	3.2	0.0	0.0	0.0	0.0	0.0	76.9
1956-57	0.0	1.5	2.1	3.4	20.5	15.5	0.0	0.0	0.0	0.0	0.0	0.0	43.0
1957-58	0.0	0.3	5.5	3.7	0.0	27.1	6.2	0.0	0.0	0.0	0.0	0.0	42.8
1958-59	0.0	0.0	2.1	21.5	13.7	15.1	0.0	0.0	0.0	0.0	0.0	0.0	52.4
1959-60	0.0	0.0	27.8	0.0	0.0	16.5	4.5	0.0	0.0	0.0	0.0	0.0	48.8
1960-61	0.0	0.0	1.6	13.4	5.4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	22.2
1961-62	0.0	5.0	20.0	23.5	17.9	8.6	3.8	0.0	0.0	0.0	0.0	0.0	78.8
1962-63	0.0	0.0	0.0	2.7	24.7	8.6	2.0	4.0	0.0	0.0	0.0	0.0	42.0
1963-64	0.0	0.0	1.4	16.8	16.9	5.3	15.0	0.4	2.0	0.0	0.0	0.0	57.8
1964-65	0.0	T	8.1	19.3	17.2	8.0	3.4	1.5	T	0.0	0.0	0.0	57.5
1965-66	T	0.0	3.0	0.0	0.0	9.0	0.7	0.0	0.0	0.0	0.0	0.0	12.7
1966-67	0.0	0.0	19.3	12.0	7.8	6.0	9.3	0.0	0.0	0.0	0.0	0.0	54.4
1967-68	0.0	0.0	5.7	11.0	9.3	2.1	0.0	2.7	0.0	0.0	0.0	0.0	30.8
1968-69	0.0	0.0	7.5	21.0	28.8	8.7	3.0	0.0	0.0	0.0	0.0	0.0	69.0
1969-70	0.0	4.0	1.5	10.3	29.2	5.5	7.5	0.0	0.0	0.0	0.0	0.0	58.0
1970-71	T	0.0	8.5	9.5	0.0	4.0	3.5	T	0.0	0.0	0.0	0.0	25.5
1971-72	0.0	3.0	5.5	18.4	15.5	9.2	8.0	4.0	0.0	0.0	0.0	0.0	63.6
1972-73	0.5	4.5	6.0	8.3	4.5	T	T	0.0	0.0	0.0	0.0	0.0	23.8
1973-74	0.0	0.0	9.5	0.0	6.4	6.0	8.0	T	0.0	0.0	0.0	0.0	29.9
1974-75	0.0	0.0	0.0	10.0	22.7	15.8	12.7	0.0	0.0	0.0	0.0	0.0	61.2
1975-76	0.0	3.0	8.8	16.0	15.3	4.5	0.8	0.0	0.0	0.0	0.0	0.0	48.3
1976-77	0.0	0.0	1.0	5.0	13.0	2.5	11.8	2.0	0.0	0.0	0.0	0.0	35.3
1977-78	0.0	0.0	16.5	48.1	30.1	16.5	6.0	1.5	0.0	0.0	0.0	0.0	118.7
1978-79	0.0	0.0	9.6	18.9	22.4	19.8	8.1	3.1	0.0	0.0	0.0	0.0	81.8
1979-80	0.0	0.0	1.7	4.3	14.3	9.1	9.1	0.1	0.0	0.0	0.0	0.0	38.4
1980-81	0.0	0.0	0.8	9.3	6.0	8.9	3.3	0.0	1.8	0.0	0.0	0.0	30.0
1981-82	0.0	0.0	0.5	19.1	25.7	7.6	4.3	4.0	0.0	0.0	0.0	0.0	61.2
1982-83	0.0	0.0	6.3	17.2	6.4	5.2	0.8	0.0	0.0	0.0	0.0	0.0	35.8
1983-84	0.0	0.0	3.9	28.0	8.6	4.8	0.5	0.0	0.1	0.0	0.0	0.0	45.8
1984-85	0.0	10.6	3.0	17.0	4.3	16.0	5.5	1.0	0.0	0.0	0.0	0.0	57.3
1985-86	0.0	0.0	10.5	7.3	14.5	13.0	3.1	0.0	0.0	0.0	0.0	0.0	48.3
1986-87	0.0	0.0	13.5	4.3	7.0	1.5	13.5	0.0	0.0	0.0	0.0	0.0	39.8
1987-88	0.0	0.0	4.0	11.5	8.5	5.5	4.0	1.0	0.0	0.0	0.0	0.0	34.5
1988-89	0.0	0.0	9.5	15.0	9.5	18.8	6.0	0.0	0.0	0.0	0.0	0.0	58.8
1989-90	0.0	0.0	4.0	15.0	5.5	16.8	8.5	1.0	0.0	0.0	0.0	0.0	50.8
1990-91	0.0	0.0	3.8	32.8	17.0	1.0	1.5	1.0	0.0	0.0	0.0	0.0	57.0
1991-92	0.0	7.3	9.5	3.5	8.8	1.5	0.3	1.0	0.0	0.0	0.0	0.0	31.8
1992-93	0.0	0.0	4.1	23.5	15.0	9.0	1.0	0.0	0.0	0.0	0.0	0.0	52.6
1993-94	0.0	0.0	2.9	9.9	1.5	22.0	0.0	2.0	0.0	0.0	0.0	0.0	38.3
1994-95	0.0	0.5	7.3	13.2	2.0	0.0	9.3	0.5	0.0	0.0	0.0	0.0	32.8
1995-96	0.0	0.0	6.0	10.5	23.3	1.0	13.3	0.0	0.0	0.0	0.0	0.0	54.1
1996-97	0.0	1.5	37.0	42.8	12.5	21.3							115.1
MEAN	0.0	1.0	6.8	14.3	13.1	9.6	4.8	1.0	0.1	0.0	0.0	0.0	50.5

Mean snowfall for all years = 50.5

Achieve Tankmix Study

Northwestern Ag Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to evaluate Achieve for crop injury and wild oat control when mixed with standard broadleaf herbicides. The Achieve/Buctril tankmix was the only treatment to result in significant crop injury. However, symptoms dissipated over time and did not appear to affect final yield. All other components being equal, Achieve with 2, 4-D ester resulted in lower wild oat control than all other chemical treatments. This antagonisium was reflected in final barley yield. A similar response was not observed with the MCPA treatment as the amine formulation was used. The untreated check yielded 49% and 31% of the best and worst treatments respectively.

Achieve Tankmix Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-14-96	BARLEY INJURY PERCENT 6-25-96	WILD OAT CONTROL PERCENT 7-28-96	BARLEY YIELD BU/A 8-30-96
1	ACHIEVE	80	WG	.18	lb ai/A	0.0	0.0	93.3	79.9
1	TF8035	1	SL	.5	% v/v				
2	ACHIEVE	80	WG	.18	lb ai/A	0.0	0.0	98.7	78.2
2	TF8035	1	SL	.5	% v/v				
2	AMMONIUM SULF	1	AP	1.24	qt pr/A				
3	ACHIEVE	80	WG	.18	lb ai/A	0.0	0.0	99.0	81.5
3	TF8035	1	SL	.5	% v/v				
3	BRONATE	4	EC	1.5	pt pr/A				
3	AMMONIUM SULF	1	AP	1.24	qt pr/A				
4	ACHIEVE	80	WG	.18	lb ai/A	28.3	5.0	99.0	92.7
4	TF8035	1	SL	.5	% v/v				
4	BUCTRIL	2	EC	2	pt pr/A				
4	AMMONIUM SULF	1	AP	1.24	qt pr/A				
5	ACHIEVE	80	WG	.18	lb ai/A	0.0	3.3	90.3	78.9
5	TF8035	1	SL	.5	% v/v				
5	MCPA AMINE	3.8	EC	1	pt pr/A				
5	AMMONIUM SULF	1	AP	1.24	qt pr/A				
6	ACHIEVE	80	WG	.18	lb ai/A	0.0	0.0	66.7	67.8
6	TF8035	1	SL	.5	% v/v				
6	2,4-D ESTER	3.8	EC	1	pt pr/A				
6	AMMONIUM SULF	1	AP	1.24	qt pr/A				
7	ASSERT	2.5	EC	1.504	pt pr/A	0.0	0.0	86.3	86.8
7	NIS(ACT-90)	1	SL	.25	% v/v				
8	UNTREATED					0.0	0.0	0.0	47.0
LSD (.05) =						4.7	4.7	10.4	16.7
Standard Dev.=						2.70031	2.70031	5.91759	9.50945
CV =						76.24	259.23	7.47	12.41
Block F						1.000	1.000	2.072	8.949
Block Prob(F)						0.3927	0.3927	0.1629	0.0031
Treatment F						41.286	1.612	97.509	6.436
Treatment Prob(F)						0.0001	0.2115	0.0001	0.0016

Achieve Tankmix Study

Site Description

Crop: Spring Barley Variety: Gallatin Planting Date: 5-6-96
Planting Method: Double Disk Drill Seeding Rate: 60 Lbs.
Depth, Unit: 1.5" Row Spacing, Unit: 7" Soil Moisture: Good

Plot Width, Unit: 10 FT Plot Length, Unit: 18.3 FT
Reps: 3 Site Type: R13 Study Design: RCB
Field Preparation/Plot Maintenance: Conventional Seedbed Preparation
Fertility: 200 Material Lbs. of 27-14-0 on 5-6-96 with Seed

Application Information

Application Date:	6-6-96
Time of Day:	1:30PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	75 F
% Relative Humidity:	31
Wind Velocity, Unit:	0 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	65 F
Soil Moisture:	GOOD
% Cloud Cover:	20

Plant Species	Plant Stage
Wild Oats	2 - 3.5 Leaf
Barley	4 - 4.5 Leaf

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H2O	20

Achieve Reduced Rate Study

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to evaluate the response of wild oats to reduced rate applications of Achieve. Wild oat control increased as rates increased, but was maximized when Achieve was applied at about 75% of the full rate. Likewise, wild oat dry matter decreased and barley yields increased as Achieve rates increased, but the response of both variables leveled off without substantial improvement when Achieve was applied at about 37% of the full rate. Although this response indicates that reduced rates might be feasible, it is important to realize that the highest yielding Achieve treatment still produced barley yields 10% less than the hand weeded control treatment.

Achieve Reduced Rate Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	WILD OAT CONTROL PERCENT 7-28-96	WILD OAT DRY WT GRAM/M2 7-29-96	SPR WHT YIELD BU/ACRE 9-9-96
1	ACHIEVE	40	WG	.022	lb ai/A	20.0	329.6	59.6
1	TF 8035	1	EC	.25	% v/v			
2	ACHIEVE	40	WG	.046	lb ai/A	52.7	142.9	70.1
2	TF 8035	1	EC	.25	% v/v			
3	ACHIEVE	40	WG	.067	lb ai/A	85.7	72.4	74.6
3	TF 8035	1	EC	.25	% v/v			
4	ACHIEVE	40	WG	.089	lb ai/A	88.0	37.5	74.0
4	TF 8035	1	EC	.25	% v/v			
5	ACHIEVE	40	WG	.134	lb ai/A	96.7	14.0	78.0
5	TF 8035	1	EC	.25	% v/v			
6	ACHIEVE	40	WG	.178	lb ai/A	97.0	10.9	78.0
6	TF 8035	1	EC	.25	% v/v			
7	UNTREATED					0.0	503.2	51.2
8	HAND WEEDED					100.0	0.0	85.7
LSD (.05) =						26.3	121.4	8.3
Standard Dev.=						15.0291	69.3078	4.73778
CV =						22.27	49.93	6.64
Block F						0.619	3.341	23.858
Block Prob(F)						0.5525	0.0651	0.0001
Treatment F						20.036	20.975	16.401
Treatment Prob(F)						0.0001	0.0001	0.0001

Achieve Reduced Rate Study

Site Description

Crop: Spring Wheat
Variety: Hi-line
Planting Date: 4-26-96
Planting Method: Field Drill
Seeding Rate: 60 Lbs
Depth, Unit: 1.5"
Row Spacing, Unit: 7"
Soil Moisture: Wet
Emergence Date: 5-14-96

Plot Width, Unit: 10 FT
Plot Length, Unit: 18.3 FT
Reps: 3
Site Type: F-4
Study Design: RCB
Field Preparation/Plot Maintenance: Conventional Seedbed Preparation
Fertility: 200 Lbs. of 27-14-0 on 4-26-96 With Seed

Application Information

Application Date:	5-24-96
Time of Day:	1:30PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	68 F
% Relative Humidity:	46
Wind Velocity, Unit:	1 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	60 F
Soil Moisture:	FIELD CAPACITY
% Cloud Cover:	20

Plant Species	Plant Stage	Density at Application
Wild Oat	2 Leaf	24/ft2
Spring Wheat	2.5- 3 Leaf	

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H20	20

Wild oats seeded with plot seeder perpendicular to spring wheat rows to insure uniform populations.

Assert Reduced Rate Study

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to evaluate the response of wild oats to reduced rate applications of Assert. Wild oat control increased as rates increased, but was maximized when Assert was applied at about 75% of the full rate. Likewise, wild oat dry matter decreased and barley yields increased as Assert rates increased, but the response of both variables leveled off without substantial improvement when Assert was applied at about 37% of the full rate. Although this response indicates that reduced rates might be feasible, it is important to realize that the highest yielding Assert treatment still produced barley yields 10% less than the hand weeded control treatment.

Assert Reduced Rate Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	WILD OAT CONTROL PERCENT 7-28-96	WILD OAT DRY WT GRAM/M2 7-29-96	SPR WHT YIELD BU/ACRE 9-9-96
1	ASSERT	2.5	EC	.046	lb ai/A	20.0	273.1	58.4
1	NIS	1	EC	.25	% v/v			
2	ASSERT	2.5	EC	.089	lb ai/A	46.7	253.3	65.5
2	NIS	1	EC	.25	% v/v			
3	ASSERT	2.5	EC	.134	lb ai/A	66.7	181.5	71.6
3	NIS	1	EC	.25	% v/v			
4	ASSERT	2.5	EC	.178	lb ai/A	76.7	127.9	73.6
4	NIS	1	EC	.25	% v/v			
5	ASSERT	2.5	EC	.268	lb ai/A	91.0	95.3	76.9
5	NIS	1	EC	.25	% v/v			
6	ASSERT	2.5	EC	.357	lb ai/A	96.7	116.6	72.3
6	NIS	1	EC	.25	% v/v			
7	UNTREATED					0.0	344.3	50.8
8	HANDWEEDED					100.0	0.0	84.8
	LSD (.05) =					16.2	84.9	15.2
	Standard Dev.=					9.23535	48.4819	8.66863
	CV =					14.85	27.86	12.52
	Block F					3.028	0.462	0.455
	Block Prob(F)					0.0807	0.6390	0.6434
	Treatment F					48.069	15.872	4.596
	Treatment Prob(F)					0.0001	0.0001	0.0074

Assert Reduced Rate Study

Site Description

Crop: Spring Wheat | Variety: Hi-Line | Planting Date: 4-26-96
Planting Method: Field Drill | Seeding Rate: 60 Lbs | Depth, Unit: 1.5"
Row Spacing, Unit: 7" | Soil Moisture: Wet | Emergence Date: 5-14-96

Plot Width, Unit: 10 FT | Plot Length, Unit: 18.3 FT
Reps: 3 | Site Type: F-4 | Study Design: RCB
Field Preparation/Plot Maintenance: Conventional Seedbed Preparation
Fertility: 200 Lbs. of 27-14-0 on 4-26-96 with Seed

Application Information

Application Date:	5-24-96
Time of Day:	1:30PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	68 F
% Relative Humidity:	46
Wind Velocity, Unit:	1 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	60 F
Soil Moisture:	FIELD CAPACITY
% Cloud Cover:	20

Plant Species	Plant Stage	Density at Application
Wild Oat	2 Leaf	24/ft2
Spring Wheat	2.5- 3 Leaf	

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H20	20

Wild oats seeded with plot seeder perpendicular to spring wheat rows to insure uniform populations.

Assert Rate and Surfactant Study

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

Surfactants can often improve the activity of postemergence herbicides. This study was conducted to compare wild oat control with Assert when applied with different surfactants. Assert was applied at different rates without a surfactant or with the nonionic surfactant Activator-90 (NIS), the methylated seed oil Sunit (MSO), and 28% urea ammonium nitrate liquid fertilizer (UAN 28%) alone or in various combinations.

The addition of surfactants significantly improved wild oat control with Assert, except for UAN 28% which produced results similar to Assert alone. Similarly, the addition of UAN 28% to either NIS or MSO failed to improve control compared to either surfactant applied alone. Wild oat control was similar when either NIS or MSO was included with Assert. However, barley yields tended to be greater when Assert was applied with MSO compared to NIS.

Assert Rate and Surfactant Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-14-96	WILD OAT DRY WT GRAMS/M2 7-23-96	WILD OAT CONTROL PERCENT 7-28-96	BARLEY YIELD BU/ACRE 8-30-96
1	ASSERT	2.5	EC	0	lb ai/A	0.0	417.7	0.0	53.9
1	CHECK	1	EC	0	lb ai/A				
2	ASSERT	2.5	EC	0	lb ai/A	3.3	422.7	0.0	48.6
2	UAN 28%	1	EC	2	qt pr/A				
3	ASSERT	2.5	EC	0	lb ai/A	0.0	330.7	0.0	42.8
3	NIS	1	EC	.25	% v/v				
4	ASSERT	2.5	EC	0	lb ai/A	0.0	469.9	0.0	48.6
4	NIS	1	EC	.25	% v/v				
4	UAN 28%	1	EC	2	qt pr/A				
5	ASSERT	2.5	EC	0	lb ai/A	0.0	350.6	0.0	49.0
5	SUNIT	1	EC	1.5	pt pr/A				
6	ASSERT	2.5	EC	0	lb ai/A	3.3	313.3	0.0	49.8
6	SUNIT	1	EC	1.5	pt pr/A				
6	UAN 28%	1	EC	2	qt pr/A				
7	ASSERT	2.5	EC	.12	lb ai/A	0.0	392.9	10.0	51.6
7	CHECK	1	EC	0	lb ai/A				
8	ASSERT	2.5	EC	.12	lb ai/A	0.0	363.0	3.3	52.5
8	UAN 28%	1	EC	2	qt pr/A				
9	ASSERT	2.5	EC	.12	lb ai/A	3.3	174.1	60.0	68.2
9	NIS	1	EC	.25	% v/v				
10	ASSERT	2.5	EC	.12	lb ai/A	5.0	201.4	67.7	64.9
10	NIS	1	EC	.25	% v/v				
10	UAN 28%	1	EC	2	qt pr/A				
11	ASSERT	2.5	EC	.12	lb ai/A	6.7	189.0	64.3	60.9
11	SUNIT	1	EC	1.5	pt pr/A				
12	ASSERT	2.5	EC	.12	lb ai/A	0.0	129.3	72.7	73.3
12	SUNIT	1	EC	1.5	pt pr/A				
12	UAN 28%	1	EC	2	qt pr/A				
13	ASSERT	2.5	EC	.23	lb ai/A	0.0	333.2	11.7	52.8
13	CHECK	1	EC	0	lb ai/A				
14	ASSERT	2.5	EC	.23	lb ai/A	0.0	375.5	35.0	53.1
14	UAN 28%	1	EC	2	qt pr/A				

CONTINUED...

Assert Rate and Surfactant Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-14-96	WILD OAT DRY WT GRAMS/M2 7-23-96	WILD OAT CONTROL PERCENT 7-28-96	BARLEY YIELD BU/ACRE 8-30-96
15	ASSERT	2.5	EC	.23	lb ai/A	0.0	139.2	81.0	89.0
15	NIS	1	EC	.25	% v/v				
16	ASSERT	2.5	EC	.23	lb ai/A	0.0	102.0	86.7	75.5
16	NIS	1	EC	.25	% v/v				
16	UAN 28%	1	EC	2	qt pr/A				
17	ASSERT	2.5	EC	.23	lb ai/A	10.0	99.5	84.7	81.0
17	SUNIT	1	EC	1.5	pt pr/A				
18	ASSERT	2.5	EC	.23	lb ai/A	20.0	69.6	88.7	83.6
18	SUNIT	1	EC	1.5	pt pr/A				
18	UAN 28%	1	EC	2	qt pr/A				
19	ASSERT	2.5	EC	.46	lb ai/A	0.0	161.6	66.7	74.6
19	CHECK	1	EC	0	lb ai/A				
20	ASSERT	2.5	EC	.46	lb ai/A	3.3	231.2	61.7	67.2
20	UAN 28%	1	EC	2	qt pr/A				
21	ASSERT	2.5	EC	.46	lb ai/A	0.0	57.2	96.3	79.4
21	NIS	1	EC	.25	% v/v				
22	ASSERT	2.5	EC	.46	lb ai/A	8.3	25.6	96.3	78.8
22	NIS	1	EC	.25	% v/v				
22	UAN 28%	1	EC	2	qt pr/A				
23	ASSERT	2.5	EC	.46	lb ai/A	18.3	47.3	97.0	93.6
23	SUNIT	1	EC	1.5	pt pr/A				
24	ASSERT	2.5	EC	.46	lb ai/A	16.7	47.3	98.3	92.0
24	SUNIT	1	EC	1.5	pt pr/A				
24	UAN 28%	1	EC	2	qt pr/A				
LSD (.05) =						10.3	131.8	16.0	16.0
Standard Dev.=						6.23973	79.8845	9.70330	9.71719
CV =						152.29	35.22	19.70	14.71
Block F						2.470	3.035	9.408	10.302
Block Prob(F)						0.0957	0.0578	0.0004	0.0002
Treatment F						2.996	9.476	49.657	7.823
Treatment Prob(F)						0.0008	0.0001	0.0001	0.0001

Assert Rate and Surfactant Study

Site Description

Crop: Barley Variety: Gallatin Planting Date: 5-6-96
Planting Method: Double Disk Drill Seeding Rate: 60 Lbs.
Depth, Unit: 1.5" Row Spacing, Unit: 7" Soil Moisture: Good

Plot Width, Unit: 10 FT Plot Length, Unit: 18.3 FT
Reps: 3 Site Type: R-13 Study Design: RCB
Field Preparation/Plot Maintenance: Conventional Seedbed Preparation
Fertility: 200 Material Lbs. of 27-14-0 on May 6, 1996 with Seed

Application Information

Application Date:	6-6-96
Time of Day:	12:00 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	75 F
% Relative Humidity:	31
Wind Velocity, Unit:	0 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	65 F
Soil Moisture:	GOOD
% Cloud Cover:	20

Plant Species	Plant Stage
Barley	4 to 4.5 Leaf
Wild Oats	2 to 3.5 Leaf, 2 Tiller

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H2O	20

Barley Tolerance to Banvel Tankmix Treatments

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to evaluate potential barley injury when treated with Banvel tankmix treatments. Treatments including Banvel were generally more injurious than those containing SAN 1418H. Also, those treatments which included NIS caused more injury than similar treatments with UAN 28%. Plant recovery was complete with no significant visible injury two months prior to harvest and no yield losses were observed.

BARLEY TOLERANCE TO BANVEL TANKMIX TREATMENTS

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-10-96	BARLEY INJURY PERCENT 6-25-96	BARLEY YIELD BU/ACRE 8-30-96
1	UNTREAT CHECK					0.0	0.0	75.6
2	BANVEL	4	SL	.093	lb ai/A	24.0	0.0	82.2
2	SAN 1418H	50	DF	.015	lb ai/A			
2	UAN 28%	4	L	2.00	lb ai/A			
3	BANVEL	4	SL	.093	lb ai/A	38.3	3.3	74.3
3	SAN 1418H	50	DF	.015	lb ai/A			
3	NIS	1	EC	.25	gal pr/100gal			
4	BANVEL	4	SL	.093	lb ai/A	29.0	3.3	77.8
4	SAN 1418H	50	DF	.031	lb ai/A			
4	UAN 28%	4	L	2.00	lb ai/A			
5	BANVEL	4	SL	.093	lb ai/A	26.7	1.7	89.1
5	SAN 1418H	50	DF	.015	lb ai/A			
5	HARMONY EXTRA	75	WG	.0075	lb ai/A			
5	UAN 28%	4	L	2.00	lb ai/A			
6	BANVEL	4	SL	.093	lb ai/A	47.3	0.0	86.2
6	SAN 1418H	50	DF	.015	lb ai/A			
6	HARMONY EXTRA	75	WG	.0075	lb ai/A			
6	NIS	1	EC	.25	gal pr/100gal			
7	SAN 1418H	50	DF	.015	lb ai/A	25.7	5.0	85.0
7	UAN 28%	4	L	2.00	lb ai/A			
8	SAN 1418H	50	DF	.031	lb ai/A	20.0	0.0	92.0
8	UAN 28%	4	L	2.00	lb ai/A			
9	SAN 1418H	50	DF	.015	lb ai/A	27.0	3.3	85.0
9	NIS	1	EC	.25	gal pr/100gal			
10	SAN 1418H	50	DF	.015	lb ai/A	16.7	0.0	91.1
10	2,4-D-DMASALT	3.8	SL	.25	lb ai/A			
10	UAN 28%	4	L	2.00	lb ai/A			
11	BANVEL	4	SL	.093	lb ai/A	32.3	3.3	84.9
11	2,4-D-DMASALT	3.8	SL	.25	lb ai/A			
11	SAN 1418H	50	DF	.015	lb ai/A			
11	UAN 28%	4	L	2.00	lb ai/A			

CONTINUED...

BARLEY TOLERANCE TO BANVEL TANKMIX TREATMENTS

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-10-96	BARLEY INJURY PERCENT 6-25-96	BARLEY YIELD BU/ACRE 8-30-96
12	SAN 1418H	50	DF	.015	lb ai/A	21.7	3.3	92.4
12	HARMONY EXTRA	75	WG	.0075	lb ai/A			
12	UAN 28%	4	L	2.00	lb ai/A			
13	BANVEL	4	SL	.093	lb ai/A	38.7	1.7	77.4
13	2,4-D-DMASALT	3.8	SL	.38	lb ai/A			
13	NIS	1	EC	.25	gal pr/100gal			
14	BANVEL	4	SL	.093	lb ai/A	40.7	0.0	87.1
14	HARMONY EXTRA	75	WG	.0075	lb ai/A			
14	NIS	1	EC	.25	gal pr/100gal			
15	BANVEL	4	SL	.093	lb ai/A	45.0	0.0	79.2
15	HARMONY EXTRA	75	WG	.015	lb ai/A			
15	NIS	1	EC	.25	gal pr/100gal			
16	UNTREAT CHECK					0.0	0.0	87.1
LSD (.05) =						7.3	5.7	16.4
Standard Dev.=						4.38511	3.42073	9.80837
CV =						16.20	218.93	11.66
Block F						1.485	2.804	2.669
Block Prob(F)						0.2426	0.0765	0.0857
Treatment F						29.895	0.804	1.057
Treatment Prob(F)						0.0001	0.6648	0.4313

Barley Tolerance to Banvel Tankmix Treatments

Site Description

Crop: Barley | Variety: Gallatin | Planting Date: 5-6-96
Planting Method: Double Disk Drill | Seeding Rate: 60 Lbs
Depth, Unit: 1.5" | Row Spacing, Unit: 7" | Soil Moisture: Good

Plot Width, Unit: 10 FT | Plot Length, Unit: 18.3 FT
Reps: 3 | Site Type: R13 | Study Design: RCB
Field Preparation/Plot Maintenance: Conventional Seedbed Preparation
Fertility: 200 Material Lbs. of 27-14-0 on 5-6-96 with Seed

Application Information

Application Date:	6-3-96
Time of Day:	10:00AM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	75 F
% Relative Humidity:	58
Wind Velocity, Unit:	0 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	64 F
Soil Moisture:	GOOD
% Cloud Cover:	30

Plant Species	Plant Stage
Barley	3.5 Leaf

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H2O	20

Reduced Herbicide Rates for Quackgrass Control in Peppermint

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to determine the optimum application timing, surfactant, and use rate of Assure II for quackgrass control in peppermint. Initially fall applications provided excellent control. However, quackgrass reinfested these areas by harvest while the spring applications provided the most complete control by seasons end. Generally treatments which included NIS provided poorer control compared to similar treatments which contained MSO + UAN. Spring applied Assure II at 7 oz./A provided greater than 95% control when applied with MSO + UAN.

Reduced Herbicide Rates for Quackgrass Control in Peppermint

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	QUACKGRS CONTROL PERCENT 10-2-95	QUACKGRS CONTROL PERCENT 7-19-96	QUACKGRS CONTROL PERCENT 10-2-96	MINT DRY MAT TONS/A 8-1-96	QUACKGRS DRY MAT TONS/A 8-1-96	QUACKGRS % OF TOT DRY MAT 8-1-96	QUACKGRS DM % OF NONTRT 8-1-96
1	ASSURE II	.8	EC	7	oz pr/A	FALL	80.0	85.3	53.3	1.23	0.45	23	83.33
1	NIS	1	EC	1	qt pr/A	FALL							
2	ASSURE II	.8	EC	7	oz pr/A	FALL	96.7	81.3	40.0	1.30	0.63	31	76.00
2	MSO	1	EC	1	qt pr/A	FALL							
2	UAN 28%	1	EC	2	qt pr/A	FALL							
3	ASSURE II	.8	EC	10	oz pr/A	FALL	97.7	84.0	45.0	1.56	0.35	19	85.33
3	NIS	1	EC	1	qt pr/A	FALL							
4	ASSURE II	.8	EC	10	oz pr/A	FALL	98.0	90.0	56.7	1.65	0.43	20	84.67
4	MSO	1	EC	1	qt pr/A	FALL							
4	UAN 28%	1	EC	2	qt pr/A	FALL							
5	ASSURE II	.8	EC	15	oz pr/A	FALL	98.7	89.3	46.7	1.53	0.46	22	83.00
5	NIS	1	EC	1	qt pr/A	FALL							
6	ASSURE II	.8	EC	15	oz pr/A	FALL	99.3	90.0	61.7	1.70	0.23	10	91.33
6	MSO	1	EC	1	qt pr/A	FALL							
6	UAN 28%	1	EC	2	qt pr/A	FALL							
7	ASSURE II	.8	EC	7	oz pr/A	SPRING	0.0	93.3	82.3	1.61	0.28	15	87.33
7	NIS	1	EC	1	qt pr/A	SPRING							
8	ASSURE II	.8	EC	7	oz pr/A	SPRING	0.0	98.0	95.3	1.85	0.03	1	99.00
8	MSO	1	EC	1	qt pr/A	SPRING							
8	UAN 28%	1	EC	2	qt pr/A	SPRING							
9	ASSURE II	.8	EC	10	oz pr/A	SPRING	0.0	98.0	94.3	1.72	0.00	0	100.00
9	NIS	1	EC	1	qt pr/A	SPRING							
10	ASSURE II	1	EC	10	oz pr/A	SPRING	0.0	99.3	97.3	1.86	0.01	0	99.67
10	MSO	1	EC	1	qt pr/A	SPRING							
10	UAN 28%	1	EC	2	qt pr/A	SPRING							
11	ASSURE II	.8	EC	15	oz pr/A	SPRING	0.0	99.3	94.0	1.68	0.00	0	100.00
11	NIS	1	EC	1	qt pr/A	SPRING							
12	ASSURE II	.8	EC	15	oz pr/A	SPRING	0.0	99.7	97.0	1.77	0.00	0	100.00
12	MSO	1	EC	1	qt pr/A	SPRING							
12	UAN	1	EC	2	qt pr/A	SPRING							
13	NONTREATED						0.0	0.0	0.0	0.15	2.37	92	0.00
LSD (.05) =							12.4	7.0	24.5	0.55	0.55	21	15.56
Standard Dev.=							7.34192	4.16102	14.5169	.323890	.324785	12.6333	9.23159
CV =							16.73	4.88	21.85	21.48	80.78	70.29	11.01
Block F							1.308	5.000	5.745	5.012	6.389	6.571	4.040
Block Prob(F)							0.2890	0.0153	0.0091	0.0152	0.0060	0.0053	0.0307
Treatment F							136.669	120.440	12.773	5.770	11.317	11.475	24.719
Treatment Prob(F)							0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Reduced Herbicide Rates for Quackgrass Control in Peppermint

Site Description

Crop: Peppermint Variety: Black Mitcham Planting Date: 4-4-93
Planting Method: Roots
Study Conducted on Established Stand of Peppermint

Plot Width, Unit: 10 FT Plot Length, Unit: 18.3 FT
Reps: 3 Site Type: R-7 Study Design: RCB
Plot Maintenance: Wheel Line Irrigation, Constant Control of Weeds
Fertility: 10- 2-95 16.5 Lbs. N, 78 Lbs. P, 120 Lbs. K (Granular)
4- 9-96 106 Lbs. N and 24 Lbs. S (Granular)
7- 1-96 40 Lbs. N (Fertigation)
7-10-96 40 Lbs. N (Fertigation)
7-23-96 45 Lbs. N (Fertigation)

Application Information

Application Date:	8-25-95	5-7-96
Time of Day:	4:00 PM	1:00 PM
Application Method:	BACKPACK	BACKPACK
Application Timing:	POST	POST
Air Temp., Unit:	75 F	57 F
% Relative Humidity:	25	47
Wind Velocity, Unit:	0 MPH	4 TO 10 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	74 F	49 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:	0	50

Plant Species		Plant Stage	Density at Application
8-25-95	Quackgrass	4-8"	10/ft2
5- 7-96	Quackgrass	6-8"	

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H20	20

Herbicide Carryover Effects on Peppermint

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to determine if mint can safely be planted into areas previously treated with either Assert or Pursuit. Due to cool and wet spring conditions, the digging of root stock, and consequently, the planting of mint was delayed one month. By seasons end, the crop had not developed to the point where harvest was advisable. Therefore subsamples were taken from each plot. Injury in response to chemical carryover was constant over time. AC299263 (Raptor) displayed no mint injury relative to untreated checks. In general, more injury was detected with Assert than Pursuit treatments.

Herbicide Carryover Effects on Peppermint

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	MINT INJURY PERCENT 7-19-96	MINT INJURY PERCENT 10-2-96	MINT DRY MAT TONS/A 9-19-96
1	ASSERT	2.5	EC	.92	12MO	76.7	66.7	0.25
1	BARLEY							
1	12 MO							
2	ASSERT	2.5	EC	.46	12MO	65.0	50.0	0.30
2	BARLEY							
2	12 MO							
3	NONTREATED				12MO	0.0	0.0	0.43
3	BARLEY							
3	12 MO							
4	PURSUIT	2	EC	.092	12MO	83.3	78.3	0.18
4	LENTILS							
4	12 MO							
5	PURSUIT	2	EC	.046	12MO	46.7	28.3	0.41
5	LENTILS							
5	12 MO							
6	NONTREATED				12MO	0.0	0.0	0.59
6	LENTILS							
6	12 MO							
7	AC299263	2	EC	.063	12MO	8.3	10.0	0.44
7	LENTILS							
7	12 MO							
8	AC299263	2	EC	.032	12MO	0.0	3.3	0.47
8	LENTILS							
8	12 MO							
9	NONTREATED					0.0	0.0	0.64
9	LENTILS							
9	12 M0							
LSD (.05) =						17.8	16.7	0.24
Standard Dev.=						10.2909	9.67648	.136620
CV =						33.08	36.80	33.11
Block F						1.285	0.366	4.985
Block Prob(F)						0.3037	0.6992	0.0208
Treatment F						37.475	31.122	3.644
Treatment Prob(F)						0.0001	0.0001	0.0133

Herbicide Carryover Effects on Peppermint

Site Description

Crop: Barley/Lentils Variety: Gallatin/Chilean Planting Date: 4-26-95
Planting Method: Plot Drill Rate, Unit: 60/50 #/A Depth, Unit: 1.5"
Row Spacing, Unit: 6" Soil Moisture: Good Emergence Date: 5-4-95

Plot Width, Unit: 10 FT Plot Length, Unit: 18.3 FT
Reps: 3 Site Type: R-3 Study Design: RCB
Field Preparation/Plot Maintenance: Roto-till and Culti-pack Prior to Seeding. Mint Stolons Planted 6-3-96. Target Irrigation of Two Inches per Week.
FERTILITY: 4-17-96 71 Lbs. N, 37 Lbs. P, 30 Lbs. K, And 14 Lbs. S /Acre
7-10-96 50 Lbs. N /Acre
8-23-96 50 Lbs. /Acre of N, P, and K

Application Information

Application Date:	5-3-95	5-22-95
Time of Day:	1:30	10:30
Application Method:	BACKPACK	BACKPACK
Application Timing:	PRE	POST
Air Temp., Unit:	59 F	64 F
% Relative Humidity:	26	35
Wind Velocity, Unit:	2 MPH	0 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	56 F	66 F
Soil Moisture:	GOOD	DRY TOP
% Cloud Cover:	0	0

Plant Species	Plant Stage	
Spring Wheat	3 Leaf	(5- 3-95)
Lentils	3 to 5"	(5-22-95)

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H20	20

Nematode Control in Peppermint

Passmore Farm, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to determine if Mocap would control or suppress nematodes in mint and consequently improve mint yields. No significant differences were detected for Lesion or Pin nematode counts in response to treatments. However, overall number of nematodes were greatly reduced with chemical treatments. Mint plots were grown under dryland conditions in 1996 which may have compounded the nematode stress measured with percent mint stand and dry weight yield. Mocap applied at 6 lbs ai/A displayed significantly higher percent mint stand and yield than both Vydate and untreated check. Mocap 3 lbs ai/A and Vydate 2 lbs ai/A had statistically higher yields than the check, with Mocap 3 lbs ai/A also significantly higher than check in percent stand. A strong correlation appears to exist between percent stand and yield.

Nematode Control in Peppermint

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	LESION NEMATODE /GM ROOT 9-25-95	LESION NEMATODE /GM ROOT 7-22-96	PIN NEMATODE /GM ROOT 9-25-95	PIN NEMATODE /GM ROOT 7-22-96	MINT STAND 0-100% 8-6-96	MINT DM YIELD TONS/A 8-6-96
1	UNTREATED				808.2	518.7	22.0	9.2	56.7	0.56
2	MOCAP	6	EC	3	1325.3	171.5	52.7	19.8	85.5	1.00
3	MOCAP	6	EC	6	1326.7	244.2	20.5	0.0	90.8	1.19
4	VYDATE	2	EC	2	1366.7	683.3	26.5	1.3	70.0	0.80
LSD (.05) =					1543.4	407.4	56.3	17.2	20.2	0.23
Standard Dev.=					1254.48	331.122	45.7475	14.0194	16.4300	.184493
CV =					103.96	81.88	150.40	184.87	21.69	20.84
Block F					1.710	2.999	2.456	0.571	1.906	10.524
Block Prob(F)					0.1931	0.0451	0.0813	0.7215	0.1530	0.0002
Treatment F					0.271	3.115	0.649	2.535	5.333	13.053
Treatment Prob(F)					0.8456	0.0578	0.5954	0.0960	0.0106	0.0002

Nematode Control in Peppermint

Site Description

Crop: Peppermint Variety: Black Mitcham Planting Date: 4-20-91
Planting Method: Roots
Study Conducted on Established Stand of Peppermint (Dryland)

Plot Width, Unit: 10 FT Plot Length, Unit: 18.3 FT
Reps: 6 Site Type: Passmore Farm Study Design: RCB
Plot Maintenance: Constant Weed Control
Fertility: 6-4-96 145 Lbs. N as 34-0-0
Cores Collected for Nematode Analysis: 9-25-95 and 7-22-96

Application Information

Application Date:	9-25-95
Time of Day:	2:00 PM
Application Method:	BACKPACK
Application Timing:	FALL
Air Temp., Unit:	72 F
% Relative Humidity:	29
Wind Velocity, Unit:	1 MPH
Dew Presence (Y/N):	N
Water Hardness:	N
Soil Temp., Unit:	60 F
Soil Moisture:	DRY
% Cloud Cover:	0

Plant Species	Plant Stage
Mint	2" Regrowth

Application Equipment

Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
Backpack	2.5	Flatfan	11002XR	14"	20"	10'	20	H2O	20

Living Mulch Crops in Peppermint

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

Living mulch crops potentially improve mint winter survival by insulating the crop. The goal is to produce as much biomass as possible during the fall in order to maximize the insulative potential from the living mulch crops. A double cut harvest system may allow for greater biomass production if the living mulch crops are established shortly after the first cutting and allowed to grow with the second crop. This study was conducted to compare the establishment of various living mulch crops in single verses double cut harvest systems.

Generally, living mulch biomass production was greatest under the single cut system. Although living mulch crops did establish in the double cut system, the competitiveness of the mint crop significantly reduced living mulch biomass production. Spring rye produced the greatest amount of biomass of all the crops evaluated. Spring rye has the additional advantage of dying out over the winter, eliminating the need for a herbicide application.

Living Mulch Crops in Peppermint

Trt No	Treatment Name	Grow Stage	MULCH DM YIELD TON/ACRE 9-15-95	MINT DM YIELD TON/ACRE 8-1-96
1	Winter Wheat	1 CUT	0.24	2.40
2	Spring Wheat	1 CUT	0.41	2.47
3	Spring Rye	1 CUT	0.68	2.36
4	Winter Rye	1 CUT	0.38	2.21
5	Hairy Vetch	1 CUT	0.07	2.08
6	Non-treated	1 CUT	0.00	2.46
7	Straw	1 CUT	0.00	2.12
8	Winter Wheat	2 CUT	0.08	2.25
9	Spring Wheat	2 CUT	0.04	2.34
10	Spring Rye	2 CUT	0.69	2.19
11	Winter Rye	2 CUT	0.25	2.04
12	Hairy Vetch	2 CUT	0.13	2.15
13	Non-treated	2 CUT	0.00	2.38
14	Straw	2 CUT	0.00	1.94
LSD (.05)	=		0.40	0.36
Standard Dev.	=		.238093	.214338
CV	=		111.98	9.56
Block F			4.850	2.511
Block Prob(F)			0.0162	0.1007
Treatment F			3.164	1.784
Treatment Prob(F)			0.0060	0.1013

Living Mulch Crops in Peppermint

Site Description

Crop: Peppermint Variety: Black Mitcham Planting Date: 1992
Planting Method: Roots
Study Conducted on Established Stand of Peppermint

Plot Width, Unit: 10 FT Plot Length, Unit: 15 FT
Reps: 3 Site Type: R-7 Study Design: RCB
Plot Maintenance: Wheel Line Irrigation, Constant Control of Weeds

Fertility: 10- 2-95	16.5 Lbs. N, 78 Lbs. P, 120 Lbs K (Granular)
4- 9-96	106 Lbs. N and 24 Lbs. S (Granular)
7- 1-96	40 Lbs. N (Fertigation)
7-10-96	40 Lbs. N (Fertigation)
7-23-96	45 Lbs. N (Fertigation)

Seeding and Harvest Information

7-14-95	Harvest #1 on double cut plots
7-20-95	Seed living mulches into plots harvested 7-14
8- 7-95	Harvest single cut plots
8-10-95	Seed living mulches into plots harvested 8-7
9-15-95	Harvest #2 on double cut plots
9-21-95	Straw treatments put down (2 tons/acre)
5- 6-96	Spray Assure II + MSO + UAN to kill surviving mulches
5-30-96	Spray Stinger (.5 pt/A) for broadleaf weeds
6- 5-96	Spray Basagran (1qt) + MSO (1qt) + UAN (2qt)/Acre
8- 1-96	Harvest plots with mint at bud stage

Living mulches seeded with double disk plot drill in six inch rows at 120 lbs./A for small grains and 40 lbs./A for hairy vetch. Seeding depth was 1.5 inches.

Peppermint Fertility Fall Management

Northwestern Ag. Research Center, Creston, Flathead County, Montana
Bob Stougaard/Doug Holen

This study was conducted to determine if fall fertilizer applications would enhance winter survival, spring vigor, and ultimately mint yields. Spring soil analysis revealed that phosphorus was the only element to differ in concentration. Levels of nitrogen and potassium were similar regardless of the fertilizer treatment applied. Fall fertilizer treatments did not affect mint vigor or hay yields.

Peppermint Fertility Fall Management

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	SOIL ANALYSIS N PPM 6-17-96	SOIL ANALYSIS P PPM 6-17-96	SOIL ANALYSIS K PPM 6-17-96	MINT VIGOR 1-10 8-6-96	MINT DM YIELD TON/ACRE 8-6-96
1	N	34	DF	50	FALL	5.3	12.0	112.0	10.0	1.18
2	P	45	DF	50	FALL	4.3	18.7	103.7	10.0	1.05
3	K	60	DF	50	FALL	5.7	13.0	118.3	10.0	1.12
4	N	34	DF	50	FALL	5.3	16.0	113.7	9.3	1.07
4	P	45	DF	50	FALL					
5	N	34	DF	50	FALL	6.7	12.3	117.0	10.0	1.20
5	K	60	DF	50	FALL					
6	P	45	DF	50	FALL	5.7	15.7	118.3	10.0	1.19
6	K	60	DF	50	FALL					
7	N	34	DF	50	FALL	7.0	14.0	115.3	10.0	1.24
7	P	45	DF	50	FALL					
7	K	60	DF	50	FALL					
8	NONTREATED					6.7	12.7	108.7	10.0	1.22
LSD (.05) =						2.7	3.8	16.3	0.7	0.29
Standard Dev.=						1.53724	2.17672	9.29766	.408249	.164681
CV =						26.35	15.23	8.20	4.12	14.21
Block F						9.222	47.101	21.954	1.000	6.937
Block Prob(F)						0.0028	0.0001	0.0001	0.3927	0.0081
Treatment F						1.008	3.386	0.915	1.000	0.534
Treatment Prob(F)						0.4662	0.0248	0.5232	0.4706	0.7948

Peppermint Fertility Fall Management

Site Description

Crop: Peppermint Variety: Black Mitchum Planting Date: 1993
Planting Method: Roots
Study Conducted on Established Stand of Peppermint

Plot Width, Unit: 10 FT Plot Length, Unit: 18.3 FT
Reps: 3 Site Type: R-5 Study Design: RCB
Plot Maintenance: Wheel Line Irrigation, Constant Control of Weeds

FERTILITY: 9-26-95	Treatment Fertilizer Application	(Granular)
4- 9-96	106 Lbs. N, 78 Lbs. P, 120 Lbs. K	(Granular)
7- 1-96	40 Lbs. N	(Fertigation)
7-10-96	40 Lbs. N	(Fertigation)
7-23-96	45 Lbs. N	(Fertigation)

Nursery Information

9-26-96	Treatment Fertilizer Application Consisting of 50 Actual Lbs. Per Nutrient Nitrogen = 34% Phosphorous = 45% Potassium = 60%
4- 9-96	Soil Samples Gathered for Analysis 10, 12 Inch Samples Taken per Plot and Bulked
5-10-96	Sprayed Stinger (.5 Pt/A) for Broadleaf Weeds
8- 6-96	Harvest Plots with Mint at Early Bud Stage

PROJECT TITLE: Intrastate Spring Barley Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Tom Blake and Pat Hensleigh, PS&ES, Bozeman, MT.

OBJECTIVE:
To evaluate spring barley varieties for yield, quality, and improved resistance to foliar diseases in consideration for future release to Montana grain growers.

RESULTS:
Yields were lower than average with only 11 of the 64 entries topping 100 bu/A. Montana line 930204 yielded best (106.43 bu/A) followed by Steptoe and Baronesse. A slow spring due to extended periods of cool and wet conditions along with dry conditions during grain fill probably led to the low yields. However, test weights and percent plump were good. A decrease in vegetative growth led to no lodging throughout the nursery. Scald was present in moderate levels on most cultivars.

SUMMARY:
Poor growing conditions at critical points in plant life-cycle led to low yields but good test weight and plumps.

FUTURE PLANS:
Cultivars will continue to be evaluated at Kalispell through cooperative testing in an attempt to identify cultivars best adapted to District 1 growing conditions.

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

Planted: April 25, 1996 Harvested: August 24, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	PLUMP PERCENT	HEIGHT INCHES	HEADING DATE
MT930204	106.43	51.10	93.00	32.67	181.33
Steptoe	105.90	48.20	97.00	31.63	178.33
Baronesse	103.33	50.90	94.00	28.73	186.00
H1851195	103.33	50.70	96.00	32.13	183.67
MT920059	102.27	52.40	98.00	32.93	184.67
MT910033	101.77	52.20	97.00	30.20	181.33
MT890008	101.27	49.00	92.00	28.20	187.00
MT930169	100.43	50.50	94.00	30.33	187.33
2B914947	100.27	50.60	94.00	29.53	188.67
MT920201	100.10	50.50	97.00	30.97	186.33
2B914541	100.07	50.00	96.00	29.93	185.33
Stander	99.93	52.20	98.00	32.57	182.67
MT940067	99.73	52.60	98.00	32.57	186.00
WPB DA592-47	99.33	47.00	92.00	22.70	184.33
MT940177	98.63	50.20	93.00	29.53	185.33
MT940079	98.27	52.20	96.00	30.97	184.00
MT940053	98.17	53.10	97.00	29.50	185.33
BSWS 2	98.13	50.20	99.00	28.73	185.67
AB 2B894311	97.83	51.10	93.00	27.53	185.33
WPB SL93516	97.67	51.10	96.00	26.90	188.33
MT940214	97.03	50.60	96.00	30.70	182.67
MT886610	96.80	51.40	93.00	30.03	182.67
Galena	96.43	50.20	95.00	25.33	188.67
MT940203	96.37	52.10	93.00	31.90	182.33
MT940121	95.83	50.80	97.00	30.87	187.00
Busch Agr 1202	95.27	51.70	97.00	29.50	184.33
Chinook	95.13	51.40	92.00	30.03	185.00
Alexis	94.80	51.00	95.00	25.60	187.00
BSWS 1	94.07	50.90	95.00	24.93	184.67
IdaGold	94.00	48.50	92.00	22.17	191.00
MT940071	93.80	51.80	95.00	24.93	185.33
MT920041	93.40	50.80	96.00	29.80	182.00
MT910150	93.13	51.70	97.00	31.90	182.00
MT930203	92.07	50.60	93.00	31.50	181.67
H5870120	91.63	47.10	97.00	28.87	178.67
MT930132	91.40	51.50	98.00	30.30	181.00
MT920161	91.13	51.60	96.00	29.93	185.00
MT940163	90.70	52.00	97.00	30.70	184.00
MT940013	90.53	50.10	95.00	30.30	184.00
Harrington	90.50	51.10	97.00	28.87	186.67
MT910189	90.47	52.10	99.00	28.83	181.33
MT940169	90.30	50.70	86.00	26.37	186.67
Logan	89.43	52.20	96.00	31.37	181.33
Stark	88.83	52.60	98.00	32.90	180.00
Foster	88.80	50.70	98.00	35.17	181.67
MT940048	88.00	52.90	90.00	27.83	185.33
MT920053	87.90	51.00	93.00	31.50	185.00
Gallatin	87.63	52.40	93.00	31.07	183.33
MT920073	87.07	51.20	97.00	27.70	182.00
Lewis	86.77	52.10	94.00	30.70	185.67
MT890018	86.13	50.80	94.00	26.77	185.00
MT940218	86.03	51.10	98.00	28.20	182.33
Moravian 14	85.70	52.40	93.00	24.40	179.33
MT940087	83.40	51.20	97.00	27.17	186.67

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Table 1 (Cont'd). Agronomic data from Intrastate Spring Barley Nursery.

VARIETY	YIELD BU/A	TEST WT LB/BU	PLUMP PERCENT	HEIGHT INCHES	HEADING DATE
MT940206	83.30	52.30	93.00	30.07	181.33
MT930059	82.80	52.70	98.00	30.70	180.33
MT940082	82.73	51.70	95.00	27.20	185.67
H3860224	82.70	50.00	97.00	28.07	189.67
MT940196	82.00	49.80	94.00	28.20	187.33
MT940049	81.27	52.20	85.00	25.33	186.67
MT940106	79.23	50.60	92.00	25.60	184.33
MT940099	77.47	52.30	94.00	25.33	186.00
MT940201	73.00	52.20	89.00	28.20	184.33
Morex	71.00	50.50	96.00	37.80	178.67
MEAN	92.33	51.10	94.90	29.26	184.26
C.V.	12.83	NA	NA	6.76	.80
LSD (.05)	19.14	NA	NA	3.20	2.39

PROJECT TITLE: Early Yield Spring Barley Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Tom Blake and Pat Hensleigh, PS&ES, Bozeman, MT

OBJECTIVE:
To evaluate spring barley varieties for yield, quality, and improved resistance to foliar diseases in consideration for future release to Montana grain growers.

RESULTS:
Yields were lower than average with only seven of the 64 entries above 100 bu/A. 11 Montana lines yielded above the six check cultivars included in the nursery. Test weights and percent plump were fair in comparison to previous years. A slow spring caused by continual cool and wet weather along with dry conditions during grain fill resulted in less than ideal growing conditions. Reduced overall vegetative growth led to a lodge-free nursery. Scald was present in moderate levels on most cultivars.

SUMMARY:
Poor growing conditions at critical growth stages resulted in low yields with fair test weights and plumps.

FUTURE PLANS:
Cultivars will continue to be evaluated at Kalispell through cooperative testing in an attempt to identify cultivars best adapted to District 1 growing conditions.

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

Planted: April 25, 1996 Harvested: August 26&28, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	PLUMP PERCENT	HEIGHT INCHES	HEADING DATE
MT950063	110.43	51.70	93.00	29.67	185.67
MT950074	105.63	51.00	96.00	28.47	184.67
MT950031	105.03	51.70	95.00	34.90	184.00
MT950098	104.37	49.40	94.00	28.47	190.33
MT950062	103.43	51.20	89.00	29.27	185.00
MT950081	102.27	51.20	97.00	28.87	186.33
MT950057	101.37	52.00	94.00	32.80	183.33
MT950064	99.73	50.20	87.00	24.70	189.00
MT950154	99.23	52.50	96.00	31.77	184.67
MT950148	99.13	51.60	94.00	34.37	184.33
MT950185	99.03	51.60	97.00	31.77	184.33
Steptoe	98.80	46.80	93.00	29.80	179.00
MT950213	98.07	45.00	86.00	30.30	183.00
Harrington	98.07	49.80	95.00	28.33	185.33
MT950211	96.97	46.10	98.00	37.00	185.33
Optic	96.80	48.90	96.00	24.53	188.00
MT950102	96.67	49.90	97.00	29.63	185.67
MT950151	96.17	51.80	87.00	31.87	181.67
MT950122	96.03	51.40	92.00	29.77	184.00
MT950107	96.00	50.70	96.00	26.93	187.33
MT950055	95.87	51.20	92.00	29.93	181.33
MT950209	95.83	45.20	88.00	30.03	180.33
Gallatin	95.83	51.00	91.00	32.03	183.67
MT950195	95.80	50.80	95.00	32.30	185.00
MT950201	95.57	48.10	93.00	30.43	181.00
MT950205	95.07	46.70	83.00	29.40	183.33
Baronesse	94.67	49.70	93.00	26.27	187.33
MT950035	94.57	52.20	96.00	35.67	184.00
MT950060	94.40	51.00	89.00	28.20	185.00
MT950174	94.03	51.10	98.00	29.27	187.67
MT950237	94.00	57.10	64.00	32.30	187.00
MT950208	92.83	46.90	90.00	32.93	185.33
MT950137	92.10	51.60	93.00	31.63	185.33
MT950077	91.83	49.80	94.00	29.00	187.67
MT950207	91.73	46.70	90.00	32.57	183.00
MT950065	90.97	51.70	95.00	31.90	183.33
MT950155	90.90	50.00	90.00	28.23	182.00
MT950173	90.70	49.70	95.00	27.70	187.33
MT950170	90.60	50.40	89.00	24.40	184.67
MT950181	90.50	51.10	89.00	30.70	183.67
MT950175	90.40	50.70	94.00	29.77	185.00
MT950156	90.13	49.80	89.00	27.20	181.33
MT950168	89.60	49.70	95.00	29.00	190.00
MT950059	88.33	51.20	91.00	25.20	186.33
MT950121	87.93	49.80	95.00	28.07	184.67
MT950214	87.60	45.60	75.00	28.87	179.67
MT950091	87.53	50.20	93.00	26.93	189.00
MT950206	86.60	45.80	88.00	24.54	180.00
MT950215	86.57	45.50	89.00	28.97	126.00
MT950217	85.80	53.40	62.00	25.07	188.33
MT950030	85.67	51.70	94.00	29.77	184.67
MT950186	85.57	52.20	95.00	29.13	184.67
MT950203	85.47	46.10	87.00	27.97	181.00
MT950210	85.33	47.00	97.00	35.27	184.00

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Table 1 (Cont'd). Agronomic data from Early Spring Barley Nursery.

VARIETY	YIELD BU/A	TEST WT LB/BU	PLUMP PERCENT	HEIGHT INCHES	HEADING DATE
MT950012	84.87	50.10	96.00	27.57	185.00
MT950169	83.93	49.90	95.00	24.93	186.33
Morex	83.33	49.60	85.00	39.00	180.33
MT950220	82.53	58.40	63.00	26.23	188.67
MT950192	82.23	49.50	91.00	27.70	185.33
MT950076	81.77	50.40	88.00	26.38	186.33
MT950199	81.47	51.60	96.00	30.70	184.67
MT950069	78.30	50.90	92.00	27.17	183.33
MT950146	74.37	50.10	94.00	29.80	185.00
MT950221	72.50	54.20	49.00	27.60	184.33
MEAN	92.17	50.15	90.19	29.54	183.80
C.V.	11.16	NA	NA	6.45	6.39
LSD (.05)	16.63	NA	NA	3.08	18.98

PROJECT TITLE: State Oat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Tom Blake and Pat Hensleigh, PS&ES, Bozeman, MT.

OBJECTIVE:
To evaluate oat varieties for adaptability, yield, quality, and disease resistance in northwestern Montana.

RESULTS:
1996 yields were considerably lower than previous years. Two AB lines yielded best at 151 and 149 bu/A respectively. A slow spring and extended dry spell mid to late season led to the poor yields but resulted in above average test weights. Oat maturity was late and consequently plots were virtually flat come harvest time due to early fall heavy rains and wind. Four of the five AB lines displayed good initial lodging resistance. Disease pressure was non-existant to light throughout the season with no effect on yield.

SUMMARY:
Adverse climatic conditions resulted in lower than average yields but produced high test weights. Plant height was also found to be shorter than normal.

FUTURE PLANS:
Cultivars will continue to be evaluated at Kalispell in an attempt to identify those best adapted for growth in northwestern Montana.

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

Planted: April 26, 1996 Harvested: September 10, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	HEIGHT INCHES	LODGING 0-9	HEADING DATE
90AB1322	151.37	38.20	35.7	1.00	187.67
86AB4582	148.60	39.10	41.3	3.33	187.00
Monida	148.60	38.20	46.3	5.00	190.33
Cayuse	145.87	36.10	40.7	3.33	188.67
83AB3250	144.53	37.70	37.9	1.67	192.00
Otana	144.50	39.60	49.3	2.00	187.67
Appaloosa	137.70	35.30	43.0	6.33	190.67
Rio Grande	132.23	37.20	37.8	4.00	186.33
Newdak	130.90	36.60	40.8	2.33	184.67
Whitestone	130.87	38.70	40.2	2.67	189.33
86AB1616	122.70	42.40	43.4	.67	191.33
ND860416	120.00	39.60	47.0	3.33	188.33
Border	111.77	37.10	41.3	4.33	191.00
Ajay	109.07	37.50	31.9	2.33	188.33
88AB3073	107.70	44.80	40.3	.00	191.00
Paul	102.27	44.60	47.1	3.00	189.67
MEAN	130.54	38.90	41.5	2.83	189.00
C.V.	11.64	NA	3.2	51.80	.28
LSD (.05)	25.35	NA	1.0	2.45	.89

PROJECT TITLE: Western Regional Spring Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Luther Talbert and Susan Lanning, PS&ES, Bozeman, MT.

OBJECTIVE:
To determine the adaptability of spring wheat varieties grown under high moisture conditions in northwestern Montana.

RESULTS:
A slow spring and long mid-season dry spell diminished considerably the yield potential of these cultivars. Washington line 7798 was the top yielder at 83 bu/A. Late season precipitation did lead to good test weights. The dry conditions also saw heights shorter than normal with the cool and damp spring contributing to later than normal maturity. Some degree of lodging was evident in approximately half of the entries with none of it severe. All entries had substantial stripe and leaf rust infection with the exception of WA7806, OR493032, and Mckay.

SUMMARY:
Poor growing conditions at critical growth stages and prevalent disease pressure resulted in considerably lower than average yields. This aside, test weights were better than previous years.

FUTURE PLANS:
Cultivars will continue to be evaluated at Kalispell in an attempt to identify those best adapted for growth in northwestern Montana.

Table 1. Agronomic data from the Western Regional Hard Red Spring Wheat Nursery grown at the Northwestern Agricultural Research Center in Kalispell, MT.

Planted: April 25, 1996 Harvested: August 31, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	HEIGHT INCHES	LODGING 0-9	HEADING DATE	LF&STRP RUST 1/
WA 7798	82.93	60.80	32.53	.00	186.67	2.00
OR492092	77.77	59.80	30.43	.00	186.67	2.00
WAWAWAI	77.37	61.10	33.70	.00	184.33	2.00
WA 7806	77.33	59.40	32.57	1.33	186.33	1.00
PENAWAWA	75.73	58.70	30.60	.00	185.67	3.00
OR390362	75.03	59.20	27.57	.33	185.00	3.00
OR488372	74.30	60.60	29.40	.00	186.00	2.00
OR895181	73.43	58.70	30.03	.00	184.67	2.00
SERRA	72.67	59.00	28.73	2.33	184.33	3.00
ID 494	72.27	60.70	28.60	.00	181.33	3.00
UT 2938	72.13	59.80	41.07	2.33	184.00	3.00
SDM50014	72.13	60.10	30.43	.00	187.67	2.00
ALPOWA	71.40	60.50	33.47	.00	186.00	3.00
CA 896	70.80	61.10	29.67	.00	184.00	2.00
OR493032	70.77	60.00	29.63	.00	187.33	1.00
SDM50030	70.23	58.60	31.23	.00	185.00	3.00
MCKAY	69.90	59.10	30.70	.00	187.67	1.00
ID 476	69.67	59.40	30.97	.00	183.00	3.00
OR487401	68.40	60.60	28.33	1.00	186.00	3.00
CA 1036	68.20	59.20	23.47	.00	183.33	3.00
UT 1146	67.57	58.70	33.73	.33	185.67	3.00
FMBR9154	66.47	58.50	28.97	1.00	182.00	3.00
ID 469	66.40	58.70	28.07	.00	183.33	3.00
ID 495	66.33	60.10	29.77	.00	185.00	3.00
CA 985	66.20	61.20	30.57	.00	184.00	3.00
ML316402	66.07	58.70	27.97	.33	185.67	3.00
ID 474	65.67	59.40	31.23	.00	185.67	3.00
SDM04055	65.23	58.20	29.00	.33	186.33	3.00
ID 496	64.93	58.90	31.10	.67	184.00	3.00
ID 489	64.87	60.80	30.70	.33	183.33	3.00
FEDERATION	64.20	56.90	42.50	2.00	186.67	3.00
ID 492	63.90	60.70	30.33	.33	185.00	3.00
SDM50005	63.43	60.80	32.83	.00	187.33	2.00
UT 1175	63.00	58.50	34.27	.67	186.00	2.00
CA 1037	62.50	58.90	20.37	.33	183.00	3.00
CA 1041	61.87	58.40	20.37	.33	183.00	3.00
UT 3006	61.80	60.50	40.30	2.33	184.33	3.00
ID 462	60.40	60.10	30.57	.33	184.67	3.00
FMBR5783	60.37	56.60	23.20	.67	183.00	3.00
UT 2464	59.90	58.40	32.93	.00	188.00	3.00
ID 493	59.90	60.70	30.70	.00	185.00	3.00
UT 3007	58.20	60.40	40.83	2.00	185.67	3.00
KLASIC	57.43	58.50	22.33	.33	180.67	3.00
ID 488	57.30	58.90	28.33	.67	184.67	3.00
CA 1032	57.10	59.20	23.23	.67	187.00	3.00
WA 7802	57.07	60.10	32.13	.67	184.33	2.00
ML042409	55.43	55.60	30.17	.33	188.00	3.00
MEAN	66.94	59.4	30.42	.47	185.03	2.70
C.V.	12.64	NA	5.13	89.57	.25	NA
LSD (.05)	13.53	NA	2.53	.68	.76	NA

1/ LEAF AND STRIPE RUST DISEASE LEVELS:

0=RESISTANT, 1=MODERATELY RESISTANT, 2=SUSCEPTIBLE, 3=HIGHLY SUSCEPTIBLE

PROJECT TITLE: Advanced Spring Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Luther Talbert and Susan Lanning, PS&ES, Bozeman, MT

OBJECTIVE:
To determine the adaptability of spring wheat varieties grown under high moisture conditions in northwestern Montana.

RESULTS:
A slow spring and long mid-season dry spell considerably lowered the yield potential for these cultivars in this area. Montana line 9311 was the top yielder at 85 bu/A, followed by Amidon and WPB 926. Heading dates were later than usual with fair test weights. Roughly 2/3 of the entries suffered some degree of lodging with MT 9565, Fortuna, and Lew displaying highest levels of susceptibility. Most entries had substantial stripe and leaf rust infection with the exception of MT 9311, Amidon, Trenton, MT 9420, Ernest, and MT 9407.

SUMMARY:
Adverse growing conditions at critical growth stages in addition to heavy disease pressure resulted in lower than average yields for this location.

FUTURE PLANS:
Cultivars will continue to be evaluated at Kalispell in an attempt to identify those best adapted for growth in northwestern Montana.

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

Planted: April 25, 1996 Harvested: August 31,1996

VARIETY	YIELD BU/A	TEST WT LB/BU	PROTEIN PERCENT	HEIGHT INCHES	LODGING 0-9	HEADING DATE	LF&STRP RUST 1/
MT 9311	85.10	62.50	12.00	37.00	.00	188.00	1.00
AMIDON	84.80	61.00	12.60	43.17	1.00	185.00	1.00
WPB 926	84.77	60.00	12.80	32.17	.00	182.33	3.00
PENAWAWA	83.20	58.70	NA	32.57	.00	184.33	3.00
MT 9504	80.93	60.40	11.80	31.37	.00	188.33	3.00
MT 9430	80.37	61.20	13.40	39.90	1.67	183.67	2.00
BZ987331	79.40	60.20	11.80	33.37	2.33	182.67	2.00
MT 9453	79.27	60.70	13.60	40.03	.00	185.67	2.00
FERGUS	78.97	61.40	12.60	33.73	1.33	182.33	3.00
MT 9503	78.73	60.70	11.30	32.83	.00	187.33	2.00
MT 9332	76.10	61.50	12.00	36.47	.67	185.67	3.00
MT 9565	75.30	62.50	11.60	40.07	4.33	185.00	3.00
WESTBRED EXPRESS	74.63	60.20	11.60	27.80	.00	183.33	3.00
TRENTON	74.23	61.60	13.80	40.83	.00	184.67	1.00
MT 9532	74.07	62.20	13.70	39.13	.33	184.00	3.00
MT 9553	73.37	60.20	11.80	34.27	2.00	183.67	3.00
MT 9420	73.23	60.60	13.50	38.70	.00	185.00	1.00
VANNA	72.33	57.40	NA	31.63	1.00	185.33	2.00
BZ992632	71.73	60.10	11.70	33.33	3.67	183.67	3.00
FORTUNA	71.47	62.00	12.60	44.10	4.67	185.00	3.00
MT 9524	71.30	61.50	11.90	36.20	1.67	183.00	3.00
MT 9427	70.23	60.50	12.60	35.43	.33	182.00	3.00
MT 9542	70.03	59.70	11.20	33.47	.67	185.67	3.00
ERNEST	69.40	60.90	12.40	41.33	.33	186.00	1.00
MT 9407	69.33	60.70	12.60	38.73	1.00	184.67	1.00
BZ992588	69.27	61.40	11.70	32.70	.33	183.67	2.00
LEN	69.20	60.60	13.30	32.57	.33	185.33	2.00
MT 9410	67.73	61.10	12.50	36.73	1.00	184.00	2.00
MTRWA116	66.03	59.40	12.50	32.80	2.00	183.67	3.00
GLENMAN	65.97	59.70	11.50	33.37	3.33	186.00	2.00
MT 9559	65.50	59.20	11.40	31.50	1.33	182.33	3.00
MCNEAL	65.33	60.60	12.60	33.63	.00	186.33	2.00
MT 9433	65.07	61.50	12.80	40.20	.00	186.00	2.00
MT 9533	64.90	60.40	11.80	38.07	.67	183.33	3.00
NEWANA	64.80	60.50	11.50	31.10	.00	187.00	3.00
HI-LINE	64.60	59.70	12.20	31.10	1.00	183.33	3.00
MT 9502	64.07	59.50	10.90	34.27	2.00	185.00	3.00
MT 9517	63.03	60.10	12.80	32.17	2.00	184.33	3.00
LEW	62.87	62.90	11.80	42.90	4.33	187.67	2.00
THATCHER	62.83	59.70	12.20	46.60	2.67	186.67	2.00
MT 9541	62.07	60.00	12.30	33.47	1.00	183.67	3.00
MT 9539	62.00	60.60	10.60	34.77	2.00	183.33	3.00
MT 9554	61.60	58.50	11.20	32.83	1.33	187.00	3.00
MT 9508	60.53	60.70	12.50	32.80	3.33	184.00	3.00
MT 9507	60.47	60.70	12.20	34.10	3.00	182.67	3.00
WESTBRED 936	60.40	59.20	12.00	30.03	.00	181.33	3.00
MT 9558	60.00	59.10	11.70	32.97	1.67	185.33	3.00
MT 9513	59.83	60.70	11.40	32.43	3.00	185.33	3.00
MT 9515	54.10	62.10	11.90	31.90	2.33	184.67	3.00
MEAN	69.89	60.54	12.17	35.36	1.34	184.66	2.49
C.V.	12.82	NA	NA	4.07	42.37	.55	NA
LSD (.05)	14.52	NA	NA	2.33	.92	1.64	NA

1/ LEAF AND STRIPE RUST DISEASE LEVEL:
0=RESISTANT, 1=MODERATELY RESISTANT, 2=SUSCEPTIBLE, 3=HIGHLY SUSCEPTIBLE

PROJECT TITLE: Western Regional Hard Red Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Phil Bruckner and Jim Berg, PS&ES, Bozeman, MT.

OBJECTIVE:
To evaluate hard red winter wheat lines for adaptability, yield, quality, and disease resistance in northwestern Montana.

RESULTS:
The mean yield for 1996 was 92.5 bu/A, which is average but lower than the two previous years. Idaho line 000498 had the highest yield at 108.5 bu/A. Idaho contributed four of the five top yielding lines. Test weights were good with seven cultivars reaching 63 lb/bu. All entries had significantly less lodging than the Kharkof check. With the exception of UT199838, McGuire, and Hybritech exp. 1643, most lines displayed solid resistance to stripe rust. The same cannot be said about leaf rust where only OR889176, OR889128, Hybritech exp. 1643, and Kharkof had low levels of infection.

SUMMARY:
Light mid to late season drought stress with moderate disease pressure led to average yields with good test weights.

FUTURE PLANS:
Continued evaluation of high potential hard red winter wheat cultivars for production in the Pacific Northwest.

Table 1. Agronomic data from the Western Regional Hard Red Winter Wheat Nursery grown at the Northwestern Agricultural Center in Kalispell, MT.

Planted: September 28, 1995 Harvested: August 19, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	HEIGHT INCHES	LODGING 0-9	HEADING DATE	STRIPE RUST 1/	LEAF RUST 1/
ID000498	108.47	61.30	37.8	1.33	166.33	1.00	3.00
WA007818	105.00	60.50	49.5	.00	170.33	1.00	2.00
ID000486	104.33	59.50	28.3	.00	166.67	1.00	3.00
ID000467	104.00	60.00	34.4	.00	168.00	1.00	3.00
ID000478	103.87	62.80	43.6	.33	165.00	1.00	2.00
UT944151	103.53	61.20	40.6	.33	168.67	1.00	2.00
UT944158	100.97	59.50	41.9	.00	170.67	1.00	3.00
RAMPART	99.97	62.00	43.2	1.00	168.00	2.00	2.00
UT199838	99.23	62.80	46.1	1.67	168.67	3.00	3.00
UT201971	98.60	63.30	48.8	4.00	168.33	1.00	3.00
WA007816	97.37	62.00	45.8	.00	168.67	1.00	3.00
MCGUIRE	97.23	62.80	39.4	.00	164.00	3.00	2.00
WA007814	96.97	63.00	45.1	2.00	167.00	1.00	2.00
WA007817	94.40	62.20	49.1	2.33	167.00	1.00	2.00
WANSER	94.03	62.30	47.9	1.67	168.00	1.00	3.00
ID000477	93.23	63.60	45.7	.67	168.00	1.00	2.00
OR889176	93.00	59.00	29.9	.00	169.00	1.00	1.00
OR870944	92.07	58.60	33.9	.00	168.00	1.00	2.00
NWCPOPE1	91.57	62.20	41.7	.00	167.67	1.00	2.00
ID000479	90.47	63.00	38.8	.00	166.67	1.00	3.00
ID000497	90.20	62.50	47.1	1.00	167.00	2.00	2.00
OR880017	90.10	60.10	34.1	.00	167.33	1.00	3.00
ID000466	89.43	62.50	47.4	1.67	166.33	1.00	3.00
WA007819	88.50	61.50	45.8	1.33	168.00	1.00	3.00
ID000468	88.30	61.00	32.7	.00	163.33	1.00	3.00
ID000481	88.20	62.00	44.6	.00	169.00	1.00	3.00
OR889128	87.33	57.80	31.5	.00	167.33	1.00	1.00
UT199487	86.80	63.60	44.1	.33	168.33	1.00	3.00
WA007815	86.20	63.70	43.2	.00	169.00	1.00	3.00
WA007773	86.10	63.70	47.8	2.67	167.33	1.00	3.00
OR908482	85.80	60.80	33.3	.00	167.00	1.00	2.00
SDM00215	84.77	60.20	29.9	.00	163.67	1.00	3.00
QUANTUM EXP. 1643	83.87	58.60	38.2	.33	166.67	3.00	1.00
KHARKOF	79.00	62.00	51.4	5.33	167.33	2.00	1.00
ID000453	76.37	62.20	46.5	.67	167.33	2.00	3.00
SDM00214	69.23	60.50	33.7	.00	167.33	1.00	2.00
MEAN	92.46	61.5	41.2	.80	167.42	1.3	2.4
C.V.	11.31	NA	3.7	93.71	.55	NA	NA
LSD (.05)	17.02	NA	2.5	1.22	1.50	NA	NA

1/ DISEASE LEVELS: 1=LOW, 2=MODERATE, 3=HIGH

PROJECT TITLE: Soft White Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Phil Bruckner and Jim Berg, PS&ES, Bozeman, MT.

OBJECTIVE:
To evaluate soft white winter wheat lines for adaptability, quality, and disease resistance in northwestern Montana.

RESULTS:
In the absence of winterkill, yields were less than 1995 but still in the acceptable range. Hill 81 and Eltan were the top yielding cultivars at 114.4 bu/A, followed closely by Malcolm. The mean test weight for the 18 cultivars was 59.8 lb/bu, with Hill 81, Neeley, and BZ6W90-470 at or above 62.0. All entries had good straw strength with little or no lodging. Stripe rust was present in small amounts throughout the nursery with leaf rust more prevalent. Hill 81, Cashup, BZ6W90-470, Madsen, and Gene displayed low levels of leaf rust infestations while the remaining cultivars were more susceptable.

SUMMARY:
Yields were lower than the first year (1995) of this nursery with low to moderate disease pressure and some water stress during early and mid grain fill.

FUTURE PLANS:
Continued soft white winter wheat evaluation through this amended nursery to best identify cultivars adapted for Pacific Northwest production including northwestern Montana.

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

Planted: September 28, 1995 Harvested: August 19, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	PLANT HEIGHT	LODGING 0-9	HEADING DATE	STRIPE RUST 1/	LEAF RUST 1/
HILL 81	114.40	62.00	38.1	.00	171.00	1.00	1.00
ELTAN	114.40	58.80	36.6	1.33	174.33	1.00	2.00
MALCOLM	113.70	59.40	34.0	.00	168.67	1.00	2.00
CASHUP	111.10	59.10	32.3	.33	169.00	1.00	1.00
NEELEY	111.10	62.90	43.2	.00	167.67	1.00	3.00
MACVICAR	108.87	59.70	34.4	.00	168.67	1.00	2.00
DAWS	108.67	60.70	35.0	.00	169.67	1.00	2.00
KMOR	107.40	57.70	35.3	.00	172.00	1.00	2.00
LAMBERT	107.10	59.00	37.1	.00	168.00	1.00	3.00
BZ6W90-470	106.83	62.00	31.5	.00	166.33	1.00	1.00
MCDERMID	106.63	60.10	32.9	1.00	168.00	1.00	2.00
MADSEN	105.13	59.70	33.9	.00	169.67	1.00	1.00
BZ6W93-461	105.03	59.50	31.5	.33	168.67	1.00	3.00
NUWEST	102.80	61.00	43.3	.00	168.00	2.00	3.00
W301	98.97	58.50	33.1	.00	167.67	1.00	2.00
STEPHENS	95.33	59.20	32.3	.00	168.00	1.00	2.00
LEWJAIN	90.23	58.70	32.7	.00	174.67	1.00	3.00
GENE	87.57	57.80	31.1	.00	167.33	1.00	1.00
MEAN	105.29	59.8	34.9	.17	169.30	1.10	2.00
C.V.	7.70	NA	2.6	336.07	.42	NA	NA
LSD (.05)	13.45	NA	1.5	.93	1.18	NA	NA

1/ DISEASE LEVELS: 1=LOW, 2=MODERATE, 3=HIGH

PROJECT TITLE: Intrastate Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Phil Bruckner and Jim Berg, PS&ES, Bozeman, MT.

OBJECTIVE:
Evaluation of Montana adapted cultivars for yield, quality, and disease resistance. Special attention to dwarf bunt, stripe rust, and leaf rust.

RESULTS:
Yields for the 49 entries ranged from 120.3 (Dynamic I) to 71.7 (Roughrider) bu/A, with a mean of 93.2. Test weights were good with a mean of 61 lb/bu and several above 62. Winterkill caused no significant stand reductions while spring water runoff did. Proteins were quite low with yellowbelly in many of the harvested plots. Overall lodging was minimal with the exception of Roughrider, Agassiz, Elkhorn, Norstar, and BZ9W92-712-b. Most of the top yielding cultivars were tolerant or resistant to stripe rust which blew through hard. Much of the surviving leaf material was then hit with leaf rust. Only eight of the 64 entries demonstrated no or low infestation levels to the rust combinations.

SUMMARY:
Early and severe disease pressure with some water stress during early to mid grain fill resulted in considerable yield loss in 1996.

FUTURE PLANS:
High yielding disease resistant cultivars will continue to be evaluated at Kalispell to identify those with the best potential for production in this region.

Table 1. Agronomic data from the Intrastate Winter Wheat Nursery grown at the Northwestern Agricultural Reseach Center in Kalispell, MT.

Planted: September 28, 1995 Harvested: August 16, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	PROTEIN PERCENT	HEIGHT INCHES	HEADING DATE	LOGDING 0-9	STRIPE RUST 1/	LEAF RUST 1/
DYNAMIC I	120.27	58.40	10.2	40.8	167.67	.00	1.00	1.00
PROMONTORY	117.33	62.50	9.9	36.1	166.00	.00	1.00	2.00
MANNING	113.70	60.00	9.4	37.1	166.00	.00	1.00	3.00
HYBRITECH 542	112.03	62.00	10.6	43.3	165.00	1.00	1.00	2.00
JUDITH	110.50	59.90	10.2	40.9	167.33	.00	1.00	2.00
BLIZZARD	108.50	62.50	11.5	46.1	168.67	2.00	1.00	2.00
NEELEY	106.83	62.40	10.2	43.7	167.67	.00	1.00	3.00
MT 91192	106.37	60.50	10.6	39.9	168.00	.00	2.00	3.00
ROCKY	106.00	62.00	10.4	43.1	166.33	.67	2.00	1.00
WINRIDGE	102.13	61.20	10.8	46.9	171.00	.00	1.00	1.00
BIGHORN	101.97	60.70	10.1	35.6	167.33	.00	1.00	1.00
NUWEST	100.23	60.80	10.5	42.9	167.33	.00	1.00	2.00
CENTURK	100.13	61.30	10.1	44.8	165.33	1.67	2.00	1.00
DYNAMIC II	99.93	58.30	11.2	37.8	169.33	.00	1.00	1.00
KESTREL	99.63	59.90	9.8	43.8	169.33	.00	2.00	1.00
MERIDIAN	98.10	60.60	10.3	34.9	168.33	.00	1.00	3.00
MT 9222	98.10	61.30	11.2	40.2	166.00	.00	3.00	3.00
BZ9W92-712-b	95.83	63.30	11.0	43.7	167.33	4.00	1.00	1.00
BONNEVILLE	95.80	63.40	12.1	48.6	169.33	.33	1.00	2.00
MT 9441	95.70	60.00	10.8	42.4	169.33	.00	1.00	2.00
QUANTUM 547	95.47	59.50	10.2	37.5	164.33	.33	3.00	1.00
MT 9432	95.23	62.70	11.5	44.1	167.00	.00	3.00	1.00
VISTA	95.13	61.40	11.6	34.0	163.33	.33	2.00	1.00
YUMA	94.07	60.90	9.4	33.7	163.33	.00	3.00	1.00
NORWIN	93.77	62.00	10.4	30.1	170.00	.00	3.00	2.00
VANGUARD	93.57	61.70	10.7	42.5	166.67	.33	3.00	2.00
HALT	93.27	59.80	11.2	31.2	163.33	.00	3.00	1.00
S89-142	92.97	61.50	11.0	41.3	170.00	2.33	1.00	1.00
RAMPART	92.37	61.70	11.2	43.2	166.67	1.00	3.00	1.00
ERHARDT	90.97	62.80	12.1	40.7	168.00	.00	1.00	1.00
AC READYMADE	90.83	62.20	12.1	45.1	167.67	.00	3.00	3.00
MCGUIRE	88.27	62.20	12.4	39.9	164.67	.00	3.00	1.00
TIBER	88.07	62.40	11.1	47.9	168.67	.00	3.00	1.00
ALLIANCE	87.07	59.60	9.0	36.2	162.67	.67	3.00	1.00
NIOBRARA	86.73	58.40	9.3	38.1	163.00	.33	3.00	1.00
AKRON	86.20	58.10	9.8	38.2	164.67	.33	3.00	1.00
JULES	86.07	57.40	8.8	37.4	168.33	.67	3.00	1.00
QUANTUM 566	84.10	59.60	10.4	39.4	165.33	1.00	3.00	1.00
GARLAND	80.80	58.20	10.8	24.0	167.33	.00	3.00	3.00
REDWIN	80.77	62.20	11.6	46.1	167.33	.00	3.00	1.00
MT 9453	79.13	61.40	12.1	41.7	168.33	.00	3.00	3.00
NORSTAR	78.10	62.50	11.0	56.2	171.67	6.67	1.00	1.00
ELKHORN	77.97	61.50	11.2	51.4	168.33	4.33	2.00	1.00
NEKOTA	77.37	60.90	11.2	34.8	162.67	.00	3.00	1.00
BZ9W92-712-a	76.00	63.00	11.8	33.6	167.33	.33	1.00	1.00
AGASSIZ	74.93	62.00	10.8	53.1	167.67	5.33	3.00	2.00
QUANTUM EXP. 1643	74.00	57.60	9.8	37.7	167.33	.00	3.00	1.00
IKE	72.33	60.90	11.3	34.1	163.33	.00	3.00	1.00
ROUGHRIDER	71.67	62.00	11.2	51.6	168.00	4.00	3.00	1.00
MEAN	93.19	61.00	10.7	40.8	166.93	.77	2.10	1.50
C.V.	11.06	NA	NA	.6	.63	95.13	NA	NA
LSD (.05)	16.71	NA	NA	2.0	1.71	1.19	NA	NA

1/ DISEASE LEVELS: 1=LOW, 2=MODERATE, 3=HIGH

PROJECT TITLE: Advanced Yield Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Doug Holen, Kalispell, MT.
Phil Bruckner and Jim Berg, PS&ES, Bozeman, MT.

OBJECTIVE:
To evaluate adapted, new, and introduced cultivars for yield, quality, and disease resistance in northwestern Montana. Special attention to dwarf bunt, stripe rust, and leaf rust.

RESULTS:
Yields for the 36 entries ranged from 119 (Neeley) to 79.8 (MTS96102) bu/A, with a mean of 103.2. Test weights were fair with little lodging. Proteins were quite low with most of the seed showing yellowbelly. Disease pressure was high but 11 of the cultivars demonstrated no or little infestation levels to stripe and leaf rust. In a year not conducive to dwarf bunt, five entries were found to be infected. MT9450, MT9523, MTS96101, MTS96104, and MTS96102 had considerable levels in the field and subsequently ended up near or at the bottom for yield.

SUMMARY:
With low to moderate disease infection and some degree of water stress during grain fill, overall yield still was about average.

FUTURE PLANS:
High yielding disease resistant cultivars will continue to be evaluated at Kalispell to identify those with the best potential for production in northwestern Montana.

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

Planted: September 28, 1995 Harvested: August 19, 1996

VARIETY	YIELD BU/A	TEST WT LB/BU	PROTEIN PERCENT	HEIGHT INCHES	LODGING 0-9	HEADING DATE	STRIPE RUST 1/	LEAF RUST /1	DWARF BUNT 2/
NEELEY	118.97	62.20	10.0	44.0	.00	167.33	1.00	3.00	-
MT 9426	117.07	60.60	9.7	38.7	.00	168.00	1.00	1.00	-
KESTREL	117.07	60.20	9.2	43.7	1.33	168.67	1.00	1.00	-
JUDITH	115.77	60.00	9.0	40.8	.33	166.67	1.00	2.00	-
MT 9446	115.13	60.40	11.4	44.2	.00	167.33	1.00	1.00	-
MT9506	113.83	61.00	9.8	43.2	.67	167.33	1.00	2.00	-
MT9514	111.57	59.80	11.2	44.6	4.00	168.33	1.00	1.00	-
MT9557	111.20	59.10	10.9	38.8	.00	166.67	1.00	3.00	-
MT 9440	108.97	61.70	10.5	42.9	.00	168.67	1.00	2.00	-
MT 9409	108.50	60.00	10.3	38.8	.00	167.33	1.00	3.00	-
MT9535	108.23	60.80	11.0	41.7	.33	166.33	1.00	2.00	-
MTW9505	108.10	61.40	9.7	43.2	.00	168.33	1.00	1.00	-
MT9550	107.07	60.70	10.8	39.6	.00	164.00	1.00	2.00	-
MT9526	105.83	61.50	10.4	44.2	.00	168.67	1.00	1.00	-
MT9552	104.93	60.40	10.1	40.0	.00	168.33	1.00	2.00	-
MT 9450	104.37	61.40	9.8	42.5	.00	167.67	1.00	1.00	+
MTS92042	103.63	61.90	10.1	44.8	1.33	166.67	2.00	2.00	-
MTS96105	103.47	61.80	10.5	39.1	.67	165.00	3.00	1.00	-
MT9513	103.17	60.60	8.6	40.9	.00	167.67	1.00	1.00	-
MT 9439	102.23	61.50	11.4	41.1	.00	169.00	1.00	1.00	-
MT9549	101.97	60.50	11.1	37.0	.00	167.00	1.00	2.00	-
PRONGHORN	101.90	61.80	10.2	42.8	2.33	162.33	1.00	1.00	-
MT9523	101.80	63.20	11.0	43.8	.00	166.33	1.00	1.00	+
MT 9403	101.37	60.20	11.1	40.9	.00	166.67	3.00	1.00	-
MT9524	99.87	62.80	9.4	47.6	.00	167.67	2.00	2.00	-
MTS96103	99.20	58.70	11.6	39.1	.00	167.67	1.00	3.00	-
MT 9418	97.83	57.80	11.2	39.4	.00	167.00	3.00	1.00	-
MTW9532	97.77	60.90	10.9	42.0	.00	172.67	2.00	2.00	-
MT9504	97.43	62.30	10.7	46.5	1.67	167.00	2.00	1.00	-
MT 9402	93.67	58.80	9.2	41.3	.00	166.33	3.00	2.00	-
MT9511	92.67	63.00	9.5	40.7	.67	169.00	1.00	2.00	-
MT 9431	92.30	63.20	11.9	45.0	.00	166.67	1.00	2.00	-
MTS96101	90.43	58.10	10.2	37.5	.00	166.67	1.00	2.00	+
REDWIN	89.00	62.60	11.9	46.6	.00	167.33	3.00	2.00	-
MTS96104	88.80	60.00	9.8	40.4	.67	165.67	3.00	2.00	+
MTS96102	79.80	55.60	8.9	39.2	.00	164.67	3.00	1.00	+
MEAN	103.19	60.70	10.4	41.9	.39	167.19	1.50	1.70	
C.V.	6.89	NA	NA	3.2	168.18	.34	NA	NA	
LSD (.05)	11.57	NA	NA	2.2	1.07	.91	NA	NA	

1/ DISEASE LEVELS: 1=LOW, 2=MODERATE, 3=HIGH
2/ DISEASE PRESENT (+) OR ABSENT (-)

YEAR/PROJECT: 1996/755

TITLE: Intrastate Alfalfa Yield Trials - Irrigated & Dryland

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
In cooperation with Robert Dunn and Dr. Ray Ditterline, MSU, Bozeman

Alfalfa varieties were established at both dryland and irrigated sites each spring from 1993 to 1996. The trials planted in 1996 were harvested twice, in late July and late September (after frost). The nurseries planted in 1995 were harvested three times: late June, late July, and late September while most of the varieties were in the late bud to first bloom stage. The irrigated 1994 trial was harvested 6/20 and 8/2 (first bud) and after frost on 9/26 (vegetative). The dryland 1993 and 1994 nurseries were harvested 6/25 and 7/30 (early bloom). The irrigated 1993 nursery was harvested 6/19 and 8/2 while in the early bloom stage. The latter three trials were plowed under after the second cutting.

Precipitation during April and May was 7.90 inches, more than double the 47-year average of 3.84 inches. Coupled with above average precipitation from October through January, spring conditions were extremely wet. The 1996 irrigated site was saturated with standing water in spots, so a seed bed could not be prepared until May 10. Emergence was so spotty that half the stand had to be reseeded by hand on June 5. Because of this, the establishment year yields for this trial were poor. Precipitation during July and August was below average. Growing season precipitation (April - August 1996) was 11.70 inches, 1.73 inches above average.

There were significant differences among varieties for total 1996 dry matter yield in the 1993 trials. 'ICI 631' and Pioneer '5454' had significantly higher yields than the other varieties under both dryland and irrigated conditions. These two varieties, with AS-K94 in the irrigated trial, also had the highest total production over the four-year trial period (20 tons/acre dryland, 21.3-21.7 irrigated). The 1994 dryland trial did not show significant differences among varieties in the three years of the study. Mean yield over the duration was 10.37 tons/acre. There was variation, however, at the irrigated site. Here 'Pasture Plus' from MGS, followed by 'Hygain' from Hyperformer, and Pioneer's 5454 and '5262' were the highest yielding cultivars. Yield data from the 1995 dryland trial was highly variable because of drought stress occurring randomly throughout the nursery in July and August. Differences among cultivars, therefore, were not significant. In the irrigated nursery 'Oneida VR', '3L 102' (Forage Genetics), 'Key', 'Accord', 'DK 127', and 5454 had the highest yields, with 6 tons/acre. The 1996 dryland trial established well, helped by abundant rainfall in May. Seeding-year production ranged from 2.30 tons/acre for Oneida VR to 3.05 tons/acre for 'WL 324'. Because of establishment difficulties mentioned above, the irrigated trial did not fare as well. Yields ranged from 0.71 tons/acre ('MT 9316') to 1.36 tons/acre ('Ultra').

'Puna' chicory was planted in the border plots of both 1996 alfalfa trials. At the dryland site the first cutting yielded 1.25 tons/acre, and the second cutting yielded 0.78 tons/acre. Chicory is a potential perennial forage, especially suited to dryland conditions because of its deep taproot. Samples were taken for quality determination.

1993 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND - 1996

VARIETY	MTNo	FD[1]	VW[2]	Occupancy	Dry Matter Yield 6/25/96 Harvest-1	7/31/96 Harvest-2	1996 TOTAL
				% of plot	t/a	t/a	t/a
ICI 631	270	4	R	90	3.10	2.25	5.35
5454	263	4	MR	89	3.11	2.15	5.25
W6040	268	--	--	88	2.96	1.97	4.93
Apollo Supreme	206	4	R	88	2.86	2.04	4.91
AS-K94	271	--	--	82	2.73	1.99	4.71
WISYN-C	267	-	-	83	2.78	1.91	4.68
5364	213	4	MR	85	2.82	1.81	4.63
Dawn	207	-	-	84	2.58	1.98	4.56
Dominator	273	4	R	84	2.58	1.93	4.51
Profit	258	2	R	86	2.58	1.91	4.49
Vernema	220	4	MR	85	2.62	1.85	4.47
Wrangler	146	2	LR	84	2.73	1.70	4.43
Dart	272	3	R	82	2.53	1.86	4.38
Venture	274	4	R	82	2.51	1.83	4.34
AP 8950	265	-	-	80	2.32	1.96	4.28
Perry	133	3	-	79	2.53	1.59	4.12
Ladak 65	2	1	-	82	2.61	1.43	4.04
Spredor 3	269	1	MR	86	2.60	1.42	4.01
ABI 9143	264	-	-	75	2.20	1.80	4.00
mean				84	2.67	1.86	4.53
LSD(0.05)				5	0.24	0.13	0.31
CV(s/mean)x100				4.0	6.4	5.0	4.9

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/22/93
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant; 4/15/96 - 16.5 lbs/a N + 78 lbs P_2O_5
Harvest area = 75 sqft
Stage of maturity at cutting:
Harvest-1: early bloom
Harvest-2: early bloom
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days
Soil series: Creston Silt Loam
Elevation: 2,940 ft.

1993 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND

VARIETY	MTNo	FD[1]	VW[2]	Dry Matter Yield 1993 t/a	1994 t/a	1995 t/a	1996 t/a	1993-96 TOTAL t/a
5454	263	4	MR	2.47	6.12	6.18	5.25	20.03
ICI 631	270	4	R	2.63	5.92	5.93	5.35	19.83
Apollo Supreme	206	4	R	2.52	5.93	5.91	4.91	19.26
5364	213	4	MR	2.38	6.13	6.02	4.63	19.16
W6040	268	--	--	2.69	5.89	5.61	4.93	19.12
AS-K94	271	--	--	2.63	6.00	5.60	4.71	18.94
WISYN-C	267	-	-	2.61	5.80	5.78	4.68	18.87
Profit	258	2	R	2.43	5.77	5.72	4.49	18.41
Dawn	207	-	-	2.58	5.59	5.66	4.56	18.39
Vernema	220	4	MR	2.56	5.59	5.72	4.47	18.34
Dominator	273	4	R	2.47	5.59	5.50	4.51	18.07
Venture	274	4	R	2.63	5.48	5.57	4.34	18.02
ABI 9143	264	-	-	2.49	5.66	5.61	4.00	17.77
Dart	272	3	R	2.43	5.48	5.43	4.38	17.72
AP 8950	265	-	-	2.53	5.23	5.20	4.28	17.24
Wrangler	146	2	LR	2.08	5.22	5.46	4.43	17.19
Perry	133	3	-	2.19	5.19	5.32	4.12	16.82
Spredor 3	269	1	MR	2.02	4.92	4.86	4.01	15.82
Ladak 65	2	1	-	1.94	4.87	4.84	4.04	15.69
mean				2.44	5.60	5.58	4.53	18.14
LSD(0.05)				0.31	0.44	0.33	0.31	1.04
CV(s/mean)x100				8.9	5.6	4.2	4.9	4.0

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/22/93

1993 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED - 1996

VARIETY	MTNo	FD[1]	VW[2]	Occupancy	Dry Matter Yield 6/19/96 Harvest-1	8/2/96 Harvest-2	1996 TOTAL
				% of plot	t/a	t/a	t/a
ICI 631	270	4	R	98	2.85	2.22	5.07
5454	263	4	MR	96	2.78	2.22	5.00
WISYN-C	267	-	-	92	2.62	2.15	4.77
Dawn	207	-	-	92	2.56	2.13	4.68
5364	213	4	MR	93	2.52	2.02	4.54
Apollo Supreme	206	4	R	94	2.39	2.04	4.43
Dart	272	3	R	95	2.40	1.99	4.38
Profit	258	2	R	92	2.35	2.04	4.38
Venture	274	4	R	93	2.35	2.02	4.37
AP 8950	265	-	-	92	2.23	2.12	4.34
AS-K94	271	--	--	90	2.29	2.04	4.33
W6040	268	--	--	92	2.33	1.97	4.29
Wrangler	146	2	LR	94	2.37	1.88	4.25
Dominator	273	4	R	93	2.27	1.96	4.23
Vernema	220	4	MR	92	2.25	1.89	4.14
Spredor 3	269	1	MR	95	2.46	1.67	4.13
Perry	133	3	-	92	2.29	1.82	4.11
Ladak 65	2	1	-	93	2.41	1.67	4.07
ABI 9143	264	-	-	86	2.09	1.91	4.00
mean				93	2.41	1.99	4.40
LSD(0.05)				4	0.19	0.11	0.27
CV(s/mean)*100				2.8	5.5	4.0	4.3

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/22/93
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant;
4/15/96 - 16.5 lbs/a N + 78 lbs P_2O_5
Harvest area = 76 sqft
Stage of maturity at cutting: Harvest-1: mid bud
Harvest-2: early bloom
Irrigation: 6"
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days
Soil series: Creston Silt Loam
Elevation: 2,940 ft.

1993 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED

VARIETY	MTNo	FD[1]	VW[2]	----------Dry Matter Yield---------- 1993 t/a	1994 t/a	1995 t/a	1996 t/a	1993-96 TOTAL t/a
ICI 631	270	--	--	3.39	6.96	6.33	5.07	21.74
AS-K94	271	--	--	3.74	7.31	5.95	4.33	21.33
5454	263	4	MR	3.06	6.86	6.37	5.00	21.30
WISYN-C	267	-	-	3.24	7.10	5.92	4.77	21.03
Dawn	207	-	-	3.20	6.73	5.90	4.68	20.51
5364	213	4	MR	3.14	6.79	5.89	4.54	20.36
Venture	274	4	R	3.36	6.86	5.70	4.37	20.29
Dart	272	3	R	3.21	6.82	5.79	4.38	20.19
Vernema	220	4	MR	3.48	6.86	5.70	4.14	20.18
W6040	268	--	--	3.38	6.72	5.78	4.29	20.17
AP 8950	265	-	-	3.38	6.58	5.77	4.34	20.07
Profit	258	2	R	3.30	6.65	5.66	4.38	19.99
Apollo Supreme	206	4	R	3.07	6.62	5.68	4.43	19.79
Wrangler	146	2	LR	3.06	6.69	5.68	4.25	19.68
Dominator	273	4	R	3.05	6.51	5.62	4.23	19.41
Perry	133	3	-	3.03	6.73	5.54	4.11	19.40
ABI 9143	264	-	-	3.24	6.39	5.10	4.00	18.73
Spredor 3	269	1	MR	2.87	5.97	5.12	4.13	18.10
Ladak 65	2	1	-	2.87	6.06	5.06	4.07	18.06
mean				3.21	6.69	5.71	4.40	20.02
LSD(0.05)				0.28	0.24	0.27	0.27	0.71
CV(s/mean)x100				6.1	2.5	3.3	4.3	2.5

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/22/93

1994 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND - 1996

VARIETY	MTNo	FD[1]	VW[2]	Occupancy	Dry Matter Yield 6/25/96 Harvest-1	7/30/96 Harvest-2	1996 TOTAL
				% of plot	t/a	t/a	t/a
5262	214	2	LR	100	3.29	1.76	5.05
Legendairy	288	2	HR	97	3.12	1.92	5.04
Hygain	284	4	R	95	3.10	1.82	4.92
ZX 9344	279	--	--	98	3.25	1.66	4.91
ABI 923AA	281	--	--	95	3.07	1.68	4.75
Avalanche	282	2	HR	97	2.96	1.68	4.64
3B50	289	--	--	97	3.01	1.51	4.53
WL-323	251	4	R	95	3.11	1.37	4.48
Ladak 65	2	1	--	98	3.05	1.37	4.42
WL 252 HQ	283	--	--	97	2.98	1.33	4.31
ZC 9030	278	--	--	97	2.93	1.29	4.22
Magnum III-Wet	285	3	MR	98	2.81	1.39	4.20
ABI 9033	280	--	--	96	2.73	1.41	4.14
MS9304	294	--	--	99	2.85	1.29	4.13
Reward	276	4	R	95	2.68	1.40	4.07
Pasture Plus	277	--	--	98	2.78	1.23	4.01
Rushmore	286	4	R	99	2.74	1.25	3.99
Sterling	290	2	R	90	2.73	1.20	3.92
Dividend	291	2	R	96	2.77	1.12	3.90
MS9301	293	--	--	97	2.70	1.16	3.86
330	287	4	R	95	2.65	1.11	3.76
PGI 9047	275	--	--	98	2.75	1.00	3.75
STI-94	292	--	--	86	2.53	1.22	3.75
Wrangler	146	2	LR	97	2.66	1.09	3.74
Perry	133	3	--	97	2.68	1.06	3.74
5454	263	4	MR	99	2.66	1.05	3.70
Vernema	220	4	MR	99	2.57	1.02	3.58
mean				96	2.86	1.35	4.20
LSD(0.05)				5	NS	NS	NS
CV(s/mean)x100				3.5	13.1	35.2	19.2

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/21/94
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant; 4/15/96 - 16.5 lbs/a N + 78 lbs P_2O_5
Stage of maturity at cutting: Harvest-1, prebloom; Harvest-2, early bloom
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days
Soil series: Flathead Very Fine Sandy Loam
Elevation: 2,940 ft.

1994 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED

VARIETY	MTNo	FD[1]	VW[2]	Dry Matter Yield 1994 t/a	1995 t/a	1996 t/a	1994-96 TOTAL t/a
Pasture Plus	277	--	--	3.50	5.88	6.12	15.50
5262	214	2	LR	3.59	5.55	5.81	14.95
5454	263	4	MR	3.37	5.71	5.87	14.95
Reward	276	4	R	3.62	5.55	5.71	14.88
ZX 9344	279	--	--	3.63	5.49	5.72	14.84
Hygain	284	4	R	3.35	5.57	5.91	14.82
330	287	4	R	3.42	5.48	5.77	14.67
Legendairy	288	2	HR	3.30	5.65	5.63	14.58
ABI 9033	280	--	--	3.40	5.44	5.63	14.47
WL-323	251	4	R	3.57	5.18	5.70	14.44
PGI 9047	275	--	--	3.49	5.40	5.50	14.39
Rushmore	286	4	R	3.33	5.44	5.50	14.27
Vernema	220	4	MR	3.76	5.16	5.35	14.27
MP2000	289	3	R	3.62	5.33	5.32	14.27
MS9301	293	--	--	3.47	5.39	5.37	14.23
MS9304	294	--	--	3.65	5.38	5.19	14.22
Magnum III-We	285	3	MR	3.36	5.29	5.54	14.19
Avalanche	282	2	HR	3.51	5.14	5.50	14.14
ABI 923AA	281	--	--	3.35	5.24	5.52	14.11
Dividend	291	2	R	3.45	5.31	5.26	14.01
91-12	283	--	--	3.43	5.05	5.39	13.86
ZC 9030	278	--	--	3.50	5.09	5.23	13.83
Sterling	290	2	R	3.20	5.23	5.38	13.81
Perry	133	3	--	3.55	5.03	5.21	13.79
Aspen	292	4	R	3.54	5.07	5.11	13.72
Wrangler	146	2	LR	3.48	4.74	5.31	13.53
Ladak 65	2	1	--	3.32	4.41	4.93	12.65
mean				3.47	5.30	5.50	14.27
LSD(0.05)				0.32	0.34	0.33	0.69
CV(s/mean)				6.5	4.5	4.3	3.4

[1] Fall Dormancy rating
[2] Vert wilt resistance

Seeding date: 4/27/94

1995 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND - 1996

Variety	MTNo	FD[1]	VW[2]	Occupancy	Dry Matter Yield 6/25/96 Harvest-1	7/30/96 Harvest-2	9/25/96 Harvest-3	1996 TOTAL
				% of plot	t/a	t/a	t/a	t/a
Ladak 65	2	1	-	100	3.13	1.09	0.44	4.66
Vernal	8	2	-	98	2.83	0.99	0.48	4.29
Riley	122	4	LR	95	3.12	1.29	0.81	5.21
5262	214	2	LR	96	3.35	1.31	0.71	5.36
5472	221	4	MR	100	2.88	1.30	0.88	5.06
Viking 1	232	2	HR	99	2.77	0.98	0.54	4.29
5454	263	4	MR	100	3.06	1.25	0.71	5.01
Stamina	296	4	HR	99	3.18	1.19	0.69	5.05
5312	297	3	HR	98	2.77	0.96	0.46	4.19
Accord	298	4	R	99	2.76	1.14	0.65	4.55
Defiant	299	2	HR	100	3.22	1.36	0.68	5.25
Haygrazer	300	4	R	97	2.78	1.15	0.71	4.64
ZX9345A	301	4	R	100	2.86	1.39	0.87	5.11
DK 127	302	3	R	99	3.23	1.01	0.51	4.74
Proof	303	3	R	98	2.85	1.04	0.57	4.46
Leafmaster	304	4	HR	90	2.91	1.13	0.71	4.75
Key	305	4	HR	98	2.95	1.01	0.55	4.51
ABI 9231	306	4	HR	99	2.84	1.32	0.75	4.90
ZX9345B	307	4	HR	99	2.66	1.11	0.69	4.46
Aspen	308	4	R	95	3.07	1.41	1.01	5.49
Oneida VR	309	3	HR	99	3.24	1.37	0.70	5.31
WI95-1	310	2	LR	100	3.46	1.53	0.90	5.89
3L 102	311	-	-	100	3.29	1.31	0.74	5.33
3L 103	312	-	-	100	2.64	0.83	0.37	3.84
FGEXP	313	-	-	99	3.13	1.25	0.78	5.16
mean				98	3.00	1.19	0.67	4.86
LSD(0.05)				3	NS	NS	NS	NS
CV (s/mean)*100				2.2	13.3	28.4	43.7	19.3

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/25/95
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant
Stage of maturity at cutting: Harv-1: prebloom; Harv-2: early bloom; Harv-3: midbloom
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days
Soil series: Flathead Very Fine Sandy Loam
Elevation: 2,940 ft.

Note: Data for harvests 2 & 3 were variable due to random drought stress.

1995 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND

VARIETY	MTNo	FD[1]	VW[2]	----------Dry Matter Yield---------- 1995 t/a	1996 t/a	1995-96 TOTAL t/a
WI95-1	310	2	LR	3.41	5.89	9.30
3L 102	311	-	-	3.49	5.33	8.83
Aspen	308	4	R	3.23	5.49	8.72
5262	214	2	LR	3.20	5.36	8.56
Oneida VR	309	3	HR	3.15	5.31	8.46
FGEXP	313	-	-	3.17	5.16	8.33
Defiant	299	2	HR	3.07	5.25	8.32
ZX9345A	301	4	R	3.07	5.11	8.18
Stamina	296	4	HR	3.12	5.05	8.18
Riley	122	4	LR	2.94	5.21	8.15
5472	221	4	MR	2.89	5.06	7.95
ABI 9231	306	4	HR	2.98	4.90	7.88
5454	263	4	MR	2.83	5.01	7.85
DK 127	302	3	R	3.07	4.74	7.80
Leafmaster	304	4	HR	3.01	4.75	7.75
Accord	298	4	R	3.17	4.55	7.71
Key	305	4	HR	3.07	4.51	7.58
Haygrazer	300	4	R	2.93	4.64	7.56
Ladak 65	2	1	-	2.85	4.66	7.51
Viking 1	232	2	HR	3.19	4.29	7.47
Proof	303	3	R	3.00	4.46	7.46
ZX9345B	307	4	HR	2.91	4.46	7.37
Vernal	8	2	-	2.80	4.29	7.09
5312	297	3	HR	2.87	4.19	7.06
3L 103	312	-	-	3.16	3.84	6.99
mean				3.06	4.86	7.92
LSD(0.05)				NS	NS	NS
CV (s/mean)*100				13.2	19.3	15.9

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 4/25/95

Note: Data variable due to random drought stress.

1995 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED - 1996

					Dry Matter Yield			
					6/21/96	*7/31/96*	*9/25/96*	*1996*
VARIETY	**MTNo**	**FD[1]**	**VW[2]**	**Occupancy**	**Harvest-1**	**Harvest-2**	**Harvest-3**	**TOTAL**
				% of plot	*t/a*	*t/a*	*t/a*	*t/a*
Ladak 65	2	1	-	97	2.73	1.48	0.76	4.97
Vernal	8	2	-	96	2.67	1.69	1.01	5.37
Riley	122	4	LR	92	2.41	1.49	0.93	4.83
5262	214	2	LR	97	2.90	1.83	1.03	5.76
5472	221	4	MR	99	2.74	1.81	1.13	5.67
Viking 1	232	2	HR	97	2.74	1.74	1.06	5.54
5454	263	4	MR	96	3.00	1.90	1.17	6.07
Stamina	296	4	HR	98	2.81	1.74	1.06	5.61
5312	297	3	HR	98	2.86	1.81	1.05	5.72
Accord	298	4	R	98	2.98	1.86	1.15	5.98
Defiant	299	2	HR	97	2.78	1.74	1.01	5.53
Haygrazer	300	4	R	87	2.44	1.57	1.04	5.04
ZX9345A	301	4	R	96	2.63	1.86	1.11	5.60
DK 127	302	3	R	97	3.03	1.88	1.14	6.04
Proof	303	3	R	97	2.97	1.86	1.09	5.92
Leafmaster	304	4	HR	77	2.44	1.50	0.99	4.93
Key	305	4	HR	97	2.93	1.91	1.17	6.01
ABI 9231	306	4	HR	98	2.84	1.83	1.08	5.75
ZX9345B	307	4	HR	92	2.51	1.75	1.06	5.31
Aspen	308	4	R	92	2.70	1.71	1.09	5.50
Oneida VR	309	3	HR	98	3.17	1.84	1.12	6.13
WI95-1	310	2	LR	98	3.01	1.85	1.10	5.95
3L 102	311	-	-	97	3.04	1.89	1.14	6.07
3L 103	312	-	-	95	2.73	1.71	1.10	5.54
FGEXP	313	-	-	97	2.94	1.82	1.12	5.88
mean				95	2.80	1.76	1.07	5.63
LSD(0.05)				4	0.27	0.15	0.09	0.45
CV(s/mean) x100				3.3	6.8	5.9	5.7	5.7

[1] Fall Dormancy rating
[2] Vert Wilt resistance

Seeding date: 4/25/95
Seeding rate: 8 lbs PLS/acre
Fertilizer: 44 lbs N + 208 lbs P_2O_5 preplant
Pesticides: Poast + Dash (1 qt + 1 qt/a) on 6/9 & 6/28/95
Irrigation: 6"
Stage of maturity at cutting: H1-bud; H2-prebloom; H3-vegetative
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days
Soil series: Creston Silt Loam
Elevation: 2,940 ft.

1995 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED

VARIETY	MTNo	FD[1]	VW[2]	----------Dry Matter Yield---------- 1995 t/a	1996 t/a	1995-96 TOTAL t/a
Oneida VR	309	3	HR	2.99	6.13	9.12
3L 102	311	-	-	3.02	6.07	9.09
Key	305	4	HR	3.02	6.01	9.03
Accord	298	4	R	3.01	5.98	8.99
DK 127	302	3	R	2.94	6.04	8.98
5454	263	4	MR	2.80	6.07	8.87
FGEXP	313	-	-	2.90	5.88	8.78
WI95-1	310	2	LR	2.78	5.95	8.73
Proof	303	3	R	2.80	5.92	8.72
Stamina	296	4	HR	2.97	5.61	8.58
5312	297	3	HR	2.69	5.72	8.41
Viking 1	232	2	HR	2.82	5.54	8.36
5262	214	2	LR	2.57	5.76	8.33
ZX9345A	301	4	R	2.73	5.60	8.33
3L 103	312	-	-	2.76	5.54	8.30
ABI 9231	306	4	HR	2.53	5.75	8.28
5472	221	4	MR	2.57	5.67	8.24
Aspen	308	4	R	2.58	5.50	8.08
ZX9345B	307	4	HR	2.63	5.31	7.94
Defiant	299	2	HR	2.40	5.53	7.93
Vernal	8	2	-	2.48	5.37	7.84
Haygrazer	300	4	R	2.55	5.04	7.59
Ladak 65	2	1	-	2.40	4.97	7.37
Leafmaster	304	4	HR	2.43	4.93	7.36
Riley	122	4	LR	2.38	4.83	7.21
mean				2.71	5.63	8.34
LSD(0.05)				0.23	0.45	0.64
CV(s/mean) x100				6.0	5.7	5.5

[1] Fall Dormancy rating
[2] Vert Wilt resistance

Seeding date: 4/25/95

1996 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND - 1996

VARIETY	MTNo	FD[1]	VW[2]	Occupancy	Dry Matter Yield 7/31/96 Harvest-1	9/27/96 Harvest-2	1996 TOTAL
				% of plot	t/a	t/a	t/a
WL 324	318	3	R	93	1.83	1.22	3.05
Bighorn	316	4	R	86	1.89	1.15	3.04
Ultra	229	3	R	93	1.80	1.15	2.95
MT 9308	330	-	-	93	1.85	1.09	2.94
Affinity+Z	315	4	HR	90	1.86	1.08	2.93
XAL 46	314	-	-	91	1.76	1.17	2.93
MT 9302	325	-	-	89	1.57	1.34	2.90
MT 9503	335	-	-	90	1.76	1.09	2.85
5454	263	4	MR	89	1.81	1.03	2.84
Hyland	322	3	R	88	1.73	1.08	2.81
MT 9304	327	-	-	91	1.57	1.23	2.81
Rainier	320	3	R	91	1.79	1.01	2.80
MT 9306	329	-	-	93	1.72	1.08	2.80
MT 9321	333	-	-	90	1.74	1.01	2.75
Magnagraze	323	3	R	91	1.68	1.04	2.72
MT 9305	328	-	-	91	1.55	1.15	2.70
Excalibur II	248	-	-	91	1.72	0.96	2.68
WL 325 HQ	319	3	R	94	1.64	1.02	2.66
Ladak 65	2	1	-	95	1.75	0.87	2.62
Riley	122	4	LR	79	1.57	1.04	2.61
329	317	-	-	89	1.71	0.88	2.59
MT 9303	326	-	-	94	1.62	0.91	2.53
MT 9309	331	-	-	91	1.57	0.95	2.52
Legendairy 2.0	321	3	R	88	1.65	0.84	2.49
MT 9310	332	-	-	86	1.58	0.90	2.47
Magnum III	238	4	MR	95	1.66	0.81	2.46
Wrangler	146	2	LR	85	1.48	0.97	2.45
MT 9316	334	-	-	89	1.55	0.87	2.41
Oasis 371	324	-	-	89	1.55	0.86	2.41
Oneida VR	309	3	HR	93	1.45	0.85	2.30
mean				90	1.68	1.02	2.70
LSD(0.05)				8(P=.10)	0.26	NS	0.48(P=.08)
CV(s/mean) x100				6.2	10.9	22.8	12.6

[1] Fall Dormancy rating

[2] Vert Wilt resistance

Seeding date: 4/26/96
Seeding rate: 8 lbs PLS/acre
Fertilizer: 25 lbs N + 120 lbs P_2O_5 preplant
Pesticides: Pursuit - 6 oz/a
Stage of maturity at cutting:
1st harvest - mid bloom
2nd harvest - vegetative

Growing season precip. (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly precip. (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days
Soil series: Flathead Very Fine Sandy Loam
Elevation: 2,940 ft.

1996 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED - 1996

VARIETY	MTNo	FD[1]	VW[2]	Dry Matter Yield 7/31/96 Harvest-1 t/a	9/27/96 Harvest-2 t/a	1996 TOTAL t/a
Ultra	229	3	R	0.46	0.90	1.36
5454	263	4	MR	0.57	0.79	1.35
Magnagraze	323	3	R	0.45	0.84	1.30
Hyland	322	3	R	0.30	0.98	1.28
Bighorn	316	4	R	0.44	0.82	1.25
Magnum III	238	4	MR	0.33	0.86	1.19
WL 325 HQ	319	3	R	0.35	0.83	1.18
MT 9308	330	-	-	0.20	0.95	1.15
Rainier	320	3	R	0.36	0.80	1.15
MT 9305	328	-	-	0.31	0.85	1.15
Oasis 371	324	-	-	0.43	0.71	1.14
329	317	-	-	0.25	0.84	1.09
MT 9302	325	-	-	0.19	0.88	1.07
WL 324	318	3	R	0.35	0.70	1.05
MT 9503	335	-	-	0.28	0.75	1.03
Excalibur II	248	-	-	0.26	0.77	1.02
MT 9306	329	-	-	0.16	0.84	1.00
XAL 46	314	-	-	0.24	0.76	1.00
Riley	122	4	LR	0.23	0.73	0.96
Affinity+Z	315	4	HR	0.31	0.64	0.96
MT 9321	333	-	-	0.19	0.74	0.93
Legendairy 2.0	321	3	R	0.19	0.72	0.91
MT 9309	331	-	-	0.23	0.68	0.91
MT 9304	327	-	-	0.18	0.68	0.86
MT 9310	332	-	-	0.24	0.62	0.86
Wrangler	146	2	LR	0.17	0.68	0.84
MT 9303	326	-	-	0.19	0.62	0.81
Oneida VR	309	3	HR	0.16	0.65	0.80
Ladak 65	2	1	-	0.14	0.60	0.74
MT 9316	334	-	-	0.11	0.60	0.71
mean				0.27	0.76	1.03
LSD(0.05)				0.17	0.14	0.25
CV(s/mean) x100				44.8	12.9	17.5

[1] *Fall Dormancy rating*
[2] *Vert Wilt resistance*

Seeding date: 5/10/96
Seeding rate: 8 lbs PLS/acre
Failure to establish - reseeded 6/5/96
Fertilizer: 44 lbs N + 208 lbs P_2O_5 preplant
Pesticides: Pursuit - 6 oz/a;
Poast - 2.5qt/a + Dash (946 ml) on 8/6/96
Irrigation: 6"
Stage of maturity at cutting: vegetative

Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31 degrees F
First fall frost: 9/23/96, 27 degrees F
Avg. frost free period: 113 days

Soil series: Creston Silt Loam
Elevation: 2,940 ft.

YEAR/PROJECT: 1996/755

TITLE: Perennial Forage Grass Trials - Irrigated

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
In cooperation with Dr. Dennis Cash, MSU, Bozeman

In 1993, a trial was initiated which included two new cultivars of meadow bromegrass (`Paddock' and `Fleet'), three cultivars of perennial ryegrass (`Greenstone', `Dairymaster', and `Zero Nui'), and `Matua' prairie grass. Matua produced almost 7 tons/acre of dry matter the first year, but did not survive the first winter. The ryegrasses survived the first 2 winters but the stands succumbed to weeds by the end of the season and did not survive the winter of 1995-96. In 1996 Paddock, Fleet, and `Regar' meadow bromegrasses yielded 2.67 to 2.91 tons/acre on the June 7 harvest. Differences within this group were not significant. The mountain bromegrass cultivar and the two wheatgrasses yielded 2.46 to 2.59 tons/acre in 1996. Over the 3 years, the meadow bromegrasses have produced significantly more dry matter than the other species in the trial and have shown the best stand persistence.

A trial comparing 6 meadow bromegrass cultivars was seeded on May 10, 1996. Cultivars included Regar, Fleet, Paddock, and 3 experimental lines. Because of extremely wet soil conditions, emergence was inhibited, and some spot reseeding was necessary. By the time of first harvest in late July, the stands had recovered considerably and displayed mediocre vigor. Yields from this first harvest averaged 360 lbs/acre. Regrowth was harvested Sept.27, and averaged 1.05 tons/acre. Paddock produced significantly more forage than any other cultivar, and Regar produced the least. Fleet, 'Mb-2', and 'Mb-1' produced significantly more forage than Regar.

IRRIGATED 1993 INTRASTATE GRASS STUDY
KALISPELL, 1996

SPECIES [1]	CULTIVAR	Growth Stage	Harvested 6/7/96 DRY MATTER YIELD ----t/a---	1993-96 Total ----t/a---
Meadow bromegrass	Paddock	heading	2.76	21.30
Meadow bromegrass	Fleet	heading	2.91	20.65
Meadow bromegrass	Regar	heading	2.67	19.32
Mountain bromegrass	CO8005308	boot	2.46	17.05
Pub. wheatgrass	Greenleaf	boot	2.59	15.47
Int. wheatgrass	Oahe	flag leaf	2.49	15.16
MEAN			2.64	18.16
LSD(0.05)			0.31	1.02
CV(s/mean)*100			7.7	3.7

Seeding date: 4/28/93
Fertilizer: Fall, 1992 - 180 lbs/a P_2O_5
6/14/93 - 80 lbs/a N
3/30/94 - 102 lbs/a N; 7/1/94 - 60 lbs/a N
4/5/95 - 102 lbs/a N
4/10/96 - 85 lbs/a N 45 lbs/a P_2O_5, 50 lbs/a K_2O, 20 lbs/a SO_2
Study terminated 6/7/96.

[1] Meadow bromegrass - *B. biebersteinii*
Pubescent wheatgrass - *Agropyron trichophorum*
Intermediate wheatgrass - *A. intermedium*

1996 MEADOW BROMEGRASS TRIAL
KALISPELL, 1996

CULTIVAR	STAND [1]	VIGOR [2]	DRY MATTER YIELD 7/31	9/27	1996 TOTAL
	%	(0-5)	tons/acre		
Paddock	88	3.25	0.23	1.21	1.44
Fleet	91	3.25	0.19	1.18	1.36
Mb-2	95	3.00	0.21	1.13	1.33
Mb-1	83	3.25	0.16	1.04	1.19
Mb-3	85	2.25	0.16	0.94	1.09
Regar	84	2.25	0.12	0.81	0.93
MEAN	88	2.88	0.18	1.05	1.23
LSD(0.05)	NS	NS	NS	0.23	0.28
CV(s/mean)	11.2	26.9	42.7	14.2	15.1

[1]Visual estimate of plot occupancy taken 7/26/96
[2] 0=dead; 5=high vigor

Seeded 5/10/96 @ 12 lb/acre.
Fertilizer: 4/10/96:
85 lbs/a N
45 lbs/a P_2O_5
50 lbs/a K_2O
20 lbs/a SO_2

YEAR/PROJECT: 1996/755

TITLE: 1996 Montana Uniform Spring Cereal Forage Trial

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
In cooperation with Dave Wichman, CARC

Four experimental lines of triticale were compared to 'Pronghorn', 5 barley and 2 oat cultivars for forage dry matter yield. Entries were seeded Apr.17, 1996, in a randomized complete block design with 4 replicates. The nursery was fertilized with 81 lbs N/a and 42 lbs P2O5/a on Apr.25.

On May 23, 'WA 799-88' barley, 'Pronghorn' triticale, and 'Celesia' oat displayed the best stand establishment, and '88L012003' triticale had only 20% plot occupancy. 'MT910207' and 'BZ 591-57' barleys and Pronghorn were the first to head (June 25), while Celesia oat was the slowest (July 7). 'Otana' oat and Pronghorn were tallest (45-46 inches), and BZ 591-57 was shortest (29 inches). All plots were harvested July 12, when the plants were between anthesis and milk stage. The oats and triticale were less mature than the barleys. There was no lodging in the nursery. The highest yielding cultivars, with over 4.5 tons/acre, were WA 799-88, 'Westford', MT 910207, and 'Haybet' barleys. The experimental triticales were the least productive, with less than 2.7 tons/acre, except for '88L003007' which produced 3.85 tons dry herbage/acre and was highest in dry matter content (41%).

1996 MONTANA UNIFORM SPRING CEREAL FORAGE TRIAL

NWARC - Kalispell

CULTIVAR	STAND[1] *percent*	HEADING *date*	HEIGHT *inches*	DRY MATTER *percent*	YIELD *tons/a*
WA 799-88 barley	95	7/2	34	36	4.79
Westford barley	88	7/4	40	32	4.57
MT 910207 barley	89	6/25	38	38	4.53
Haybet barley	91	7/2	38	37	4.50
Pronghorn trit	96	6/25	46	37	4.39
Otana oat	89	7/4	45	32	4.19
Celesia oat	93	7/7	42	31	3.98
BZ 591-57 barley	86	6/25	29	35	3.85
88L003007 trit	86	7/2	44	41	3.85
881012013 trit	51	7/4	41	35	2.62
88L012003 HR trit	36	7/3	40	37	2.29
88L012003 trit	20	7/3	37	35	1.70
mean	77	7/1	39	35	3.77
LSD(0.05)	5	1	2	4	0.65
CV(s/mean)	4.9	0.6	3.5	7.8	12.0

[1] evaluated 5/23/96

Seeding date: 4/17/96
Harvest area = 46 sqft
Irrigation: none
Fertilizer: 81 lbs N/a & 42 lbs P_2O_5/a
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31° F
First fall frost: 9/23/96, 27° F
Avg. frost free period: 113 days
Soil series: Creston Silt Loam
Elevation: 2,940 ft.

YEAR/PROJECT: 1996/755

TITLE: Safflower Forage Trial - Planting / Harvest Timing - Dryland

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC

Safflower (cultivar `Centennial') was seeded for forage at dryland sites at Kalispell, Sidney, Moccasin, Bozeman, and Corvallis and at an irrigated site at Sidney. The study was designed as a split plot with three planting dates as main plots and three harvest dates as subplots. At Kalispell the planting dates - "PD"s were May 3, May 21, and June 10, and the harvest dates - "HD"s were Aug.2 (when the plots with the earliest PD were just beginning to bloom), Aug.15 (PD-1 at 90% wilt), and Aug.26 (PD-1 at 95% wilt). Each delay in planting resulted in fewer weeds during stand establishment, although safflower stand was not affected by PD. Dry matter forage yield decreased with each delay in PD - from 3.74 to 2.58 tons/acre. There was a significant increase in yield with each delay in HD. Samples from each plot have been submitted for protein, ADF, and NDF analyses.

Prior to each harvest, 10 plants were randomly selected from each plot and separated into stems, leaves, and heads. Total wet weight of each component from each plot was recorded, dried, ground, and submitted for protein, ADF, and NDF analyses. Wet weight of heads decreased with each delay in PD (means across HD) and increased with each delay in harvest. The interaction between PD and HD was not significant. There were no significant differences among treatments in leaf wet weight. The plants did not show major signs of leaf disease, and leaf loss even in the more mature plants was minimal. Stem weight increased as HD was delayed. PD did not have a significant effect within each HD.

SAFFLOWER FORAGE PLANTING/HARVEST DATE TRIAL - 1996
Kalispell

Planting Date	1/ Weeds (# / sqft)	Safflower Stand (# / sqft)
May 3	6.9	9.5
May 23	2.2	10.3
June 10	0.5	10.3
mean	3.2	10.0
LSD(0.05)	1.6	NS
CV(s/mean)	59.5	16.8

Height (inches)

Planting Date	Harvest Date Aug 2	Aug 23	Aug 26	mean	
May 3	33.5	33.3	32.0	32.9	
May 23	29.0	28.8	28.5	28.8	
June 10	28.3	27.8	28.0	28.0	
mean	30.3	29.9	29.5	LSD(0.05)	PD = 3.5 HD = NS PD x HD = NS

Dry Matter (%)

Planting Date	Harvest Date Aug 2	Aug 23	Aug 26	mean	
May 3	0.41	0.36	0.43	0.40	
May 23	0.39	0.37	0.40	0.38	
June 10	0.31	0.35	0.43	0.36	
mean	0.37	0.36	0.42	LSD(0.05)	PD = NS HD = .03 PDxHD = 0.07 (P=0.07)

Dry Matter Yield (tons / acre)

Planting Date	Harvest Date Aug 2	Aug 23	Aug 26	mean	
May 3	3.43	3.61	4.19	3.74	
May 23	2.65	2.96	3.33	2.98	
June 10	2.00	2.59	3.17	2.58	
mean	2.69	3.05	3.56	LSD(0.05)	PD = 0.82 HD = 0.36 PDxHD - NS

1/ Recorded when safflower was approximately 2" tall.

SAFFLOWER FORAGE PLANTING/HARVEST DATE TRIAL - 1996
Kalispell

PARTITIONS - WET WEIGHT

Heads (gms)

Planting Date	Harvest Date Aug 2	Aug 23	Aug 26	mean	
May 3	178.4	344.3	484.9	335.9	
May 23	106.7	200.5	433.3	246.8	
June 10	54.4	144.5	287.9	162.3	
mean	113.2	229.8	402.0	LSD(0.05)	PD = 134.7 HD = 44.52 PD x HD = NS

Leaves (gms)

Planting Date	Harvest Date Aug 2	Aug 23	Aug 26	mean	
May 3	109.9	158.4	123.6	130.6	
May 23	117.6	126.3	145.0	129.6	
June 10	146.0	146.4	164.9	152.4	
mean	124.5	143.7	144.5	LSD(0.05)	PD = NS HD = NS PD x HD = NS

Stems (gms)

Planting Date	Harvest Date Aug 2	Aug 23	Aug 26	mean	
May 3	168.3	221.2	200.5	196.7	
May 23	123.2	137.7	211.3	157.4	
June 10	143.9	157.8	221.7	174.5	
mean	145.1	172.2	211.2	LSD(0.05)	PD = NS HD = 27.3 PD x HD = NS

YEAR/PROJECT: 1996/755

TITLE: Safflower Plant Population Study - Dryland

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC

On May 21, 1996 `Centennial' safflower was seeded in 6- and 12-inch rows at rates of 10, 20, 30, and 40 lbs. PLS/acre. Stands (# of plants/ft^2) increased as seeding rate increased. The 6-inch spacing produced slightly denser stands than the 12-inch spacing. Weed emergence and safflower plant vigor were not influenced by either seeding rate or row spacing. Plant height at harvest decreased slightly as seeding rate increased. The 40-lb seeding rate seemed to slow maturity.

The trial was harvested Aug.15 when 4-24% of the flowers had wilted. Neither seeding rate nor row spacing produced significant differences in forage yield. The lack of response indicates that 10 lbs/acre PLS is sufficient for either 6- or 12-inch rows.

Protein and fiber content is being analyzed. Since stand density did not affect weed emergence or stand vigor, the only advantage to higher seeding rates could be the retardation of maturity and higher forage quality.

SAFFLOWER POPULATION TRIAL
KALISPELL, 1996

Stand (plants/ft²)

Seeding Rate(lbs/a)	Row Spacing 6-inch	12-inch	mean		
10	6.4	6.8	6.6		
20	10.5	9.0	9.8		
30	15.0	13.4	14.2		
40	18.5	16.6	17.6		
				LSD(0.05)	SR = 1.7
mean	12.6	11.4	12.0		RS = 1.2(P=.06
					SR x RS = NS

Weeds (#/ft²)

Seeding Rate(lbs/a)	Row Spacing 6-inch	12-inch	mean		
10	1.5	1.4	1.4		
20	1.6	1.9	1.8		
30	1.4	1.5	1.4		
40	1.6	1.5	1.6		
				LSD(0.05)	SR = NS
mean	1.5	1.6	1.5		RS = NS
					SR x RS = NS

Vigor (0-5)

Seeding Rate(lbs/a)	Row Spacing 6-inch	12-inch	mean		
10	4.3	4.0	4.1		
20	4.5	4.5	4.5		
30	4.3	4.0	4.1		
40	4.0	4.0	4.0		
				LSD(0.05)	SR = NS
mean	4.3	4.1	4.2		RS = NS
					SR x RS = NS

Height (inches)

Seeding Rate(lbs/a)	Row Spacing 6-inch	12-inch	mean	
10	31.3	31.3	31.3	
20	30.5	30.8	30.6	
30	30.0	30.0	30.0	
40	29.0	30.0	29.5	
				LSD(0.05) SR = 0.9
mean	30.2	30.5	30.3	RS = NS
				SR x RS = NS

Stage of Maturity at Harvest (% wilt)

Seeding Rate(lbs/a)	Row Spacing 6-inch	12-inch	mean	
10	14	24	19	
20	11	9	10	
30	9	23	16	
40	6	4	5	
				LSD(0.05) SR = 11(P=.07)
mean	10	15	12	RS = NS
				SR x RS = NS

Dry Matter Yield (t/a)

Seeding Rate(lbs/a)	Row Spacing 6-inch	12-inch	mean	
10	3.74	3.62	3.68	
20	3.91	3.78	3.85	
30	3.63	4.03	3.83	
40	3.80	3.62	3.71	
				LSD(0.05) SR = NS
mean	3.77	3.76	3.77	RS = NS
				SR x RS = NS

Seeded 5/21/96
Harvested 8/15/96

YEAR/PROJECT: 1996/755

TITLE: Safflower Forage - Nitrogen Rate Trial

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC

This study was designed to determine the amount of nitrogen fertilizer needed to produce optimum safflower forage yield and quality. Treatments were four rates of N (30, 60, 90, and 120 lbs/a) and a 0-N control arranged in a randomized complete block design with four replicates. The study was seeded with 'Centennial' safflower at 25 lbs/a PLS on May 21, 1996, and the N rates applied the same day. Each plot was seeded in 7 rows, 15 feet long with 6-inch row spacing. No differences in plant vigor or height were observed. All plots were harvested Aug.15, 1996. Flowers were beginning to wilt in all plots, with the high N rates (90-120 lbs/a) slightly more mature than the 30-lb and 0-N plots. There were no differences among N rates in dry matter yield, and none produced more forage than the unfertilized control. Samples are being analyzed for protein, ADF, and NDF.

SAFFLOWER FORAGE - NITROGEN RATE TRIAL
KALISPELL, 1996

RATE	VIGOR[1]	HEIGHT	STAGE	YIELD
lbs N/a	*(0-5)*	*inches*	*% wilt*	*tons DM/a*
0	4.5	32.25	10	3.68
30	5.0	31.75	8	3.76
60	4.5	31.50	19	3.66
90	5.0	31.25	26	3.63
120	4.5	31.75	26	3.53
mean	4.7	31.70	18	3.65
LSD(0.05)	NS	NS	16[2]	NS
CV(s/mean)	10.3	2.9	59.7	8.1

[1] Estimates of plant vigor on 7/8/96
[2] P=0.08

Planting date: 5/21/96
Harvest date: 8/15/96

YEAR/PROJECT: 1996/758

TITLE: Western Regional Dry Pea & Lentil Yield Trials - Dryland

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
In cooperation with Dr. Fred Muehlbauer, WSU

Twelve dry pea and lentil varieties were seeded on April 17, 1996. Excellent stands were obtained. Precipitation from April through August was 11.7 inches, 17% above average. Except for a cooler than average May, temperatures during this period were normal for the location. High moisture conditions in April and May promoted good establishment and vegetative growth, but drier conditions June through August were conducive to good pod and seed development. The disease problems encountered in 1995 were not present.

Mean seed yields for the peas was 2410 lbs/acre, more than 1000 lbs. higher than 1995. The lentils averaged 2139 lbs/acre, more than 2.5 times the mean yields for 1995. The highest yielding pea varieties were `PS210387' (a 'Flavanda' derived experimental cross), with 3016 lbs/acre, and Flavanda, with 2972 lbs/acre. Highest yielding lentil varieties were 'Pardina', 'Richlea', 'Eston', 'Crimson', and 'Brewer' with more than 2200 lbs/acre. *Schlerotinea* mold symptoms were not observed this year.

WESTERN REGIONAL DRY PEA YIELD TRIAL
KALISPELL, MT - 1996

VARIETY	STAND	FIRST FLOWER	NODES to 1st FLOWER	MATURITY	HEIGHT	SEED SIZE	YIELD
	%	day [1]	#	day [1]	inches	#/lb	lbs/acre
PS210387	95	69	14	104	28	2069	3016
Flavanda	92	68	12	104	28	2196	2972
Rex	92	67	14	105	40	1936	2592
Radley	91	71	16	108	26	2921	2536
PS210370	94	60	9	106	23	2114	2532
PS010603	93	59	14	111	46	2050	2430
Latah	97	60	12	111	46	2518	2401
Umatilla	95	65	13	111	50	2104	2299
Columbian	96	57	8	111	50	2260	2200
Alaska 81	96	59	9	112	51	2362	2048
PS210377	97	67	12	114	53	2172	1956
PS110028	97	62	12	113	48	1983	1937
mean	95	64	12	109	41	2224	2410
LSD(0.05)	3	1	1	2	5	147	346
CV(s/mean)	2.3	1.5	6.9	1.1	8.2	4.6	10.0

[1] *days after seeding*

Seeding date: 4/17/96
Harvest area: 42 ft²
Irrigation: none
Fertilizer: 9 lbs N/a & 42 lbs P_2O_5/a
Pesticide: Treflan - 0.5 lb AI/a preplant
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31° F
First fall frost: 9/23/96, 27° F
Avg. frost free period: 113 days
Soil series: Creston Silt Loam
Elevation: 2,940 ft.

WESTERN REGIONAL LENTIL YIELD TRIAL
KALISPELL, MT - 1996

VARIETY	STAND	FIRST FLOWER	MATURITY	HEIGHT	SEED SIZE	YIELD
	%	*day¹*	*day¹*	*inches*	*#/lb*	*lbs/acre*
Pardina	94	66	115	15	12190	2526
Richlea	95	67	117	21	8528	2513
Eston	84	65	115	18	13680	2420
Crimson	93	65	110	16	12050	2243
Brewer	88	60	114	19	7231	2232
LC206400	95	62	116	20	7834	2174
LC960254	95	60	112	19	6464	2065
Palouse	95	60	115	16	6299	1973
Redchief	94	60	116	17	8272	1966
Matador	71	72	116	18	16390	1925
LC260718	96	61	114	19	7040	1905
Laird	89	70	119	19	6656	1729
mean	91	64	115	18	9386	2139
LSD(0.05)	3	2	4	3	571	323
CV(s/mean	2.7	2.1	2.4	12.5	4.2	10.5

¹ days after seeding

Seeding date: 4/17/96
Harvest area = 43 sqft
Irrigation: none
Fertilizer: 9 lbs N/a & 42 lbs P_2O_5/a
Pesticide: Treflan - 0.5 lb AI/a preplant
Growing season precipitation (Apr 96-Aug 96): 11.70", avg.9.97"
Yearly Precipitation (Sep 95 - Aug 96): 24.49", avg.19.87"
Last spring frost: 5/21/96, 31° F
First fall frost: 9/23/96, 27° F
Avg. frost free period: 113 days
Soil series: Creston Silt Loam
Elevation: 2,940 ft.

WESTERN REGIONAL DRY PEA YIELD TRIAL
KALISPELL, MT - 1992-96

VARIETY	1996	1995	1994[1]	1993	1992	mean
			lbs/acre			
Flavanda	2972					2972
IMPCS			1234	2116	2784	2045
Latah	2401	1253	1189	2225	2804	1974
Umatilla	2299	1535	957	2516	2461	1954
Rex	2592	1289				1941
Columbian	2200	1448	1353	1799	2841	1928
Alaska 81	2048	1495	1309	1907	2782	1908
Radley	2536	1216				1876
Trapper	1480		747	1824	3146	1799
mean	2419	1404	1092	2012	2808	
LSD(0.05)	346	276	290	477	449	
CV(s/mean	10.0	14	17.8	14.6	11.1	

[1] Low rainfall and above average temperatures reduced yields.

WESTERN REGIONAL LENTIL YIELD TRIAL
KALISPELL, MT - 1992-96

VARIETY	1996	1995[2]	1994	1993[2]	1992	mean
			lbs/acre			
	2513					2513
Richlea	1925					1925
Matador	2420	1168				1794
Eston	2526	732	1431			1563
Pardina	2232	802	1124	669	2240	1413
Brewer	2243	942	1074	885	1917	1412
Crimson	1966	801	878	446	2210	1260
Redchief				771	1720	1246
Emerald	1973	1018	319	693	1931	1187
Palouse	1729	715	717	460	1495	1023
Laird			1324	261	1393	993
Chilean 78						
	2225	910	924	598	1844	
mean	323	153	281	351	443	
LSD(0.05)	10.5	12.8	18.1	40.3	17.0	
CV(s/mean)						

[2] *Yields reduced due to white mold (Scherotinea).*

YEAR/PROJECT: 1996/758

TITLE: Spring Canola Variety Trial - Dryland

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC

Five varieties of *Brassica napus* were evaluated for Svalof Weibull Seed Ltd.: 'Sponsor, 'Coronet', 'SW 02530', 'Bullet', and 'SWLM 02579'. Two varieties from Bonis & Co. Ltd, 'OAC-Springfield' and 'BC 94-123', were also included. The study was designed as a randomized complete block with 4 replicates. Plots consisted of four 8-foot rows spaced 12 inches apart, with 24 inches between plots. All cultivars were seeded at 7 lbs/a on Apr.17, 1996. Treflan, at 0.5 lb AI/a, was preplant incorporated, and the nursery was fertilized with 54 lbs N/a and 28 lbs P_2O_5/a on April 25. Maturation time averaged 113 days after seeding, with little variation among cultivars. No *Sclerotinea* symptoms were observed this year. Seed yields averaged 1720 lbs/a, and variation among cultivars was not statistically significant.

1996 CANOLA VARIETY TRIAL - KALISPELL, MONTANA

Entries submitted by Svalof Weibull Seed Ltd.

VARIETY	VIGOR	FLOWERING	PETAL DROP	MATURITY	HEIGHT	YIELD
	(0-5)[1]		days after seeding		inches	lbs/acre
Sponsor	3.00	61.8	85.0	114.8	44.8	1949
Coronet	3.75	61.0	85.3	113.1	44.0	1504
SW 02530	3.50	60.8	85.8	113.1	44.8	1829
Bullet	3.25	58.0	84.3	112.5	45.2	1615
SWLM 02579	4.50	61.5	85.5	114.8	47.6	2046
OAC-Springfield	4.25	60.0	84.0	112.8	40.1	1600
BC 94-123	3.75	61.5	85.0	112.5	41.3	1496
mean	3.71	60.7	85.0	113.4	44.0	1720
LSD (0.05)	1.25	0.6	1.4	1.9	2.8	554
P-VALUE	0.21	0.00	0.15	0.08	0.00	0.27
CV(s/mean)x100	22.6	0.6	1.1	1.1	4.3	21.7

[1]5 =high vigor; 0=dead

Location: Northwestern Agricultural Research Center, Kalispell, Montana, USA
Latitude: 48 degrees N; Longitude: 114 degrees W
Crop year precipitation (Sept. 1995 - Aug. 1996): 24.49", avg.19.87"
Season precipitation (Apr.-Aug. 1996): 11.70",avg.9.97"
Last frost in spring: 5/21/96 (31° F)
Maximum summer temperature: 91° F on 7/19/96
Irrigation: none
Fertilizer: 54 lbs N/a & 28 lbs P_2O_5/a
Weed control: Treflan - 0.5 lb ai/a
Seeding date: 4/17/96
Seeding rate: 7 lbs/acre
Design: RCB with 4 replicates
Plots: four 8 ft rows spaced 12 in apart; 24 inches between plots
Harvest area: 38 ft²

TITLE: Evaluation of Mint Cultivars in the Presence and Absence of *V. dahliae*.

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise S. Prestbye, Research Technician, MSU, Kalispell, MT

PROCEDURES: Peppermint and spearmint cultivars were established in Creston silt loam soils at the Northwestern Agricultural Research Center at Kalispell, MT in spring of 1994. The experiment was planted at two sites: one infected with *Verticillium* wilt in fall, 1994, and one kept free of the disease.

Nuclear plants were obtained from three different sources. Black Mitcham, nodal tissue derived, and grown in soil plugs was obtained from Lakes, Ronan, MT. Meristem Black Mitcham and meristem Native and Scotch spearmints were obtained from Starkels, Ronan, MT. All other entries (stem-tip propagated) were provided by MIRC from Don Roberts' breeding program. Harvest area for hay yield was 94 to 99 square feet. The peppermint and spearmint experiments were arranged separately in randomized complete block designs with four replicates.

Each nursery was sprinkler irrigated to insure maximum growth. Each experimental site was fertilized with 85 lbs N, 45 lbs P_2O_5, 50 lbs K_2O, and 20 lbs SO_2/acre on Apr. 9-10; 70 lbs N/acre on Aug. 13; and 60 lbs N/acre on Aug. 30, 1996. Sinbar was applied at 0.5 lb/acre on May 2.

Cultivars were evaluated for agronomic characteristics and disease symptoms. For peppermint, analysis of variance of a 2 x 7 factorial in a split plot design with *Vert* wilt inoculated and *Vert* wilt free sites as whole plots and cultivars as subplots showed no significant site x cultivar interaction for yield components. Very little disease was observed in the *Vert* wilt nursery for the last two seasons. Data, therefore, were pooled and analyzed as a randomized complete block with 8 replicates per cultivar entry. Total oil yield (sum of 2 cuttings) of spearmint did show significance of the interaction, so cultivars were compared separately at each site . Dry matter yields of peppermint cultivars were obtained on Aug. 7 and of spearmint on July 19 and Sept. 11, 1996. Approximately 20 pounds of green hay was air dried and later distilled. Samples were sent to Wm. Leman Co. for quality analyses.

RESULTS AND DISCUSSION:

Peppermint

The winter of 1995-96 resulted in severe winter kill in some areas of N.W. Montana. No differences were noted in peppermint survival in these studies. However, the peppermint as a group survived the winter better than did the spearmint. Also, it was evident that the meristem derived spearmint had more winter hardiness than the stem tip spearmint.

Tissue culture material (meristem and nodal) did not exhibit the abnormally high vigor characteristics of past years. In fact, the experimental lines M-83-7 and T-84-5 were sometimes more vigorous than the tissue culture material.

There was little variation in dry matter (hay) yields among cultivars. Murray Mitcham had significantly lower hay yields than Black Mitcham nodal and meristem. Hay yields were not related to spring vigor.

Peppermint oil yields were greatest for Black Mitcham stem tip, Roberts Mitcham, and Black Mitcham *in vitro* nodal and lowest for T-84-5, BM meristem, M-83-7, and Murray Mitcham. Contrary to 1995, oil yields were positively correlated with hay yields ($R=0.35$) but showed no relationship to spring vigor. Dry matter yield was inversely related to row cover ($R= -0.75$). Hay yield had a positive but rather weak correlation with oil yield ($R=0.35$). BM-stem tip had slightly, but not significantly, higher oil yield than BM-nodal. Differences in early vigor were not as noticeable this year.

Disease symptoms were minimal at both sites. Peppermint rust was evident at both sites, but only at low levels. Vert wilt symptoms were seen on only a few isolated plants in the inoculated site.

Spearmint

The meristem-derived spearmint covered the rows more completely, had more stolon spread, and was generally more vigorous than stem tip spearmint.

Meristem derived Native spearmint produced more hay than stem tip derived spearmint in both harvests at each site. For Scotch, hay yields were greater only for the first harvest. Total oil yields were greater for meristem than for stem tip spearmint, particularly for Native. It is clear that greater vigor is needed to maximize spearmint oil yields in the double cut system which is typical for spearmint.

Spring stand evaluation (6/4/96) and height at harvest (8/9/96) of peppermint cultivars in the Vert wilt infected site.

CULTIVAR	ROW COVER (0-5)[1]	VIGOR (0-5)[2]	STOLON SPREAD (0-5)[3]	HEIGHT inches
Black Mitcham-stem tip	3.5	3.3	2.4	28.3
Black Mitcham-in vitro nodal	4.0	3.0	3.0	32.8
Black Mitcham-in vitro meris	3.8	3.5	3.8	30.5
Murray Mitcham-stem tip	4.0	3.8	3.3	29.0
Roberts Mitcham-stem tip	4.0	3.5	3.8	29.0
M-83-7 - stem tip	3.5	4.3	3.0	31.0
T-84-5 - stem tip	4.0	4.0	2.8	31.8
mean	3.8	3.6	3.1	30.3
LSD(0.10)	0.6	0.9	0.6	2.3
CV(s/mean)x100	13.3	21.0	14.6	6.2

Spring stand evaluation (6/4/96) and height at harvest (8/9/96) of peppermint cultivars in the Vert free site.

CULTIVAR	ROW COVER (0-5)[1]	VIGOR (0-5)[2]	STOLON SPREAD (0-5)[3]	HEIGHT inches
Black Mitcham-stem tip	3.0	3.3	1.8	36.3
Black Mitcham-in vitro nodal	3.0	2.8	2.0	34.5
Black Mitcham-in vitro meris	3.5	2.8	2.0	34.3
Murray Mitcham-stem tip	3.3	3.3	1.3	33.5
Roberts Mitcham-stem tip	3.5	2.8	1.8	33.5
M-83-7 - stem tip	3.0	3.5	2.0	32.8
T-84-5 - stem tip	3.3	3.3	1.0	34.5
mean	3.2	3.1	1.7	34.2
LSD(0.10)	0.8	0.9	1.1	2.6
CV(s/mean)x100	21.0	25.2	55.4	6.2

Spring stand evaluation of spearmint cultivars at both sites* on 6/4/96 and height at each site on 7/19/96.

CULTIVAR	ROW COVER (0-5)[1]	VIGOR (0-5)[2]	STOLON SPREAD (0-5)[3]	HEIGHT (inches) Vert	Vert free
Native-stem tip	1.25	2.38	1.75	22.5	25.3
Native-meristem	2.38	3.63	3.25	26.3	31.5
Scotch-stem tip	2.50	2.13	2.13	21.0	22.8
Scotch-meristem	3.25	2.88	3.00	23.3	23.5
mean	2.34	2.75	2.53	23.3	25.8
LSD(0.10)	0.46	0.58	0.91	2.2	2.7
CV(s/mean)x100	22.6	24.5	41.9	7.5	8.1

[1] 0=no cover; 5=entire plot area covered
[2] 0=no growth; 5=all plants exhibiting healthy, vigorous growth
[3] 0=no spread from crowns; 5=extensive spreading
** Data combined - site X cultivar interaction not significant.*

Yield parameters of peppermint cultivars at Kalispell, harvested 8/9/96.

CULTIVAR	OIL ONTEN	HAY YIELD	OIL YIELD
	ml/lb	*t/a*	*lbs/a*
Black Mitcham-stem	5.7	4.59	97.3
Black Mitcham-nodal	5.3	4.62	91.5
Black Mitcham-meristem	5.0	4.63	85.2
Murray Mitcham-stem	5.5	4.27	86.7
Roberts Mitcham-stem	5.8	4.44	95.0
M-83-7 - stem	5.2	4.50	86.3
T-84-5 - stem	5.1	4.43	84.6
mean	5.4	4.49	89.5
LSD(0.10)	0.6	0.34	9.2
P-VALUE	0.19	0.61	0.13
CV(s/mean)x100	13.7	8.89	12.2

Site X cultivar interactions not significant at P>0.10.

Oil content, hay and oil yield of spearmint cultivars at the Vert wilt infected site in 1996.

	1st Cutting 7/19/96			*2nd Cutting 9/11/96*			
CULTIVAR	OIL ONTEN	HAY YIELD	OIL YIELD	OIL ONTEN	HAY YIELD	OIL YIELD	TOTAL OIL
	ml/lb	*t/a*	*lbs/a*	*ml/lb*	*t/a*	*lbs/a*	*lbs/a*
Native-stem tip	4.5	1.99	33.6	3.4	2.75	35.6	69.2
Native-meristem	4.3	3.38	54.8	3.1	2.93	34.4	89.1
Scotch-stem tip	4.9	2.84	64.1	3.7	2.97	51.5	115.6
Scotch-meristem	5.5	3.65	75.8	4.6	3.06	53.0	128.8
mean	4.8	2.96	57.0	3.7	2.93	43.6	100.7
LSD(0.10)	1.3	0.43	12.4	0.8	0.26	7.4	14.0
CV(s/mean)x100	20.5	11.1	16.3	16.8	7.0	12.6	10.4

Oil content, hay and oil yield of spearmint cultivars at the Vert free site in 1966.

	1st Cutting 7/19/96			*2nd Cutting 9/11/96*			
CULTIVAR	OIL ONTEN	HAY YIELD	OIL YIELD	OIL ONTEN	HAY YIELD	OIL YIELD	TOTAL OIL
	ml/lb	*t/a*	*lbs/a*	*ml/lb*	*t/a*	*lbs/a*	*lbs/a*
Native-stem tip	3.9	3.01	42.8	2.5	3.24	30.7	73.4
Native-meristem	4.6	4.04	67.5	2.7	3.55	35.7	103.1
Scotch-stem tip	5.9	2.81	61.8	3.7	2.97	40.5	102.3
Scotch-meristem	5.8	3.35	73.8	3.3	3.00	37.7	111.6
mean	5.1	3.30	61.4	3.0	3.19	36.1	97.6
LSD(0.10)	1.2	0.69	16.9	0.7	0.23	7.9	17.9
CV(s/mean)x100	18.5	16.1	21.3	18.1	5.5	16.6	13.8

Quality components of peppermint cultivars at Kalispell, MT in 1996.

CULTIVAR	Stage	Total Heads	Total Ketones	Total Menthol	Mentho-furan	Menthone	Menthol	Esters	Pulegone
					GC%				
Black Mitcham-stem tip	1st blm	10.5	25.3	46.6	3.3	21.4	40.4	3.1	0.6
Black Mitcham-in vitro nodal	1st blm	9.8	27.3	45.9	3.6	23.2	39.9	3.0	0.7
Black Mitcham-meristem	1st blm	10.3	25.4	47.4	3.0	21.5	41.5	2.8	0.6
Murray Mitcham-stem tip	late bud	11.2	27.8	45.9	1.8	23.7	39.5	3.3	0.3
Roberts Mitcham-stem tip	late bud	10.8	29.9	44.6	2.0	25.7	38.8	2.8	0.4
M-83-7 - stem tip	late bud	10.9	26.8	46.7	2.0	22.8	39.9	3.6	0.4
T-84-5 - stem tip	late bud	10.6	30.3	45.0	2.3	26.2	38.5	3.3	0.4
mean		10.6	27.6	46.0	2.5	23.5	39.8	3.1	0.5
LSD(0.10)		0.3	1.7	1.4	0.2	1.6	1.0	0.4	0.1
CV(s/mean)x100		3.8	7.1	3.6	10.2	7.9	2.9	14.5	20.8

Site X cultivar interactions not significant at P>0.10.

Quality components of spearmint cultivars at Kalispell, MT in 1996.

1st Harvest - 7/19/96	Stage	a-Pinene	Limonene	Cineole	Octanol	Dihydro-carvone	Carvone
				GC%			
Native-stem tip	late bud	1.11	10.9	2.18	1.05	1.71	59.7
Native-meristem	late bud	1.11	11.1	2.44	0.96	2.17	58.7
Scotch-stem tip	early blm	1.04	18.5	1.38	2.14	0.85	62.9
Scotch-meristem	1st blm	1.06	18.5	1.20	1.99	1.24	63.3
mean		1.08	14.8	1.80	1.53	1.49	61.1
LSD(0.10)		NS	1.1	0.16	0.12	0.19	1.8
CV(s/mean)x100		9.58	8.6	10.38	8.89	14.43	3.4

2nd Harvest - 9/11/96		a-Pinene	Limonene	Cineole	Octanol	Dihydro-carvone	Carvone
				GC%			
Native-stem tip	1st bud	1.13	11.1	1.93	1.05	2.15	59.1
Native-meristem	1st bud	1.12	11.3	1.89	0.95	3.25	58.4
Scotch-stem tip	veg	0.96	18.3	1.37	2.14	0.95	63.8
Scotch-meristem	veg	1.04	19.6	0.81	1.84	1.41	63.1
mean		1.06	15.1	1.50	1.50	1.94	61.1
LSD(0.10)		0.08	1.1	0.24	0.07	0.21	1.8

TITLE: Peppermint Propagation Evaluation

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise S. Prestbye, Research Technician, MSU, Kalispell, MT

PROCEDURES: The experiment was established in 1995 on a Creston silt loam soil that was plowed out of alfalfa the previous fall. Nuclear plants of Black Mitcham peppermint were obtained from four sources: Lakes, of Ronan, MT provided nodal tissue derived plants in soil plugs from both 1992 and 1994 cultures, and plants grown with bare roots in growth medium from 1994; Summit Labs, the MIRC propagator, provided plants derived from stem tip cuttings; Michigan State University provided 2 lines (A-1, A-2) derived from tissue culture of internode stem sections from a single mother plant (their protocol used prior to transformation), and 3 lines (P-1, P-2, P-3) derived from 3 protoclones from another single plant (their protocol for protoplast culture).

The site was fertilized with 85 lbs N, 45 lbs P_2O_5, 50 lbs K_2O and 20 lbs SO_2 /acre on Apr.9, 1996; 70 lbs N/acre on Aug.13; and 60 lbs N/acre on Aug.30. Sinbar was applied at 0.5 lb AI/acre on Apr.16, 1996. The nursery was sprinkler irrigated to insure maximum growth.
Entries were evaluated June 4, 1996 for stand vigor characteristics. There was no sign of disease, and insect damage was minor. Dry matter yields were obtained on Aug.8. Approximately 20 pounds of green hay was air dried and later distilled. Oil samples were sent to Wm. Leman Co. for quality analysis.

RESULTS AND DISCUSSION:

The material from Lakes 1992 *in vitro* nodal culture had the most vigorous growth as of early June, as evidenced by row coverage, plant vigor, and stolon spread. The 1994 *in vitro* propagated plants from Lakes and the Michigan A lines had more vigorous stands than the stem tip propagated plants from Summit. The visual difference between the Michigan A lines, which were propagated from an individual donor plant using an internodal tissue culture protocol, and the Michigan P lines, which were propagated from individual cells from another single donor plant raises the question: are these vigor differences due to differences in the two mother plants or in the two cell culture methods?

Early season vigor differences carried over to harvest time on Aug.8 as variation in plant height. The three nodal lines from Lakes and the Michigan A1 line produced the longest stems, and the Michigan P lines had the shortest. The 1994 nodal bare root line from Lakes produced the most oil in 1996, significantly more than plants from the same culture grown in soil plugs. We do not know why the bare root material would yield more than the plug material. Dry matter yield followed the same trend. There was a strong positive correlation between oil yield and early season vigor ($r=0.74$) and between oil yield and late season vigor, as indicated by plant height ($r=0.81$). The stem tip propagated line from Summit produced much less dry matter than the *in vitro* lines. The oil yield from the Summit line was slightly, but not significantly, less than the *in vitro* plug-grown lines. The two Michigan A lines produced significantly more hay and oil than the P lines.

There were no significant differences in menthol or menthofuran levels among propagation sources. There were some interesting differences in other components, however. The Lake-92 culture line was lower in total heads and higher in pulegone than the Lake-94 or Summit lines. The Michigan "A" lines had different levels of heads, total ketones, menthone, esters, and pulegone than the Michigan "P" lines. The origin of these phenotypic differences among Black Mitcham propagation lines,at the chemical level, deserves further study.

Spring stand observations on Black Mitcham propagation lines at Kalispell on June 4, 1996.

PROPAGATION SOURCE	ROW COVER	VIGOR	STOLON SPREAD
	(0-5)[1]	*(0-5)[2]*	*(0-5)[3]*
Lake-plug-1994 *	4.0	3.8	3.8
Lake-plug-1992 *	4.5	4.3	4.3
Lake-bare root-1994 *	3.8	3.8	3.3
Summit-bare root **	2.3	2.3	1.5
Michigan-A1	4.3	3.8	2.5
Michigan-A2	3.8	3.5	2.8
Michigan-P1	2.5	2.3	1.8
Michigan-P2	1.8	2.3	1.8
Michigan-P3	1.8	1.8	2.5
mean	3.2	3.1	2.7
LSD(0.10)	0.7	0.5	0.9
CV(s/meanX100)	18.7	14.4	28.6

** in vitro-nodal*
*** stem tip*
[1] 0=no cover; 5=entire plot area covered
[2] 0=no growth; 5= plants exhibiting healthy, vigorous growth
[3] 0=no spread from crowns; 5=extensive spreading

Harvest components of Black Mitcham propagation lines planted at Kalispell in 1995 and harvested Aug.8, 1996.

PROPAGATION SOURCE	PLANT HEIGHT	OIL CONTENT	HAY YIELD	OIL YIELD
	in	*ml/lb*	*t/a*	*lbs/a*
Lake-plug-1994 *	37.5	4.8	3.96	99.0
Lake-plug-1992 *	38.8	4.4	4.45	104.4
Lake-bare root-1994 *	39.8	4.9	4.70	117.0
Summit-bare root **	35.5	5.5	3.25	93.5
Michigan-A1	39.5	4.9	4.07	102.5
Michigan-A2	34.5	4.8	4.02	98.9
Michigan-P1	30.5	5.6	2.78	82.7
Michigan-P2	32.5	5.9	2.71	75.2
Michigan-P3	31.8	5.8	2.68	76.9
mean	35.6	5.2	3.62	94.4
LSD(0.10)	3.5	0.8	0.49	14.0
CV(s/meanX100)	8.1	12.7	11.2	12.2

** in vitro-nodal*
*** stem tip*

Quality components of Black Mitcham propagation lines at Kalispell, MT in 1996.

PROPAGATION SOURCE	Stage	Total Heads %	Total Ketones %	Total Menthol %	Mentho-furan %	Menthone %	Menthol %	Esters %	Pulegone %
Lake-plug-1994 *	late bud	10.7	27.8	43.8	2.1	24.1	38.1	3.0	0.4
Lake-plug-1992 *	late bud	10.1	30.4	43.0	2.8	26.3	37.5	2.7	0.6
Lake-bare root-1994 *	late bud	10.7	30.0	43.0	2.3	26.0	37.6	2.7	0.4
Summit-bare root **	1st blm	10.9	29.6	43.2	2.1	25.7	38.0	2.5	0.4
Michigan-A1	veg	10.3	28.3	44.2	2.4	24.2	38.7	2.7	0.5
Michigan-A2	veg	10.6	27.3	45.0	2.4	23.4	39.1	3.1	0.5
Michigan-P1	veg	8.8	31.4	44.5	2.5	26.8	37.2	3.9	0.4
Michigan-P2	veg	9.8	31.2	43.9	2.2	26.9	37.4	3.4	0.3
Michigan-P3	veg	9.4	30.8	44.8	2.1	26.6	38.0	3.6	0.3
mean		10.1	29.6	43.9	2.3	25.5	37.9	3.1	0.4
LSD(0.10)		0.6	2.0	1.5	NS	1.9	NS	0.5	0.1
CV(s/meanX100)		5.2	5.7	2.8	16.1	6.2	2.4	13.2	29.1

* in vitro-nodal
** *stem tip*

Oil analysis by Wm. Leman Company.

TITLE: Black Mitcham Peppermint Propagation Trial

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise S. Prestbye, Research Technician, MSU, Kalispell, MT
Dr. Bill Grey, Asst. Research Professor, MSU, Bozeman, MT

PROCEDURES: The experiment was established in 1996 on a Creston silt loam soil that had been planted to barley the previous year. Nuclear plants from MIRC representing stem tip, *in vitro* nodal and *in vitro* meristem propagation from a single plant and from random selection from the Black Mitcham mother block maintained at Summit Labs were planted on June 4 and 5 in a randomized complete block design with 4 replicates. The plantlets (in soil plugs) were placed on one foot centers in four rows spaced 20 inches apart, 20 feet in length. A seventh line was received from MIRC which had one cycle *in vitro* and then went directly to the greenhouse.

Seven lines were stem tip propagated at the NWARC. Stolons were obtained on Feb.14 from two meristem fields (one which had exhibited lower vigor but high yield in 1995; the other, high vigor/lower yield), from two entries in the 1994 cultivar evaluation trial (Lakes and Roberts MIRC), from two productive fields in the Flathead Valley, and from George McClelland in Idaho. The stolons were planted in seven flats on Feb.16. The first stem tip cuttings were made on Apr.3. On Apr.22 the propagules showed damping off (*Pythium*) symptoms. The trays were sprayed with Benlate to combat the fungus, and subsequent propagations were very successful. They were planted in the field on June 17.

The site was fertilized with 100 lbs N, 52 lbs P_2O_5, 60 lbs K_2O, and 24 lbs SO_2 per acre on June 28 and with 50 lbs N and 12 lbs SO_2 per acre on Aug.1. Assure II was applied at 10 oz/acre and Basagran at 1 pt/acre on July12. On July 26 Assure II and Basagran were applied again at the same rates, along with COC at 1 pt/acre and Sinbar at 0.5 lb AI/acre.

Entries were evaluated for agronomic characteristics on Aug.28. On Sept.16, above-ground material was removed from three one-foot square areas in each plot, and wet and dry weights obtained.

RESULTS AND DISCUSSION:

The material from MIRC and the Lake-96 plants had more vigorous growth primarily because they were planted two weeks before the NWARC nuclear plants. Both groups were rated for plot row cover, plant vigor, and stolon spread on Aug.28, but the ratings were evaluated as two separate groups. There were no significant differences among entries in the first group (MIRC and Lake-96), although MIRC-3,-5,&-6 appeared slightly more vigorous than MIRC-2,-4,&-7. There were significant differences in wet and dry matter sampled on Sept.16. The MIRC portion of this

experiment is being conducted as a "double blind" test until fall of 1997. Thus, we do not know which propagation techniques are increasing plant vigor. Interestingly, the Lake material that was intentionally propagated from material infected with several species of bacteria was as vigorous as any MIRC material.

The objective of propagating at the NWARC was to determine if high vigor growth characteristics are transferred through stem tip propagation. Results from the 1994 cultivar evaluation trial showed that *in vitro* Lake material, which was more vigorous than Roberts stem tip material, produced less oil. After stem tip propagating and planting in the field in 1996, Lake material was more vigorous and tended to produce more wet matter than Roberts stem tip. This would lead us to suspect that the high vigor characteristics are transferred through propagation. Whether this increased vigor results in lower oil yield will be determined in 1997.

We also propagated from material obtained from two separate meristem fields at the NWARC. Until 1996, the R-7 field has produced more hay, but less oil than the R-5 field. Wet weight in 1996 for R-7 tended to be higher than R-5, but other parameters showed no increased vigor for the R-7 material.

Stand establishment observations on Black Mitcham propagation lines planted at Kalispell in 1996.

Evaluated 8/28/96

Source	ROW COVER *(0-5)*[1]	VIGOR *(0-5)*[2]	STOLON SPREAD *(0-5)*[3]
MIRC-1	4.6	4.5	5.0
MIRC-2	4.5	4.3	4.0
MIRC-3	4.8	4.8	4.8
MIRC-4	4.8	4.3	4.5
MIRC-5	4.8	4.8	4.8
MIRC-6	4.8	4.9	4.8
MIRC-7	4.8	4.3	4.8
Lake-96	4.5	4.8	4.8
Lake-94	3.5	3.3	3.5
Roberts-94	2.3	2.9	3.0
R-5 field	2.8	3.3	3.3
R-7 field	2.8	3.3	2.8
Montana-1	2.3	3.0	2.8
Montana-2	2.3	3.5	2.3
Idaho	2.4	2.5	3.5
Comparison of MIRC + Lake-96 entries (planted 6/4-5):			
LSD(0.10)	0.3	0.63	0.5
CV(s/mean x100	5.4	11.4	9.3
P-VALUE	0.59	0.42	0.12
Comparison of NWARC propagated entries (planted 6/17):			
LSD(0.10)	0.7	0.5	0.9
CV(s/mean x100	21.2	13.3	23.6
P-VALUE	0.04	0.06	0.19

[1] 0=no cover; 5=entire plot area covered
[2] 0=no growth; 5= plants exhibiting healthy, vigorous growth
[3] 0=no spread from crowns; 5=extensive spreading

Topgrowth biomass of Black Mitcham propagation lines planted at Kalispell in 1996.

Sampled 9/16/96

Source [1]	WET WT *g/3 sqft*	DRY WT
MIRC-1	663	179
MIRC-2	588	157
MIRC-3	619	167
MIRC-4	576	156
MIRC-5	631	167
MIRC-6	692	186
MIRC-7	704	183
Lake-96	704	180
Source [2]		
Lake-94	357	115
Roberts-94	304	110
R-5 field	346	118
R-7 field	370	119
Montana-1	312	110
Montana-2	246	97
Idaho	247	98
Comparison of MIRC + Lake-96 entries:		
LSD(0.10)	83	16
CV(s/mean x100	10.6	7.9
P-VALUE	0.07	0.02
Comparison of NWARC propagated entries:		
LSD(0.10)	69	12
CV(s/mean x100	18.1	8.8
P-VALUE	0.03	0.02

[1] planted 6/4-5/96
[2] planted 6/17/96

TITLE: Stolon Vigor Study

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise S. Prestbye, Research Technician, MSU, Kalispell, MT

PROCEDURES: The study was designed as a split plot with 4 replicates. Main plots were 3 cropping systems: barley, wheat, and fallow, planted or tilled in spring 1995. Subplots within each main plot included stolon sources: Idaho stolons from plants harvested at 20% bloom; Idaho stolons from plants harvested at 90% bloom; stolons from eastern Montana; stolons from western Montana. The Idaho and Montana-west stolons came from 1994 *in vitro* nodal propagated nuclear plants which had been dug and replanted. The Montana-east stolons were from 1995 *in vitro* nodal nuclears. The stolons were planted at the NWARC in October 1995, in 10' by 30' plots.

The nursery was fertilized with 50 lbs. N, 30 lbs. P_2O_5, 30 lbs. K_2O, and 15 lbs. SO_2/acre on 4/30/96. An additional 80 lbs. N/a was applied 6/28/96, and 60 lbs. N + 15 lbs. SO_2/acre was applied 8/1/96 (powdery mildew appearing). Sinbar was applied at 0.5 lb. AI/a on 6/3/96, and Assure II (15 oz./a) + Basagran (1 qt./a) + COC (1 qt./a) was applied on 6/6/96.

In the spring of 1996, the plots were evaluated for stand establishment and plant vigor. Prior to harvest, morphological stage, height, and lodging were noted. All plots were harvested 8/19/96. Green weight of the harvested material was recorded as it was cut and subsamples taken from two plots in each replicate to determine dry matter content. Approximately 20 pounds of herbage from each plot was air dried and distilled to determine oil yield, and samples sent to A.M.Todd, Co. for chemical analyses.

RESULTS AND DISCUSSION:

Mint stands in the areas which had been cropped to barley in 1995 showed more vigorous stand establishment than those in areas previously cropped to wheat or fallowed. Stolons from Idaho produced more vigorous stands than Montana stolons, with those from eastern Montana producing more vigorous stands than the stolons from western Montana.

The entire nursery was harvested 8/19/96. Mint from the Idaho-90% bloom stolons was slightly taller and lodged more than mint from the other sources. Early season vigor differences carried through to dry matter yield at harvest time. Plots cropped to barley in 1995 produced significantly more dry matter than those cropped to wheat or left fallow, and the Idaho stolons produced more herbage than those from eastern Montana, which produced more than those from western Montana. Although there was no difference in dry matter production between the Idaho stolons from stands harvested at different stages of maturity, the stolons from the 20% bloom harvest yielded significantly more oil than those from the 90% bloom

harvest. In fact, mint from the Idaho-90% stolons did not produce significantly more oil than the eastern Montana source. Mint grown from the western Montana stolons had the lowest oil yield - 23% less than the Idaho-20% stolon source. There were no significant interactions between previous crop and stolon source in any yield factors.

All plots were harvested in the late bud stage of maturity, except for those from the Idaho-20% stolons in the fallow blocks, which were just starting to bloom. This uniformity of maturity was reflected in lack of variation in the major oil quality constituents. Neither previous crop residue nor stolon source had any effect on menthol, menthone, or ester levels in the oil. The only compounds which varied among stolon sources were menthofuran and pulegone. Eastern Montana grown stolons had lower menthofuran and pulegone than other sources regardless of stubble type.

Since winter-kill was not a problem at this site, we were unable to test producer observations on differential winter-hardiness of stolon sources. Our data did indicate, however, that stolons obtained from the Idaho field were more vigorous than those from the two Montana sources during the first year of production. However, oil yields from the Montana-east stolons and Idaho-90% were similar at harvest.We were surprised at the relative performance of the Idaho stolons from the fields harvested at different maturity stages (20 vs 90% bloom), having assumed that a more mature stand at harvest would produce more "vigorous" stolons.

STAND ESTABLISHMENT (% of plot)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	86.3	88.8	70.0	76.3	80.3
barley	92.5	91.3	80.0	70.0	83.4
fallow	87.5	90.0	71.3	57.5	76.6
mean	88.8	90.0	73.8	67.9	

LSD(0.10): Previous Crop = 4.8
Stolon Source = 4.8
Interaction = 9.2

VIGOR (0-5)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	4.3	4.3	2.5	2.8	3.4
barley	4.8	4.9	3.6	2.9	4.0
fallow	4.5	4.1	2.8	2.1	3.4
mean	4.5	4.4	3.0	2.6	

LSD(0.10): Previous Crop = 0.5
Stolon Source = 0.3
Interaction = NS

STAGE OF MATURITY AT HARVEST

	Stolon Source			
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West
wheat	100% bud	100% bud	90% bud	100% bud
barley	100% bud	100% bud	90% bud	100% bud
fallow	1st bloom	100% bud	90% bud	100% bud

HEIGHT AT HARVEST (in.)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	29.8	32.3	27.3	28.8	29.5
barley	32.0	33.0	30.8	29.3	31.3
fallow	32.0	31.3	28.3	27.8	29.8
mean	31.3	32.2	28.8	28.6	

LSD(0.10): Previous Crop = NS
Stolon Source = 1.5
Interaction = NS

LODGING (% of plot)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	71	91	78	81	80
barley	88	90	90	74	85
fallow	85	89	75	69	79
mean	81	90	81	75	

LSD(0.10): Previous Crop = NS
Stolon Source = 8
Interaction = NS

DRY MATTER YIELD (t/a)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	3.74	3.74	2.98	2.78	3.31
barley	4.15	4.00	3.64	2.94	3.68
fallow	3.96	3.73	3.19	2.33	3.30
mean	3.95	3.82	3.27	2.68	

LSD(0.10): Previous Crop = 0.27
Stolon Source = 0.24
Interaction = NS

OIL CONTENT (ml/lb)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	5.8	5.3	6.2	6.1	5.9
barley	5.1	5.3	5.8	6.1	5.6
fallow	5.6	5.1	5.8	6.8	5.8
mean	5.5	5.2	5.9	6.3	

LSD(0.10): Previous Crop = NS
Stolon Source = 0.4
Interaction = NS

OIL YIELD (lbs/a)

	Stolon Source				
Previous Crop	Idaho 20%	Idaho 90%	Montana-East	Montana-West	mean
wheat	82.2	75.5	70.3	64.5	73.1
barley	80.8	80.3	79.6	67.9	77.2
fallow	83.0	71.5	70.8	58.1	70.8
mean	82.0	75.7	73.6	63.5	

LSD(0.10): Previous Crop = 3.0
Stolon Source = 5.2
Interaction = NS

YEAR/PROJECT: **1996/758**

TITLE: Effect of second harvest date on hay and oil yield, and oil quality of double cut peppermint.

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise S. Prestbye, Research Technician, MSU, Kalispell, MT

PROCEDURES: In spring of 1995, plots 10' wide by 15' long were delineated within a fourth year stand of meristem derived 'Black Mitcham' peppermint (root source - Glacier Mint). Four replicates of 5 plots representing 4 second cut harvest dates and a single cut control were assigned in a randomized complete block design. The first cutting for all 4 double cut treatments was on 7/11/95. The single cut control was harvested 8/7/95. Second cuttings were made on 9/1, 9/8, 9/15, and 9/22/95.

The field containing the trial received 230 lbs N/a, 78 lbs P_2O_5/a, 120 lbs K_2O/a, and 24 lbs SO_2/a. An additional 50 lbs. N/a was applied to the plot area on 6/20/96 because of nitrogen deficiency symptoms.

Stolons were dug from a 15-inch square area in each plot on June 14, 1996, washed, and weighed wet to determine how spring stolon mass was affected by double cutting. The entire nursery was harvested August 12, at the full bud stage. Twenty to 25 pounds of green hay from each plot was air dried and later distilled. Oil samples were sent to A.M.Todd for quality analyses.

RESULTS:

In 1995, total oil yields ranged from 46.3 lbs/acre for the single cut control to 71.1 lbs/acre for the 7/11-9/15 schedule.

Because of variation in stolon weights within each treatment (CV=52%), significance could not be established. There does appear to be a trend toward increasing stolon mass as second harvest was delayed, with the single cut control having the greatest accumulation.

Double cutting peppermint in 1995 did not affect hay yields in 1996. Taking the second 1995 harvest on Sept.8, however, did reduce oil yields in 1996. Results from this double cut study differ from the 1994-95 double cut study. In that experiment, double cutting in 1994 had no deleterious effects on oil yield in 1995. We believe the additional stress of the 1995-96 winter explains the differing results of the two studies. Considering the severe 1995/96 winter, we expected to have greater deleterious effects than actually occurred.

Oil quality component analyses showed no differences among treatments, except for pulegone. Menthol level was lower than desirable, indicating a slightly immature oil, which would be expected from a stand which had not yet begun to bloom.

Performance of Meristem Black Mitcham in 1996 as Affected by 1995 Double Cutting.

1995 HARVESTS			1996 Data [3]		
First Cutting	Second Cutting	STOLON [2] WEIGHT	HAY YIELD	OIL CONTENT	OIL YIELD
		gms	*t/a*	*ml/lb*	*lbs/a*
7/11	9/1	48.3	2.38	7.1	63.7
7/11	9/8	55.5	2.26	6.3	53.7
7/11	9/15	76.2	2.42	6.5	59.1
7/11	9/22	74.4	2.40	7.1	64.8
8/1[1]		94.8	2.27	6.9	59.5
mean		69.8	2.34	6.8	60.1
LSD(0.10)		45.9	NS	1.0	9.8
CV(s/mean*100)		52.2	6.6	11.6	12.9

[1] Check - cut once at 10% bloom in 1995.
[2] Dug 6/14/96
[3] All plots cut once at full bud on 8/12/96.

1996 quality components of meristem Black Mitcham which was double cut in 1995.

1995 Harvests								
First Cutting	Second Cutting	Mentho-furan	Menthone	Diso-menthone	Menthol	Neo-menthol	Esters	Pulegone
7/11	9/1	2.09	21.6	2.75	42.84	3.43	4.20	0.14
7/11	9/8	2.13	21.1	2.69	42.13	3.46	4.41	0.14
7/11	9/15	2.22	21.8	2.75	42.38	3.39	4.00	0.17
7/11	9/22	2.25	22.6	2.79	42.16	3.33	3.94	0.17
8/1[1]		2.14	21.6	2.75	42.75	3.39	4.01	0.16
mean		2.17	21.8	2.74	42.45	3.40	4.11	0.15
LSD(0.10)		NS	NS	NS	NS	NS	NS	0.02
CV(s/mean*100)		4.3	3.9	2.0	1.4	2.3	6.0	8.7

1996 - single cutting - 8/12/96
Stage: full bud

YEAR/PROJECT: **1996/758**

TITLE: Peppermint Fall Harvest Management Trial

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise S. Prestbye, Research Technician, MSU, Kalispell, MT

PROCEDURES: Plots (10' x 30') were laid out in an established stand of Black Mitcham, meristem derived (stolon source - Sonstelie Farms), and treatments assigned in a randomized complete block design with 4 replicates. Treatments were 7 harvest dates at 10-day intervals (Aug.1-Sept.30) and an uncut check. At each harvest, morphological stage, height, lodging, and dry matter yield were determined. Approximately 20 pounds of herbage from each plot was air dried and distilled to determine oil yield, and samples sent to A.M.Todd, Co. for chemical analyses. In late October stolons were dug from 1-sq.ft. areas of each plot, separated by color (green and white), and 20, 2-inch segments of the largest stolons were weighed.

In October 1995 the field containing the trial received 16.5 lbs N/a, 78 lbs P_2O_5 /a, and 120 lbs K_2O/a fertilizer. In April 1996, 106 lbs N/a and 24 lbs SO_2/a were applied. Fertigation contributed another 125 lbs N/a. Pesticide applications included Sinbar at 0.5 lb AI/a, and Orthene at 1.0 lb AI/a on 6/21 and again on 7/31.

RESULTS: The 8/1 harvest treatment was at the 20% bud stage, and by the 9/19 treatment the mint had reached 90% bloom. The first killing frost (27° F) occurred Sept.23, so the mint had been frozen for the final harvest on 9/27 resulting in significant leaf drop. Dry matter yield increased from 8/1 to 9/10, from bud to mid bloom stage, and then decreased after 9/10. Oil yield increased from 48.1 lbs/a on 8/1 to 77.9 lbs/a on 8/30. Oil yield then decreased to 56.1 lbs/a on 9/27. Differences in oil yield from 9/10 to 9/27 were not significant.

The chemical constituents of the oil corresponded with the increased maturity as harvest was delayed. August 30, when the stand had reached 20% bloom, was a breakpoint in the rate of change of the major quality components. The conversion of menthone to menthol was rapid between the first two harvests, while the plants were at the bud stage. No real change occurred in either from 8/12 to 8/30, the initial blooming phase. As the mint matured beyond the early bloom stage, however, menthol level increased an average of 1.25% per week, while menthone decreased by the same amount. The esters remained under 4% until Aug. 30 then jumped to 6.3% during the next 20-day period before leveling off after Sept.19. Menthofuran increased until the full bloom stage, then decreased during the final period, as flower loss occurred.

Stolons were sampled Oct.21. Variation within treatments was large, but there was a trend toward increased stolon mass in plots harvested after 9/10/96 (mid bloom). Change in stolon mass was inversely related to regrowth (stem & leaf) biomass.

Stage and height at harvest, dry matter, oil content, and oil yield of Black Mitcham peppermint on seven dates in 1996.

HARVEST DATE	MORPH STAGE	HEIGHT *inches*	DRY MATTER *tons/acre*	OIL CONTENT *ml/lb DM*	OIL YIELD *lbs/a*
8/1	20%bud	19.5	1.89	6.7	48.1
8/12	100%bud	24.0	2.33	6.9	59.8
8/22	10%bloom	27.8	2.98	6.6	74.5
8/30	20%bloom	30.0	3.01	6.8	77.9
9/10	mid bloom	32.5	3.61	4.6	62.4
9/19	90%bloom	32.5	2.98	5.6	62.9
9/27	frozen	32.5	2.67	5.5	56.1
mean		28.4	2.78	6.1	63.1
LSD(0.10)		2.6	0.27	0.6	6.5
CV(s/mean) %		7.5	7.9	7.6	8.4

Quality components of Black Mitcham peppermint harvested on different dates in 1996.

HARVEST DATE	MORPH STAGE	Mentho-furan	Menthone	Diso-menthone	Menthol	Neo-menthol	Esters	Pulegone	Cineole
8/1	20%bud	1.9	24.8	2.9	38.9	3.2	3.7	0.15	4.4
8/12	100%bud	2.3	20.1	2.6	43.1	3.6	3.7	0.19	4.6
8/22	10%bloom	3.3	19.1	2.3	42.9	3.5	3.6	0.47	5.2
8/30	20%bloom	4.2	18.9	2.2	42.2	3.5	3.9	0.57	5.1
9/10	mid bloom	4.6	16.8	1.9	43.7	3.6	5.2	0.38	4.8
9/19	90%bloom	4.9	14.4	1.7	45.4	3.7	6.3	0.21	4.7
9/27	frozen	4.4	13.4	1.7	47.2	3.7	6.2	0.17	4.6
mean		3.7	18.2	2.2	43.3	3.5	4.6	0.30	4.8
LSD(0.10)		0.3	1.7	0.1	1.3	0.1	0.5	0.05	0.2
CV(s/mean) %		5.8	7.6	4.7	2.4	2.6	8.5	14.1	3.9

Stolons* of Black Mitcham peppermint harvested on different dates in 1996.

HARVEST DATE	st/leaf WWT *gms*	green stolon WWT *gms*	white stolon WWT *gms*	20-2" pieces WWT *gms*	green stolon DWT *gms*	white stolon DWT *gms*	20-2" pieces DWT *gms*	TOTAL STOLON WWT *gms*	TOTAL STOLON DWT *gms*
8/1	85.9	63.0	100.0	13.9	17.1	18.3	3.1	176.9	38.4
8/12	73.5	68.2	83.5	13.2	17.9	15.0	2.8	164.9	35.7
8/22	52.9	69.2	101.4	13.9	16.6	16.9	2.8	184.5	36.2
8/30	24.8	52.9	139.7	16.4	11.7	20.9	2.7	208.9	35.3
9/10	17.9	85.9	103.8	17.6	17.5	14.4	3.0	207.3	34.8
9/19	6.9	87.8	165.6	18.2	20.0	27.9	3.5	271.5	51.4
9/27	5.8	96.5	134.9	17.4	22.6	22.7	3.5	248.8	48.7
check	114.8	85.1	136.7	17.9	23.8	25.9	3.9	239.7	53.5
mean	47.8	76.1	120.7	16.1	18.4	20.2	3.2	212.8	41.7
LSD(0.10)	34.9	27.7	69.1	3.3	7.4	14.3	0.8	68.7	14.7
P-VALUE	0.00	0.16	0.50	0.06	0.21	0.66	0.16	0.15	0.15
CV(s/mean)	59.9	29.9	47.0	16.8	33.2	58.1	19.7	26.5	28.9