FORTY-NINTH ANNUAL REPORT
1997

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

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Kalispell, MT 59901

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DISTRIBUTION OF THE
1997 NORTHWESTERN AGRICULTURAL RESEARCH CENTER REPORT

COPIES

1 Plant, Soil & Environmental Sciences Department

4 Research Center Staff, N.W. Agricultural Research Center

11 County Extension Agents in Northwestern Montana

Deer Lodge	- Barbara Andreozzi
Flathead	- Cheryl Weatherell
Granite	- Dan Lucas
Lake	- Jack Stivers
Lincoln	- Mike McCurry
Mineral	- Kevin Chamberlain
Missoula	- Gerald Marks
Powell	- David Streufert
Ravalli	- G. Rob Johnson
Sanders	- John Halpop
Flathead Reservation	- Joel Clairmont

1 Agriculture Department of Farm Service Agency, Kalispell

1 Flathead Chapter Future Farmers of America

1 Soil Conservation Service, Kalispell

4 Feed/Seed/Fertilizer Dealers

Equity Supply Co., Kalispell
Cenex, Kalispell
Westland Seeds, Inc., Ronan
Lake Glacier View Farm, Ronan

1 MSU Western Agricultural Research Center

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 copier	$ 4,725.00 (Grant & State Funds)
Purchase of desk for Admin. Support	$ 1,119.00 (Grant Funds)

Full Time Staff Members	Years in Service
Leon E. Welty - Supt. & Prof. Agronomy (Began January 1973)	24
Robert N. Stougaard - Associate Professor, Weed Science (Began November 1991)	6
Doug L. Holen Jr. - Research Associate (Began April 1996)	1
Gary R. Haaven - Ag Research Spec. I (Began April 1982)	15
Louise M. Strang - Ag Research Spec. III (Began May 1983)	14
Elaine M. Scott - Administrative Support (Began August 1990)	7
Paul P. Koch - Farm/Ranch Hand III (Began May 1995)	2
Vern R. Stewart - Professor Emeritus	

Part Time Employees:

Jan Haaven (May 1 through November 14)
Sarah Gunderson (March 3 through December 19)
Mary Arnold (April 7 through October 24)
Don Burtch (June 16 through August 22)

Student Employees:

Gail Sharp (May 13 through December 31)
Jami Henry (April 22 through October 3)
Lesile Stremel (April 22 through August 22)
Jenny Bocksnick (April 22 through August 26)

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 1997:

John Deere 6400 tractor	$ 2,460.00
John Deere 870 tractor	$ 1,374.00
Purchased Suburban	$30,262.00 (Grant Funds)

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 computer for Weed Scientist	$ 3,023.00 (Grant Funds)
Purchase of desk for Research Associate	$ 1,099.00 (Grant Funds)
Purchase of Tissue Culture Chamber	$13,285.00 (Grant Funds)

FORAGE INVESTIGATION 755

The Forage Investigation Project (755) includes research related to all types of forage for feed from seeding to data collection to publications.

MISCELLANEOUS AND PULSE CROP INVESTIGATIONS 758

The Miscellaneous Crops Project (758) includes research related to miscellaneous and pulse crops to include peas, lentils, canola, mint, etc., from seeding to data collection to publications.

PROFESSIONAL & CLIENTELE PRESENTATIONS 1997

DATE	ACTIVITY	WHO	WHERE
1/9	Advisory Committee	Welty, Stougaard, Holen	Missoula
1/22	Mint Industry Research Council Meeting	Welty	LasVegas, NV
2/13	Montana Mint Committee	Welty, Stougaard, Holen	NWARC
2/14	Lake's Seed, Inc.	Welty, Stougaard, Holen	Ronan
2/16	Mint Growers Association	Welty, Stougaard, Holen	Kalispell
3/11	Western Society Weed Science	Stougaard	Portland, OR
3/20	Pea & Lentil - Producers	Stougaard	Kalispell
3/24	WRCC-69 Meeting	Stougaard	Portland, OR
3/26	Producer Meeting	Welty, Stougaard	NWARC
4/8	MSU for a Day Pres. Malone	Welty, Stougaard	NWARC
5/9	Area Business People	Welty	NWARC
6/9	Central Field Day	Welty	CARC
6/17	Mint Producers & Tasmanian Farmer-Tour	Welty, Stougaard	NWARC
6/30	Japanese Farmers-Tour	Welty	NWARC
7/3	Mint Growers - Tour	Welty	NWARC
7/9	Mint Growers - Tour	Welty, Stougaard	NWARC
7/15	Field Day	Welty, Stougaard, Holen	NWARC
7/17	Mint Twilight Tour	Welty, Stougaard, Holen	NWARC
7/22	Pea Growers - Tour	Welty	NWARC
7/29	Australian Mint Researcher-Tour	Welty, Stougaard	NWARC
8/4	Japanese Students - Tour	Welty	NWARC
8/5	Japanese Students - Tour	Welty	NWARC

PROFESSIONAL & CLIENTELE PRESENTATIONS 1997-cont.

8/8	Japanese Students - Tour	Welty	NWARC
8/12	Japanese Students - Tour	Welty	NWARC
8/15	Japanese Students - Tour	Welty	NWARC
8/20	Japanese Students - Tour	Welty	NWARC
8/21	Japanese Students - Tour	Welty	NWARC
8/28	English Flavorists/Buyers-Tour	Welty	NWARC
9/11	Cayuse Prairie Students-Tour	Welty	NWARC
9/18	Cayuse Prairie Students-Tour	Stougaard	NWARC
10/22	Cayuse Prairie Students-Tour	Welty	NWARC
10/22	Montana Mint Committee-Research Meeting	Welty	NWARC
10/27	American Society of Agronomy-Poster Paper	Welty	Anaheim, CA

CLIMATOLOGICAL DATA
NORTHWESTERN AGRICULTURAL RESEARCH CENTER
Kalispell, MT

The 1996/1997 crop year presented wetter and cooler than average conditions. Precipitation from September 1996 through August 1997 was 34% above average and accumulated growing degree days were 5% below average. Most of the excess precipitation and cold temperatures occurred in the fall of 1996 (11.6 inches of moisture from September through December). The 1997 growing season (April - August) received 10.65 inches, only 7% above average, and the mean temperature for this period was only 1° below average. The first fall frost did not occur until October 8, 24 days later than normal, resulting in a 23% longer than average frost-free period. Abundant snow cover protected the crops from mid November through late March. Sub-zero air temperatures in January did not affect winter crop survival.

Because of the cool wet spring, small grain planting was 2 to 3 weeks behind schedule, as in 1996. Generally, the small grains are seeded by April 20. Barley seeded on heavier wet soils was stunted and yellow. *Pythium* was prevalent under these wet conditions and contributed to yield losses. Wet conditions persisted until July when warmer temperatures and below average precipitation resulted in moisture stress and lower than normal yields on lighter soils. Evidently, the cereals had not developed normal roots under the high moisture conditions after spring seeding. Rain kicked in again in August, delaying harvest. As in the previous year, small grain production was challenging.

Alfalfa did not experience the winterkill or 'icing over' problems of the precious year. Water logged soils at some sites caused yellowing and stunted growth. Because of the cool, wet spring first harvest was delayed and yields were below normal. Second and third harvests were near normal.

The 1996/1997 winter was much easier on peppermint than last winter. Soil temperature at the peppermint root level never dropped much below the freezing point, and stress on stolons and rhizomes was minimal. There was no mid winter thaw, and the insulation of the snow cover prevented large temperature fluctuations. Throughout the Flathead Valley, mint winter damage was minimal compared to 1996. There were 229 growing degree days in May, which got the mint off to a good start. Peppermint oil yields were about normal for this area. Unfortunately for producers, the market was not as healthy.

This crop year is beginning very differently from the previous two. The first frost occurred 24 days later than normal. Precipitation from September through February was 42% below normal for the period and average temperature was 7% above normal. Snowfall was 62% below normal as of the end of February. Winter finally arrived in March. As of this writing (March 9) we received 1.25 inches of precipitation with 8 inches of snowfall. This is one third of the total snowfall for the 1997-98 winter thus far. We have received 64% of normal precipitation for this period (Sept.-March), and our total snow accumulation is 50% of normal and 17% of last year's (over 120 inches).

Following is a list of tables giving a complete description of the weather for the crop year (September 1996 through August 1997) and 1997 (January through December).

Table 1. Summary of climatic data by months for 1996-97 crop year (September through August) and averages for the period 1949-97 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, 1997. (Average)

Table 3. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1997. (Maximum)

Table 4. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1997. (Minimum)

Table 5. Summary of precipitation records at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1997.

Table 6. Precipitation by day for crop year September 1, 1992 through August 31, 1997, Northwestern Agricultural Research Center, Kalispell, MT.

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 through 1997.

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950-1997.

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center, January 1950 through December 1997.

Table 10. Summary of precipitation records at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 through December 1997.

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, Kalispell, MT, May 1, 1949 through October 31, 1997.

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

Table 1. Summary of climatic data by months for 1996-97 crop year (September thru August) and averages for the period 1949-97 at the Northwestern Agricultural Research Center, Kalispell, MT.

ITEM	Sept. 1996	Oct. 1996	Nov. 1996	Dec. 1996	Jan. 1997	Feb. 1997	Mar. 1997	Apr. 1997	May 1997	June 1997	July 1997	Aug. 1997	Total or Average
Precipitation (inches) Current Year	2.67	1.58	3.99	3.52	1.50	1.62	1.18	1.69	2.62	3.41	0.99	1.94	26.71
Avg. 1949 to 1996-97	1.58	1.39	1.53	1.66	1.50	1.16	1.16	1.51	2.33	2.94	1.63	1.55	19.94
Mean Temperature (F) Current Year	52.3	42.1	27.3	19.8	19.8	28.0	32.3	38.3	52.3	57.8	62.8	63.8	41.4
Avg. 1949 to 1996-97	53.5	43.2	32.4	25.3	22.2	27.6	33.7	43.2	51.7	58.3	63.9	62.9	43.2

Last killing frost in spring	
1997	May 21 (32 degrees F)
Avg. 1949-97	May 24
First killing frost in fall	
1997	October 8 (30 degrees F)
Avg. 1949-97	September 15
Frost Free Period	
1997	140 days
Avg. 1949-97	114 days
Growing Degree Days (base 50):	
May 1 - Oct. 31, 1997	1763 days
Avg. 1949-97	1876.5 days
Maximum summer temperature	92 degrees F on August 4, 1997
Minimum winter temperature	-14 degrees F on January 13, 1997

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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 thru August 31, 1997.

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
1996-97	52.3	42.1	27.3	19.8	19.8	28.0	32.3	38.3	52.3	57.8	62.8	63.8	41.4
MEAN	53.5	43.2	32.4	25.3	22.2	27.6	33.7	43.2	51.7	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, 1997.

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
1996-97	64.3	53.2	33.9	25.7	26.9	34.2	40.9	48.4	64.3	68.6	75.6	78.5	51.2
MEAN	68.5	55.3	39.9	32.0	29.6	36.0	43.5	54.9	64.7	71.5	79.6	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, 1997.

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
1996-97	40.3	31.0	20.7	13.9	12.7	21.8	23.7	28.3	40.3	47.0	50.1	49.2	31.6
MEAN	38.5	31.2	24.8	18.7	15.3	19.2	23.9	31.5	38.7	45.0	48.1	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, 1997.

	Total precipitation in inches by month and year												
YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL
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
1996-97	2.67	1.58	3.99	3.52	1.50	1.62	1.18	1.69	2.62	3.41	0.99	1.94	26.71
MEAN	1.58	1.39	1.59	1.66	1.50	1.16	1.16	1.51	2.33	2.94	1.63	1.55	20.01

Mean precipitation for all crop years = 20.01

Table 6. Precipitation by day for crop year, September 1, 1996 through August 31, 1997.
Northwestern Agricultural Research Center, Kalispell, MT.

DATE	SEPT. 1996	OCT. 1996	NOV. 1996	DEC. 1996	JAN. 1997	FEB. 1997	MAR. 1997	APR. 1997	MAY 1997	JUNE 1997	JULY 1997	AUG. 1997	YTD
1	0.16			0.06	0.10	0.01	0.06	0.07	0.04	0.11	T	0.05	
2				T	0.04	0.24	0.09	0.03			0.21	0.10	
3	0.05			0.01	0.02	0.08	0.11						
4	0.08			T	0.03		0.03	0.24	0.47	0.06			
5	0.23	0.07	0.08	0.04			0.02		0.02	0.21		0.39	
6	0.21		0.02	0.01			0.01				0.03		
7			0.25	T	0.12				0.02				
8			0.10	0.02				0.02	0.03			0.37	
9				0.17	0.03		0.01	0.01			0.11	0.17	
10				0.16	0.30		0.05				0.24		
11					0.20	0.04				0.22			
12				0.11		0.14	0.25			0.55			
13	T	0.15					0.11			0.10			
14	0.20	0.15	T	0.30		0.01		T	0.04			0.04	
15	0.24	0.12	0.11			0.12							
16	0.18	0.05	0.02		T	0.01	0.19					0.18	
17		0.06	0.05		T		0.04	0.01			T		
18	0.80		0.14		0.36					0.25	0.10		
19	0.03	0.08	1.50	0.15	0.08	0.02		0.05		0.02	T	0.01	
20	T	0.16	0.30	0.15		0.08	T	0.32			0.05		
21	0.47	0.03	T	0.37	0.10			0.18				0.04	
22	0.02	T	0.36	0.13		0.04				0.19	0.04		
23		0.01	0.01	0.04									
24		0.30	0.12	0.11					0.31	0.36		0.10	
25		0.04	0.34	0.23	0.03	0.02			0.59	0.55		0.47	
26			0.14		0.01	0.16			0.73				
27			0.01	0.33		0.60	0.10	0.23	0.12				
28			0.37	0.27	0.01	0.05	0.01	0.22					
29		0.36	0.04	0.30				0.03		0.14		0.02	
30		T	0.03	0.51	0.07			0.28	0.16	0.65	0.03		
31				0.05	T		0.10		0.09		0.18		
TOTAL	2.67	1.58	3.99	3.52	1.50	1.62	1.18	1.69	2.62	3.41	0.99	1.94	26.71

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 thru 1997.

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
1997	May 8	30	Oct. 8	30	152
Mean for years	May 24	30	Sept. 14	30	114

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950-97.

	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
1997	Jan. 13	-14	Aug. 4	92

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center January 1950 through December 1997.

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
1997	19.8	28.0	32.3	38.3	52.3	57.8	62.8	63.8	55.6	43.7	33.0	27.9	42.9
MEAN	22.2	27.6	33.7	43.2	51.7	58.3	63.9	63.0	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 1997.

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
1997	1.50	1.62	1.18	1.69	2.62	3.41	0.99	1.94	2.36	0.94	0.33	0.42	19.00
MEAN	1.50	1.16	1.16	1.51	2.33	2.94	1.63	1.55	1.60	1.38	1.56	1.65	20.00

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, May 1, 1949 through October 31, 1997. 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
1997	229.0	295.5	423.0	465.5	280.5	69.5	1763.0
MEAN	233.5	333.9	467.6	456.5	280.3	104.8	1876.5

Mean growing degree days for all years = 1876.5

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	11.3	2.6	0.0	0.0	0.0	0.0	128.9
MEAN	0.0	1.0	6.8	14.3	13.1	9.6	4.9	1.0	0.1	0.0	0.0	0.0	50.8

Mean snowfall for all years = 50.8

ACHIEVE TANKMIX STUDY

Achieve is a new postemergence grass herbicide which has demonstrated excellent activity against wild oat. This study was conducted to evaluate Achieve in combination with different broadleaf herbicide for crop tolerance and wild oat control in barley.

Wet soil conditions resulted in severe pythium damage to the barley crop, the extent of which precluded taking yield measurements. No differences in crop injuiry were detected, regardless of the tankmix partner. Although Achieve treatments provided at least 90% wild oat control, slight differences in efficacy were noted. As in the past, reuced wild oat control was noted when Achieve was combined with 2, 4-D ester. However, the addition of ammonium sulfate appears to counter this effect.

Site Description

Crop: Barley
Variety: Gallatin
Planting Date: 5-13-97
Planting Method: Disk Drill
Rate, Unit: 73 Lbs, Acre
Depth, Unit: 1.5"
Row Spacing, Unit: 7"
Soil Moisture: Good
Emergence Date: 5-20-97

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 3
Site Location: R-13
Study Design: RCB
Field Preparation/Plot Maintenance:
Fertility: 5-13-97 58 Lbs. N and 28 Lbs. P
Weed Control: 6- 9-97 Bronate sprayed at 1.5 pt.

Soil Description

Texture: Sandy Loam % OM:5.2 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.5 Soil Name: Kalispell Fine Sandy Loam

Application Information

Application Date:	6-2-97
Time of Day:	3:30 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	66 F
% Relative Humidity:	48
Wind Velocity, Unit:	3 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	70 F
Soil Moisture:	GOOD
% Cloud Cover:	20

Plant Species	Plant Stage	Density at Application
Wild Oats	2 Leaf	45 Ft2
Barley	4 Leaf & 1 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

Achieve Tankmix Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-16-97	WILD OAT CONTROL PERCENT 7-4-97	WILD OAT CONTROL PERCENT 7-21-97
1	ACHIEVE	80	WG	.18	lb ai/A	3.3	100.0	100.0
1	TF8035	1	SL	.5	% v/v			
2	ACHIEVE	80	WG	.18	lb ai/A	8.3	99.7	100.0
2	TF8035	1	SL	.5	% v/v			
2	AMMONIUM SULF	100	WG	1.5	lb pr/A			
3	ACHIEVE	80	WG	.18	lb ai/A	3.3	99.7	100.0
3	TF8035	1	SL	.5	% v/v			
3	Bronate	4	EC	.7511	lb ai/A			
4	ACHIEVE	80	WG	.18	lb ai/A	3.3	99.3	100.0
4	TF8035	1	SL	.5	% v/v			
4	Bronate	4	EC	.7511	lb ai/A			
4	AMMONIUM SULF	100	WG	1.5	lb pr/A			
5	ACHIEVE	80	WG	.18	lb ai/A	20.0	99.3	100.0
5	TF8035	1	SL	.5	% v/v			
5	Buctril	2	EC	.5	lb ai/A			
6	ACHIEVE	80	WG	.18	lb ai/A	16.7	99.0	100.0
6	TF8035	1	SL	.5	% v/v			
6	Buctril	2	EC	.5	lb ai/A			
6	AMMONIUM SULF	100	WG	1.5	lb pr/A			
7	ACHIEVE	80	WG	.18	lb ai/A	8.3	99.7	98.7
7	TF8035	1	SL	.5	% v/v			
7	STARANE	1.63	EC	.125	lb ai/A			
8	ACHIEVE	80	WG	.18	lb ai/A	6.7	100.0	100.0
8	TF8035	1	SL	.5	% v/v			
8	STARANE	1.63	EC	.125	lb ai/A			
8	AMMONIUM SULF	100	WG	1.5	lb pr/A			
9	ACHIEVE	80	WG	.18	lb ai/A	6.7	93.3	94.3
9	TF8035	1	SL	.5	% v/v			
9	2,4-D Ester	4	SC	.5	lb ai/A			
10	ACHIEVE	80	WG	.18	lb ai/A	10.0	98.7	97.7
10	TF8035	1	SL	.5	% v/v			
10	2,4-D Ester	4	SC	.5	lb ai/A			
10	AMMONIUM SULF	100	WG	1.5	lb pr/A			
11	ACHIEVE	80	WG	.18	lb ai/A	6.7	99.7	99.7
11	TF8035	1	SL	.5	% v/v			
11	CURTAIL M	2.77	EC	.3463	lb ai/A			
12	ACHIEVE	80	WG	.18	lb ai/A	6.7	99.7	100.0
12	TF8035	1	SL	.5	% v/v			
12	CURTAIL M	2.77	EC	.3463	lb ai/A			
12	AMMONIUM SULF	100	WG	1.5	lb pr/A			

CONTINUED...

Achieve Tankmix Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY INJURY PERCENT 6-16-97	WILD OAT CONTROL PERCENT 7-4-97	WILD OAT CONTROL PERCENT 7-21-97
13	ACHIEVE	80	WG	.18	lb ai/A	0.0	99.0	98.7
13	TF8035	1	SL	.5	% v/v			
13	PEAK	57	WG	.0089	lb ai/A			
14	ACHIEVE	80	WG	.18	lb ai/A	0.0	100.0	99.7
14	TF8035	1	SL	.5	% v/v			
14	PEAK	57	WG	.0089	lb ai/A			
14	AMMONIUM SULF	100	WG	1.5	lb pr/A			
15	ACHIEVE	80	WG	.18	lb ai/A	3.3	100.0	97.3
15	TF8035	1	SL	.5	% v/v			
15	PEAK	57	WG	.0178	lb ai/A			
16	ACHIEVE	80	WG	.18	lb ai/A	6.7	98.3	99.3
16	TF8035	1	SL	.5	% v/v			
16	PEAK	57	WG	.0178	lb ai/A			
16	AMMONIUM SURF	100	WG	1.5	lb pr/A			
17	UNTREATED					0.0	0.0	0.0
	LSD (.05) =					14.4	3.3	2.4
	Standard Dev.=					8.63368	1.99386	1.41551
	CV =					133.43	2.14	1.52
	Block F					0.769	1.189	0.303
	Block Prob(F)					0.4717	0.3177	0.7404
	Treatment F					1.186	437.635	867.978
	Treatment Prob(F)					0.3293	0.0001	0.0001

ACHIEVE / SURFACTANT STUDY

Achieve is a new postemergence grass herbicide which has demonstrated excellent activity against wild oat. This study was conducted to evaluate Achieve in combination with different surfactants against registered wild oat herbicides for wild oat control in barley.

Wet soil conditions resulted in severe pythium damage to the barley crop, the extent of which precluded taking yield measurements. However, crop injury and wild oat control differences were apparent. Achieve treatments resulted in minor crop injury. The greatest crop injury was noted for Cheyenne. This is not surprising as the product is not labeled for use in barley. Horizon also caused significant crop injury early in the season, but the crop later appeared to recover.

Achieve treatments provided at least 95% wild oat control. Surfactant type had no effect on wild oat control. Of the wild oat herbicides evaluated, the poorest control was obtained with Assert. Puma also failed to provide adequate control at the lowest rate, but dramatically improved as the use rate was doubled.

Site Description

Crop: Barley   Variety: Gallatin   Planting Date: 5-13-97
Planting Method: Disk Drill   Rate, Unit: 73 Lbs, Acre
Depth, Unit: 1.5"   Row Spacing, Unit: 7"
Soil Moisture: Good   Emergence Date: 5-20-97

Plot Width, Unit: 10 FT   Plot Length, Unit: 15 FT   Reps: 3
Site Location: R-13   Study Design: RCB
Field Preparation/Plot Maintenance:
Fertility: 5-13-97 58 Lbs. N & 28 Lbs. P
Weed Control: 6- 9-97 Bronate at 1.5 pt.

Soil Description

Texture: Sandy Loam   % OM: 4.2   % Sand: 60   % Silt: 30   % Clay: 10
pH: 7.7   Soil Name: Kalispell Fine Sandy Loam

Application Information

Application Date:	6-2-97
Time of Day:	1:00 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	64 F
% Relative Humidity:	57
Wind Velocity, Unit:	3 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	68 F
Soil Moisture:	GOOD
% Cloud Cover:	30

Plant Species	Plant Stage	Density at Application
Wild Oats	2 Leaf	45 Ft2
Barley	4 Leaf & 1 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

Achieve / Surfactant Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY CROP INJ PERCENT 6-16-97	BARLEY CROP INJ PERCENT 7-4-97	WILD OAT CONTROL PERCENT 7-4-97	WILD OAT CONTROL PERCENT 7-21-97
1	ACHIEVE	80	WG	.125	lb ai/A	5.0	0.0	99.0	95.7
1	TF8035	1	SL	.5	% v/v				
2	ACHIEVE	80	WG	.125	lb ai/A	5.0	0.0	95.7	100.0
2	TF8035	1	SL	.5	% v/v				
2	AMMONIUM SULF	100	WG	1.5	lb pr/A				
3	ACHIEVE	80	WG	.18	lb ai/A	13.3	0.0	98.3	99.3
3	TF8035	1	SL	.5	% v/v				
4	ACHIEVE	80	WG	.18	lb ai/A	11.7	0.0	99.0	99.3
4	TF8035	1	SL	.5	% v/v				
4	AMMONIUM SULF	100	WG	1.5	lb pr/A				
5	ACHIEVE	80	WG	.25	lb ai/A	6.7	0.0	100.0	100.0
5	TF8035	1	SL	.5	% v/v				
6	ACHIEVE	80	WG	.25	lb ai/A	10.0	0.0	98.0	98.3
6	TF8035	1	SL	.5	% v/v				
6	AMMONIUM SULF	100	WG	1.5	lb pr/A				
7	ACHIEVE	80	WG	.18	lb ai/A	3.3	0.0	98.3	100.0
7	TF8035	1	SL	.5	% v/v				
7	LIQUID AMSULF	1	sl	1.5	lb pr/A				
8	ACHIEVE	80	WG	.18	lb ai/A	13.3	0.0	99.0	100.0
8	TF8035	1	SL	.5	% v/v				
8	32% UAN	2.67	SL	2.5	% v/v				
9	HOELON	3	EC	1	lb ai/A	16.7	0.0	86.7	89.7
10	ASSERT	2.5	EC	.47	lb ai/A	1.7	0.0	71.7	60.0
10	NIS	8.35	SL	.25	% v/v				
11	TILLER	3.08	EC	.6545	lb ai/A	8.3	0.0	90.0	86.7
12	CHEYENNE	2.7	EC	.4725	lb ai/A	53.3	30.0	94.7	89.7
13	PUMA	1.56	EC	.0644	lb ai/A	0.0	0.0	94.0	66.7
14	PUMA	1.56	EC	.1287	lb ai/A	3.3	0.0	98.3	98.3
15	HORIZON	2.09	EC	.05	lb ai/A	41.7	0.0	98.7	100.0
15	COC	8.35	SL	1	% v/v				
16	HORIZON	2.09	EC	.06	lb ai/A	18.3	0.0	98.3	100.0
16	COC	8.35	SL	1	% v/v				
17	UNTREATED					0.0	10.0	0.0	0.0
	LSD (.05) =					14.4	7.0	8.8	13.3
	Standard Dev.=					8.66379	4.20084	5.28548	7.99326
	CV =					69.58	178.54	5.91	9.16
	Block F					3.318	1.000	2.614	1.170
	Block Prob(F)					0.0491	0.3791	0.0888	0.3234
	Treatment F					8.342	9.625	62.222	30.446
	Treatment Prob(F)					0.0001	0.0001	0.0001	0.0001

ACHIEVE REDUCED RATE STUDY

Achieve is a new postemergence grass herbicide which has demonstrated excellent activity against wild oat. This study was conducted to evaluate the efficacy of reduced rate applications of Achieve to wild oat. Achieve was applied as fractions of the labeled 1.0X rate as follows: 0.12, 0.25, 0.37, 0.50, 0.75, and 1.0X, where 0.178 lb ai/A represents the current labeled rate. Nontreated and handweeded treatments were also included for comparison. Wild oat dry matter, plant density, panicles, and seed yield measurements were taken shortly before harvest. The plots were harvested to determine spring wheat yield and test weight.

All wild oat parameters decreased as Achieve rate was increased but there appears to be little difference in results between the 1.0X rate and the 0.75X rate. As wild oat plant densities and dry weights were reduced, there was a corresponding reduction in wild oat panicles and seed production. Spring wheat yield steadily improved as Achieve rate was increased. Nonetheless the highest yielding Achieve treatment still produced spring wheat yields 11% less than the handweeded control treatment.

Site Description

```
Crop: Spring Wheat          Variety: McNeal          Planting Date: 4-25-97
Planting Method: Disk Drill                          Rate, Unit: 69 Lbs/Acre
Depth, Unit: 1.5"                                    Row Spacing, Unit: 7"
Soil Moisture: Good                                  Emergence Date: 5-6-97

Plot Width, Unit: 10 FT     Plot Length, Unit: 15 FT     Reps: 3
Site Location: R-3                                Study Design: RCB
Field Preparation/Plot Maintenance:
     Fertility:       4-16-97    87 Lbs. N and 42 Lbs. P
     Weed Control:    5-19-97    Bronate at 1.5 pts.
     Quad Harvest:    7-28-97    All reported wild oat data
     Plot Harvest:    8-22-97
     Wild oats planted at 68 Lbs/A or 24 pure-live seeds/ft2
```

Soil Description

```
Texture: SiL       % OM: 2.5     % Sand: 40     % Silt: 50     % Clay: 10
pH: 7.4         Soil Name: Creston Silt Loam
```

Application Information

```
Application Date:       5-21-97
Time of Day:            2:00 PM
Application Method:     BACKPACK
Application Timing:     POST
Air Temp., Unit:        79 F
% Relative Humidity:    15
Wind Velocity, Unit:    4 MPH
Dew Presence (Y/N):     N
Soil Temp., Unit:       80 F
Soil Moisture:          DRY
% Cloud Cover:          0

Plant Species           Plant Stage
Wild Oat                3 Leaf
Spring Wheat            4 Leaf & 1 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	H20	20

Achieve Reduced Rate Study

Treatment Name	Rate	Rate Unit	W. OAT DRY WT GRMS/FT2	W.OAT PLANTS FT2	W. OAT HEADS FT2	W. OAT SEEDS FT2	W. OAT 1000 KWT GRAMS	SPR WHT YIELD BU/ACRE	SPR WHT TEST WT LB/BU
UNTREATED			55.7	20.9	29.2	1173.3	15.6	23.8	62.6
ACHIEVE TF 8035	.022 0.5	lb ai/A % v/v	53.2	18.6	33.6	1149.0	14.5	28.9	62.3
ACHIEVE TF 8035	.046 0.5	lb ai/A % v/v	37.7	15.6	22.2	865.2	12.1	31.6	61.6
ACHIEVE TF 8035	.067 0.5	lb ai/A % v/v	25.9	18.5	23.7	613.2	11.4	38.0	61.0
ACHIEVE TF 8035	.089 0.5	lb ai/A % v/v	11.8	8.0	9.6	274.1	11.0	40.6	61.3
ACHIEVE TF 8035	.134 0.5	lb ai/A % v/v	6.9	4.7	5.3	166.8	8.7	47.9	61.1
ACHIEVE TF 8035	.178 0.5	lb ai/A % v/v	5.4	4.8	6.3	170.3	10.0	51.4	61.2
HAND WEEDED			0.0	0.0	0.0	0.0	0.0	58.1	62.3
LSD (.05) =			25.2	9.5	13.5	581.3	1.8	7.5	1.0
CV =			58.62	47.70	47.50	60.19	9.64	10.63	0.96
Treatment Prob(F)			0.0010	0.0017	0.0006	0.0024	0.0001	0.0001	0.0211

WILD OAT POPULATION DYNAMICS WITH REDUCED ACHIEVE RATES

This study investigates long-term wild oat population changes resulting from the use of reduced herbicide rates. The purpose of this study is to determine what level of wild oat control is needed to prevent weed populations from increasing in subsequent years.

The herbicide treatments listed on the data table were applied to wild oat infested spring wheat during 1996. The study area was than recropped to spring wheat in 1997. Different wild oat populations were generated in 1997 as a result of the previous years treatments. During 1996, wild oat control increased as herbicide rate increased. This response was reflected in the 1997 wild oat densities. As would be expected, wild oat densities in 1997 were lowest where control in the previous year was greatest.

Based on the previous years wild oat density, it appears that Achieve applied at 0.089 lb ai/A results in a steady state equilibrium for wild oat densities. Higher rates should reduce wild oat populations.

The range in wild oat densities also provided an assessment of competition on spring wheat yield. Wheat yield ranged from 6 to 41 bu/A depending on the wild oat density. Wild oat competition did not result in wheat mortality, but greatly affected tiller production, and to a lesser extent, test weight.

Site Description

```
Crop: Spring Wheat          Variety: McNeal            Planting Date: 4-22-97
Planting Method: Disk Drill                            Rate, Unit: 69 Lbs/A
Depth, Unit: 1.5"                                      Row Spacing, Unit: 7"
Soil Moisture: Good                                    Emergence Date: 5-4-97

Plot Width, Unit: 10 FT     Plot Length, Unit: 15 FT   Reps: 3
Site Location: F-4                                     Study Design: RCB
Field Preparation/Plot Maintenance: Previous crop =Spring wheat
     Fertility:        4-22-97     58 Lbs. N and 28 Lbs. P
                       5- 8-97     50 Lbs. N
     Weed Control:     5-19-97     Bronate at 1.5 pts./A
                       8-17-97     Swathed plots
                       8-22-97     Harvest plots
```

Soil Description

```
Texture: Clay Loam        % OM: 2.6     % Sand: 26     % Silt: 45     % Clay: 29
pH: 5.9
```

Wild Oat Population Dynamics with Reduced Achieve Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	WILD OAT PLNT/FT2 7 DAYS 4-29-97	WILD OAT PLNT/FT2 8 DAYS 4-30-97	WILD OAT PLNT/FT2 9 DAYS 5-1-97	WILD OAT PLNT/FT2 21 DAYS 5-13-97	WILD OAT PLNT/FT2 7-8-97	WILD OAT DRY WT GRAM/FT2	WILD OAT 1000 KWT GRAMS
1	UNTREATED					5.2	11.7	21.5	132.5	142.0	70.8	22.8
2	ACHIEVE	40	WG	.022	lb ai/A	1.8	4.8	9.1	72.2	80.4	54.4	24.2
2	TF 8035	1	EC	.25	% v/v							
3	ACHIEVE	40	WG	.046	lb ai/A	2.0	2.9	6.6	68.3	61.0	62.3	24.2
3	TF 8035	1	EC	.25	% v/v							
4	ACHIEVE	40	WG	.067	lb ai/A	0.6	1.5	3.0	35.5	38.7	49.8	24.6
4	TF 8035	1	EC	.25	% v/v							
5	ACHIEVE	40	WG	.089	lb ai/A	0.6	1.3	3.0	24.3	27.2	42.5	25.1
5	TF 8035	1	EC	.25	% v/v							
6	ACHIEVE	40	WG	.134	lb ai/A	0.2	0.5	0.6	3.3	5.5	16.9	26.0
6	TF 8035	1	EC	.25	% v/v							
7	ACHIEVE	40	WG	.178	lb ai/A	0.3	0.8	0.9	4.3	4.1	15.0	26.4
7	TF 8035	1	EC	.25	% v/v							
8	HAND WEEDED					0.2	0.2	0.2	3.4	0.0	0.0	0.0
	LSD (.05) =					2.8	4.5	8.4	33.1	34.3	19.7	4.5
	Standard Dev.=					1.62175	2.55970	4.79855	18.9089	19.6120	11.2716	2.5910
	CV =					118.66	86.77	85.50	44.00	43.72	28.93	10.61
	Block F					3.780	4.630	2.881	6.045	2.359	10.996	0.181
	Block Prob(F)					0.0487	0.0286	0.0896	0.0128	0.1310	0.0013	0.8367
	Treatment F					3.344	6.690	6.609	17.442	18.423	15.210	0.977
	Treatment Prob(F)					0.0260	0.0013	0.0014	0.0001	0.0001	0.0001	0.4846

Wild Oat Population Dynamics with Reduced Achieve Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	SPR WHT YIELD BU/A 8-22-97	SPR WHT H2O %	SPR WHT TEST WT LBS/BU	SPR WHT PLNT/FT2 7-8-97	SPR WHT HDS/FT2 7-8-97
1	UNTREATED					6.3	6.90	58.4	13.9	14.4
2	ACHIEVE	40	WG	.022	lb ai/A	12.7	10.33	61.5	11.8	13.7
2	TF 8035	1	EC	.25	% v/v					
3	ACHIEVE	40	WG	.046	lb ai/A	13.1	10.20	61.5	15.4	17.6
3	TF 8035	1	EC	.25	% v/v					
4	ACHIEVE	40	WG	.067	lb ai/A	19.8	12.23	61.6	13.1	16.2
4	TF 8035	1	EC	.25	% v/v					
5	ACHIEVE	40	WG	.089	lb ai/A	22.9	13.33	61.2	14.8	20.1
5	TF 8035	1	EC	.25	% v/v					
6	ACHIEVE	40	WG	.134	lb ai/A	34.5	15.67	62.1	15.4	25.4
6	TF 8035	1	EC	.25	% v/v					
7	ACHIEVE	40	WG	.178	lb ai/A	38.7	14.57	62.2	14.6	29.7
7	TF 8035	1	EC	.25	% v/v					
8	HAND WEEDED					41.5	15.27	62.2	16.7	30.5

LSD (.05) =	8.8	2.41	1.9	4.9	10.2
Standard Dev.=	5.03943	1.37641	1.06051	2.80114	5.84672
CV =	21.27	11.18	1.73	19.39	27.90
Block F	0.069	6.750	3.638	4.828	0.159
Block Prob(F)	0.9334	0.0089	0.0556	0.0254	0.8545
Treatment F	20.408	14.429	4.043	0.855	3.972
Treatment Prob(F)	0.0001	0.0001	0.0144	0.5629	0.0135

ASSERT REDUCED RATE STUDY

This study was conducted to evaluate the response of wild oat to reduced rate applications of Assert. Assert was applied as fractions of the labeled 1.0X rate as follows: 0.12, 0.25,0.37, 0.50, 0.75, and 1.0X where 0.357 lb ai/A represents the 1.0X rate. Nontreated and handweeded treatments were also included for comparison. Wild oat dry matter, plant density, panicles, and seed yield measurements were taken shortly before harvest. The plots were harvested to determine spring wheat yield and test weight.

For all wild oat measurements, maximum herbicidal effect was noted at the 0.75X rate. The trend was for wild oat parameters to decrease as Assert rate increased, but was most apparent for wild oat dry matter and seed production. Not only did wild oat seed numbers decline with rate, but seed weight declined as well. Spring wheat yield increased as herbicide rate was increased except for a slight yield reduction observed at the highest Assert rate. While this difference was nonsignificant, it indicates that crop injury may have resulted at the highest rate. The handweeded treatments produced yields which were 26% greater than the highest yielding Assert treatment.

Site Description

```
Crop: Spring Wheat       Variety: McNeal              Planting Date: 4-25-97
Planting Method: Disk Drill                           Rate, Unit: 69 Lbs/Acre
Depth, Unit: 1.5                                            Row Spacing, Unit: 7"
Soil Moisture: Good                                   Emergence Date: 5-6-97

Plot Width, Unit: 10 FT     Plot Length, Unit: 15 FT  Reps: 3
Site Location: R-3                                    Study Design: RCB
Field Preparation/Plot Maintenance:
      Fertility:           4-16-97     87 Lbs. N and 42 Lbs. P
      Weed Control:        5-19-97     Bronate at 1.5 pts.
      Quad Harvest:        7-28-97     All reported wild oat data
      Plot Harvest:        8-22-97
      Wild oats planted at 68 Lbs./A or 24 pure-live seeds/ft2
```

Soil Description

```
Texture: SiL          % OM: 2.5       % Sand: 40     % Silt: 50     % Clay: 10
pH: 7.4          Soil Name: Creston Silt Loam
```

Application Information

```
Application Date:          5-21-97
Time of Day:               2:00 PM
Application Method:        BACKPACK
Application Timing:        POST
Air Temp., Unit:           79 F
% Relative Humidity:       15
Wind Velocity, Unit:       4 MPH
Dew Presence (Y/N):        N
Soil Temp., Unit:          80 F
Soil Moisture:             DRY
% Cloud Cover:             0
```

Plant Species	Plant Stage
Wild Oat	3 Leaf
Spring Wheat	4 Leaf & 1 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	H20	20

Assert Reduced Rate Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	W.OAT DRY WT GRMS/FT2	W. OAT PLANTS FT2	W. OAT PANICLES FT2	W. OAT SEEDS FT2	W. OAT 1000 KWT GRAMS	SPR WHT YIELD BU/ACRE	SPR WHT TEST WT LBS/BU
1	UNTREATED					59.8	28.0	27.0	1199.4	16.6	24.6	62.1
2	ASSERT	2.5	EC	.046	lb ai/A	42.8	19.3	33.3	778.8	12.7	32.8	61.8
2	NIS	1	EC	.25	% v/v							
3	ASSERT	2.5	EC	.089	lb ai/A	32.1	17.2	26.8	776.9	11.0	32.9	61.8
3	NIS	1	EC	.25	% v/v							
4	ASSERT	2.5	EC	.134	lb ai/A	23.5	15.8	31.3	761.0	12.3	38.6	62.5
4	NIS	1	EC	.25	% v/v							
5	ASSERT	2.5	EC	.178	lb ai/A	29.8	15.6	34.2	662.9	9.3	42.1	62.1
5	NIS	1	EC	.25	% v/v							
6	ASSERT	2.5	EC	.268	lb ai/A	15.6	10.9	21.6	347.8	8.9	43.6	61.1
6	NIS	1	EC	.25	% v/v							
7	ASSERT	2.5	EC	.357	lb ai/A	15.6	19.4	24.5	350.4	9.5	39.2	61.4
7	NIS	1	EC	.25	% v/v							
8	HANDWEEDED					0.0	0.0	0.0	0.0	0.0	59.2	63.0
	LSD (.05) =					14.6	10.1	11.7	401.5	2.1	6.2	1.2
	Standard Dev.=					8.32671	5.77579	6.68859	229.238	1.2152	1.56060	.706956
	CV =					30.40	36.61	26.92	37.60	12.11	9.10	1.14
	Block F					3.917	1.333	1.660	3.104	0.527	28.322	3.511
	Block Prob(F)					0.0446	0.2952	0.2255	0.0766	0.6017	0.0001	0.0581
	Treatment F					14.591	5.783	8.013	7.647	46.024	24.429	2.290
	Treatment Prob(F)					0.0001	0.0027	0.0005	0.0007	0.0001	0.0001	0.0886

WILD OAT POPULATION DYNAMICS WITH REDUCED ASSERT RATES

This study investigates long-term wild oat population changes resulting from the use of reduced herbicide rates. The purpose of this study is to determine what level of wild oat control is needed to prevent weed populations from increasing in subsequent years.

The herbicide treatments listed on the data table were applied to wild oat infested spring wheat in 1996. The study area was recropped to spring wheat in 1997. Different wild oat populations were generated in 1997 as a result of the previous years treatments. During 1996, wild oat control increased as herbicide rate increased. As would be expected, wild oat densities in 1997 were lowest where control in the previous year was greatest. Although Assert reduced wild oat dry matter during 1996, the surviving plants produced viable seed, causing an increase in wild oat densities the following year. Based on the previous years wild oat densities, it appears that populations increased regardless of the Assert rate applied in 1996.

Site Description

Crop: Spring Wheat   Variety: McNeal   Planting Date: 4-22-97
Planting Method: Disk Drill   Rate, Unit: 69 Lbs/A
Depth, Unit: 1.5"   Row Spacing, Unit: 7"
Soil Moisture: Good   Emergence Date: 5-4-97

Plot Width, Unit: 10 FT   Plot Length, Unit: 15 FT   Reps: 3
Site Location: F-4   Study Design: RCB
Field Preparation/Plot Maintenance: Previous crop =Spring wheat

Fertility:	4-22-97	58 Lbs. N and 28 Lbs. P
	5-8-97	50 Lbs. N
Weed Control:	5-19-97	Bronate at 1.5 pts./A
	8-17-97	Swathed plots
	8-22-97	Harvest plots

Soil Description

Texture: Clay Loam   % OM: 2.6   % Sand: 26   % Silt: 45   % Clay: 29
pH: 5.9

Wild Oat Population Dynamics with Reduced Assert Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	SPR WHT YIELD BU/A 8-22-97	SPR WHT H2O %	SPR WHT TEST WT LBS/BU	SPR WHT PLNT/FT2 7-9-97	SPR WHT HDS/FT2 7-9-97
1	UNTREATED					7.5	7.67	60.2	14.5	14.0
2	ASSERT	2.5	EC	.046	lb ai/A	11.8	8.30	60.8	18.4	18.3
2	NIS	1	EC	.25	% v/v					
3	ASSERT	2.5	EC	.089	lb ai/A	11.0	11.07	60.5	15.8	15.2
3	NIS	1	EC	.25	% v/v					
4	ASSERT	2.5	EC	.134	lb ai/A	16.4	10.47	60.4	19.4	20.1
4	NIS	1	EC	.25	% v/v					
5	ASSERT	2.5	EC	.178	lb ai/A	16.2	10.47	60.7	15.1	19.5
5	NIS	1	EC	.25	% v/v					
6	ASSERT	2.5	EC	.268	lb ai/A	17.6	11.83	60.3	18.1	18.7
6	NIS	1	EC	.25	% v/v					
7	ASSERT	2.5	EC	.357	lb ai/A	19.7	13.07	61.3	17.0	19.5
7	NIS	1	EC	.25	% v/v					
8	HANDWEEDED					50.2	15.87	62.0	16.3	34.8

	YIELD	H2O	TEST WT	PLNT/FT2	HDS/FT2
LSD (.05) =	8.0	2.35	1.7	9.0	11.2
Standard Dev.=	4.58375	1.33992	.986715	5.14001	6.38259
CV =	24.39	12.08	1.62	30.53	31.88
Block F	0.113	0.638	0.858	4.267	1.718
Block Prob(F)	0.8938	0.5430	0.4453	0.0357	0.2152
Treatment F	25.214	11.352	1.135	0.328	2.989
Treatment Prob(F)	0.0001	0.0001	0.3958	0.9282	0.0386

Wild Oat Population Dynamics with Reduced Assert Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	WILD OAT PLNT/FT2 7 DAYS 4-29-97	WILD OAT PLNT/FT2 8 DAYS 4-30-97	WILD OAT PLNT/FT2 9 DAYS 5-1-97	WILD OAT PLNT/FT2 21 DAYS 5-13-97	WILD OAT PLNT/FT2 7-9-97	WILD OAT DRY WT GRAM/FT2	WILD OAT 1000 KWT GRAMS
1	UNTREATED					6.2	11.8	21.4	140.0	152.5	72.4	23.1
2	ASSERT	2.5	EC	.046	lb ai/A	1.3	3.3	6.4	66.0	76.3	62.4	23.5
2	NIS	1	EC	.25	% v/v							
3	ASSERT	2.5	EC	.089	lb ai/A	4.0	6.6	12.2	84.2	99.5	67.2	24.1
3	NIS	1	EC	.25	% v/v							
4	ASSERT	2.5	EC	.134	lb ai/A	0.6	1.5	2.9	61.0	82.8	55.2	24.2
4	NIS	1	EC	.25	% v/v							
5	ASSERT	2.5	EC	.178	lb ai/A	2.3	4.7	8.3	60.0	60.9	64.5	24.4
5	NIS	1	EC	.25	% v/v							
6	ASSERT	2.5	EC	.268	lb ai/A	2.3	4.9	9.5	46.7	53.9	59.6	24.8
6	NIS	1	EC	.25	% v/v							
7	ASSERT	2.5	EC	.357	lb ai/A	2.7	4.1	7.0	45.4	64.1	57.1	25.5
7	NIS	1	EC	.25	% v/v							
8	HANDWEEDED					0.0	0.1	0.1	1.3	0.0	0.0	0.0
LSD (.05) =						3.3	6.4	11.4	60.8	53.2	19.9	1.6
Standard Dev.=						1.90321	3.67737	6.48113	34.6913	30.3787	11.3571	.896256
CV =						78.89	79.73	76.44	54.95	41.19	20.73	3.70
Block F						4.282	4.498	5.005	4.347	3.746	14.208	1.710
Block Prob(F)						0.0354	0.0310	0.0229	0.0340	0.0498	0.0004	0.2165
Treatment F						3.194	2.772	2.947	3.860	6.058	12.113	2.031
Treatment Prob(F)						0.0307	0.0496	0.0405	0.0151	0.0021	0.0001	0.1227

INTEGRATED WILD OAT MANAGEMENT IN BARLEY

This study was conducted to determine if alternative crop planting patterns and densities could improve barley competitiveness toward wild oat, thereby allowing for reductions in herbicide rates. Barley was seeded at densities of 60, 110, and 150 lb/A in either broadcast or six inch drill patterns to a wild oat infested area. Assert was then applied as fractions of the labeled rate as follows: 0, 0.25, 0.50, and 1.0X.

Barley population and dry matter yields were greatest for broadcast seeding patterns. All other parameters were not affected by seeding pattern. Wild oat dry matter yields decreased as both barley seeding density and Assert rates were increased. These two factors interacted in a positive manner, resulting in greater wild oat dry matter reductions than either single tactic alone. These results indicate that reduced herbicide rate strategies are more consistent when combined with higher crop seeding rates.

Site Description

```
Crop: Barley                  Variety: Gallatin       Planting Date: 4-22-97
Planting Method: Broadcast & Drill                    Rate, Unit: 60, 110, & 150, Lbs/A
Depth, Unit: Brdcst =0-3", Drill =1.5"                Row Spacing, Unit: 6"
Soil Moisture: Good           Emergence Date: Brdcst =4-30-97, Drill =5-3-97

Plot Width, Unit: 10 FT       Plot Length, Unit: 15 FT     Reps: 4
Site Location: R-3                                    Study Design: Factorial
Field Preparation/Plot Maintenance: Previous crop =Spring wheat
     Fertility          4-16-97     87 Lbs. N and 42 Lbs. P
     Weed Control       5-19-97     Bronate at 1.5 pts./A
                        8-20-97     Harvest plots
                                    Wild oats broadcast incorporated at 80 Lbs/A
```

Soil Description

```
Texture: SiL                 % OM: 3.4    % Sand: 40    % Silt: 50    % Clay: 10
pH: 7.7                   Soil Name: Creston Silt Loam
```

Application Information

```
Application Date:          5-12-97
Time of Day:               11:30 AM
Application Method:        BACKPACK
Application Timing:        POST
Air Temp., Unit:           71 F
% Relative Humidity:       27
Wind Velocity, Unit:       5 MPH
Dew Presence (Y/N):        N
Soil Temp., Unit:          74 F
Soil Moisture:             GOOD
% Cloud Cover:             0

Weed Species    Weed Stage
 Barley           2 Leaf
 Wild Oat         1-2 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

Integrated Wild Oat Management in Barley

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	WILD OAT PLNT/FT2 5-15-97	WILD OAT PLNT/FT2 7-21-97	WILD OAT DRY WT GRAM/FT2 7-30-97	WILD OAT CONTROL % 8-6-97	BARLEY PLNT/FT2 7-21-97	BARLEY DRY WT GRAM/FT2 7-30-97	BARLEY YIELD BU/A 8-20-97
1	BROADCAST				29.0	33.1	45.1	0.0	29.1	79.2	61.0
1	60 #/A										
1	NONTREATED										
2	BROADCAST				38.2	38.9	16.0	67.3	34.2	95.0	85.3
2	60 #/A										
2	ASSERT	2.5	EC	.12							
3	BROADCAST				28.6	13.9	3.2	85.8	31.3	115.7	94.9
3	60 #/A										
3	ASSERT	2.5	EC	.23							
4	BROADCAST				37.0	9.9	1.6	95.5	27.9	102.4	95.1
4	60 #/A										
4	ASSERT	2.5	EC	.46							
5	BROADCAST				31.5	28.3	29.0	17.5	37.6	75.2	74.1
5	110 #/A										
5	NONTREATED										
6	BROADCAST				27.9	24.5	8.9	82.5	36.5	69.4	89.5
6	110 #/A										
6	ASSERT	2.5	EC	.12							
7	BROADCAST				40.6	15.0	2.2	88.0	48.1	112.4	92.6
7	110 #/A										
7	ASSERT	2.5	EC	.23							
8	BROADCAST				27.2	9.7	0.8	96.8	59.3	118.7	97.3
8	110 #/A										
8	ASSERT	2.5	EC	.46							
9	BROADCAST				42.5	37.6	23.5	34.5	64.6	76.3	75.6
9	150 #/A										
9	NONTREATED										
10	BROADCAST				24.3	22.6	5.4	81.5	55.1	100.4	93.5
10	150 #/A										
10	ASSERT	2.5	EC	.12							
11	BROADCAST				42.3	23.8	5.0	89.5	57.6	99.2	91.9
11	150 #/A										
11	ASSERT	2.5	EC	.23							
12	BROADCAST				33.6	7.1	0.9	97.0	65.1	109.0	95.7
12	150 #/A										
12	ASSERT	2.5	EC	.46							
13	6" DRILL				29.8	26.2	33.8	0.0	22.6	54.9	67.2
13	60 #/A										
13	NONTREATED										
14	6" DRILL				43.0	31.3	14.2	57.5	24.8	77.7	82.9
14	60 #/A										
14	ASSERT	2.5	EC	.12							

CONTINUED...

Integrated Wild Oat Management in Barley

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	WILD OAT PLNT/FT2 5-15-97	WILD OAT PLNT/FT2 7-21-97	WILD OAT DRY WT GRAM/FT2 7-30-97	WILD OAT CONTROL % 8-6-97	BARLEY PLNT/FT2 7-21-97	BARLEY DRY WT GRAM/FT2 7-30-97	BARLEY YIELD BU/A 8-20-97
15	6" DRILL				26.2	16.8	4.7	75.8	21.4	69.8	89.6
15	60 #/A										
15	ASSERT	2.5	EC	.23							
16	6" DRILL				24.0	8.7	0.8	95.5	19.7	70.4	91.6
16	60 #/A										
16	ASSERT	2.5	EC	.46							
17	6" DRILL				39.6	29.2	24.1	17.5	32.6	55.9	70.9
17	110 #/A										
17	NONTREATED										
18	6" DRILL				31.5	21.6	8.7	67.5	36.2	73.0	89.1
18	110 #/A										
18	ASSERT	2.5	EC	.12							
19	6" DRILL				35.8	22.5	3.2	85.8	39.4	62.5	95.3
19	110 #/A										
19	ASSERT	2.5	EC	.23							
20	6" DRILL				30.7	6.0	0.7	96.3	33.5	80.4	95.2
20	110 #/A										
20	ASSERT	2.5	EC	.46							
21	6" DRILL				48.8	35.0	20.5	26.3	48.6	63.0	75.3
21	150 #/A										
21	NONTREATED										
22	6" DRILL				32.5	22.4	6.0	76.3	51.7	80.1	85.4
22	150 #/A										
22	ASSERT	2.5	EC	.12							
23	6" DRILL				33.7	23.1	3.3	87.0	52.1	65.8	91.2
23	150 #/A										
23	ASSERT	2.5	EC	.23							
24	6" DRILL				43.1	7.2	0.5	98.0	49.3	93.4	93.5
24	150 #/A										
24	ASSERT	2.5	EC	.46							
LSD (.05) =					19.0	14.8	7.7	8.5	16.8	25.4	10.7
Standard Dev.=					13.4136	10.4493	5.44906	6.03422	11.8820	17.9715	7.5743
CV =					39.19	48.76	50.00	8.95	29.15	21.57	8.77
Block F					2.506	4.612	1.459	1.406	0.711	0.858	1.056
Block Prob(F)					0.0662	0.0053	0.2333	0.2484	0.5487	0.4672	0.3737
Treatment F					1.028	3.724	20.399	117.353	5.466	4.574	7.332
Treatment Prob(F)					0.4449	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

SPRING WHEAT SEEDING PATTERN AND DENSITY STUDY

This study was established to compare the effect of crop seeding pattern and densities on the agronomic response of three spring wheat varieties. Border, Pondera, and McNeal spring wheats were seeded conventionally with a double disk drill on six inch row spacings or by broadcast methods at rates of either 60, 110, or 150 lb/A.

Spring wheat heads/tillers and dry weights per unit area were greater for broadcast treatments than for drilled treatments. This response demonstrates that broadcast treatments result in a more uniform seeding arrangement and minimize plant to plant competition. The greater plant weight and tillering resulted in slightly greater lodging for the broadcast treatments.

Seeding density had minimal effect on the crop except for percent moisture at harvest. As seeding rates increased, grain moisture decreased, indicating that higher seeding rates hasten maturity. While several agronomic factors were impacted by the imposed treatments, there were no yield differences regardless of variety, seeding pattern, or density.

Site Description

Crop: Spring Wheat
Variety: Border, Fortuna, & McNeal
Planting Date: 4-22-97
Planting Method: Broadcast & Drill
Rate, Unit: 60, 110, & 150, Lbs/A
Depth, Unit: Brdcst =0-3", Drill =1.5"
Row Spacing, Unit: 6"
Soil Moisture: Good
Emergence Date: Brdcst =5-1-97, Drill =5-3-97

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 4
Site Location: R-3
Study Design: Factorial
Field Preparation/Plot Maintenance: Previous crop =Spring wheat

Fertility:	4-16-97	87 Lbs. N and 42 Lbs. P
Weed Control:	5-19-97	Bronate at 1.5 pts./A
	8-21-97	Harvest plots

Soil Description

Texture: SiL
% OM: 3.4
% Sand: 40
% Silt: 50
% Clay: 10
pH: 7.7
Soil Name: Creston Silt Loam

Spring Wheat Seeding Pattern And Density Study

Trt No	Treatment Name	SPR WHEAT PLNT/FT2 7-28-97	SPR WHEAT HEAD/FT2 7-28-97	SPR WHEAT DRY WT GRAMS/FT2 8-1-97	SPR WHEAT LODGING 0-9 8-15-97	SPR WHEAT YIELD BU/A 8-20-97	SPR WHEAT H2O % 8-20-97	SPR WHEAT TEST WT LBS/BU 9-3-97
1 1 1	BORDER BROADCAST 60 #/A	20.9	69.2	102.7	1.3	72.5	14.58	62.0
2 2 2	BORDER BROADCAST 110 #/A	37.9	86.2	101.9	1.3	67.2	14.38	62.4
3 3 3	BORDER BROADCAST 150 #/A	55.3	85.0	108.4	2.3	75.5	14.15	62.3
4 4 4	BORDER 6" DRILL 60 #/A	21.9	66.5	92.2	0.8	69.0	14.67	62.1
5 5 5	BORDER 6" DRILL 110 #/A	38.8	64.9	69.4	1.0	72.0	14.03	62.2
6 6 6	BORDER 6" DRILL 150 #/A	46.6	70.6	81.8	0.8	65.0	14.48	62.0
7 7 7	FORTUNA BROADCAST 60 #/A	31.1	86.9	116.9	7.0	70.6	14.30	62.4
8 8 8	FORTUNA BROADCAST 110 #/A	47.3	93.5	110.8	6.8	71.6	13.95	62.2
9 9 9	FORTUNA BROADCAST 150 #/A	60.5	77.9	103.5	6.8	67.7	13.97	62.1
10 10 10	FORTUNA 6" DRILL 60 #/A	22.5	49.1	79.4	4.3	69.0	14.10	61.9
11 11 11	FORTUNA 6" DRILL 110 #/A	34.1	65.6	97.0	4.0	68.3	12.63	62.6
12 12 12	FORTUNA 6" DRILL 150 #/A	48.4	64.6	83.8	5.8	73.7	12.83	62.2
13 13 13	McNEAL BROADCAST 60 #/A	41.2	87.2	127.6	0.0	74.8	15.45	62.0
14 14 14	McNEAL BROADCAST 110 #/A	51.0	77.0	97.8	0.0	65.9	14.35	62.1

CONTINUED...

Spring Wheat Seeding Pattern And Density Study

Trt No	Treatment Name	SPR WHEAT PLNT/FT2 7-28-97	SPR WHEAT HEAD/FT2 7-28-97	SPR WHEAT DRY WT GRAMS/FT2 8-1-97	SPR WHEAT LODGING 0-9 8-15-97	SPR WHEAT YIELD BU/A 8-20-97	SPR WHEAT H2O % 8-20-97	SPR WHEAT TEST WT LBS/BU 9-3-97
15 15 15	McNEAL BROADCAST 150 #/A	54.6	84.1	106.3	0.5	74.1	15.05	62.1
16 16 16	McNEAL 6" DRILL 60 #/A	20.2	48.6	82.1	0.0	75.2	17.30	61.9
17 17 17	McNEAL 6" DRILL 110 #/A	35.9	70.6	112.5	0.0	76.2	15.22	61.9
18 18 18	McNEAL 6" DRILL 150 #/A	47.0	67.2	94.9	0.3	67.3	14.40	62.2
LSD (.05) =		18.7	22.5	25.2	1.0	7.6	1.79	0.5
Standard Dev.=		13.0655	15.7363	17.6119	.717051	5.33959	1.24989	0.350300
CV =		32.89	21.55	17.92	30.37	7.54	8.66	0.5681
Block F		0.077	0.453	0.256	0.180	1.252	0.483	0.7531
Block Prob(F)		0.9722	0.7166	0.8570	0.9094	0.3007	0.6955	0.52604
Treatment F		3.764	2.619	2.867	53.784	1.771	2.564	1.179
Treatment Prob(F)		0.0001	0.0041	0.0019	0.0001	0.0594	0.0049	0.3139

SPRING WHEAT AND BARLEY SEED SIZE STUDY

This study was conducted to determine if crop competitiveness toward wild oat could be improved through the selection and use of large seed size classes.

Seed size classes were obtained by screening bulk seed of McNeal spring wheat and Gallatin barley over a standard 6/64 sieve. That which remained on top of the sieve was considered large, and that which passed through was considered small. Large, small, and ungraded (Bulk)seed of each variety was seeded at 60 lb/A as well as at a target population of 16 plants per square foot. Wild oat seed was then broadcast over designated plots and raked in to facilitate germination.

The greatest differences were observed between crop species, with barley being the most competitive toward wild oat. Compared to spring wheat, barley plants had greater leaf areas (LAI), produced more heads/tillers, and were less affected by wild oat competition. Crop seed size had no effect on wild oat dry weights, but yield reductions were less with the use of large seed compared to small. These results indicate that yield loss due to weeds can be reduced by using large seed size classes.

Site Description

```
Crop: Spring Wheat & Barley                           Variety: McNeal & Gallatin
Planting Date: 4-23-97                                Planting Method: Plot Drill
Rate, Unit: 60 Lbs/A & 16 Plants/Ft2                  Depth, Unit: 3"
Row Spacing, Unit: 6"      Soil Moisture: Good        Emergence Date: 5-5-97

Plot Width, Unit: 4.2 FT          Plot Length, Unit: 15 FT      Reps: 3
Site Location: R-3                                              Study Design: RCB
Field Preparation/Plot Maintenance: Previous crop =Spring wheat
      Fertility:        4-16-97    87 Lbs. N and 42 Lbs.P
      Weed Control:     5-19-97    Bronate at 1.5 pts./A
                        8-26-97    Harvest plots
                                   Wild oats hand seeded and incorporated at 71 Lbs/A
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Soil Description

```
Texture: SiL       % OM: 3.4    % Sand: 40    % Silt: 50    % Clay: 10
pH: 7.7                    Soil Name: Creston Silt Loam
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Spring Wheat & Barley Seed Size Study

Trt No	Treatment Name	CANOPY LAI 7-13-97	CROP PLNT/FT2 7-23-97	CROP HEAD/FT2 7-23-97	CROP DRY WT GRAMS/FT2 7-28-97	WILD OAT DRY WT GRAMS/FT2 7-28-97	CROP YIELD BU/A 8-26-97	CROP TEST WT LB/BU
1 1 1 1	McNEAL LARGE 60 LBS/A WILD OATS	3.700	13.8	16.9	41.0	83.6	37	62.2
2 2 2	McNEAL LARGE 60 LBS/A	2.367	13.0	35.7	101.3		69	61.6
3 3 3 3	McNEAL LARGE 16 PLNTS/FT2 WILD OATS	3.333	13.0	14.1	27.3	69.1	35	62.5
4 4 4	McNEAL LARGE 16 PLNTS/FT2	2.470	10.8	30.4	98.9		71	61.8
5 5 5 5	McNEAL SMALL 60 LBS/A WILD OATS	3.717	13.8	16.9	26.1	62.0	32	62.0
6 6 6	McNEAL SMALL 60 LBS/A	2.600	13.2	30.8	80.1		69	61.9
7 7 7 7	McNEAL SMALL 16 PLNTS/FT2 WILD OATS	3.487	10.0	11.9	17.5	85.5	27	61.4
8 8 8	McNEAL SMALL 16 PLNTS/FT2	2.100	13.0	29.9	80.6		67	61.9
9 9 9 9	McNEAL BULK 60 LBS/A WILD OATS	3.510	17.1	21.0	41.5	48.3	39	61.5
10 10 10	McNEAL BULK 60 LBS/A	2.533	14.4	39.3	107.4		73	60.9
11 11 11 11	McNEAL BULK 16 PLNTS/FT2 WILD OATS	3.870	16.5	17.9	33.5	63.0	30	61.3
12 12 12	McNEAL BULK 16 PLNTS/FT2	2.030	10.8	29.6	90.2		70	61.5
13 13 13 13	GALLATIN LARGE 60 LBS/A WILD OATS	4.173	12.7	43.1	78.0	30.3	65	53.5

CONTINUED...

Spring Wheat & Barley Seed Size Study

Trt No	Treatment Name	CANOPY LAI 7-13-97	CROP PLNT/FT2 7-23-97	CROP HEAD/FT2 7-23-97	CROP DRY WT GRAMS/FT2 7-28-97	WILD OAT DRY WT GRAMS/FT2 7-28-97	CROP YIELD BU/A 8-26-97	CROP TEST WT LB/BU
14	GALLATIN	2.943	9.7	50.9	91.9		94	53.1
14	LARGE							
14	60 LBS/A							
15	GALLATIN	4.007	18.3	38.8	64.9	40.4	72	53.2
15	LARGE							
15	16 PLNTS/FT2							
15	WILD OATS							
16	GALLATIN	3.027	12.7	57.6	100.0		91	52.9
16	LARGE							
16	16 PLNTS/FT2							
17	GALLATIN	3.417	16.1	7.9	46.8	49.0	58	53.7
17	SMALL							
17	60 LBS/A							
17	WILD OATS							
18	GALLATIN	2.943	13.3	56.2	101.8		97	53.0
18	SMALL							
18	60 LBS/A							
19	GALLATIN	3.443	9.1	24.1	37.4	34.3	56	52.7
19	SMALL							
19	16 PLNTS/FT2							
19	WILD OATS							
20	GALLATIN	2.940	12.7	62.8	110.1		90	53.7
20	SMALL							
20	16 PLNTS/FT2							
21	GALLATIN	3.697	10.0	31.0	50.9	58.3	69	53.4
21	BULK							
21	60 LBS/A							
21	WILD OATS							
22	GALLATIN	3.110	13.0	65.0	109.5		93	52.3
22	BULK							
22	60 LBS/A							
23	GALLATIN	3.527	14.9	42.9	64.9	44.4	70	53.0
23	BULK							
23	16 PLNTS/FT2							
23	WILD OATS							
24	GALLATIN	2.910	14.7	46.2	88.1		97	53.4
24	BULK							
24	16 PLNTS/FT2							
LSD (.05) =		0.485	4.8	13.8	27.5	25.4	10	1.1
Standard Dev.=		.294114	2.88933	8.34843	16.6779	14.9377	6.33234	.650824
CV =		9.31	21.90	23.83	23.69	26.82	9.67	1.13
Block F		5.011	2.254	0.514	0.033	2.504	5.348	0.115
Block Prob(F)		0.0107	0.1169	0.6017	0.9676	0.1058	0.0083	0.8912
Treatment F		12.235	2.034	10.411	9.985	4.293	37.098	135.444
Treatment Prob(F)		0.0001	0.0213	0.0001	0.0001	0.0020	0.0001	0.0001

SPRING WHEAT VARIETY BLENDS

A variety blend is defined as a simple procedure of mechanically mixing seed from two or more varieties in an attempt to obtain genetic diversity. It is suggested that variety blends will yield higher under certain environmental conditions than the average of the individual component varieties. The deeper genetic pool allows for buffering against detrimental factors such as; weeds, insects, disease, lodging, and drought, translating to more stable yearly performances than varieties grown independently.

This study found no significant differences between the blends and the average of the individual component varieties for plants/ft2, heading, test weight, 1000 kernel weight, and protein. Yield was found to be completely non-significant. An explanation for the blends "average" performance is probably due to the stress-free growing season in which all varieties performed equally as well.

Site Description

```
Crop: Spring Wheat            Variety: Various              Planting Date: 4-23-97
Planting Method: Plot Drill                                 Rate, Unit: 80 Lbs/A
Depth, Unit: 1.5"             Row Spacing, Unit: 6"         Soil Moisture: Good
Emergence Date: 5-5-97

Plot Width Unit: 4.2 FT       Plot Length, Unit: 15 FT      Reps: 3
Site Location: R-3                                         Study Design: RCB
Field Preparation/Plot Maintenance:
     Fertility:         4-16-97    87 Lbs. N and 42 Lbs.P
     Weed Control:      5-19-97    Bronate at 1.5 pt.
                        8-26-97    Harvest plots
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Soil Description

```
Texture: SiL       % Om: 2.5     % Sand: 40     % Silt: 50     % Clay: 10
Ph: 7.4         Soil Name: Creston Silt Loam
```

Spring Wheat Variety Blends

Trt No	Treatment Name	SPR WHT PLNT/FT2 5-15-97	SPR WHT HD DATE JULIAN	SPR WHT TEST WT LBS/BU 8-29-97	SPR WHT 1000 KWT GRAMS 8-29-97	SPR WHT PROTEIN PERCENT	SPR WHT YIELD BU/AC 8-26-97
1	AMIDON	23	172.0	61.1	37.9	14.20	70.0
2	McNEAL	17	173.3	62.2	42.6	14.53	73.8
3	FERGUS	12	167.3	61.9	43.5	14.27	78.3
4	AMIDON/McNEAL/FERGUS	22	169.3	61.6	43.2	14.53	79.3
5	HI-LINE	25	169.3	61.9	40.2	14.33	69.8
6	WPB 926	11	167.0	61.2	50.1	14.03	73.4
7	NEWANA	23	174.0	62.3	40.0	13.63	71.0
8	HI-LINE/926/NEWANA	19	168.0	62.2	42.3	14.00	73.2
	LSD (.05) =	9	0.9	0.6	4.4	0.44	10.2
	Standard Dev.=	5.02790	.540062	.357566	2.50722	.253503	5.81661
	CV =	26.35	0.32	0.58	5.90	1.79	7.90
	Block F	0.120	1.000	0.000	0.755	3.738	10.737
	Block Prob(F)	0.8875	0.3927	1.0000	0.4884	0.0500	0.0015
	Treatment F	3.412	76.551	5.080	6.238	4.219	1.135
	Treatment Prob(F)	0.0241	0.0001	0.0048	0.0019	0.0106	0.3963

BARLEY VARIETY BLENDS

A variety blend is a simple procedure of mechanically mixing seed of two or more varieties in an attempt to obtain genetic diversity. It is suggested that variety blends will yield higher under certain environmental conditions than the average of the individual component varieties. The deeper genetic pool allows for buffering against detrimental factors such as: weeds, insects, disease, lodging, and drought, translating to more stable yearly performances than varieties grown independently.

This study found no significant differences between the blends and the average of the individual component varieties for plants/ft2, heading, and lodging. Yield was found to be completely non-significant. While slight differences did occur between the blends and components' mean for % plump, test weight was identical. An explanation for the blends "average" performance could be due to the environmental conditions present for this growing season which did not bring into effect the genetic diversity present in the blends or simply the varieties selected were not all that diverse.

Site Description

Crop: Barley   Variety: Various   Planting Date: 5-10-97
Planting Method: Plot Drill   Rate, Unit: 77 Lbs/A
Depth, Unit: 1.5"   Row Spacing, Unit: 6"
Soil Moisture: Good   Emergence Date: 5-16-97

Plot Width, Unit: 4.16 FT   Plot Length, Unit: 10 FT   Reps: 3
Site Location: Y-2   Study Design: RCB
Field Preparation/Plot Maintenance:
Fertility: 5-19-97 58 Lbs. N and 28 Lbs. P
Weed Control: 6- 2-97 Bronate at 1.5 pts.
Harvest Plots: 8-21-97

Barley Variety Blends

Trt No	Treatment Name	BARLEY STAND PLNTS/FT2 5-21-97	BARLEY HD DATE JULIAN	BARLEY LODGING 0-9 8-21-97	BARLEY YIELD BU/ACRE 8-21-97	BARLEY TEST WT LBS/BU	BARLEY PLUMP PERCENT
1	BARONESSE	20.5	187.7	3.3	115.8	54.1	94.00
2	CHINOOK	21.0	186.3	2.7	99.8	55.9	92.00
3	GALLATIN	25.2	185.7	4.0	97.1	53.9	89.50
4	BARONESSE/CHINOOK/GALLATIN	23.8	186.3	3.0	101.8	54.6	93.00
5	MEDALLION	31.5	187.3	3.7	109.8	48.9	72.00
6	LEWIS	19.1	185.7	3.0	101.0	55.0	94.00
7	STARK	20.5	182.7	2.0	108.3	55.1	98.00
8	MEDALLION/LEWIS/STARK	23.5	185.3	3.0	93.0	53.2	86.50
	LSD (.05) =	7.4	1.4	2.0	16.4		
	Standard Dev.=	4.19882	.805488	1.14694	9.27469		
	CV =	18.14	0.43	37.20	8.98		
	Block F	0.496	9.440	2.882	4.145		
	Block Prob(F)	0.6195	0.0025	0.0895	0.0405		
	Treatment F	2.682	10.853	0.851	1.932		
	Treatment Prob(F)	0.0551	0.0001	0.5655	0.1448		

FIDEL / RAPTOR TOLERANCE STUDY

Raptor is a new member of the imidazolinone herbicide family. This product has demonstrated tolerance toward legumes but not cereals. The exception being 'Fidel', a winter wheat cultivar developed by American Cyanamid. This study was conducted to evaluate the tolerance of Fidel to applications of Raptor as a function of herbicide rate, surfactant type and crop growth stage.

The planting was late (10/21/96) and the crop did not emerge until the following spring. Raptor was applied at the 2 and 4- leaf growth stage of the crop on 4/21/97 and 4/28/97, respectively.

Winter wheat crop injury increased as herbicide rates increased. Crop injury was not observed or was minor when Raptor was applied at the 1X and 2X rates. While significant crop injury did occur at the 4X and 8X dosages, there was no effect on yield or the associated yield components. The observed injury appears to only effect heading dates and delay crop maturity. Injury appeared to be less severe when Raptor was applied with a nonionic surfactant, but these differences were not significant.

An application of Raptor was made to a small planting of Judith winter wheat. This was done to confirm the sensitivity of wheat to this chemical. No yield data is available since Raptor killed the entire wheat planting. Although only one susceptible variety was screened, it appears that the resistant trait is needed if Raptor is to be used.

Fidel appears to have excellent tolerance to Raptor under the conditions of this experiment and yielded well considering the late planting. Additional studies should be conducted under more typical planting conditions to verify crop tolerance to Raptor applications.

Fidel / Raptor Tolerance Study

Site Description

Crop: Winter Wheat   Variety: Fidel   Planting Date: 10-21-96
Planting Method: Plot drill   Rate, Unit: 94 Lbs./A
Depth, Unit: 1.5"   Row Spacing, Unit: 6"   Emergence Date: Spring
Soil Moisture: Good

Plot Width, Unit: 10 FT   Plot Length, Unit: 15 FT
Reps: 3   Site Location: R-3   Study Design: RCB
Plot Maintenance:
Fertility: 9-19-96   32 Lbs. N and 40 Lbs. S
5-9-97   96 Lbs. N and 46 Lbs. P
Weed Control: 5-19-97   Bronate at 1.5 pt.

Soil Description

Texture: Coarse Silty Mixed   % OM: 2.7   % Sand: 40   % Silt: 50   % Clay: 10
pH: 7.1   Soil Name: Creston Silt Loam

Application Information

Application Date:	4-21-97	4-28-97
Time of Day:	3:30 PM	2:00 PM
Application Method:	BACKPACK	BACKPACK
Application Timing:	POST (2LF)	POST (4LF)
Air Temp., Unit:	58 F	57 F
% Relative Humidity:	44	57
Wind Velocity, Unit:	2-4 MPH	0-4 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	59 F	52 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:	90	95

Weed Species	Weed Stage	Density at Application
4-21 Fidel	2 to 3 leaf	12 plants/ linear ft.
4-28 Fidel	3 to 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

Fidel / Raptor Tolerance Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	FIDEL CROP INJ PERCENT 4-28-97	FIDEL CROP INJ PERCENT 5-5-97	FIDEL CROP INJ PERCENT 5-12-97	FIDEL CROP INJ PERCENT 5-19-97	FIDEL CROP INJ PERCENT 5-27-97	FIDEL H DATE JULIAN
1	UNTREATED					0.0	0.0	0.0	0.0	0.3	164.0
2	RAPTOR	1	EC	.020	2-LF	0.0	0.0	3.3	0.0	0.0	164.3
2	NIS	1	EC	.25							
2	UAN 28%	100	EC	1							
3	RAPTOR	1	EC	.040	2-LF	0.0	0.0	3.3	3.3	3.3	164.3
3	NIS	1	EC	.25							
3	UAN 28%	100	EC	1							
4	RAPTOR	1	EC	.080	2-LF	0.0	6.7	30.0	28.3	23.3	165.0
4	NIS	1	EC	.25							
4	UAN 28%	100	EC	1							
5	RAPTOR	1	EC	.160	2-LF	0.0	55.0	66.7	73.3	75.0	166.7
5	NIS	1	EC	.25							
5	UAN 28%	100	EC	1							
10	RAPTOR	1	EC	.020	2-LF	0.0	0.0	5.0	6.7	3.3	164.0
10	SUN-IT II	100	EC	.75							
10	UAN 28%	100	EC	1							
11	RAPTOR	1	EC	.040	2-LF	0.0	3.3	11.7	3.3	3.3	164.0
11	SUN-IT II	100	EC	.75							
11	UAN 28%	100	EC	1							
12	RAPTOR	1	EC	.080	2-LF	0.0	28.3	48.3	45.0	36.7	165.0
12	SUN-IT II	100	EC	.75							
12	UAN 28%	100	EC	1							
13	RAPTOR	1	EC	.160	2-LF	0.0	56.7	78.3	81.7	83.3	167.0
13	SUN-IT II	100	EC	.75							
13	UAN 28%	100	EC	1							
6	RAPTOR	1	EC	.020	4-LF		3.3	6.7	8.3	0.0	164.0
6	NIS	1	EC	.25							
6	UAN 28%	100	EC	1							
7	RAPTOR	1	EC	.040	4-LF		0.0	13.3	18.3	10.0	165.0
7	NIS	1	EC	.25							
7	UAN 28%	100	EC	1							
8	RAPTOR	1	EC	.080	4-LF		3.3	33.3	40.0	43.3	165.7
8	NIS	1	EC	.25							
8	UAN 28%	100	EC	1							
9	RAPTOR	1	EC	.160	4-LF		3.3	60.0	83.3	85.0	168.0
9	NIS	1	EC	.25							
9	UAN 28%	100	EC	1							

CONTINUED...

Fidel / Raptor Tolerance Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	FIDEL CROP INJ PERCENT 4-28-97	FIDEL CROP INJ PERCENT 5-5-97	FIDEL CROP INJ PERCENT 5-12-97	FIDEL CROP INJ PERCENT 5-19-97	FIDEL CROP INJ PERCENT 5-27-97	FIDEL H DATE JULIAN
14	RAPTOR	1	EC	.020	4-LF		0.0	3.3	3.3	3.3	164.3
14	SUN-IT II	100	EC	.75							
14	UAN 28%	100	EC	1							
15	RAPTOR	1	EC	.040	4-LF		0.0	16.7	13.3	10.0	164.3
15	SUN-IT II	100	EC	.75							
15	UAN 28%	100	EC	1							
16	RAPTOR	1	EC	.080	4-LF		0.0	50.0	66.7	63.3	167.3
16	SUN-IT II	100	EC	.75							
16	UAN 28%	100	EC	1							
17	RAPTOR	1	EC	.160	4-LF		10.0	68.3	91.7	91.7	170.7
17	SUN-IT II	100	EC	.75							
17	UAN 28%	100	EC	1							
LSD (.05) =						0	15.4	15.4	18.5	21.9	1.6
Standard Dev.=						0	9.21888	9.22386	11.0951	13.1265	.979571
CV =						0	92.19	31.47	33.29	41.68	0.59
Block F						0.000	1.453	1.631	4.376	2.332	5.538
Block Prob(F)						1.0000	0.2488	0.2117	0.0209	0.1134	0.0086
Treatment F						0.000	12.195	25.969	27.476	21.069	10.774
Treatment Prob(F)						1.0000	0.0001	0.0001	0.0001	0.0001	0.0001

Table 2.

Fidel / Raptor Tolerance Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	FIDEL Grow Stg	FIDEL PLANTS FT2	FIDEL HEADS FT2	FIDEL DRY MAT GRM/PLNT	FIDEL YIELD BU/ACRE	FIDEL TEST WT LBS/BU	FIDEL 1000 KWT GRAMS	PROTEIN PERCENT
1	UNTREATED					15	30	4.4	80.4	60.3	45.6	11.97
2	RAPTOR	1	EC	.020	2-LF	16	34	4.8	83.1	60.3	45.4	11.83
2	NIS	1	EC	.25								
2	UAN 28%	100	EC	1								
3	RAPTOR	1	EC	.040	2-LF	16	35	5.6	91.4	60.2	45.8	12.20
3	NIS	1	EC	.25								
3	UAN 28%	100	EC	1								
4	RAPTOR	1	EC	.080	2-LF	14	27	5.1	82.1	60.0	45.7	12.30
4	NIS	1	EC	.25								
4	UAN 28%	100	EC	1								
5	RAPTOR	1	EC	.160	2-LF	16	36	4.4	79.9	54.7	45.2	12.37
5	NIS	1	EC	.25								
5	UAN 28%	100	EC	1								
10	RAPTOR	1	EC	.020	2-LF	15	33	5.4	90.1	60.0	45.7	12.03
10	SUN-IT II	100	EC	.75								
10	UAN 28%	100	EC	1								
11	RAPTOR	1	EC	.040	2-LF	15	30	4.9	87.9	60.0	45.6	12.03
11	SUN-IT II	100	EC	.75								
11	UAN 28%	100	EC	1								
12	RAPTOR	1	EC	.080	2-LF	15	30	5.1	88.3	60.1	46.7	12.50
12	SUN-IT II	100	EC	.75								
12	UAN 28%	100	EC	1								
13	RAPTOR	1	EC	.160	2-LF	12	30	5.9	87.1	58.9	45.2	12.43
13	SUN-IT II	100	EC	.75								
13	UAN 28%	100	EC	1								
6	RAPTOR	1	EC	.020	4-LF	14	28	5.7	84.0	60.4	45.6	11.87
6	NIS	1	EC	.25								
6	UAN 28%	100	EC	1								
7	RAPTOR	1	EC	.040	4-LF	15	35	5.3	91.3	60.1	46.5	12.27
7	NIS	1	EC	.25								
7	UAN 28%	100	EC	1								
8	RAPTOR	1	EC	.080	4-LF	16	34	5.4	86.6	62.5	46.7	12.43
8	NIS	1	EC	.25								
8	UAN 28%	100	EC	1								
9	RAPTOR	1	EC	.160	4-LF	17	31	4.2	80.8	59.5	47.1	12.27
9	NIS	1	EC	.25								
9	UAN 28%	100	EC	1								
14	RAPTOR	1	EC	.020	4-LF	14	30	5.2	92.9	59.8	46.0	12.07
14	SUN-IT II	100	EC	.75								
14	UAN 28%	100	EC	1								
15	RAPTOR	1	EC	.040	4-LF	11	30	6.6	95.2	59.8	46.4	11.97
15	SUN-IT II	100	EC	.75								
15	UAN 28%	100	EC	1								
16	RAPTOR	1	EC	.080	4-LF	13	32	6.4	89.0	59.8	45.8	12.17
16	SUN-IT II	100	EC	.75								
16	UAN 28%	100	EC	1								
17	RAPTOR	1	EC	.160	4-LF	12	31	6.9	96.4	52.1	45.3	12.07
17	SUN-IT II	100	EC	.75								
17	UAN 28%	100	EC	1								
LSD (.05) =						5	8	2.1	17.1	5.0	1.8	0.43
Standard Dev.=						3.10084	4.73540	1.27180	10.2407	2.96968	1.10527	.255869
CV =						21.52	15.02	23.69	11.71	5.01	2.41	2.10
Block F						12.462	13.239	4.017	0.312	1.022	1.371	0.446
Block Prob(F)						0.0001	0.0001	0.0278	0.7343	0.3712	0.2684	0.6440
Treatment F						0.748	0.946	1.062	0.755	1.934	0.815	1.915
Treatment Prob(F)						0.7272	0.5312	0.4264	0.7201	0.0549	0.6605	0.0576

WILD OAT CONTROL IN LENTILS WITH ASSURE II

This study was established to evaluate wild oat control with Assure II as a function of application rate and surfactant type. Assure II was applied at 3, 7, and 10 oz/A with either a nonionic surfactant (NIS), methylated seed oil (MSO), or crop oil concentrate (COC). Surfactant type had a significant effect on wild oat control, the importance of which became more evident as rates were reduced. MSO was the most effective surfactant, followed by COC and NIS, respectively.

Site Description

Crop: Lentils	Variety: Brewers	Planting Date: 4-23-97
Planting Method: Dbl	Disk drill	Rate, Unit: 70 Lbs/A
Depth, Unit: 1.5"	Soil Moisture: Good	Emergence Date: 4-30-97

Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT	Reps: 3
Site Type: Offstation		Study Design: RCB

Plot Maintenance: Area was hand weeded for broadleaves with seeding and fertility done in a manner consistent with the field as a whole.

Application Information

Application Date:	5-21-97
Time of Day:	11:00 AM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	71 F
% Relative Humidity:	23
Wind Velocity, Unit:	2 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	70 F
Soil Moisture:	GOOD
% Cloud Cover:	0

Weed Species	Weed Stage
Wild Oats	3 Leaf
Lentils	3"

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

Wild Oat Control in Lentils with Assure II

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	WILD OAT CONTROL PERCENT 7-11-97	WILD OAT CONTROL PERCENT 7-21-97
1	ASSURE II	.8	EC	10	98.3	97.7
1	MSO	1	EC	1		
2	ASSURE II	.8	EC	10	97.3	98.0
2	COC	1	EC	1		
3	ASSURE II	.8	EC	10	95.0	97.0
3	NIS	1	EC	.25		
4	ASSURE II	.8	EC	7	97.0	95.3
4	MSO	1	EC	1		
5	ASSURE II	.8	EC	7	94.7	88.3
5	COC	1	EC	1		
6	ASSURE II	.8	EC	7	76.7	78.3
6	NIS	1	EC	.25		
7	ASSURE II	.8	EC	3	89.7	85.0
7	MSO	1	EC	1		
8	ASSURE II	.8	EC	3	68.3	70.0
8	COC	1	EC	1		
9	ASSURE II	.8	EC	3	6.7	10.0
9	NIS	1	EC	.25		
10	NONTREATED				0.0	0.0

LSD (.05) =	16.8	14.4
Standard Dev.=	9.80986	8.38650
CV =	13.56	11.65
Block F	3.826	6.588
Block Prob(F)	0.0412	0.0071
Treatment F	44.342	56.929
Treatment Prob(F)	0.0001	0.0001

QUACKGRASS CONTROL IN PEPPERMINT WITH ASSURE II

This study was established to evaluate quackgrass control with Assure II as a function of application rate, timing, and surfactant type. Assure II was applied at 7, 10, and 15 oz/A with either a nonionic surfactant (NIS), or methylated seed oil (MSO) plus 28% UAN as fall (9/23/96) or spring (5/6/97) applications. Sequential applications also were included which consisted of fall (9/23/96) plus spring (5/29/97) timings. The difference in timings for the two spring applications results from the fact that quackgrass spring regrowth was delayed where fall applications had previously been applied. All timings were targeted at the 6 to 8 inch quackgrass growth stage.

Generally, quackgrass control was similar regardless of surfactant type or application timing e.g. fall vs spring. Assure use rate appeared to be the only variable which significantly affected control. The exception being when sequential applications were used. Sequential treatments provided the most complete control, with minor differences in control being detected as a function of rate.

The same series of treatments will be re-applied to the same plots to evaluate long-term control strategies. Fall repeat timings were applied 9/8/97. The spring repeat timings will again be applied at the 6 to 8 inch stage of quackgrass regrowth.

Site Description

```
Crop: Peppermint                Variety: Black Mitchum          Planting Date: 4-4-93
Planting Method: Roots
Study conducted on an established stand of peppermint.

Plot Width, Unit: 10 FT         Plot Length, Unit: 15 FT
Reps: 3                         Site Location: R-7              Study Design: RCB
Plot Maintenance: Wheel line irrigation
      Fertility:          4-11-97     150 Lbs. N, 30 Lbs. S
                          6-16-97      50 Lbs. N
                         10- 8-97      17 Lbs. N, 78 Lbs. P, 120 Lbs. K
      Weed Control:       Stinger at .5 pt.
                          Basagran at 2 qt. + Buctril at .5 pt.
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Soil Description

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Texture: Silt Loam          % OM: 4.4     % Sand: 40     % Silt: 50     % Clay: 10
pH: 7.8          Soil Name: Creston Silt Loam
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Application Information

Application Date:	9-23-96	5-6-97	5-29-97	9-8-97
Time of Day:	1:30 PM	11:00 AM	10:00 AM	11:00
Application Method:	BACKPACK	BACKPACK	BACKPACK	BACKPACK
Application Timing:	POST	POST	POST	POST
Air Temp., Unit:	54 F	55 F	68 F	68 F
% Relative Humidity:	58	51	55	48
Wind Velocity, Unit:	7 MPH	3 MPH	3 MPH	0 MPH
Dew Presence (Y/N):	N	Y	Y	Y
Soil Temp., Unit:	50 F	50 F	62 F	68 F
Soil Moisture:	GOOD	GOOD	GOOD	GOOD
% Cloud Cover:	0	85	30	0

Plant Species	Plant Stage	Density at Application
9-23 Quackgrass	4-8"	Full
5-6 Quackgrass	6-8"	Full
5-29 Quackgrass	6-9"	Full
Mint	4"	Spotty

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

Quackgrass Control in Peppermint with Assure II

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	QUACK CONTROL PERCENT 5-6-97	QUACK CONTROL PERCENT 7-17-97	MINT DRY MAT TON/ACRE 8-12-97	QUACK DRY MAT TON/ACRE 8-12-97	MINT OIL LB/ACRE 8-12-97
1	ASSURE II	.8	EC	7	oz pr/A	FALL	99.3	60.0	1.78	1.72	45.0
1	NIS	1	EC	1	qt pr/A	FALL					
2	ASSURE II	.8	EC	7	oz pr/A	FALL	99.7	75.0	1.95	1.48	54.7
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	100.0	72.7	1.33	1.89	50.8
3	NIS	1	EC	1	qt pr/A	FALL					
4	ASSURE II	.8	EC	10	oz pr/A	FALL	100.0	79.3	2.01	1.35	47.1
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	100.0	81.7	2.14	0.85	50.6
5	NIS	1	EC	1	qt pr/A	FALL					
6	ASSURE II	.8	EC	15	oz pr/A	FALL	100.0	88.0	2.42	0.47	53.8
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	50.0	0.95	2.52	25.7
7	NIS	1	EC	1	qt pr/A	SPRING					
8	ASSURE II	.8	EC	7	oz pr/A	SPRING	0.0	40.0	0.72	2.69	21.6
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	71.7	1.52	1.53	40.1
9	NIS	1	EC	1	qt pr/A	SPRING					
10	ASSURE II	1	EC	10	oz pr/A	SPRING	0.0	81.3	1.86	0.86	47.8
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	83.3	2.00	0.60	46.6
11	NIS	1	EC	1	qt pr/A	SPRING					
12	ASSURE II	.8	EC	15	oz pr/A	SPRING	0.0	86.7	2.10	0.22	52.8
12	MSO	1	EC	1	qt pr/A	SPRING					
12	UAN 28%	1	EC	2	qt pr/A	SPRING					
13	ASSURE II	.8	EC	7	oz pr/A	FALL	99.0	96.0	2.66	0.33	61.3
13	NIS	1	EC	1	qt pr/A	FALL					
13	ASSURE II	.8	EC	7	oz pr/A	SPRING					
13	NIS	1	EC	1	qt pr/A	SPRING					
14	ASSURE II	.8	EC	10	oz pr/A	FALL	99.7	96.0	2.82	0.05	60.9
14	NIS	1	EC	1	qt pr/A	FALL					
14	ASSURE II	.8	EC	10	oz pr/A	SPRING					
14	NIS	1	EC	1	qt pr/A	SPRING					
15	ASSURE II	.8	EC	15	oz pr/A	FALL	100.0	98.7	2.57	0.03	60.1
15	NIS	1	EC	1	qt pr/A	FALL					
15	ASSURE II	.8	EC	15	oz pr/A	SPRING					
15	NIS	1	EC	1	qt pr/A	SPRING					
16	NONTREATED						0.0	0.0	0.01	3.50	0.6
LSD (.05) =							0.6	16.0	1.06	1.29	17.9
Standard Dev.=							.357461	9.60693	.635896	.772053	10.6977
CV =							0.64	13.25	35.28	61.46	23.79
Block F							0.652	4.770	0.746	1.044	0.798
Block Prob(F)							0.5281	0.0159	0.4829	0.3645	0.4601
Treatment F							61312.945	20.669	4.180	5.257	6.944
Treatment Prob(F)							0.0001	0.0001	0.0004	0.0001	0.0001

LONG-TERM. QUACKGRASS CONTROL IN PEPPERMINT WITH ASSURE II

Quackgrass is a weed which commonly infests mint fields in western Montana. While Assure II has demonstrated significant activity towards this weed, annual applications are needed to maintain acceptable levels of control. This study was conducted to monitor long-term control of quackgrass when utilizing annual applications of Assure II with the intent of optimizing herbicide inputs.

Assure II was applied at 7, 10, and 15 oz/A with either a nonionic surfactant (NIS) or methylated seed oil (MSO) plus 28% UAN. These treatments were applied either in the fall or spring when 6 to 8 inches of quackgrass regrowth was present. The first series of treatments were applied during the 1995/1996 season. Fall treatments were applied on 8/25/95 and spring treatment were applied on 5/27/96. Treatments were then reapplied to the same plots during the 1996/1997 season. Sequential fall applications were made on 9/23/96 and sequential spring applications were made on 5/6/97. This report details the results of the sequential applications.

The effect of quackgrass competition on mint hay and oil yields is apparent in the nontreated check. Left uncontrolled, quackgrass developed into a sod, completely eliminating the mint crop. Generally all treatments initially provided excellent control, regardless of rate, surfactant, or application timing. However, long-term control did appear to be affected by use rate, with control improving as the rate of Assure II increased. The effect of surfactants was slight and was only apparent at the lowest rate. This was especially evident with the spring applications where MSO plus 28% UAN provided better control than NIS. Overall, spring applications provided the most complete control and may be related to the time interval difference between application and harvest.

Long-Term. Quackgrass control in Peppermint with Assure II.

Site Description

Crop: Peppermint   Variety: Black Mitcham   Planting Date: 4-4-93
Planting Method: Roots
Study conducted on an established stand of peppermint.

Plot Width, Unit: 10 FT   Plot Length, Unit: 15 FT
Reps: 3   Site Location: R-7   Study Design: RCB
Plot Maintenance: Wheel line irrigation
Fertility: 4-11-97 150 Lbs. N, 30 Lbs. S
6-16-97 50 Lbs. N
Weed Control: Stinger at .5 pt.
Basagran at 2 qt. + Buctril at .5 pt.

Soil Description

Texture: Silt Loam   % OM: 4.4   % Sand: 40   % Silt: 50   % Clay: 10
pH: 7.8   Soil Name: Creston Silt Loam

Application Information

Application Date:	8-25-95	5-7-96	9-23-96	5-6-97
Time of Day:	4:00 PM	1:00 PM	12:45 PM	10:30 AM
Application Method:	BACKPACK	BACKPACK	BACKPACK	BACKPACK
Application Timing:	POST	POST	POST	POST
Air Temp., Unit:	75 F	57 F	54 F	55 F
% Relative Humidity:	25	47	58	51
Wind Velocity, Unit:	0 MPH	7 MPH	7.5 MPH	3 MPH
Dew Presence (Y/N):	N	N	N	Y
Soil Temp., Unit:	74 F	49 F	50 F	50 F
Soil Moisture:	GOOD	GOOD	GOOD	GOOD
% Cloud Cover:	0	50	0	80

Plant Species		Plant Stage	Density at Application
8-25-95	Quackgrass	4-8"	10/ft
5- 7-96	Quackgrass	6-8"	
9-23-96	Quackgrass	4-8"	Full
5- 6-97	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

Long-Term. Quackgrass Control in Peppermint with Assure II.

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	QUACK CONTROL PERCENT 11-12-96	QUACK CONTROL PERCENT 5-6-97	QUACK CONTROL PERCENT 7-17-97	MINT DRY MAT TON/ACRE 8-12-97	QUACK DRY MAT TON/ACRE 8-12-97	MINT OIL YLD LB/ACRE 8-12-97
1	ASSURE II	.8	EC	7	FALL	95.0	98.7	71.7	1.58	1.79	48.0
1	NIS	1	EC	1	FALL						
2	ASSURE II	.8	EC	7	FALL	96.0	96.7	76.7	1.36	1.82	53.7
2	MSO	1	EC	1	FALL						
2	UAN 28%	1	EC	2	FALL						
3	ASSURE II	.8	EC	10	FALL	96.0	99.7	83.3	1.87	1.25	53.2
3	NIS	1	EC	1	FALL						
4	ASSURE II	.8	EC	10	FALL	96.0	99.7	82.7	2.22	1.01	52.0
4	MSO	1	EC	1	FALL						
4	UAN 28%	1	EC	2	FALL						
5	ASSURE II	.8	EC	15	FALL	96.0	100.0	92.0	2.30	0.72	55.6
5	NIS	1	EC	1	FALL						
6	ASSURE II	.8	EC	15	FALL	95.0	100.0	91.7	2.67	0.15	61.2
6	MSO	1	EC	1	FALL						
6	UAN 28%	1	EC	2	FALL						
7	ASSURE II	.8	EC	7	SPRING	79.0	53.3	73.3	2.00	1.10	52.9
7	NIS	1	EC	1	SPRING						
8	ASSURE II	.8	EC	7	SPRING	92.0	79.7	96.3	2.72	0.44	62.5
8	MSO	1	EC	1	SPRING						
8	UAN 28%	1	EC	2	SPRING						
9	ASSURE II	.8	EC	10	SPRING	93.3	84.0	99.0	2.93	0.07	53.3
9	NIS	1	EC	1	SPRING						
10	ASSURE II	1	EC	10	SPRING	97.7	88.7	96.7	3.07	0.00	64.9
10	MSO	1	EC	1	SPRING						
10	UAN 28%	1	EC	2	SPRING						
11	ASSURE II	.8	EC	15	SPRING	94.0	85.0	98.3	2.83	0.01	59.6
11	NIS	1	EC	1	SPRING						
12	ASSURE II	.8	EC	15	SPRING	98.7	92.3	99.3	2.75	0.01	61.1
12	MSO	1	EC	1	SPRING						
12	UAN	1	EC	2	SPRING						
13	NONTREATED					0.0	0.0	0.0	0.02	3.47	0.6
LSD (.05) =						8.7	10.3	16.7	0.86	1.03	16.1
Standard Dev.=						5.18483	6.12285	9.92741	.512093	.612913	9.53438
CV =						5.97	7.39	12.16	23.51	67.30	18.27
Block F						0.201	1.061	4.066	1.081	3.583	2.434
Block Prob(F)						0.8191	0.3616	0.0302	0.3551	0.0435	0.1090
Treatment F						78.570	63.152	21.321	8.100	8.221	8.753
Treatment Prob(F)						0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

1996 MINT CARRYOVER STUDY

Mint acreage has been expanding in western Montana. As more producers become interested in this crop, questions have arose with respect to previous herbicide use injuring baby mint. This study was conducted to investigate the carryover potential of three ALS inhibitors - Assert, Pursuit, and Raptor.

The three herbicides were applied in the spring of 1996 at their respective 1X and 2X use rates. Nontreated controls were also included for each product. The study is designed to look at a 12 month and 24 month recropping interval. Baby mint was planted the spring of 1997 in those plots which were designated for the 12 month rotation interval. The plots designated for the 24 month recrop interval were planted to spring wheat.

Severe injury was observed with both Pursuit and Assert 12 months after application. While injury was greatest at the 2X rate, the level of injury observed with the 1X rates of both herbicides was also unacceptable and was reflected in mint hay yields. Raptor appears to be the most tolerant towards mint as injury was minor and mint hay yields were not significantly different from the nontreated control.

Site Description

Crop: Peppermint	Variety: Black Mitchum	Planting Date: 4-24-97
Planting Method: Hand	Row Spacing, Unit: 22"	Seeding Depth: 4"
Soil Moisture: Good		Emergence Date: 5-15-97
Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT	
Reps: 3	Site Location: R-3	Study Design: RCB

Field Preparation/Plot Maintenance: Roto-tilled and culti-packed prior to stolon planting. Irrigated as needed beginning 5-12-97.

Fertility:	4-21-97	100 Lbs. N, 52 Lbs. P, 60 Lbs. K, 24 Lbs. S
	7- 1-97	100 Lbs. N
	8-19-97	50 Lbs. N
Weed control:	5-16-97	Sinbar at 1 Lb.
	5-30-97	Assure II at 15 oz.

Soil Description

Texture: Coarse Silty Mix % OM: 3.0 % Sand: 40 % Silt: 50 % Clay: 10
pH: 7.4 Soil Name: Creston Silt Loam

Application Information

Application Date:	5-3-96	5-24-96
Time of Day:	12:00 PM	11:00 AM
Application Method:	BACKPACK	BACKPACK
Application Timing:	PRE	POST
Air Temp., Unit:	52 F	65 F
% Relative Humidity:	72	31
Wind Velocity, Unit:	0 MPH	3 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	50 F	58 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:	0	10

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

1996 MINT CARRYOVER STUDY

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	MINT INJURY PERCENT 7-4-97	MINT YIELD DW TON/ACRE 8-5-97
1	ASSERT	2.5	EC	.92	66.7	0.59
1	BARLEY					
1	12 MO					
2	ASSERT	2.5	EC	.46	45.0	0.90
2	BARLEY					
2	12 MO					
3	NONTREATED				10.0	1.13
3	BARLEY					
3	12 MO					
4	PURSUIT	2	EC	.092	55.0	0.59
4	LENTILS					
4	12 MO					
5	PURSUIT	2	EC	.046	41.7	0.78
5	LENTILS					
5	12 MO					
6	NONTREATED				10.0	1.04
6	LENTILS					
6	12 MO					
7	AC299263	2	EC	.063	20.0	1.06
7	LENTILS					
7	12 MO					
8	AC299263	2	EC	.032	20.0	1.06
8	LENTILS					
8	12 MO					
9	NONTREATED				0.0	1.22
9	LENTILS					
9	12 MO					

LSD (.05) =	37.7	0.29
Standard Dev.=	21.7520	170074
CV =	72.96	18.27
Block F	1.176	30.147
Block Prob(F)	0.3338	0.0001
Treatment F	3.353	5.474
Treatment Prob(F)	0.0189	0.0019

LIVING MULCH STUDY

A living mulch should insulate the mint from cold temperatures and dessication. The greater the amount of plant material produced in the fall, the better the insulative properties should be. This study evaluated living mulch crops and straw mulches in an attempt to enhance winter survivability of peppermint .

Early, persistant, and abundant snow cover prevented an assessment of winter injury with these treatments. More to the point, there were no differences in mint hay yields. However, differences were observed in terms of the amount of residue remaining the next spring from the various treatments. The greatest residue was obtained from an October application of straw. The August straw treatment and the spring rye treatments produced equal quantities of residue. Spring triticale had the lowest amount of residue remaining. Efforts will continue to evaluate different crops as potential living mulches.

Site Description

Crop: Peppermint Variety: Black Mitchum
Planting Method: Roots
Study conducted on an established stand of peppermint.

Plot Width, Unit: 10 FT Plot Length, Unit: 15 FT Reps: 3
Site Location: R-5 Study Design: RCB
Field Preparation/Plot Maintenance:

Mulches:	8-21-96	Rye (Gazelle) planted at 120 Lbs./A
		Triticale (Sunland) planted at 120 Lbs./A
	8-22-96	Straw 1 application at 1 ton/A
	9-17-96	Straw 2 application at 1 ton/A
Fertility:	8-22-96	50 Lbs. N, 50 Lbs. P, 50 Lbs. K
	4-21-97	100 Lbs. N, 52 Lbs. P, 60 Lbs. K, 24 Lbs. S
	7- 1-97	132 Lbs. N
Weed Control	4-13-97	Stinger at .5 pt. + Sinbar at .5 lb.
	5- 8-97	Poast at 2 pts.
	5-14-97	Basagran at 2 qt. + Buctril at .5 pt.

Soil Description

Texture: Coarse Silty Mixed % Om: 2.8 % Sand: 40 % Silt: 50 % Clay: 10
Ph: 6.4 Soil Name: Creston Silt Loam

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 STUDY

Trt No	Treatment Name	RESIDUE TON/ACRE 4-17-97	MINT YIELD TON/ACRE 8-18-97
1	SPRING RYE	0.86	2.75
2	SPRING TRITICALE	0.33	2.85
3	STRAW I (AUG)	0.86	2.71
4	STRAW II (OCT)	1.29	3.08
5	CHECK	0.00	2.79
LSD (.05) =		0.52	0.79
Standard Dev.=		.278784	.418870
CV =		41.65	14.76
Block F		0.044	0.471
Block Prob(F)		0.9576	0.6407
Treatment F		9.872	0.364
Treatment Prob(F)		0.0035	0.8281

TOADFLAX SCREEN

Toadflax infestations are rapidly expanding in local mint production fields. Few options are available to control this perennial noxious weed. This research was initiated to evaluate several commonly use herbicides in an attempt to find management options for this weed. The intent was not only to find control options for mint production, but to also develop management strategies for other widely grown rotational crops.

The herbicides evaluated included Raptor, Pursuit, Harmony Extra, Roundup, 2,4-D, Stinger, Sinbar, Sencor, and Goal. These herbicides were applied in the fall and spring when toadflax plants were 4 inches tall.

The toadflax and mint stands were both erratic, making the control and crop injury assessments difficult. However, a few generalizations can be made. Most products provided similar control regardless of whether they were applied in the fall or spring. The exceptions were Harmony Extra and Sencor, both of which showed greater activity when applied in the spring. Stinger and Sinbar were the least effective in controlling toadflax, whereas Goal showed the greatest activity. While Goal initially caused dramatic injury symptoms, the toadflax eventually recovered.

Site Description

Crop: Peppermint

Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT		Reps: 3
Site Location: Tutvedt farm			Study Design: RCB
Field Preparation/Plot Maintenance:			
Fertility:	9-24-96	30 Lbs. N, 104 Lbs. P, & 120 Lbs. K	
Weed control:	9-24-96	Sinbar at 1 lb/A	
	5-18-97	Tankmix: Stinger at 6 oz/A + Buctril at 1 pt/A + Basagran at 1 pt/A + Tough at 1 pt/A + COC at 1 pt/A	
Irrigation:		Center pivot as needed	

Application Information

	A	B
Application Date:	9-27-96	5-20-97
Time of Day:	2:00 PM	11:00 AM
Application Method:	BACKPACK	BACKPACK
Application Timing:	POST	POST
Air Temp., Unit:	66 F	68 F
% Relative Humidity:	42	29
Wind Velocity, Unit:	2 MPH	5 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	54 F	59 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:	20	0

Plant Species		Plant Stage	Density at Application
9-27	Toadflax		20% of Area
5-20	Toadflax	4 inch	
	Mint	2 inch	

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

TOADFLAX SCREEN

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Toadflax Injury Percent 10-10-96	Toadflax Injury Percent 10-28-96	Toadflax Injury Percent 6-9-97
1	RAPTOR	2	EC	4	oz pr/A	FALL	20.0	38.3	83.3
1	28% UAN	1	EC	2	qt pr/A				
1	MSO	1	EC	1	qt pr/A				
2	PURSUIT	2	EC	4	oz pr/A	FALL	20.0	45.0	80.0
2	28% UAN	1	EC	2	qt pr/A				
2	MSO	1	EC	1	qt pr/A				
3	HARMONY EXTRA	75	DF	.6	oz pr/A	FALL	21.7	56.7	65.0
3	28% UAN	1	EC	2	qt pr/A				
3	MSO	1	EC	1	qt pr/A				
4	ROUNDUP	4	EC	2	qt pr/A	FALL	21.7	40.0	66.7
4	28% UAN	1	EC	2	qt pr/A				
4	MSO	1	EC	1	qt pr/A				
5	2,4-D	3.8	EC	1	qt pr/A	FALL	33.3	55.0	70.0
5	28% UAN	1	EC	2	qt pr/A				
5	MSO	1	EC	1	qt pr/A				
6	STINGER	3	EC	1	pt pr/A	FALL	5.0	20.0	30.0
6	28% UAN	1	EC	2	qt pr/A				
6	MSO	1	EC	1	qt pr/A				
7	SINBAR	80	WP	2	lb pr/A	FALL	38.3	41.7	16.7
7	28% UAN	1	EC	2	qt pr/A				
7	MSO	1	EC	1	qt pr/A				
8	SENCOR	75	DF	.67	lb pr/A	FALL	36.7	61.7	33.3
8	28% UAN	1	EC	2	qt pr/A				
8	MSO	1	EC	1	qt pr/A				
9	GOAL	1.6	EC	10	pt pr/A	FALL	99.0	99.3	66.7
9	28% UAN	1	EC	2	qt pr/A				
9	MSO	1	EC	1	qt pr/A				
10	RAPTOR	2	EC	4	oz pr/A	SPRING	0.0	0.0	88.3
10	28% UAN	1	EC	2	qt pr/A				
10	MSO	1	EC	1	qt pr/A				
11	PURSUIT	2	EC	4	oz pr/A	SPRING	0.0	0.0	83.3
11	28% UAN	1	EC	2	qt pr/A				
11	MSO	1	EC	1	qt pr/A				
12	HARMONY EXTRA	75	DF	.6	oz pr/A	SPRING	0.0	0.0	93.0
12	28% UAN	1	EC	2	qt pr/A				
12	MSO	1	EC	1	qt pr/A				

CONTINUED...

TOADFLAX SCREEN

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Toadflax Injury Percent 10-10-96	Toadflax Injury Percent 10-28-96	Toadflax Injury Percent 6-9-97
13	ROUNDUP	4	EC	2	qt pr/A	SPRING	0.0	0.0	56.7
13	28% UAN	1	EC	2	qt pr/A				
13	MSO	1	EC	1	qt pr/A				
14	2,4-D	3.8	EC	1	qt pr/A	SPRING	0.0	0.0	80.0
14	28% UAN	1	EC	2	qt pr/A				
14	MSO	1	EC	1	qt pr/A				
15	STINGER	3	EC	1	pt pr/A	SPRING	0.0	0.0	26.7
15	28% UAN	1	EC	2	qt pr/A				
15	MSO	1	EC	1	qt pr/A				
16	SINBAR	80	WP	2	lb pr/A	SPRING	0.0	0.0	26.7
16	28% UAN	1	EC	2	qt pr/A				
16	MSO	1	EC	1	qt pr/A				
17	SENCOR	75	DF	.67	lb pr/A	SPRING	0.0	0.0	80.0
17	28% UAN	1	EC	2	qt pr/A				
17	MSO	1	EC	1	qt pr/A				
18	GOAL	1.6	EC	10	pt pr/A	SPRING	0.0	0.0	99.3
18	28% UAN	1	EC	2	qt pr/A				
18	MSO	1	EC	1	qt pr/A				
19	CHECK						0.0	0.0	26.7
20	CHECK						0.0	0.0	33.3

LSD (.05) =	12.7	12.4	51.9
Standard Dev.=	7.69552	7.53012	31.4575
CV =	52.06	32.91	52.18
Block F	0.717	0.570	3.209
Block Prob(F)	0.4947	0.5703	0.0516
Treatment F	29.645	46.402	2.152
Treatment Prob(F)	0.0001	0.0001	0.0219

TOADFLAX CONTROL WITH GOAL IN PEPPERMINT

Toadflax infestations are rapidly expanding in local mint production fields. Few options are available to control this perennial noxious weed. This research was initiated to evaluate applications of Goal herbicide for the potential to manage this pest.

This study evaluated Goal as a function of application timing, rate, and formulation. Early applications on April 30 consisted of liquid and impregnated formulations applied at several rates. Conventional postemergence applications were made on May 20, and consisted solely of the liquid formulation. Sequential applications were made 19 days later to half of the May 20 treatments.

The toadflax and mint stands were both erratic, making the control and crop injury assessments difficult. However, a few generalizations can be made. There appears to be little difference in herbicide tolerance between toadflax and the mint crop. Both species responded to applications of goal to the same extent. Sequential applications provided greater control than single applications. Sequential application made at 0.25 lb ai/A initially provided 98 percent control of both species. The toadflax eventually recovers, as growth resumes from the underground rhizome system.

The liquid formulation provided greater toadflax control than that of the impregnated material. Correspondingly, the degree of mint injury also was greater with the liquid formulation. The 2.0 pound rate of Goal, when impregnated, provided about 60 percent control of toadflax, yet only resulted in a 17 percent crop injury rating. While these results are preliminary, it appears that the impregnated formulation of goal may be the best approach to manage toadflax.

Toadflax Control with Goal in Peppermint

Site Description

Crop: Peppermint

Plot Width, Unit: 10 FT   Plot Length, Unit: 15 FT   Reps: 3
Site Location: Tutvedt farm   Study Design: RCB
Field Preparation/Plot Maintenance:
Weed control: 5-18-97   Tankmix:
Stinger at 6 oz/A +
Buctril at 1 pt/A +
Basagran at 1 pt/A +
Tough at 1 pt/A +
COC at 1 pt A
Irrigation: Center pivot as needed

Application Information

	A	B	C
Application Date:	4-30-97	5-20-97	5-29-97
Time of Day:	12:00 PM	11:00 AM	12:30
Application Method:	BACKPACK	BACKPACK	BACKPACK
Application Timing:	DORMANT	POST	POST
Air Temp., Unit:	56 F	68 F	70 F
% Relative Humidity:	38	29	33
Wind Velocity, Unit:	6 MPH	5 MPH	1.5 MPH
Dew Presence (Y/N):	N	N	Y
Soil Temp., Unit:	48 F	59 F	68 F
Soil Moisture:	GOOD	GOOD	GOOD
% Cloud Cover:	95	0	50

	Plant Species	Plant Stage	Density at Application
4-30	Toadflax	1 inch	Sparse
	Canada Thistle	2 inch Rosette	Spotty
5-20	Toadflax	4 inch	
	Mint	2 inch	
5-29	Toadflax	4 inch	

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

Toadflax Control with Goal in Peppermint

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Toadflax Injury Percent 5-20-97	Toadflax Injury Percent 6-9-97	Mint Crop Inj Percent 6-9-97
1	GOAL	2.0	EC	2.0	lb ai/A	E Post Emer	63.3	98.3	86.7
2	GOAL	2.0	EC	1.0	lb ai/A	E Post Emer	51.3	56.7	40.0
3	GOAL	2.0	EC	0.5	lb ai/A	E Post Emer	21.3	44.2	32.1
4	GOAL	.005	G	2.0	lb ai/A	E Post Emer	43.8	61.7	17.1
5	GOAL	.005	G	1.0	lb ai/A	E Post Emer	15.0	38.3	10.0
6	GOAL	2.0	EC	0.25	lb ai/A	2-3"	0.0	88.2	42.1
6	MSO	1	EC	1	qt pr/A				
6	UAN 28%	1	EC	2	qt pr/A				
7	GOAL	2.0	EC	0.125	lb ai/A	2-3"	0.0	51.7	26.7
7	MSO	1	EC	1	qt pr/A				
7	UAN 28%	1	EC	2	qt pr/A				
8	GOAL	2.0	EC	0.06	lb ai/A	2-3"	31.7	36.7	43.3
8	MSO	1	EC	1	qt pr/A				
8	UAN 28%	1	EC	2	qt pr/A				
9	GOAL	2.0	EC	0.25	lb ai/A	2-3"	0.0	98.7	99.0
9	MSO	1	EC	1	qt pr/A				
9	UAN 28%	1	EC	2	qt pr/A				
9	GOAL	2.0	EC	0.25	lb ai/A	+ 1 Week			
9	MSO	1	EC	1	qt pr/A				
9	UAN 28%	1	EC	2	qt pr/A				
10	GOAL	2.0	EC	0.125	lb ai/A	2-3"	0.0	68.3	68.3
10	MSO	1	EC	1	qt pr/A				
10	UAN 28%	1	EC	2	qt pr/A				
10	GOAL	2.0	EC	0.125	lb ai/A	+ 1 Week			
10	MSO	1	EC	1	qt pr/A				
10	UAN 28%	1	EC	2	qt pr/A				
11	GOAL	2.0	EC	0.06	lb ai/A	2-3"	0.0	59.7	53.0
11	MSO	1	EC	1	qt pr/A				
11	UAN 28%	1	EC	2	qt pr/A				
11	GOAL	2.0	EC	0.06	lb ai/A	+ 1 Week			
11	MSO	1	EC	1	qt pr/A				
11	UAN 28%	1	EC	2	qt pr/A				
12	CHECK						0.0	0.0	0.0

	Toadflax Injury 5-20-97	Toadflax Injury 6-9-97	Mint Crop Inj 6-9-97
LSD (.05) =	32.0	57.4	48.1
Standard Dev.=	19.1227	34.4193	28.8453
CV =	175.68	76.22	83.58
Block F	0.356	0.065	0.413
Block Prob(F)	0.7038	0.9374	0.6652
Treatment F	3.402	2.968	3.763
Treatment Prob(F)	0.0017	0.0030	0.0004

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, lodging resistance, and improved resistance to foliar diseases, in consideration for future release to Montana grain growers.

RESULTS: Yields were lower than average with 21 of the 64 entries topping 100 bu/A. Yields ranged from 121 bu/A (Nebula) to 77 (MT940013). Overall test weight (52.4 lbs/bu) was very good when compared to previous years. Only Nebula and MTLB 48 did not make 50 lbs/bu. Significant lodging was documented in 1997 which may have led to the poor average percent plump. Six cultivars had plumps of 94.5%, while MTLB 48 was only 66.5%. 42% of the entries were above 90% plump. Eight cultivars displayed good lodging resistance including Nebula, BZ594-19, Logan, Stark, and four experimentals, while eight others, led by Harrington, were very poor. A late spring resulted in heading dates, and harvest one to two weeks later than normal. Foliar diseases were overwhelming in that those present were just bulked into an overall leaf-spot complex and rated by how much of the plant was affected. Little to no susceptibility differences existed among the cultivars under high pressure, as all were hit equally as severe.

SUMMARY: Late planting and saturated soils led to slow initial growth and below average yields. Test weights measured high despite significant lodging throughout the nursery. The lodging in combination with severe disease pressure, did however, result in low percent 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: May 10, 1997 Harvested: August 21, 1997

VARIETY	HD DATE JULIAN	HEIGHT INCH	YIELD BU/A	TWT LB/BU	PLUMP %	LDG 0-9	LF SPOT 0-3 1/	PYTHIUM 1-3 2/
Nebula	189.69	30.80	121.19	48.40	87.50	-.19	2.97	2.97
Stander	183.53	38.91	114.36	52.00	94.50	1.27	2.73	2.68
WPB BZ 594-19	187.40	36.61	113.33	53.90	94.50	-.07	2.94	2.99
Logan	183.62	37.36	111.30	53.10	91.00	.77	3.06	3.07
AC 96/1114	189.34	34.38	110.05	51.40	90.50	1.94	2.82	2.99
MT950186	185.49	34.90	109.34	54.80	92.50	3.27	2.63	3.01
Baronesse	187.98	34.06	109.02	52.80	90.50	2.93	3.02	3.00
Foster	183.30	39.32	108.31	51.30	93.50	1.73	2.94	2.67
Stark	183.12	39.22	106.83	52.70	94.50	.62	3.05	3.04
H1851195	186.72	39.45	106.48	52.90	93.00	4.65	2.79	2.95
2B945337	184.52	37.11	105.48	52.70	94.50	1.61	2.92	3.01
MTLB 32	187.18	35.30	104.85	52.40	78.00	4.39	2.67	2.98
MT930204	183.38	39.32	104.56	52.90	90.50	4.50	2.83	2.69
Chinook	185.78	36.77	104.46	53.10	89.00	3.12	2.70	2.39
MT940214	183.72	37.20	104.17	53.60	91.00	1.62	3.06	3.00
GS 1750	190.17	27.59	104.13	51.50	89.50	1.18	2.90	3.00
MT930169	188.06	36.81	102.85	51.80	71.00	4.62	2.46	3.00
MT940218	182.70	36.71	102.49	52.90	92.00	.17	2.83	2.99
BA 1202	187.60	36.20	101.43	51.90	94.50	2.50	2.54	2.93
MT950175	186.38	36.66	100.46	53.70	90.50	4.02	2.54	2.97
Harrington	188.15	40.00	100.07	52.20	87.00	6.35	2.89	3.02
Lewis	186.90	38.91	99.97	54.10	90.00	3.02	2.81	2.96
MT910189	184.61	37.88	99.93	53.20	93.00	2.24	2.71	2.65
Coors C22	192.38	33.49	99.78	50.60	85.50	3.20	2.92	2.97
MT950081	186.99	35.02	99.72	54.20	92.50	3.85	2.87	2.99
2B914947	189.60	36.80	98.59	51.10	86.50	1.41	2.79	2.97
MT886610	185.57	37.36	98.31	53.10	86.50	3.34	2.94	2.97
MTLB 2	186.51	34.52	97.46	52.50	93.00	.61	2.83	3.05
MTLB 6	185.36	34.80	96.23	52.80	87.50	2.29	2.73	2.97
MT940082	185.72	33.07	96.02	54.10	91.00	.54	2.90	3.03
2B925550	187.90	37.74	95.16	53.40	94.50	2.55	2.97	2.68
MT920041	185.75	36.53	94.88	52.00	91.50	1.10	2.79	2.97
MT950102	188.12	33.27	94.74	53.20	89.50	1.71	2.67	2.32
MT940087	188.00	36.11	94.61	53.40	92.00	2.51	2.55	2.38
MT920073	184.82	33.22	94.44	52.40	89.50	2.41	2.64	2.78
MT950091	188.45	32.50	94.33	53.30	86.00	3.32	2.60	2.99
MT920161	185.77	38.37	93.86	52.60	83.50	3.55	2.79	2.99
Galena	190.63	32.13	93.41	51.90	84.00	2.41	2.74	2.91
MT940196	187.32	34.18	93.24	51.10	83.50	3.56	2.86	2.36
MT940121	188.12	35.58	92.33	51.50	89.00	2.89	2.53	2.71
MT950170	183.83	30.94	92.15	51.00	85.50	3.14	2.79	3.03
MTLB 57	184.65	33.71	92.09	52.30	86.50	3.40	2.54	2.95
Gallatin	185.45	38.89	91.76	53.30	86.50	2.67	2.95	3.00
MT950155	184.84	32.23	91.64	51.90	91.00	1.27	2.60	3.01
MT920201	187.67	38.20	91.62	51.90	88.50	2.65	2.60	2.98
MT950121	185.72	36.68	90.98	52.30	94.00	3.29	2.97	2.97
MT950168	190.17	33.97	90.62	50.70	88.50	4.83	2.84	2.97
MT950156	184.35	34.98	90.13	51.70	86.50	1.53	2.90	2.97
MTLB 30	189.17	34.44	89.39	51.80	88.00	2.91	3.13	2.38
MTLB 5	188.20	36.38	89.24	51.90	85.50	3.98	2.43	2.29
MT940053	188.83	34.30	89.07	53.30	72.50	1.41	2.79	3.00

(Continued on next page)

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

Planted: May 10, 1997 Harvested: August 21, 1997

VARIETY	HD DATE JULIAN	HEIGHT INCH	YIELD BU/A	TWT LB/BU	PLUMP %	LDG 0-9	LF SPOT 0-3 1/	PYTHIUM 1-3 2/
MT920059	187.42	38.71	89.06	53.90	90.00	1.35	2.90	2.98
MT920053	186.27	36.29	88.48	53.40	87.00	2.79	2.71	3.00
MT950064	192.22	28.93	88.24	51.60	77.00	2.91	2.46	3.03
MT950151	182.60	37.12	86.86	52.70	89.00	3.59	2.87	2.95
MT950154	186.48	35.26	86.86	53.00	83.50	2.42	2.67	3.05
MTLB 48	190.25	34.99	86.51	49.30	66.50	4.07	2.48	2.69
H3860224	189.37	36.36	86.34	52.60	89.50	1.77	2.89	2.68
MT910150	185.72	34.95	84.67	54.10	92.00	1.41	2.84	2.31
MT940071	185.13	32.29	84.51	52.90	88.50	.74	2.59	2.97
MT940177	186.77	33.56	82.27	51.90	83.00	2.97	2.49	2.75
Moravian 14	182.80	29.92	81.04	53.30	86.50	1.98	2.30	3.02
MTLB 13	187.70	33.05	80.91	50.30	85.10	1.88	2.57	2.70
MT940013	187.08	31.78	77.27	50.80	84.00	3.21	2.40	2.99
MEAN	186.7	35.4	96.5	52.4	88.0	2.5	2.8	2.9
C.V.	0.5	6.4	11.6	NA	NA	45.8	12.7	9.9
LSD (0.5)	1.4	3.8	18.3	NA	NA	1.9	0.6	0.5

1/ DISEASE LEVELS: 1=DISEASE COMPLEX UP 1/3 OF PLANT, 2=UP 2/3 OF PLANT, 3= WHOLE PLANT

2/ DISEASE LEVELS: 1=COMPETE PLOT YELLOWING & STUNTING, 2=PARTIAL PLOT YELLOWING & STUNTING, 3=LITTLE OR NO PLOT EFFECT

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, lodging resistance, and improved resistance to foliar diseases, in consideration for future releases to Montana grain growers.

RESULTS: As a result of high visible variability within and between plots, and demonstrated by heading date measurements, this nursery was terminated on August 4.

SUMMARY: A cool and very wet spring resulted in late planting and poor early growth conditions. Early in the season, plants displayed stunted and yellowing symptoms later identified as Pythium. The result was erratic growth patterns within plots and specifically between reps due to Pythium patches. Pythium evaluations revealed no genetic resistance among cultivars, resulting in plots not representative enough for normal or altered variable measurements.

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 Yield Spring Barley Nursery grown at the Northwestern Agricultural Research Center in Kalispell, MT

Planted: May 10, 1997 Harvested: Terminated

VARIETY	HD DATE JULIAN	PYTHIUM 1-3 1/
MT960044	196.08	1.93
MT960162	195.75	1.58
MT960045	195.62	1.93
MT960013	194.78	2.71
MT960111	194.22	2.37
MT960141	193.62	1.95
MT960152	193.46	1.70
MT960154	193.22	1.69
MT960017	192.76	1.98
MT960127	192.24	2.33
MT960101	192.04	2.06
MT960175	191.96	2.06
MT960029	191.84	2.32
MT960098	191.82	2.07
MT960192	191.73	1.61
MT960019	191.70	2.30
MT960156	191.42	2.04
Harrington	191.25	1.62
MT960184	191.07	1.87
MT960039	191.03	2.56
MT960140	190.82	1.93
MT960174	190.79	1.67
MT960099	190.52	2.27
MT960082	190.18	2.59
MT960178	190.14	2.41
MT960157	190.11	2.02
MT960028	190.11	2.01
BC167-46	189.89	2.45
MT960087	189.89	2.38
MT960195	189.66	2.28
MT960222	189.64	2.09
MT960086	189.64	2.63
MT960228	189.51	2.37
MT960182	189.44	2.00
MT960225	189.03	1.67
MT960188	189.02	2.90
MT960197	188.97	3.00
MT960198	188.97	1.36
MT960102	188.67	2.68
MT960089	188.60	1.59
MT960213	188.44	2.38
MT960055	188.40	2.67
Baronesse	188.39	2.35
Chinook	188.29	2.06
Gallatin	188.06	2.68
MT960199	188.00	1.40
Lewis	187.75	2.33
MT960181	187.54	2.32

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Table 1 (Con't). Agronomic data from Early Yield Spring Barley Nursery.

VARIETY	HD DATE JULIAN	PYTHIUM 1-3
MT960041	187.44	1.90
MT960104	186.68	1.66
MT960230	186.40	1.85
MT960226	185.88	2.11
Stark	185.57	2.33
MT960170	184.68	2.61
Morex	184.08	2.32
BC167-49	183.69	1.93
MT960177	183.56	2.41
BC167-32	183.11	1.95
Steptoe	182.26	2.10
BC72-44	181.72	2.44
BC72-50	181.23	2.14
BC72-31	180.89	2.08
BC72-14	180.73	1.94
BC167-41	180.01	2.41
MEAN	189.00	2.10
C.V.	0.59	26.70
LSD (.05)	1.88	0.95

1/ DISEASE LEVELS: 1=COMPLETE PLOT YELLOWING & STUNTING, 2=PARTIAL PLOT YELLOWING & STUNTING, 3=LITTLE OR NO PLOT EFFECT

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: Yields in 1997 varied from 185 bu/A (Monida) to 86 (Whitestone). Due to late planting and adverse early growing conditions, heading dates and harvest maturity was delayed one to two weeks from normal. Height was also affected which resulted in shorter plots and less lodging than average. Four varieties displayed good lodging resistance (87AB5125, 90AB1322, Ajay, and Whitestone). Test weight was slightly better than past averages with Monida and ABSP 9-2 exceeding 39 lbs/bu.

SUMMARY: Adverse initial growing conditions resulted in poor yields but good test weights. The disease Pythium was present throughout the nursery which resulted in reduced plant height, later maturity, and an overall plant discoloration from dark to pea green.

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 Montana Statewide Oat Nursery grown at the Northwestern Agricultural Research Center in Kalispell, MT.

Planted: May 10, 1997 Harvested: September 23, 1997

VARIETY		HD DATE JULIAN	HEIGHT INCH	YIELD BU/A	LDG 0-9	TWT LB\BU
CI483126	Monida	193.00	45.53	185.47	3.33	39.20
ABSP 9-2	83/Ab3119/Monida	190.33	39.23	168.17	3.00	39.90
86AB664	Ogle/75Ab861	191.00	41.10	157.67	1.33	36.50
CELSIA	Celsia	194.00	43.93	144.33	2.00	38.40
87AB5125	Ogle/75Ab861	191.67	37.67	140.70	.00	38.50
PRAIRIE	Prairie	187.00	37.27	128.67	1.33	37.30
90Ab1322	80Ab1322/Monida	189.33	32.40	127.43	.33	38.80
ND860416	Otana/Valley	191.67	40.70	127.33	1.33	38.80
86AB4582	Monida/Reselection	189.33	39.90	125.90	1.67	37.40
83AB3250	Powell	195.00	35.83	122.70	1.33	36.40
CI 9252	Otana	191.33	37.63	112.73	2.33	37.90
82Ab1142	Ajay	190.00	32.03	100.33	.00	38.20
81Ab5792	Rio Grande	188.00	34.77	97.73	3.00	36.60
ND870258	Whitestone	193.00	30.20	86.10	.33	36.20
MEAN		191.0	37.7	130.4	1.5	37.9
C.V.		0.3	14.5	18.4	102.0	NA
LSD (.05)		1.0	9.2	40.2	2.6	NA

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: Late planting due to very wet conditions, in combination with a severe outbreak of Pythium, led to the lowest average yield this nursery has had in Kalispell. Yields ranged from 68.8 bu/A (MT9644) to 21.6 (MT9453). Heading dates were one week later than normal. Test weight, lodging, and height were at or near normal for this location. 39% of the entries had test weights at 60 lbs/bu or above while 45% of the entries displayed good lodging resistance. Proteins averaged 12.3 percent with MT9627 highest at 13.9% and Penawawa (soft white) lowest at 9.6.

SUMMARY: Pythium affects on plots were apparent early in the season and continued through grain fill and dry down. Early leaf loss and little tillering indicated low yields by heading. No genetic resistance is recognized in spring wheats, meaning the Pythium ratings taken are a measurement of damage rather than resistant vs. susceptible.

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: May 10, 1997 Harvested: August 30, 1997

VARIETY	HD DATE JULIAN	HEIGHT INCH	YIELD BU/A	LDG 0-9	TWT LB/BU	PYTHIUM 1-3 1/	PROTEIN %
MT 9644	187.00	39.10	68.80	2.00	60.90	2.33	13.4
BZ987331	184.00	30.70	59.93	1.00	59.10	2.67	12.1
VANNA	190.00	32.00	52.17	.00	57.70	2.33	9.4
GRANDIN	185.00	34.50	49.93	.00	60.20	3.00	13.1
MT 9607	185.00	40.80	49.30	3.00	60.10	2.67	13.7
MT 9627	186.00	30.47	46.20	.33	61.90	2.33	13.9
MT 9608	186.67	39.77	45.13	2.67	59.80	2.33	13.2
ERNEST	186.33	34.90	42.30	1.00	60.20	2.33	13.6
MT 9675	188.67	31.73	41.63	.33	57.50	2.00	10.8
MCNEAL	187.33	32.43	41.47	.00	59.50	2.33	13.0
MT 9433	188.67	36.87	41.30	.33	60.10	2.00	12.8
BZ992632	184.33	32.17	41.00	2.67	58.60	2.00	11.5
MT 9653	187.33	39.50	39.70	2.33	61.70	2.00	13.3
MT 9541	186.00	33.63	39.47	.33	61.20	2.33	13.5
MT 9513	184.00	31.33	39.43	3.00	60.50	1.33	13.2
NEWANA	188.67	29.17	39.33	.00	59.50	2.33	11.4
WESTBRED 926	181.67	29.67	37.33	.33	57.80	2.33	12.8
MT 9410	184.00	36.47	36.93	1.33	60.80	2.33	12.4
MT 9667	185.67	37.13	36.73	2.67	57.80	2.33	13.5
MT 9619	186.33	35.30	36.60	1.33	60.30	2.00	11.4
MT 9507	184.33	31.77	36.57	1.67	59.10	2.00	13.1
MT 9542	187.67	28.23	36.33	1.00	57.20	1.67	11.2
THATCHER	188.67	40.43	35.67	1.67	58.20	2.00	11.2
MT 9553	185.33	31.90	35.60	.67	60.30	2.33	12.3
WESTBRED 936	182.33	26.10	34.67	.00	59.50	2.33	11.3
HI-LINE	184.33	27.53	34.63	.33	56.70	2.33	13.1
PENAWAWA	188.33	28.47	34.60	.00	58.10	1.67	9.6
MT 9565	183.33	35.70	34.27	2.00	61.90	2.00	11.9
MT 9628	183.67	29.57	34.13	.00	60.60	1.67	13.4
LEW	190.00	37.93	33.80	2.67	59.30	2.33	11.8
MT 9539	186.33	32.17	33.20	1.00	60.20	2.00	12.4
WESTBRED EXPRESS	186.33	24.80	32.50	.00	59.10	1.33	10.5
TRENTON	185.33	35.33	32.30	.33	59.80	2.00	12.1
MT 9609	184.33	34.73	32.17	2.33	59.20	2.33	12.6
LEN	186.33	27.43	31.73	.00	57.90	1.67	13.5
MT 9602	184.67	35.67	31.43	1.67	60.30	2.00	12.6
MT 9508	183.67	27.70	31.33	3.00	58.80	1.33	13.6
MT 9660	187.00	32.27	31.00	.00	59.10	1.33	12.4
BZ992588	185.33	27.73	30.63	.00	60.10	2.00	12.7
MT 9668	187.00	34.10	30.17	1.67	58.80	2.00	12.8
AMIDON	187.00	37.63	29.63	1.33	60.90	1.67	12.8
FERGUS	181.67	28.37	29.63	.67	58.90	1.33	12.0
MT 9603	186.67	38.20	28.33	2.33	59.90	1.67	12.2
FORTUNA	184.67	38.47	26.23	4.00	56.70	2.00	11.6
MT 9662	187.33	25.73	25.03	.00	59.20	1.67	10.2
MT 9558	189.33	29.67	24.93	.67	56.80	2.00	12.8
MT 9631	188.33	35.07	24.57	2.00	62.20	1.67	11.4
GLENMAN	187.67	27.57	22.47	2.33	56.40	1.67	11.4
MT 9453	188.67	33.07	21.63	1.00	59.60	1.33	13.1
MEAN	186.1	32.9	36.4	1.2	59.4	2.0	12.3
C.V.							
LSD (.05)							

1/ DISEASE LEVELS: 1=COMPLETE PLOT YELLOWING & STUNTING, 2=PARTIAL PLOT YELLOWING & STUNTING, 3=LITTLE OR NO PLOT EFFECT

PROJECT TITLE: **Preliminary Hard White Spring Wheat Evaluation**

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

OBJECTIVE: To evaluate experimental hard white spring wheat cultivars for yield, lodging, quality, and disease resistance in northwestern Montana.

RESULTS: Overall yields were very poor in response to high levels of Pythium (also called browning root rot) infection. Yields for the 31 entries ranged from 55 (MTHW9603) to 26 (hard red check-HiLine) bu/A with an overall mean of 36. Test weights were fair with 81% below 60 lbs/bu. Test weights ranged from 62.4 (MTHW9718) to 56.4 (MTHW9704) lbs/bu. As a result of the Pythium, height and yield were significantly reduced, which led to minor lodging. Most entries displayed good straw strength. While Pythium was this years most performance limiting factor, ratings did not identify real susceptibility differences, such a response confirms the belief that no genetic resistance exists among small grain varieties. Proteins ranged from 13.9 (MTHW9418) to 9.8 (ID377S) %, and averaged 12.2%.

SUMMARY: The Pythium epidemic severely hindered data collection as all agronomic measurements were drastically influenced. 1997 was the first year this evaluation was located in Kalispell so results could not be compared to previous years.

FUTURE PLANS: Promising hard white spring wheats will continue to be evaluated at Kalispell to identify those with the potential to become a recommended variety in District 1.

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

Planted: May 10, 1997 Harvested: August 30, 1997

VARIETY	HD DATE JULIAN	HEIGHT INCH	YIELD BU/A	LDG 0-9	TWT LB/BU	PYTHIUM 1-3 1/	PROTEIN %
MTHW9603	187.00	31.87	54.93	1.33	58.60	2.33	12.2
MTHW9708	186.33	30.73	52.53	.67	59.00	2.33	12.6
MTHW9701	186.00	26.23	49.37	.00	58.00	2.33	12.1
MTHW9702	184.00	29.63	48.13	1.00	58.70	2.33	12.5
MTHW9420	184.33	26.53	41.73	.00	60.40	2.33	12.1
MTHW9712	181.00	31.00	40.87	3.33	60.80	2.00	12.9
MTHW9706	185.33	31.63	40.27	.00	59.50	2.00	12.9
MTHW9704	184.00	28.87	37.97	1.67	56.40	2.00	11.1
MTHW9718	181.33	31.77	37.53	2.00	62.40	1.67	13.9
MTHW9520	188.00	31.90	36.80	1.00	59.30	2.33	11.5
MTHW9418	182.00	26.90	36.77	.33	60.20	2.00	13.9
MTHW9705	184.33	27.93	36.73	.67	59.60	2.00	11.9
MTHW9709	185.00	29.40	36.13	1.33	58.40	1.67	12.8
MTHW9716	183.00	30.70	35.97	2.33	58.90	1.33	13.1
KLASIC	180.67	22.83	35.43	1.00	59.20	2.00	11.2
ID377S	183.67	28.23	34.87	.00	59.60	2.00	9.8
MTHW9717	184.33	30.43	34.03	1.00	59.60	2.00	13.5
MTHW9707	186.33	27.03	33.30	1.00	57.50	2.33	12.5
MTHW9714	184.00	35.17	33.07	2.33	61.60	2.33	12.2
MTHW9511	179.67	24.40	33.03	2.67	59.80	2.00	11.3
MTHW9713	184.67	28.07	32.23	1.67	59.30	2.00	10.9
MTHW9710	183.67	27.80	31.23	.67	58.70	1.67	13.5
MTHW9421	184.33	28.77	31.03	.67	57.40	1.67	11.5
MTHW9703	183.00	26.77	30.83	.67	58.60	2.00	12.1
MTHW9604	186.00	30.97	30.43	.33	59.10	1.67	11.1
MTHW9715	185.00	29.80	29.63	2.67	59.10	1.67	12.1
MTHW9515	179.00	25.60	28.83	2.67	61.30	1.67	11.9
MTHW9711	186.33	26.53	28.80	1.00	58.40	1.33	11.7
MTHW9422	184.67	26.10	26.87	.67	58.20	1.67	11.6
MTHW9508	179.67	28.37	26.50	2.00	59.80	1.67	11.6
HI-LINE	183.33	24.80	26.33	.33	59.60	2.00	13.0
MEAN	183.9	28.6	35.9	1.2	59.3	1.9	12.2
C.V.	0.6	9.1	34.5	63.9	NA	25.3	NA
LSD (.05)	1.8	4.2	20.2	1.3	NA	0.8	NA

1/ DISEASE LEVELS: 1=COMPLETE PLOT YELLOWING & STUNTING, 2=PARTIAL PLOT YELLOWING & STUNTING, 3=LITTLE OR NO PLOT EFFECTS

PROJECT TITLE: **Intrastate Winter Wheat Evaluation: Lodging and disease resistance**

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

OBJECTIVE: To evaluate of Montana adapted cultivars for yield, lodging, quality, and disease resistance. Special attention to fully document dwarf bunt, stripe rust, and leaf rust reactions.

RESULTS: Overall yields were very good considering that winter survival ranged from 5% (BZ9W92-712-a) to 78% (Agassiz), with a mean of 48%. Yields for the 48 entries ranged from 126 (Promontory) to 71 (Roughrider) bu/A with an overall mean of 102. Test weights were good with 33% of the varieties below 60 lbs/bu. The mean test weight was 60.3 lbs/bu with a high of 62.7 (MT9524). Lodging throughout the nursery was significant with a handful of cultivars nearly flat (Roughrider, Agassiz, Norstar, and Winridge). Promontory, Quantum 1824, MT9524, MT9432, and Redwin displayed excellent lodging resistance. Winter condition were ideal for the germination and plant inoculation of TCK. Pronghorn, Yuma, Niobrara, Halt, and Roughrider were hit hardest by TCK and resulted in poor agronomic performance. Promontory, Blizzard, Quantum 566, Manning, Winridge, and Bonneville were least affected by TCK which resulted in all being located in the top 10 for yield. Moderate to high levels of leaf rust was present. Seventeen of the 48 cultivars showed no signs of infection while eight were highly infested.

SUMMARY: Yields and test weights were surprisingly good in relation to the poor growing season and heavy disease pressures present throughout. This crop year was beneficial to gathering good lodging and disease notes and specific variety responses to the detrimental conditions.

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 as well as document potential production problems for producers across the state.

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

Planted: September 25, 1996 Harvested: August 20, 1997

VARIETY	W SURV %	HD DATE JULIAN	HEIGHT INCH	LDG 0-9	YIELD BU/A	TWT LB/BU	LF RST 0-3 1/	TCK 0-3 1/	AGRO 0-9 2/
PROMONTORY	45.00	161.71	37.00	.33	126.05	59.10	2.00	-.05	6.90
KESTREL	48.33	163.91	45.27	3.18	123.89	60.10	.00	1.67	4.81
MORGAN	46.67	164.88	42.27	6.52	121.59	60.80	2.00	1.46	2.75
BLIZZARD	40.00	165.41	47.27	6.33	119.26	61.60	3.00	.22	4.01
BIGHORN	46.67	163.79	37.00	3.67	117.85	60.60	1.00	.94	5.90
QUANTUM 566	23.33	162.38	39.50	4.44	116.44	60.20	.00	-.16	4.30
MANNING	45.00	163.19	39.53	6.00	115.14	58.70	3.00	.27	4.29
MT9514	51.67	164.31	42.13	5.34	114.65	60.80	1.00	1.76	4.09
WINRIDGE	56.67	166.84	48.53	7.20	113.55	61.60	2.00	.25	3.77
BONNEVILLE	41.67	167.15	47.80	6.07	111.71	61.50	3.00	.31	4.07
NEELEY	55.00	165.13	45.03	6.02	110.45	60.50	3.00	2.05	4.35
ROCKY	40.00	162.35	44.63	4.41	109.89	60.70	.00	1.94	4.51
ND9257	50.00	163.21	42.63	3.57	109.77	60.60	.00	2.35	4.71
ND9272	73.33	162.30	40.80	2.21	108.98	60.30	2.00	1.48	5.06
SD89153	55.00	161.83	42.77	3.33	108.73	62.40	1.00	1.33	4.24
ERHARDT	56.67	163.15	41.43	3.80	108.41	61.30	1.00	1.02	4.46
QUANTUM EXP. 1824	40.00	161.55	35.27	.54	108.14	58.50	.00	.53	6.37
NEKOTA	48.33	160.55	37.27	3.92	107.88	61.40	.00	1.73	4.52
HYBRITECH 542	61.67	161.13	43.43	4.70	107.33	60.70	2.00	2.42	3.30
PRONGHORN	45.00	159.03	42.03	4.12	106.68	60.80	.00	2.49	3.78
JUDITH	50.00	162.68	43.30	2.53	105.74	59.10	1.00	1.92	5.58
MT9524	55.00	163.02	45.03	.23	105.49	62.70	2.00	1.41	6.11
NUWEST	55.00	162.61	41.73	6.77	104.50	59.80	2.00	1.98	3.33
CENTURK	43.33	162.27	44.63	4.47	104.34	61.10	.00	1.80	3.48
MT 9432	43.33	163.21	44.10	.91	103.62	62.30	2.00	2.13	4.82
MCGUIRE	40.00	160.21	39.23	3.01	103.38	62.20	.00	.53	5.69
MT 9441	63.33	163.38	41.30	4.60	103.15	59.80	3.00	2.19	4.38
ALLIANCE	58.33	159.86	39.13	5.89	102.12	59.20	.00	2.28	2.65
VANGUARD	40.00	163.37	43.30	3.81	100.06	60.50	.00	1.54	4.67
S86-1533	70.00	161.42	40.17	4.18	99.30	59.50	.00	2.32	3.65
YUMA	43.33	159.91	34.53	3.52	98.43	58.90	1.00	2.61	3.95
REDWIN	43.33	165.38	46.87	1.07	98.17	61.60	3.00	1.93	4.72
VISTA	43.33	159.32	35.93	3.77	97.89	59.20	1.00	2.55	3.51
JULES	46.67	163.72	40.70	6.16	97.71	56.80	.00	2.31	3.08
TIBER	43.33	165.65	47.37	1.72	97.11	61.30	2.00	2.06	3.87
SD89119	46.67	161.55	42.23	6.54	94.92	60.60	1.00	1.86	3.03
MT 91192	70.00	164.50	42.00	4.26	94.60	58.10	2.00	2.35	5.09
RAMPART	20.00	164.73	44.20	5.42	94.35	60.70	2.00	1.10	3.71
NORSTAR	43.33	167.80	52.33	7.32	93.77	62.00	3.00	2.14	2.39
NIOBRARA	48.33	159.79	40.43	3.93	93.63	58.60	.00	2.82	3.95
AKRON	38.33	161.96	40.17	2.98	92.89	60.80	.00	1.72	4.03
HALT	46.67	159.01	35.43	2.08	88.23	57.30	1.00	2.73	3.90
MT 9222	36.67	163.28	39.93	1.91	86.25	60.50	3.00	1.76	4.30
ELKHORN	45.00	166.13	49.63	6.38	86.18	60.30	.00	1.89	3.29
AGASSIZ	78.33	163.25	46.73	8.70	76.52	60.30	3.00	2.16	1.51
BZ9W92-712-a	5.33	163.43	32.53	1.13	75.59	59.10	.00	.70	2.63
NORWIN	56.67	163.67	30.97	1.36	74.47	57.80	1.00	2.27	3.94
ROUGHRIDER	50.00	163.79	49.20	8.23	71.34	60.30	1.00	2.94	1.90
MEAN	47.8	163.0	42.0	4.1	102.3	60.3	1.3	1.7	4.1
C.V.	35.9	0.4	4.7	27.5	9.9	NA	NA	29.7	21.0
LSD (.05)	27.7	1.0	3.2	1.9	17.2	NA	NA	0.8	1.4

1/ DISEASE LEVELS: 1=LOW, 2=MODERATE, 3=HIGH
2/ AGRONOMIC SCALE BASED ON OVERALL APPEARANCE (POOR 0 TO 9 GOOD)

PROJECT TITLE: **Advanced Yield Winter Wheat Evaluation: Lodging and disease resistance**

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, lodging, quality, and disease resistance in northwestern Montana. Special attention to fully document dwarf bunt (TCK), stripe rust, and leaf rust reactions.

RESULTS: Overall yields were good considering that winter survival ranged from 61% (MT9426) to 85% (MT9513), with a mean of 67%. Yields for the 36 entries ranged from 123 (MT9535) to 76 (MTW9617) bu/A with an overall mean of 97. Test weights were fair with 50% of the cultivars below 60 lbs/bu but four topping 62 (MT9523, MT9623, MTS97107, and MT9658). The mean test weight was 59.8. Lodging was significant throughout the nursery. MT9523 and MT9602 illustrated excellent lodging resistance while nine other cultivars showed good straw strength. Winter conditions were ideal for the germination and plant inoculation of TCK. Ten of the entries were very susceptible to TCK with four cultivars (MT9535, MT9610, MTS97104, and MT9557) displaying moderate resistance. Moderate to high levels leaf rust was present and documented. Eleven of the 36 cultivars were highly susceptible with none found to be resistant.

SUMMARY: Yields and test weight were good in relation to the poor growing season and heavy disease pressures present throughout. This crop year was beneficial in gathering good lodging and disease notes and specific cultivar responses to the detrimental conditions.

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 as well as document potential production problems for producers across the state.

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

Planted: September 25, 1996 Harvested: August 20, 1997

VARIETY	W SURV %	HD DATE JULIAN	HEIGHT INCH	LDG 0-9	YIELD BU/A	TWT LB/BU	LF RUST 0-3 1/	TCK 0-3 1/	AGRO 0-9 2/
MT9535	64.45	165.46	39.63	5.06	123.35	59.60	3.00	1.19	4.18
NEELEY	77.67	165.89	44.37	5.39	113.09	61.20	1.00	1.91	3.93
MTS97102	70.80	165.92	39.50	1.98	108.45	58.60	1.00	1.92	5.03
MT9610	73.56	163.93	47.10	4.66	107.69	60.30	1.00	1.32	4.36
MT9523	73.05	162.78	42.53	1.06	105.18	62.20	3.00	2.02	4.96
MT9623	70.89	166.56	47.77	4.56	105.11	62.00	2.00	1.68	3.89
MT 9426	60.89	165.11	39.23	6.73	105.11	60.20	1.00	1.89	3.73
MTW9505	69.37	164.22	43.17	3.75	101.49	61.00	2.00	1.62	4.82
MT9605	62.36	162.22	45.97	1.76	101.22	59.20	3.00	2.51	3.92
MTS97104	74.20	167.44	38.07	1.24	101.07	57.40	3.00	1.08	5.75
KESTREL	71.06	164.28	45.30	3.42	100.49	60.30	2.00	2.83	4.28
MT9557	69.77	163.83	38.07	7.19	100.27	57.90	2.00	1.36	3.86
MTW9635	82.93	163.90	41.60	3.46	100.26	58.90	1.00	2.09	4.03
MTS97105	70.49	166.68	38.87	1.31	100.23	58.10	2.00	1.75	4.33
MT9513	84.74	163.75	38.97	2.33	98.85	60.30	1.00	2.59	4.35
MTS97103	74.94	166.75	40.83	1.22	98.11	57.80	3.00	1.57	4.84
REDWIN	63.91	164.64	45.17	2.00	97.26	61.30	1.00	1.98	3.97
MT9601	79.43	163.87	38.07	6.80	96.97	58.30	1.00	2.67	2.97
MTS97107	78.62	162.53	45.40	4.84	96.86	62.10	1.00	1.57	4.33
JUDITH	75.37	162.60	39.63	3.39	96.02	58.80	2.00	2.62	4.15
MT 9403	71.21	162.94	40.17	2.01	95.52	60.40	2.00	2.35	4.71
MT9526	65.00	166.15	43.30	1.40	94.90	60.70	3.00	2.44	5.54
MT 9431	72.10	163.06	43.17	1.56	94.20	61.90	2.00	2.06	4.39
MTS97101	70.80	166.31	41.20	1.52	93.56	57.40	3.00	1.70	4.20
MT9602	69.94	166.83	38.87	.54	93.26	60.10	3.00	1.59	5.42
MT 9409	71.90	164.92	37.27	4.01	92.95	58.80	3.00	2.46	4.16
MT9620	63.79	165.75	46.20	3.56	92.74	60.10	2.00	2.24	3.97
MTW9636	70.20	166.40	41.07	1.61	91.69	57.70	1.00	2.16	4.27
MT9621	62.79	164.74	44.87	5.46	90.88	61.80	3.00	2.44	3.53
MT9640	70.92	162.40	39.50	4.30	89.52	59.90	2.00	2.78	3.20
MT9506	69.71	164.28	41.47	4.94	89.41	60.80	1.00	2.33	4.12
MTW9633	66.06	161.96	45.70	3.97	87.79	59.70	1.00	3.14	3.71
MT 9402	81.72	163.06	39.80	2.46	87.75	57.40	1.00	2.41	4.31
MT9658	70.09	162.42	35.27	2.73	87.24	62.20	1.00	2.98	4.28
MTW9631	68.30	165.81	42.67	4.38	86.25	58.40	2.00	2.53	4.05
MTW9617	73.62	163.29	40.17	3.38	75.81	58.50	3.00	3.22	3.46
MEAN	67.4	164.5	41.7	5.6	97.2	59.8	1.9	2.1	4.3
C.V.	11.1	0.4	4.0	27.6	7.6	NA	NA	23.1	13.3
LSD (.05)	13.6	1.1	2.7	1.6	12.7	NA	NA	0.9	1.0

1/ DISEASE LEVELS: 1=LOW, 2=MODERATE, 3=HIGH
2/ AGRONOMIC SCORE BASED ON OVERALL APPEARANCE (POOR 0 TO 9 GOOD)

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: This study was terminated on April 29 due to an overall stand survival of 25%.

SUMMARY: 130 continuous days of snow cover led to severe levels of snow mold which became lethal to a bulk of the stand. Recovery of slightly infected plants was slow to non-existent due to extended cold and saturated soil conditions.

FUTURE PLANS: Continued soft white winter wheat evaluations with this 18 variety nursery in an attempt to identify cultivars best adapted for the Pacific Northwest and northwestern Montana's unique conditions specifically.

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

Planted: September, 25, 1996 Harvested: Terminated

VARIETY	WINTER % SURVIVAL
ML 6W93-598	41.67
MACVICAR	36.67
LAMBERT	33.33
ELTAN	31.67
CASHUP	31.67
MALCOLM	28.67
ROD	28.33
KMOR	28.33
STEPHENS	28.33
LEWJAIN	28.33
DAWS	27.00
NEELEY	23.67
HILL 81	21.67
MCDERMID	20.00
BU 6W93-481	18.67
W301	16.67
MADSEN	13.33
GENE	5.67
MEAN	25.8
C.V.	75.4
LSD (.05)	32.2

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 1997 was 95.2 bu/A, which is average for this location but generous in a year which saw only 56% stand survival due to severe snow mold infection . Washington line 007818 had the highest yield at 117 bu/A, with the lowest being the long time check Kharkof at 57 bu/A. Utah lines produced three of the top four yielding cultivars. Overall nursery test weights were slightly below average at 59.7 lbs./bu, with six entries above 62 and five below 58. Severe lodging was documented with only WA007816, Utah 100, 82Cam097, OR889176, and OR908482 displaying mentionable resistance. 82Cam097 is a very late cultivar.

SUMMARY: 130 days of continuous deep snow cover led to conditions ideal for snow mold infection and spread, and for a full blown TCK outbreak. While winterkill and disease pressures were significant, yields were average in this nursery. Test weights were lower due to severe lodging and TCK bunted kernels.

FUTURE PLANS: 1997 concludes the inclusion of this nursery in the cultivar evaluation tests in an attempt to centralize efforts on the remaining nurseries and best serve the research needs of northwestern Montana in relation to variety performances.

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

Planted: September 25, 1996 Harvested: August 21, 1997

VARIETY	W SURV %	HD DATE JULIAN	HEIGHT INCH	LDG 0-9	YIELD BU/A	TWT LB/BU
WA007818	53.33	167.00	48.53	5.00	116.83	59.10
UT201971	66.67	165.33	45.77	7.00	112.43	62.50
UT203032	53.33	164.00	39.10	4.00	112.10	62.00
UT199847	50.00	163.33	42.77	6.33	111.17	62.50
ID000498	63.33	162.33	37.80	7.00	109.83	57.90
WA007815	56.67	166.67	42.10	5.00	108.87	63.00
ID000511	50.00	163.33	39.13	5.67	106.47	62.00
ID000512	53.33	164.00	38.87	6.33	105.97	59.00
WA007816	60.00	166.00	43.33	2.33	103.00	60.80
UT199838	56.67	163.67	43.57	6.67	101.37	62.30
ID000479	60.00	165.33	39.87	5.33	99.93	59.10
95CAM012	48.33	165.67	44.60	4.67	99.33	61.00
UTAH 100	60.00	166.00	38.60	2.33	98.43	56.20
ID000510	53.33	164.00	39.77	4.00	98.27	58.40
ID000509	60.00	163.00	38.07	7.33	97.73	56.40
ID000513	53.33	164.00	35.27	3.33	97.63	58.10
82CAM097	48.33	170.00	40.07	2.00	94.73	58.40
WA007814	56.67	163.33	42.37	5.67	94.67	60.30
ID000497	56.67	163.33	44.23	5.67	94.27	61.60
OR889176	63.33	166.00	32.53	1.00	91.03	57.00
UT944158	61.67	166.67	41.60	7.00	89.97	54.80
ID000501	30.00	162.33	29.13	3.00	88.47	60.60
WA007773	70.00	164.67	45.70	7.33	87.37	61.10
WA007817	70.00	164.33	49.23	7.00	86.73	60.30
ID000514	50.00	164.67	43.57	6.67	85.17	59.60
WANSER	56.67	164.33	45.93	6.00	83.63	60.30
ID000477	63.33	164.33	44.47	6.00	76.47	61.70
WA007819	53.33	163.67	38.57	5.33	74.37	59.20
OR908482	35.00	163.33	32.17	2.00	73.03	58.00
KHARKOF	56.67	165.67	40.53	8.33	57.43	58.60
MEAN	55.7	164.7	40.9	5.2	95.2	59.7
C.V.	19.4	0.3	6.9	21.3	10.7	NA
LSD (.05)	17.7	0.8	4.6	1.8	16.7	NA

YEAR / PROJECT: 1997 / 755

TITLE: **Intrastate Alfalfa Yield Trials - Irrigated & Dryland**

PROJECT LEADERS: R. Ditterline / R. Dunn, MSU-Bozeman

COOPERATORS: L. Welty / L. Strang, MSU-NWARC

Alfalfa varieties were established each spring from 1995 to 1997 at dryland sites and from 1994 to 1997 at irrigated sites. The dryland trials planted in 1995 and 1996 and the 1995 irrigated trial were harvested three times: in mid-June, early August, and after frost (late September to early October). The 1997 trials were harvested early August and after frost. The irrigated 1994 trial was harvested 6/16 and 8/8 and the study terminated. The 1996 irrigated trial exhibited poor vigor due to saturated soil during the early growing season. It was harvested 6/16 and then left to reestablish itself until after frost. Both 1995 nurseries and the 1996 dryland trial were harvested three times: at the bud stage in mid-June, full bloom in early August, and after frost.

Precipitation during the April through August growing season was only 7% above average, but was 91% above average from September to December of 1996 resulting in saturated soil conditions at the irrigated sites. Because of this, yields in the 1995 and 1996 irrigated trials were very poor compared to the dryland trials which are located on lighter soil at a higher elevation.

The 1994 irrigated trial was terminated after the second harvest in 1997 (Table 1a). Mean dry matter production for the 4-year duration was 18.32 tons/acre. The most productive cultivar was 'Pasture Plus' with 19.65 tons/acre, and the lowest was 'Ladak' 65' with 16.28 tons/acre (Table 1b). The 1995 dryland trial showed uniform vigorous spring growth due to abundant moisture on well-drained soil (Table 3a). There were no significant differences among cultivars in total yield for 1997, or over the 3-year life of the nursery (Table 3b). Mean total dry matter yield for 1997 was 6.08 tons/acre, with DK 127 having the highest. The irrigated nursery had areas of soil saturation damage, which reduced yields about 30% compared to the previous season (Table 2b). 'Oneida VR' and 'Key', which have high resistance to *Vert* wilt had the highest yields in 1997 with over 4 tons/acre (Table 2a). The 1996 dryland trial, located in a well-drained site, experienced healthy, vigorous spring growth (Table 5a). Total 1997 production (3 cuttings) averaged 5.21 tons/acre, with no significant differences among cultivars at the 95% confidence level. Because of excessively wet spring soil conditions, the irrigated trial did not fare as well. Yields ranged from 2.02 tons/acre (Ladak 65) to 3.08 tons/acre ('Ultra') (Table 4a). The 1997 dryland trial was seeded May 2. Stand establishment was variable, and portions of some plots were reseeded on June 2. Yields averaged 2.17 tons/acre over two cuttings (Table 6b). The irrigated 1997 trial was seeded May 7. Stand establishment was good, and the two cuttings produced an average of 2.83 tons/acre (Table 6a).

The 'Puna' chicory planted in the borders of both 1996 alfalfa trials grew vigorously again in 1997. It is interesting that the chicory at the heavy soil, irrigated site tolerated the extreme wet soil conditions much better than the alfalfa in the same nursery. Chicory is perennial forage especially suited to dryland conditions because of its deep taproot, but it also exhibited adaptation to soggy soil conditions.

Table 1a. Total dry matter yield of the 1994 Intrastate Alfalfa Yield Trial at Kalispell-irrigated in 1997.

VARIETY	MTNo	FD[1]	VW[2]	Vigor (0-5)	Harvest-1 t/a	Harvest-2 t/a	Total t/a
WL-323	251	4	R	4.0	2.36	2.02	4.38
330	287	4	R	3.8	2.36	1.98	4.34
Hygain	284	4	R	4.5	2.39	1.93	4.32
ZX 9344	279	–	–	4.0	2.38	1.89	4.27
PGI 9047	275	–	–	3.5	2.24	2.03	4.27
5454	263	4	MR	4.5	2.47	1.80	4.27
91-12	283	–	–	4.0	2.27	1.96	4.23
Rushmore	286	4	R	3.5	2.24	1.98	4.22
Pasture Plus	277	–	–	4.3	2.36	1.80	4.16
ABI 9033	280	–	–	3.3	2.33	1.82	4.14
Reward	276	4	R	3.8	2.25	1.86	4.11
MP2000	289	3	R	3.3	2.24	1.87	4.11
ABI 923AA	281	–	–	3.5	2.24	1.87	4.11
Legendairy	288	2	HR	3.8	2.22	1.87	4.09
5262	214	2	LR	3.8	2.25	1.79	4.04
MS9301	293	–	–	3.3	2.23	1.78	4.01
Avalanche	282	2	HR	3.3	2.21	1.79	4.00
Magnum III-Wet	285	3	MR	3.3	2.27	1.70	3.97
Sterling	290	2	R	3.5	2.25	1.72	3.96
Wrangler	146	2	LR	3.5	2.29	1.61	3.90
Vernema	220	4	MR	3.5	2.14	1.70	3.84
MS9304	294	–	–	3.5	2.20	1.63	3.83
Dividend	291	2	R	3.3	2.11	1.72	3.83
ZC 9030	278	–	–	3.3	2.13	1.68	3.81
Aspen	292	4	R	3.3	2.11	1.65	3.76
Perry	133	3	–	3.3	2.16	1.47	3.63
Ladak 65	2	1	–	2.8	2.14	1.48	3.62
mean				3.6	2.25	1.79	4.04
LSD(0.05)				0.7	0.14	0.27	0.34
CV(s/mean)x100				14.0	4.6	10.7	5.9

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

Seeding date: 4/27/94
Stage of maturity at cutting: harv1-mid bud

Table 1b. Total dry matter yield of the 1994 Intrastate Alfalfa Yield Trial at Kalispell-irrigated from 1994 to1997.

VARIETY	MTNo	FD[1]	VW[2]	1994	1995	1996	1997	1994-97 TOTAL
				t/a	t/a	t/a	t/a	t/a
Pasture Plus	277	–	–	3.50	5.88	6.12	4.16	19.65
5454	263	4	MR	3.37	5.71	5.87	4.27	19.21
Hygain	284	4	R	3.35	5.57	5.91	4.32	19.14
ZX 9344	279	–	–	3.63	5.49	5.72	4.27	19.11
330	287	4	R	3.42	5.48	5.77	4.34	19.01
Reward	276	4	R	3.62	5.55	5.71	4.11	18.99
5262	214	2	LR	3.59	5.55	5.81	4.04	18.99
WL-323	251	4	R	3.57	5.18	5.70	4.38	18.82
Legendairy	288	2	HR	3.30	5.65	5.63	4.09	18.67
PGI 9047	275	–	–	3.49	5.40	5.50	4.27	18.66
ABI 9033	280	–	–	3.40	5.44	5.63	4.14	18.61
Rushmore	286	4	R	3.33	5.44	5.50	4.22	18.49
MP2000	289	3	R	3.62	5.33	5.32	4.11	18.37
MS9301	293	–	–	3.47	5.39	5.37	4.01	18.24
ABI 923AA	281	–	–	3.35	5.24	5.52	4.11	18.22
Magnum III-Wet	285	3	MR	3.36	5.29	5.54	3.97	18.15
Avalanche	282	2	HR	3.51	5.14	5.50	4.00	18.14
Vernema	220	4	MR	3.76	5.16	5.35	3.84	18.11
91-12	283	–	–	3.43	5.05	5.39	4.23	18.09
MS9304	294	–	–	3.65	5.38	5.19	3.83	18.05
Dividend	291	2	R	3.45	5.31	5.26	3.83	17.84
Sterling	290	2	R	3.20	5.23	5.38	3.96	17.77
ZC 9030	278	–	–	3.50	5.09	5.23	3.81	17.64
Aspen	292	4	R	3.54	5.07	5.11	3.76	17.48
Wrangler	146	2	LR	3.48	4.74	5.31	3.90	17.42
Perry	133	3	–	3.55	5.03	5.21	3.63	17.42
Ladak 65	2	1	–	3.32	4.41	4.93	3.62	16.28
mean				3.47	5.30	5.50	4.04	18.32
LSD(0.05)				0.32	0.34	0.33	0.34	0.85
CV(s/mean)				6.5	4.5	4.3	5.9	3.3

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

Seeding date: 4/27/94
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant;
16.5 lbs N + 78 lbs/a P_2O_5 on 4/15/96

Table 2a. Total dry matter yield of the 1995 Intrastate Alfalfa Yield Trial at Kalispell-irrigated in 1997.

VARIETY	MTNo	FD[1]	VW[2]	Occupancy	Harvest-1	Harvest-2	Harvest-3	1997 TOTAL
				% of plot	t/a	t/a	t/a	t/a
Oneida VR	309	3	HR	99	1.63	1.63	0.91	4.17
Key	305	4	HR	99	1.48	1.64	0.96	4.07
Accord	298	4	R	99	1.42	1.68	0.96	4.06
WI95-1	310	2	LR	100	1.57	1.65	0.84	4.05
DK 127	302	3	R	99	1.31	1.73	0.97	4.01
Stamina	296	4	HR	99	1.38	1.57	0.89	3.84
ABI 9231	306	4	HR	98	1.31	1.60	0.90	3.81
ZX9345A	301	4	R	98	1.34	1.57	0.89	3.80
FGEXP	313	-	-	98	1.27	1.53	0.93	3.73
ZX9345B	307	4	HR	97	1.27	1.52	0.87	3.66
5454	263	4	MR	98	1.33	1.50	0.81	3.64
Defiant	299	2	HR	96	1.15	1.53	0.84	3.52
5472	221	4	MR	97	1.16	1.48	0.87	3.51
5262	214	2	LR	97	1.16	1.47	0.81	3.44
3L 102	311	-	-	96	1.12	1.43	0.86	3.41
Haygrazer	300	4	R	99	1.27	1.30	0.78	3.36
Aspen	308	4	R	91	1.11	1.37	0.85	3.33
5312	297	3	HR	96	1.17	1.36	0.78	3.30
Proof	303	3	R	96	1.04	1.44	0.80	3.28
Leafmaster	304	4	HR	91	1.17	1.34	0.76	3.27
Viking 1	232	2	HR	97	1.01	1.38	0.85	3.24
3L 103	312	-	-	96	1.08	1.30	0.84	3.21
Vernal	8	2	-	95	1.20	1.29	0.71	3.19
Riley	122	4	LR	94	1.10	1.24	0.77	3.11
Ladak 65	2	1	-	97	1.30	1.12	0.48	2.90
mean				97	1.25	1.47	0.84	3.56
LSD(0.05)				5(P=.06)	NS	0.28	0.12	0.45
CV(s/mean) x100				3.7	23.3	13.4	10.1	5.7

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

Seeding date: 4/25/95
Fertilizer: 22 lbs/a N + 104 lbs/a P_2O_5 on 5/8/97
Stage of maturity at cutting: Harvest 1&3 - early bud

Table 2b. Total dry matter yield of the 1995 Intrastate Alfalfa Yield Trial at Kalispell-irrigated from 1995-1997.

VARIETY	MTNo	FD[1]	VW[2]	1995	1996	1997	1995-97 TOTAL
				t/a	t/a	t/a	t/a
Oneida VR	309	3	HR	2.99	6.13	4.17	13.29
Key	305	4	HR	3.02	6.01	4.07	13.10
Accord	298	4	R	3.01	5.98	4.06	13.05
DK 127	302	3	R	2.94	6.04	4.01	13.00
WI95-1	310	2	LR	2.78	5.95	4.05	12.78
5454	263	4	MR	2.80	6.07	3.64	12.51
FGEXP	313	-	-	2.90	5.88	3.73	12.51
3L 102	311	-	-	3.02	6.07	3.41	12.50
Stamina	296	4	HR	2.97	5.61	3.84	12.42
ZX9345A	301	4	R	2.73	5.60	3.80	12.13
ABI 9231	306	4	HR	2.53	5.75	3.81	12.09
Proof	303	3	R	2.80	5.92	3.28	12.00
5262	214	2	LR	2.57	5.76	3.44	11.77
5472	221	4	MR	2.57	5.67	3.51	11.75
5312	297	3	HR	2.69	5.72	3.30	11.71
ZX9345B	307	4	HR	2.63	5.31	3.66	11.60
Viking 1	232	2	HR	2.82	5.54	3.24	11.60
3L 103	312	-	-	2.76	5.54	3.21	11.50
Defiant	299	2	HR	2.40	5.53	3.52	11.45
Aspen	308	4	R	2.58	5.50	3.33	11.41
Vernal	8	2	-	2.48	5.37	3.19	11.03
Haygrazer	300	4	R	2.55	5.04	3.36	10.95
Leafmaster	304	4	HR	2.43	4.93	3.27	10.62
Riley	122	4	LR	2.38	4.83	3.11	10.32
Ladak 65	2	1	-	2.40	4.97	2.90	10.26
mean				2.71	5.63	3.56	11.89
LSD(0.05)				0.23	0.45	0.45	1.27
CV(s/mean) x100				6.0	5.7	5.7	7.6

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

Seeding date: 4/25/95
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 prelant;
22 lbs/a N + 104 lbs/a P_2O_5 on 5/8/97

Table 3a. Total dry matter yield of the 1995 Intrastate Alfalfa Yield Trial at Kalispell-dryland in 1997.

Variety	MTNo	FD[1]	VW[2]	Occupancy	Harvest-1	Harvest-2	Harvest-3	1997 TOTAL
				% of plot	t/a	t/a	t/a	t/a
DK 127	302	3	R	99	2.77	2.53	1.28	6.58
Key	305	4	HR	98	2.75	2.47	1.31	6.53
WI95-1	310	2	LR	100	2.95	2.36	1.18	6.48
Oneida VR	309	3	HR	99	2.94	2.35	1.19	6.48
5472	221	4	MR	100	2.81	2.41	1.24	6.46
Leafmaster	304	4	HR	90	2.57	2.57	1.22	6.36
Accord	298	4	R	99	2.68	2.41	1.23	6.32
5262	214	2	LR	96	2.85	2.31	1.10	6.25
Aspen	308	4	R	95	2.63	2.36	1.25	6.23
Stamina	296	4	HR	99	2.71	2.31	1.16	6.18
5312	297	3	HR	98	2.70	2.28	1.18	6.16
5454	263	4	MR	100	2.83	2.17	1.11	6.11
Haygrazer	300	4	R	97	2.65	2.25	1.14	6.04
Defiant	299	2	HR	100	2.77	2.21	1.04	6.01
ZX9345A	301	4	R	100	2.59	2.26	1.14	5.98
3L 102	311	-	-	100	2.63	2.22	1.12	5.97
FGEXP	313	-	-	99	2.69	2.15	1.10	5.93
ZX9345B	307	4	HR	99	2.52	2.24	1.11	5.87
Proof	303	3	R	98	2.53	2.24	1.10	5.86
Viking 1	232	2	HR	99	2.61	2.11	1.06	5.78
Vernal	8	2	-	98	2.54	2.20	1.01	5.75
3L 103	312	-	-	100	2.48	2.16	1.12	5.75
ABI 9231	306	4	HR	99	2.59	2.07	1.08	5.74
Riley	122	4	LR	95	2.64	2.06	0.97	5.66
Ladak 65	2	1	-	100	2.67	2.10	0.76	5.53
mean				98	2.68	2.27	1.13	6.08
LSD(0.05)				3	NS	NS	0.22	NS
CV (s/mean)*100				2.2	8.2	13.3	14.1	9.7

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

Fertilizer: 22 lbs/a N + 104 lbs/a P_2O_5 on 4/23/97

Table 3b. Total dry matter yield of the 1995 Intrastate Alfalfa Yield Trial at Kalispell-dryland from 1995-97.

VARIETY	MTNo	FD[1]	VW[2]	1995	1996	1997	1995-97 TOTAL
				t/a	t/a	t/a	t/a
WI95-1	310	2	LR	3.41	5.89	6.48	15.79
Aspen	308	4	R	3.23	5.49	6.23	14.96
Oneida VR	309	3	HR	3.15	5.31	6.48	14.95
5262	214	2	LR	3.20	5.36	6.25	14.81
3L 102	311	-	-	3.49	5.33	5.97	14.79
5472	221	4	MR	2.89	5.06	6.46	14.40
DK 127	302	3	R	3.07	4.74	6.58	14.39
Stamina	296	4	HR	3.12	5.05	6.18	14.36
Defiant	299	2	HR	3.07	5.25	6.01	14.33
FGEXP	313	-	-	3.17	5.16	5.93	14.26
ZX9345A	301	4	R	3.07	5.11	5.98	14.17
Leafmaster	304	4	HR	3.01	4.75	6.36	14.11
Key	305	4	HR	3.07	4.51	6.53	14.11
Accord	298	4	R	3.17	4.55	6.32	14.02
5454	263	4	MR	2.83	5.01	6.11	13.95
Riley	122	4	LR	2.94	5.21	5.66	13.82
Haygrazer	300	4	R	2.93	4.64	6.04	13.61
ABI 9231	306	4	HR	2.98	4.90	5.74	13.61
Proof	303	3	R	3.00	4.46	5.86	13.33
Viking 1	232	2	HR	3.19	4.29	5.78	13.26
ZX9345B	307	4	HR	2.91	4.46	5.87	13.23
5312	297	3	HR	2.87	4.19	6.16	13.22
Ladak 65	2	1	-	2.85	4.66	5.53	13.05
Vernal	8	2	-	2.80	4.29	5.75	12.84
3L 103	312	-	-	3.16	3.84	5.75	12.73
mean				3.06	4.86	6.08	14.00
LSD(0.05)				NS	NS	NS	NS
CV (s/mean)*100				13.2	19.3	9.7	11.9

[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;
22 lbs/a N + 104 lbs/a P_2O_5 on 4/23/97

Table 4a. Total dry matter yield of the 1996 Intrastate Alfalfa Yield Trial at Kalispell-irrigated in 1997.

Variety	MTNo	FD[1]	VW[2]	Stand	6/16/97 Harvest-1	10/2/97 Harvest-2	1997 TOTAL
				%	t/a	t/a	t/a
Ultra	229	3	R	85	1.23	1.85	3.08
MT 9305	328	-	-	81	1.23	1.68	2.91
Rainier	320	3	R	91	1.32	1.56	2.88
Hyland	322	3	R	88	1.06	1.80	2.86
Legendairy 2.0	321	3	R	90	1.24	1.56	2.80
Oasis 371	324	-	-	90	1.27	1.53	2.79
Magnum III	238	4	MR	88	1.19	1.61	2.79
329	317	-	-	86	1.06	1.65	2.70
Bighorn	316	4	R	84	1.11	1.55	2.66
Wrangler	146	2	LR	86	1.15	1.51	2.66
Magnagraze	323	3	R	89	1.09	1.55	2.64
MT 9308	330	-	-	80	1.04	1.57	2.61
5454	263	4	MR	89	1.14	1.43	2.57
WL 325 HQ	319	3	R	83	1.09	1.48	2.56
MT 9503	335	-	-	78	0.99	1.56	2.55
WL 324	318	3	R	85	1.10	1.42	2.51
Excalibur II	248	-	-	85	0.99	1.51	2.50
MT 9310	332	-	-	70	0.98	1.50	2.47
Oneida VR	309	3	HR	75	0.84	1.54	2.38
Affinity+Z	315	4	HR	81	0.91	1.46	2.37
MT 9321	333	-	-	73	0.80	1.58	2.37
Riley	122	4	LR	74	0.95	1.41	2.36
MT 9303	326	-	-	76	0.81	1.52	2.33
XAL 46	314	-	-	70	0.80	1.53	2.33
MT 9316	334	-	-	79	0.84	1.49	2.33
MT 9304	327	-	-	73	0.92	1.41	2.32
MT 9309	331	-	-	74	0.86	1.38	2.24
MT 9306	329	-	-	69	0.71	1.52	2.23
MT 9302	325	-	-	60	0.59	1.60	2.19
Ladak 65	2	1	-	76	0.74	1.28	2.02
mean				80	1.00	1.53	2.53
LSD(0.05)				16	NS	0.14	0.52
CV(s/mean) x100				14.6	34.7	6.5	14.6

[1] *Fall Dormancy rating*

[2] *Vert Wilt resistance*

Seeding date: 5/10/96

Stage of maturity at cutting: Harvest 1 - early bud; Harvest 2 - late bloom

Table 4b. Total dry matter yield of the 1996 Intrastate Alfalfa Yield Trial at Kalispell-irrigated from 1996-97.

VARIETY	MTNo	FD[1]	VW[2]	1996	1997	TOTAL
				t/a	t/a	t/a
Ultra	229	3	R	1.36	3.08	4.43
Hyland	322	3	R	1.28	2.86	4.14
MT 9305	328	-	-	1.15	2.91	4.06
Rainier	320	3	R	1.15	2.88	4.03
Magnum III	238	4	MR	1.19	2.79	3.98
Magnagraze	323	3	R	1.30	2.64	3.94
Oasis 371	324	-	-	1.14	2.79	3.94
5454	263	4	MR	1.35	2.57	3.92
Bighorn	316	4	R	1.25	2.66	3.91
329	317	-	-	1.09	2.70	3.79
MT 9308	330	-	-	1.15	2.61	3.76
WL 325 HQ	319	3	R	1.18	2.56	3.74
Legendairy 2.0	321	3	R	0.91	2.80	3.71
MT 9503	335	-	-	1.03	2.55	3.57
WL 324	318	3	R	1.05	2.51	3.56
Excalibur II	248	-	-	1.02	2.50	3.52
Wrangler	146	2	LR	0.84	2.66	3.50
MT 9310	332	-	-	0.86	2.47	3.33
XAL 46	314	-	-	1.00	2.33	3.33
Affinity+Z	315	4	HR	0.96	2.37	3.33
Riley	122	4	LR	0.96	2.36	3.32
MT 9321	333	-	-	0.93	2.37	3.30
MT 9302	325	-	-	1.07	2.19	3.26
MT 9306	329	-	-	1.00	2.23	3.23
MT 9304	327	-	-	0.86	2.32	3.18
Oneida VR	309	3	HR	0.80	2.38	3.18
MT 9309	331	-	-	0.91	2.24	3.15
MT 9303	326	-	-	0.81	2.33	3.14
MT 9316	334	-	-	0.71	2.33	3.03
Ladak 65	2	1	-	0.74	2.02	2.76
mean				1.03	2.53	3.57
LSD(0.05)				0.25	0.52	0.68
CV(s/mean) x100				17.5	14.6	13.6

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

Seeding date: 5/10/96

Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant

Pesticides: 6-oz/a Pursuit, 2-qt/a Poast + 946 ml Dash on 8/6/96

Table 5a. Total dry matter yield of the 1996 Intrastate Alfalfa Yield Trial at Kalispell-dryland in 1997.

VARIETY	MTNo	FD[1]	VW[2]	Vigor (0-5)	Harvest-1 t/a	Harvest-2 t/a	Harvest-3 t/a	1997 TOTAL t/a
Ultra	229	3	R	4.5	2.60	1.94	1.14	5.69
MT 9304	327	-	-	5.0	2.63	1.86	1.20	5.68
Bighorn	316	4	R	4.8	2.58	1.92	1.16	5.66
Rainier	320	3	R	5.0	2.66	1.82	1.11	5.58
MT 9503	335	-	-	4.8	2.58	1.85	1.11	5.54
Riley	122	4	LR	4.8	2.51	1.77	1.20	5.48
XAL 46	314	-	-	5.0	2.65	1.80	1.03	5.48
WL 324	318	3	R	5.0	2.63	1.74	1.06	5.42
Hyland	322	3	R	5.0	2.48	1.81	1.13	5.41
5454	263	4	MR	5.0	2.46	1.83	1.09	5.38
MT 9305	328	-	-	4.8	2.52	1.76	1.07	5.35
Oneida VR	309	3	HR	5.0	2.58	1.74	1.01	5.33
MT 9309	331	-	-	4.8	2.44	1.83	1.05	5.32
Affinity+Z	315	4	HR	5.0	2.35	1.82	1.11	5.28
WL 325 HQ	319	3	R	5.0	2.49	1.72	1.07	5.28
Magnagraze	323	3	R	4.8	2.34	1.85	1.07	5.25
MT 9321	333	-	-	4.5	2.39	1.85	0.98	5.22
Excalibur II	248	-	-	4.8	2.56	1.69	0.97	5.21
MT 9310	332	-	-	4.3	2.47	1.78	0.94	5.20
MT 9308	330	-	-	4.5	2.51	1.68	0.98	5.17
MT 9302	325	-	-	4.8	2.46	1.65	1.05	5.16
Magnum III	238	4	MR	5.0	2.42	1.67	1.05	5.14
Wrangler	146	2	LR	4.8	2.37	1.79	0.97	5.12
Oasis 371	324	-	-	5.0	2.46	1.64	0.89	4.99
MT 9306	329	-	-	4.5	2.42	1.63	0.92	4.97
Legendairy 2.0	321	3	R	4.8	2.21	1.62	0.94	4.76
MT 9316	334	-	-	5.0	2.58	1.37	0.77	4.71
Ladak 65	2	1	-	4.5	2.41	1.54	0.72	4.67
329	317	-	-	4.3	2.27	1.42	0.78	4.46
MT 9303	326	-	-	4.5	2.15	1.47	0.77	4.39
mean				4.8	2.47	1.73	1.01	5.21
LSD(0.05)				0.5	NS	NS	NS	NS
CV(s/mean) x100				7.1	9.5	16.3	23.8	12.5

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

Stage of maturity at cutting: Harvest 1 - early bud; Harvest 2 - 90% bloom; Harvest 3 - early bud

Table 5b. Total dry matter yield of the 1996 Intrastate Alfalfa Yield Trial at Kalispell-dryland from 1996-97.

VARIETY	MTNo	FD[1]	VW[2]	1996 t/a	1997 t/a	1996-1997 TOTAL t/a
Bighorn	316	4	R	3.04	5.66	8.70
Ultra	229	3	R	2.95	5.69	8.64
MT 9304	327	-	-	2.81	5.68	8.49
WL 324	318	3	R	3.05	5.42	8.48
XAL 46	314	-	-	2.93	5.48	8.40
MT 9503	335	-	-	2.85	5.54	8.39
Rainier	320	3	R	2.80	5.58	8.38
Hyland	322	3	R	2.81	5.41	8.22
5454	263	4	MR	2.84	5.38	8.22
Affinity+Z	315	4	HR	2.93	5.28	8.21
MT 9308	330	-	-	2.94	5.17	8.11
Riley	122	4	LR	2.61	5.48	8.08
MT 9302	325	-	-	2.90	5.16	8.06
MT 9305	328	-	-	2.70	5.35	8.05
MT 9321	333	-	-	2.75	5.22	7.97
Magnagraze	323	3	R	2.72	5.25	7.97
WL 325 HQ	319	3	R	2.66	5.28	7.94
Excalibur II	248	-	-	2.68	5.21	7.89
MT 9309	331	-	-	2.52	5.32	7.84
MT 9306	329	-	-	2.80	4.97	7.76
MT 9310	332	-	-	2.47	5.20	7.67
Oneida VR	309	3	HR	2.30	5.33	7.63
Magnum III	238	4	MR	2.46	5.14	7.60
Wrangler	146	2	LR	2.45	5.12	7.57
Oasis 371	324	-	-	2.41	4.99	7.39
Ladak 65	2	1	-	2.62	4.67	7.28
Legendairy 2.0	321	3	R	2.49	4.76	7.24
MT 9316	334	-	-	2.41	4.71	7.12
329	317	-	-	2.59	4.46	7.05
MT 9303	326	-	-	2.53	4.39	6.93
mean				2.70	5.21	7.91
LSD(0.05)				0.48(P=.08)	NS	NS
CV(s/mean) x100				12.6	12.5	11.42

[1] *Fall Dormancy rating*

[2] *Vert Wilt resistance*

Seeding date: 4/26/96

Fertilizer: 25 lbs/a N + 120 lbs/a P_2O_5 preplant; Pesticides: 6-oz/a Pursuit on 8/6/96

Table 6a. Total dry matter yield of the 1997 Intrastate Alfalfa Yield Trial at Kalispell-irrigated.

VARIETY	MTNo	FD[1]	VW[2]	Stand	8/1/97 Harvest-1	10/6/97 Harvest-2	1997 TOTAL
				%	t/a	t/a	t/a
5301	340	–	–	88	1.87	1.38	3.26
DK 140	342	4	R	96	1.92	1.21	3.13
DK 142	343	4	R	100	1.95	1.08	3.03
3L 102	336	–	–	92	1.81	1.19	3.00
Rhino	339	3	R	97	1.88	1.09	2.97
DK 143	344	3	R	89	1.83	1.10	2.93
5396	345	–	–	88	1.75	1.18	2.93
Cimmaron 3I	338	4	LR	91	1.71	1.21	2.91
Ace	337	4	R	96	1.78	1.13	2.91
645	341	3	R	93	1.74	1.04	2.78
Oneida VR	309	3	HR	92	1.62	1.13	2.75
Wrangler	146	2	LR	91	1.62	0.94	2.56
Ladak 65	2	–	–	95	1.62	0.82	2.44
Riley	122	4	LR	46	1.11	0.93	2.05
mean				89	1.73	1.10	2.83
LSD(0.05)				6	0.18	0.12	0.27
CV(s/mean) x100				5.0	7.2	7.3	6.6

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

Seeded 5/9/97
Seeding rate: 8 lbs/a

Fertilizer: Fall, 1996 - 44 lbs/a N + 208 lbs/a P_2O_5
Pesticide: 6/3/97 - Pursuit, 6 oz/a
Stage of maturity at cutting: Harvest 1 - 1st bloom; Harvest 2 - early bud

Table 6b. Total dry matter yield of the 1997 Intrastate Alfalfa Yield Trial at Kalispell-dryland.

VARIETY	MTNo	FD[1]	VW[2]	Stand	Harvest-1	Harvest-2	TOTAL
				%	t/a	t/a	t/a
DK 142	343	4	R	94	1.63	0.77	2.40
DK 140	342	4	R	90	1.69	0.71	2.39
Rhino	339	3	R	90	1.59	0.79	2.38
645	341	3	R	91	1.56	0.73	2.28
3I 102	336	–	–	91	1.52	0.74	2.27
Cimmaron 3i	338	4	LR	88	1.48	0.78	2.26
DK 143	344	3	R	89	1.53	0.71	2.24
Oneida VR	309	3	HR	91	1.44	0.76	2.19
5301	340	–	–	85	1.50	0.64	2.14
5396	345	–	–	85	1.52	0.62	2.13
Wrangler	146	2	LR	95	1.41	0.65	2.06
Ladak 65	2	–		90	1.47	0.57	2.03
Ace	337	4	R	88	1.37	0.64	2.02
Riley	122	4	LR	41	0.95	0.58	1.52
mean				86	1.47	0.69	2.17
LSD(0.05)				10	0.19	0.13	0.23
CV(s/mean) x100				7.7	9.1	13.3	7.4

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

Seeded 5/2/97
Seeding rate: 8 lbs/a

Fertilizer: Fall, 1996 - 44 lbs/a N + 208 lbs/a P_2O_5
Stage of maturity at cutting: Harvest 1 - late bloom; Harvest 2 - early bud

YEAR / PROJECT: 1997 / 755

TITLE: **1997 Montana Uniform Spring Cereal Forage Trial - Dryland**

PROJECT LEADER: D. Wichman, MSU-CARC

COOPERATORS: L. Welty / L. Strang, MSU-NWARC

Two cultivars of triticale, 6 barley, 3 oat cultivars, and an oat/barley combination were compared for forage dry matter yield (Table 1). Entries were seeded May 7, 1997, in a randomized complete block design with 4 replicates.

All entries had vigorous stands. 'MT910207' barley was the first to head (June 29), while 'Charisma' oat was the latest (July 16). 'Otana' oat was tallest (54 inches), and Charisma oat was shortest (40 inches). All plots were harvested July 18, when the plants were between anthesis and soft dough stage. The oats were less mature than the barleys and triticale. The highest yielding cultivars, with over 5 tons/acre, were 'Haybet', 'Westford', and 'Washford' barleys. The experimental barleys and triticales were least productive.

Table 1. Agronomic data for the Cereal Forage Trial at Kalispell in 1997.

Entry	Vigor (0-5)[1]	Heading day[2]	Height inches	Maturity at harvest	Yield t/a
Haybet Barley	4.3	58	48	8	5.35
Westford Barley	5.0	62	49	6	5.28
Washford Barley	5.0	62	46	6	5.02
Otana Oats	4.3	62	54	6	4.98
Celesia Oats	4.0	63	51	6	4.93
BZ 593-164 Barley	5.0	62	51	7	4.89
Oat/Barley	4.5	61	48	7	4.84
MT 910207 Barley	4.5	53	46	9	4.66
Pronghorn Triticale	4.5	58	51	7	4.62
Sunland Triticale	4.0	60	46	7	4.59
Charisma Oats	4.0	70	40	5	4.47
FR 588-241 Barley	5.0	61	41	7	4.47
mean	4.5	61	48	7	4.84
LSD(0.05)	0.5	1	2	1	0.58
CV(s/mean)	7.4	1.2	2.5	9.5	8.2

1/ low-high vigor
2/ days after planting
3/ 5=early inflorescence; 6=inflorescence; 7=anthesis; 8=milk; 9=soft dough

Seeding Rates: Barley/Oat - 33 lbs/a
Pronghorn - 60 lbs/a
Sunland - 40 lbs/a
Oat/Barley - 50 lbs/a

YEAR / PROJECT: 1997 / 755

TITLE: **Perennial Forage Grass Trial - Irrigated**

PROJECT LEADER: D. Cash, MSU-Bozeman

COOPERATORS: L. Welty / L. Strang, MSU-NWARC

A trial comparing 6 meadow bromegrass cultivars was seeded on May 10, 1996. Cultivars included 'Regar', 'Fleet', 'Paddock', and 3 experimental lines. In 1997 all cultivars exhibited excellent vigor and stand persistence. Four cuttings were made between June and October. Total yields from the four harvests averaged 6.62 tons/acre and were similar for all cultivars (Table 1).

Table1. Total dry matter yields (tons/acre) of meadow bromegrass cultivars at Kalispell in 1997.

CULTIVAR	Harvest-1	Harvest-2	Harvest-3	Harvest-4	1997 TOTAL
Mb-1	2.44	1.64	1.36	1.08	6.51
Mb-2	2.50	1.72	1.38	1.14	6.74
Mb-3	2.47	1.66	1.39	1.14	6.66
Regar	2.49	1.75	1.41	1.08	6.73
Fleet	2.45	1.67	1.31	0.99	6.42
Paddock	2.52	1.70	1.40	1.07	6.69
Mean	2.48	1.69	1.37	1.08	6.62
LSD(0.05)	NS	NS	NS	NS	NS
CV(s/mean)	8.6	5.0	7.7	6.8	4.5

YEAR / PROJECT: 1997 / 755

TITLE: **Chicory/Orchardgrass Harvest Timing Trial – Irrigated**

PROJECT LEADER: L. Welty, MSU-NWARC
L. Strang, MSU-NWARC

'Puna' chicory and 'Potomac' orchardgrass were seeded alone and in mixtures in a randomized complete block design with 4 replicates. The experiment was designed as a 3 x 3 factorial with 3 species treatments (chicory, orchardgrass, and mixture) and 3 harvest-timing treatments (two, three, and four cuttings). Seeding date was May 7, 1997. Plots containing an alfalfa/chicory mixture bordered each replicate. Seeding rate was 4 lbs/a for the chicory, 6 lbs/acre for the grass and 3-lbs/acre chicory with 4-lbs/acre orchard grass for the mixture. The harvest timing treatments will begin in 1998. For the establishment year, the nursery was cut twice, on August 1 and October 6. At the first harvest chicory yields averaged 2.24 tons/acre, orchard grass 0.79 tons/acre, and the mixture 2.37 tons/acre. At the fall cutting chicory averaged 1.56 tons/acre, orchard grass 2.20 tons/acre, and the mixture 1.89 tons/acre (Table 1). Chicory was dominant over the grass the first part of the season, but orchard grass dominated the late season regrowth. This preliminary data indicates that chicory mixed with orchard grass can provide a steady supply of forage throughout the growing season. The effects of different cutting intervals will be tested beginning in 1998.

Table 1. Total dry matter yields (tons/acre) of chicory, orchard grass, chicory/orchard grass mixture, and chicory/alfalfa mixture at Kalispell in 1997.

Species	**Harvest-1** *8/1/97*	**Harvest-2** *10/6/97*	**Total Yield**
Chicory	2.24	1.56	3.80
Orchard grass	0.79	2.20	2.98
Chic+Orch	2.37	1.89	4.26
Chic+Alfalfa	3.18	1.51	4.68
mean	2.14	1.79	3.93
LSD(0.05)	0.12	0.31	0.33
CV(s/mean)	3.5	11.0	5.3

Seeding date: 5/7/97
Fertilizer: 5/24/97 - 60 lbs N/A
Pesticide: 6/3/97 - Pursuit, 6 oz/a

YEAR / PROJECT: 1997 / 758

TITLE: **1997 Western Regional Dry Pea and Lentil Yield Trials - Dryland**

PROJECT LEADER: Dr. Fred Muehlbauer, WSU, Pullman, WA

COOPERATORS: L eon E. Welty , Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT
Steve Druffel, Spokane Seed, Spokane, WA

Sixteen dry pea and twelve lentil varieties were seeded on May 7, 1997. Excellent stands were obtained. Precipitation from April through August was 10.65 inches, 7% above average. Except for a cooler than average April, temperatures during this period were nearly normal. Wet winter and spring weather delayed planting by three weeks compared to the norm. Slightly higher than average moisture conditions from April through June promoted good establishment and vegetative growth. These conditions retarded pod and seed development in the lentils, thereby reducing yields 35% compared to 1996. The older, lower yielding pea cultivars also had lower yields than in 1996, but some of the newer entries in the trial produced over 3000 lbs/acre (Table 1). No disease problems were encountered.

The highest yielding pea cultivar was 'CLM Carrera' (submitted by Spokane Seeds), an early maturing semi-leaf yellow pea which produced 3963 lbs/acre (Table 1). 'Eston' was the highest yielding lentil variety with 1888 lbs/acre (Table 2). *Sclerotinia* mold symptoms were not observed this year.

There has been increased interest in dwarf and semi-dwarf and "semi-leafless" (afila type) varieties. Because they are resistant to lodging, varieties of these growth types are less susceptible to foliar diseases such as *Sclerotinia* and dry more rapidly at maturity. In this trial, the yellow- seeded 'CLM Carrera', 'Capella', 'Fallon', and 'CDN Carnival' and the green-seeded 'Radley', 'Solara', and 'PS210370' have these growth form characteristics.

Table 1. Agronomic data for the Dry Pea Yield Trial at Kalispell in 1997.

Variety	Stand	First Flower	Nodes to 1st Flower	Maturity	Height	Seed Size	Yield
	%	day [1]	#	day [1]	Inches	#/lb	lbs/a
CLM Carrera	93	50	13	92	30	1910	3963
Rex	98	52	14	94	40	1992	3387
Fallon	96	53	14	93	34	1872	3361
Solara	97	54	13	94	25	1823	3344
CDN Express	90	55	13	98	39	2148	3091
CDN Carnival	95	57	16	93	36	2539	3065
PS210370	97	46	9	91	28	2068	2922
Radley	98	56	15	94	30	2828	2679
CDN Grande	96	56	14	97	43	2415	2543
Capella	97	56	15	94	37	2280	2426
Joel	98	47	12	92	52	2250	1875
Shawnee	97	45	11	91	58	2270	1792
Columbian	97	40	8	93	44	2473	1694
Umatilla	97	49	13	92	56	2135	1693
Alaska 81	99	41	8	91	62	2871	1463
Latah	99	44	10	93	59	2825	1453
mean	96	50	12	93	42	2294	2547
LSD(0.05)	3	1	1	2	8	275	454
CV(s/mean)	1.9	1.3	5.5	1.4	14.2	8.4	12.5

[1] *days after seeding*

Seeding date: 5/7/97

Harvest area: 40 ft²

Fertilizer: 22 lbs N/a & 104 lbs P_2O_5 on 5/8/97.

Table 2 . Agronomic data for the Lentil Yield Trial at Kalispell in 1997.

VARIETY	STAND	FIRST FLOWER	MATURITY	HEIGHT	SEED SIZE	YIELD
	%	*day[1]*	*day[1]*	*inches*	*#/lb*	*lbs/acre*
Eston	98	57	103	24	15670	1888
Crimson	97	59	99	22	16480	1568
Brewer	97	49	99	26	8335	1563
Mason	97	52	98	24	7229	1415
LC460266	97	50	99	23	8283	1402
Palouse	96	51	98	24	7024	1394
Pardina	98	51	99	25	13520	1297
LC460212	95	56	101	23	7641	1295
Redchief	93	49	98	25	9250	1286
LC460202	89	54	99	22	7723	1183
LC460199	97	54	99	23	8174	1169
Richlea	98	58	103	24	9489	1159
mean	96	53	99	23	9902	1385
LSD(0.05)	NS	1	1	2	718	218
CV(s/mean)	5.0	1.3	1	6.1	5.0	11.0

[1] days after seeding

Seeding date: 5/7/97 Fertilizer: 22 lbs N/a & 104 lbs P_2O_5 on 5/8/97

Harvest area = 40 sqft

YEAR / PROJECT: 1997 / 758

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

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT
Bill Grey, Asst. Research Professor, MSU, Bozeman, MT

No differences in winter survival among peppermint cultivars were observed in 1997 (Table 1a). As in 1996, spearmint cultivars were hurt by the winter more than peppermint cultivars. Native was superior to Scotch in stand survival and stolon spread (Table 3a). Unlike 1996, no differences between meristem and non-meristem propagated spearmint were found (Table 3a & b). Disease (mainly rust) and insect predations were minor in 1997.

Black Mitcham stem-cut propagated (Plant Tech material) produced the highest peppermint oil yields, while T-84-5 had the lowest (Table 1b). Differences among peppermint hay yields were not significant. When oil yields are compared over the duration of the experiment (excluding the establishment year) Black Mitcham - stem-cut (Plant Tech) had significantly higher average yield than the other entries in the trial, including the Blacks from the other sources. The meristem-propagated material had significantly lower average yield than the other Blacks. In 1997, meristem Black Mitcham was producing as well as or better than all entries other than stem-cut Plant Tech-94 (Table 2a.). Although oil yield differences persisted, dry matter production was similar for all cultivars the last two years (Table 2b.).

Native spearmint was much more vigorous than Scotch, especially during the first growth cycle in 1997 (Table 3a). There were no consistent differences between propagation types as in previous years. Native yielded 33% more dry matter and 19% less oil than Scotch in 1997 (Table 3b). This is in contrast to last year's observation that greater vigor is needed to maximize oil yields in a double cut spearmint situation. When total season oil yields are compared over the duration of the trial, Scotch produced more oil than Native, and the meristem lines produced more than the stem-cut lines for both species (Table 4a). Native produced more dry matter than Scotch, but differences between meristem and non-meristem derived lines were not significant (Table 4b).

The Black Mitcham peppermint oil differed from the other peppermint cultivars in several quality components. The Blacks had higher levels of menthofuran and pulegone and lower levels of menthone than the other varieties (Tables 5a & b). Meristem Black Mitcham had higher menthol and lower menthofuran than the stem-cut and *in vitro* nodal propagated lines. The two spearmint cultivars produced oils with different chemical compositions (Table 6a & b). Native had higher levels of cineole and dihydrocarvone and lower levels of limonene, octanol, and carvone than Scotch. Stem-cut Native had consistently higher carvone levels than meristem Native suggesting an interaction between cultivar and propagation source for this product.

Table 1a. Spring stand evaluation (5/15/97) of peppermint cultivars in 1997.

	ROW COVER (0-5)[1]	VIGOR (0-5)[2]	STOLON SPREAD (0-5)[3]
Black Mitcham-stem cut	3.8	4.9	3.3
Black Mitcham- *in vitro* nodal	3.9	4.4	3.6
Black Mitcham-meristem	3.8	4.1	3.9
Murray Mitcham-stem cut	3.8	4.4	3.4
Roberts Mitcham-stem cut	3.8	4.3	3.8
M-83-7 - stem cut	3.8	4.4	3.9
T-84-5 - stem cut	3.6	4.4	3.1
Mean	3.8	4.4	3.6
LSD(0.10)	NS	0.4	0.5
CV(s/mean)x100	12.5	9.9	16.0

[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*

Table 1b. Hay and oil yield of peppermint cultivars harvested in 1997.

	HAY YIELD t/a	OIL YIELD lbs/a
Black Mitcham-stem cut	4.90	80.1
Black Mitcham- *in vitro* nodal	5.31	74.7
Black Mitcham-meristem	4.41	73.8
Murray Mitcham-stem cut	5.21	70.1
Roberts Mitcham-stem cut	4.98	71.2
M-83-7 - stem cut	5.15	74.6
T-84-5 - stem cut	5.06	66.5
Mean	5.00	73.0
LSD(0.10)	NS	6.7

Table 2a. Oil yield of peppermint cultivars evaluated at Kalispell, MT from 1995 to 1997 (lbs/acre).

	1995	1996	1997	MEAN
Black Mitcham - stem cut	54.0	97.3	80.1	77.1
Black Mitcham - *in vitro* nodal	45.0	91.5	74.7	70.4
Black Mitcham - meristem	35.5	85.2	73.8	64.8
Murray Mitcham - stem cut	43.2	86.7	70.1	66.7
Roberts Mitcham - stem cut	47.4	95.0	71.2	71.2
M-83-7 - stem cut	48.5	86.3	74.6	69.8
T-84-5 - stem cut	44.2	84.6	66.5	65.1
mean	45.4	89.5	73.0	69.3
LSD(0.10)	4.4	9.2 (P=0.14)	6.7	4.8

Table 2b. Hay yield of peppermint cultivars evaluated at Kalispell, MT from 1995 to 1997 (tons/acre).

	1995	1996	1997	Mean
Black Mitcham - stem cut	4.44	4.59	4.90	4.64
Black Mitcham - *in vitro* nodal	4.58	4.62	5.31	4.84
Black Mitcham - meristem	4.63	4.63	5.41	4.89
Murray Mitcham - stem cut	4.90	4.27	5.21	4.79
Roberts Mitcham - stem cut	4.99	4.44	4.98	4.80
M-83-7 - stem cut	5.02	4.50	5.15	4.89
T-84-5 - stem cut	4.77	4.43	5.06	4.75
mean	4.76	4.50	5.15	4.80
LSD(0.10)	0.37	NS	NS	NS

Table 3a. Spring stand evaluation (5/15/97) of spearmint cultivars in 1997.

	ROW COVER (0-5)[1]	STOLON SPREAD (0-5)[2]
Native-stem cut	3.5	4.4
Native-meristem	4.0	4.8
Scotch-stem cut	1.8	3.1
Scotch-meristem	1.6	3.1
mean	2.7	3.8
LSD(0.10)	0.4	0.5
CV(s/mean)x100	15.4	15.7

Table 3b. Hay and oil yield of spearmint cultivars in 1997.

	1st Cutting 7/7/97		2nd Cutting 9/ 9/97			
	Hay Yield	Oil Yield	Hay Yield	Oil Yield	Total Hay	Total Oil
	t/a	*lbs/a*	*t/a*	*lbs/a*	*t/a*	*lbs/a*
Native-stem cut	5.04	59.4	3.51	49.9	8.55	109.3
Native-meristem	5.02	56.1	3.64	45.5	8.66	101.6
Scotch-stem cut	3.43	73.2	3.01	54.3	6.44	127.5
Scotch-meristem	3.34	76.1	3.16	57.7	6.50	133.8
mean	4.21	66.2	3.33	51.9	7.53	118.1
LSD(0.10)	0.28	9.8	0.24	6.8	0.35	12.5
CV(s/mean)x100	7.6	17.2	8.4	15.3	5.4	12.3

Table 4a. Oil yield of spearmint cultivars evaluated at Kalispell, MT from 1995 to 1997 (lbs/acre).

First Harvest

Species	Propagation	1995	1996	1997	mean
Native	stem-cut	35.0	38.2	59.4	44.2
Native	meristem	38.9	61.1	56.1	52.0
Scotch	stem-cut	56.5	56.8	73.2	62.2
Scotch	meristem	67.5	74.8	76.1	72.8
Mean		49.5	57.7	66.2	57.8
LSD(0.10)		7.7	10.0	9.8	5.1

Second Harvest

Species	Propagation	1995	1996	1997	mean
Native	stem-cut	30.0	32.9	49.9	37.6
Native	meristem	33.8	35.0	45.5	38.1
Scotch	stem-cut	40.6	45.3	54.3	46.7
Scotch	meristem	47.0	45.4	57.7	50.0
Mean		34.8	37.7	49.9	40.8
LSD(0.10)		4.6	5.8	6.8	3.0

TOTAL YIELD

Species	Propagation	1995	1996	1997	mean
Native	stem-cut	65.0	73.4	109.3	82.6
Native	meristem	72.7	96.1	101.6	90.1
Scotch	stem-cut	97.1	106.4	127.5	110.3
Scotch	meristem	114.5	120.2	133.8	122.8
Mean		78.3	92.0	112.8	94.3
LSD(0.10)		8.5	12.3	12.5	6.5

Table 4b. Hay yield of spearmint cultivars evaluated at Kalispell, MT from 1995 to 1997 (tons dry matter/acre).

First Harvest

Species	Propagation	1995	1996	1997	mean
Native	Stem-cut	3.11	3.09	5.04	3.74
Native	Meristem	3.62	3.42	5.02	4.02
Scotch	Stem-cut	2.85	2.99	3.43	3.09
Scotch	Meristem	3.22	3.07	3.34	3.21
mean		3.20	3.14	4.21	3.51
LSD(0.10)		0.31	0.48	0.28	0.26

Second Harvest

Species	Propagation	1995	1996	1997	mean
Native	Stem-cut	2.79	3.16	3.76	3.24
Native	Meristem	3.24	3.21	3.37	3.27
Scotch	Stem-cut	2.59	2.93	3.21	2.91
Scotch	Meristem	2.69	2.94	2.97	2.86
mean		2.83	3.06	3.33	3.07
LSD(0.10)		0.22	0.20	0.45	0.17

TOTAL YIELD

Species	Propagation	1995	1996	1997	mean
Native	Stem-cut	5.76	6.24	8.81	6.93
Native	Meristem	6.78	6.62	8.39	7.26
Scotch	Stem-cut	5.14	5.91	6.64	5.90
Scotch	Meristem	5.56	6.00	6.30	5.95
mean		5.81	6.19	7.53	6.51
LSD(0.10)		0.40	NS	0.59	0.35

Table 5a. Quality components of peppermint cultivars at the R-3 site in 1997 (GC%).

	Growth Stage	Total Heads	Total Ketones	Total Alcohol	Menthofuran	Menthone	Menthol	Esters	Pulegone
Black Mitcham-stem cut	midbloom	10.3	19.0	49.4	9.9	16.9	38.9	4.8	2.0
Black Mitcham-*in vitro* nodal	midbloom	10.6	22.1	48.2	8.9	19.9	37.8	4.7	1.9
Black Mitcham-meristem	midbloom	10.0	22.3	49.7	7.6	20.1	39.4	4.5	1.6
Murray Mitcham-stem cut	midbloom	11.3	25.2	48.6	4.8	22.8	38.1	4.8	1.0
Roberts Mitcham-stem cut	midbloom	10.7	26.8	47.4	5.0	24.1	37.2	4.6	1.1
M-83-7 - stem cut	midbloom	10.9	25.7	48.0	5.6	23.1	37.7	4.6	1.3
T-84-5 - stem cut	midbloom	10.6	26.7	47.5	6.0	24.1	36.9	4.9	1.4
Mean		10.6	24.0	48.4	6.8	21.6	38.0	4.7	1.5
LSD(0.10)		0.4	3.8	NS	0.6	3.6	NS	NS	0.2
CV(s/mean)x100		2.8	12.8	4.8	7.6	13.5	4.9	7.7	9.3

Table 5b. Quality components of peppermint cultivars at the R-8 site in 1997.

	Growth Stage	Total Heads	Total Ketones	Total Alcohol	Menthofuran	Menthone	Menthol	Esters	Pulegone
Black Mitcham-stem cut	bud	11.5	22.6	49.7	4.3	20.4	39.1	4.7	0.9
Black Mitcham-*in vitro* nodal	bud	10.7	26.4	48.7	4.2	24.0	38.4	4.5	0.9
Black Mitcham-meristem	bud	11.0	23.1	51.4	3.6	21.0	40.8	4.6	0.7
Murray Mitcham-stem cut	bud	11.6	27.4	49.4	1.9	24.7	38.9	4.7	0.4
Roberts Mitcham-stem cut	bud	11.3	28.1	48.9	2.2	25.5	38.4	4.7	0.4
M-83-7 - stem cut	bud	11.1	26.9	49.8	2.2	24.3	39.0	4.9	0.4
T-84-5 - stem cut	bud	11.3	31.2	46.5	2.4	28.6	36.0	4.7	0.4
mean		11.2	26.5	49.2	3.0	24.1	38.7	4.7	0.6
LSD(0.10)		0.4	2.3	2.2	0.3	2.2	1.8	NS	0.1
CV(s/mean)x100		3.1	7.2	3.6	8.3	7.5	3.9	5.8	16.9

Table 6a. Quality components of speamint cultivars at the R-3 site in 1997 (GC%).

1st Cutting 7/7/97	Stage	a:Pinene	b:Pinene	Limonene	Cineole	Octanol	Dihydro carvone	Carvone
Native-stem	mid bloom	0.9	1.3	8.4	1.6	1.0	2.0	60.1
Native-meristem	mid bloom	0.9	1.3	9.3	1.6	1.0	2.5	58.8
Scotch-stem	mid bloom	0.7	1.1	14.1	1.1	2.3	0.9	69.4
Scotch-meristem	early bloom	0.8	1.2	13.9	1.0	2.2	1.2	70.1
mean		0.8	1.2	11.4	1.3	1.6	1.6	64.6
LSD(0.10)		0.0	0.0	0.5	0.2	0.1	0.4	1.2
CV(s/mean)x100		3.4	3.1	3.4	13.2	5.3	17.1	1.4

2nd Cutting 9/9/97	Growth Stage	a:Pinene	b:Pinene	Limonene	Cineole	Octanol	Dihydro carvone	Carvone
Native-stem	mid bloom	1.3	1.7	9.6	2.0	0.9	3.0	60.6
Native-meristem	early bloom	1.4	1.9	10.5	2.4	0.9	4.2	57.8
Scotch-stem	mid bloom	1.1	1.6	18.0	1.4	2.5	1.0	65.8
Scotch-meristem	mid bloom	1.3	1.9	19.9	1.3	2.4	1.5	63.0
mean		1.3	1.8	14.5	1.8	1.7	2.4	61.8
LSD(0.10)		0.2	NS	1.6	0.1	0.2	0.3	2.7
CV(s/mean)x100		9.9	9.1	8.3	5.4	6.9	10.6	3.4

Table 6b. Quality components of speamint cultivars at the R-8 site in 1997 (GC%).

1st Cutting 7/7/97	Growth Stage	a:Pinene	b:Pinene	Limonene	Cineole	Octanol	Dihydro carvone	Carvone
Native-stem	mid bloom	0.9	1.1	8.5	1.4	1.0	1.8	60.5
Native-meristem	mid bloom	0.9	1.3	9.1	1.5	1.0	2.9	58.6
Scotch-stem	mid bloom	0.7	1.0	14.2	1.2	2.5	0.7	70.3
Scotch-meristem	early bloom	0.7	1.0	13.6	1.0	2.2	0.8	71.5
mean		0.8	1.1	11.3	1.3	1.7	1.6	65.2
LSD(0.10)		0.1	NS	0.8	0.2	0.1	0.2	2.0
CV(s/mean)x100		11.3	16.1	5.2	8.7	3.0	9.9	2.2

2nd Cutting 9/9/97	Growth Stage	a:Pinene	b:Pinene	Limonene	Cineole	Octanol	Dihydro Carvone	Carvone
Native-stem	mid bloom	1.1	1.5	9.0	2.0	1.0	2.4	62.9
Native-meristem	early bloom	1.3	1.7	10.1	2.2	0.9	3.6	58.2
Scotch-stem	early bloom	1.0	1.5	16.7	1.5	2.3	1.0	66.6
Scotch-meristem	mid bloom	1.1	1.5	16.8	1.2	2.1	1.4	66.3
mean		1.1	1.5	13.1	1.7	1.6	2.1	63.5
LSD(0.10)		0.1	0.1	0.8	0.2	0.1	0.2	1.5
CV(s/mean)x100		6.1	6.1	4.6	10.2	5.7	8.8	1.9

YEAR/PROJECT: 1997 / 758

TITLE: **Black Mitcham Peppermint Propagation Trial, 1995-1997**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT

The four propagation lines from Lake and Summit had good winter survival. The three *in vitro* culture lines were slightly more vigorous than the stem-cut line (Table 1), but differences were not as obvious as in 1996.

No significant differences among the four lines for either hay or oil yield were found in 1997 (Table 2a & b). Unlike the previous year, the stem cut material produced as much oil as the *in vitro* material.

When yields were averaged over the two years after establishment, the stem-cut line averaged less oil than the *in vitro* lines, but not by a significant amount (Table 2a). There were significant differences, however, in average hay production (Table 2b). The stem cut line produced less vegetation than the nodal culture lines, showing less vigorous vegetative growth.

There were no significant oil quality differences among propagation types in 1997 (Table 3).

Table 1. Spring stand observations on Black Mitcham propagation lines at Kalispell in 1997.

Propagation Source	Row Cover (0-5)[1]	Stolon Spread (0-5)[2]
in vitro nodal-1994-plug	4.0	4.8
in vitro nodal-1992-plug	4.4	4.7
in vitro nodal-1994-bare root	4.0	5.0
stem cut - bare root	3.3	4.3
Mean	3.4	4.2
LSD(0.10)	0.6	0.5

[1] *0=no cover; 5=entire plot area covered*

[2] *0=no spread from crowns; 5=extensive spreading*

Table 2a. Oil yield of Black Mitcham propagation lines evaluated at Kalispell, MT from 1996 to 1997 (lbs/acre).

Propagation Source	Oil Yield 1996	Oil Yield 1997	Average
in vitro nodal-1994-plug	99.0	89.8	94.4
in vitro nodal-1992-plug	103.2	86.4	94.8
in vitro nodal-1994-bare root	117.1	82.4	99.7
stem cut - bare root	93.5	89.6	91.6
mean	94.3	83.5	88.9
LSD(0.10)	14.3	NS	8.2

Table 2b. Hay yield of Black Mitcham propagation lines evaluated at Kalispell, MT from 1996 to 1997 (tons dry matter/acre).

Propagation Source	Yield 1996	Yield 1997	Average
in vitro nodal-1994-plug	3.96	4.37	4.16
in vitro nodal-1992-plug	4.42	4.38	4.40
in vitro nodal-1994-bare root	4.70	4.33	4.51
stem cut - bare root	3.25	4.20	3.72
mean	3.62	4.19	3.90
LSD(0.10)	0.50	NS	0.41

Table 3. Quality components of Black Mitcham propagation lines in 1997 (GC%).

PROPAGATION SOURCE	Stage	Total Heads	Total Ketones	Total Alcohol	Menthofuran	Menthone	Menthol	Esters	Pulegone
		%	%	%	%	%	%	%	%
Lake-plug-1994 *	veg.	9.9	31.0	45.5	1.0	28.0	36.2	3.7	0.1
Lake-plug-1992 *	veg.	9.3	32.9	44.9	1.0	29.8	35.4	3.8	0.1
Lake-bare root-1994 *	veg.	9.2	33.7	44.5	1.0	30.5	34.9	3.7	0.2
Summit-bare root **	veg.	9.5	31.3	45.3	1.9	28.5	35.7	3.9	0.3
mean		9.5	32.2	45.1	1.2	29.2	35.6	3.8	0.2
LSD(0.10)		NS	NS	NS	NS	NS	NS	NS	NS

YEAR / PROJECT: 1997 / 758

TITLE: **Black Mitcham Peppermint Propagation Trial, 1996-1997**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell
Dr. Bill Grey, Asst. Research Professor MSU, Bozeman, MT
Gail Sharp, Research Assistant, MSU, Bozeman, MT
Cathy & Tom Smith, Summit Labs, Fort Collins, CO

The seven MIRC entries (Table 1) allow us to compare different propagation methods carried out in the same laboratory, eliminating variance due to the propagation environment (equipment, personnel, source material, etc.). Plants propagated from meristem culture produced significantly more dry matter than non-meristem plants (Tables 1 & 2). This supports previous observations that meristem derived Black Mitcham exhibits more vigorous growth than non-meristem peppermint. There was no difference in hay yield between single parent derivation and propagation from a group.

Propagation method, parental selection, and the interaction between them (Table 4) affected oil yield. Meristem propagated plants produced less oil than either stem cut or nodal tissue culture propagated plants. Plots containing plants propagated from a random selection within the mother block tended to produce more oil than those containing clones from a single parent. The difference was most notable for the stem cut propagated mint. Parental source was an insignificant factor within the nodal and meristem groups. The superiority of using a random selection of parental plants indicates that there is some variation within the Black Mitcham mother block for some trait influencing oil yield. The fact that this was not observed in the entries that had been propagated by meristem culture suggests that this "high oil" factor was reduced or eliminated by this technique. Since the random selection lines were never subjected to heat treatment, we cannot blame this aspect of the process.

Cathy Smith of Summit Labs reported that leaf samples from the Black Mitcham parent plant were sent to Dr. Steve Lommel at North Carolina State University. His laboratory confirmed the presence of a new mint virus in the parent plant. Samples of both the heat-treated and non heat-treated meristem lines from this study were submitted in September 1996. Although there was no official report submitted, Summit Labs was told that all samples were virus-free.

The objective of propagating at NWARC was to determine if the high vigor/lower oil yield characteristic attributed to in vitro nodal or meristem culture could be transferred through the stem-cut process. Plants derived from the Lake-94 (source: Lake-92) nodal material produces significantly more dry matter and less oil than that derived from the Roberts-94 (Plant Tech) stem cut material, which parallels differences observed in the original 1994 nursery (Table 2). Thus, it appears that the high vigor/low oil yield characteristics associated with the 94 nodal material or conversely, the high oil yield/low vigor associated with the Plant Tech material are being transferred through the stem-cut process. All plant material stem-cut propagated from original tissue culture material (Lake-94, R-5 field – meristem, R-7 field – meristem) in the early 90's tended to produce more hay and less oil than original stem-cut material.

Bill Grey and Gail Sharp at MSU examined the endophyte-yield relationship. Stem samples from each plot in two replicates of this study were collected after harvest, surface sterilized with Clorox, and the sap extracted in a phosphate buffer. Serial dilutions were made from the tissue suspensions and plated out. Results are summarized in Table 2. Peppermint propagated from field sources (PlantTech-94, R-7, Montana-1, and Idaho) had the highest endophyte levels, particularly PlantTech-94, which came from a low vigor high yielding entry in the 1994 Cultivar Evaluation Trial. Overall, plants propagated by tissue culture (nodal or meristem) had lower endophyte levels (MIRC 2-5, Lake-96). Of the MIRC entries, MIRC-6, which was stem cut propagated from a random selection of mother block plants, had the highest endophyte level as well as the highest oil yield (Table 2).

Correlation between response variables reveals a strong negative correlation between dry matter production and oil yield (Table 3). Oil yield and early season stand vigor are also negatively correlated. Endophytic bacteria level is negatively correlated with vigor and hay yield, implying a stress effect by the endophyte. Any direct correlation with oil yield is insignificant, so bacteria alone cannot account for high oil production.

Analysis of oil components showed no significant differences in levels of total alcohol, menthol, or esters among the 15 propagation lines tested. There were significant differences, however, in other components, indicating variation in oil chemistry among propagation sources and methods (Table 5). Most notably, MIRC-2, -5, and –7 (single parent sources) had higher menthone levels than the MIRC lines propagated from several random plants from the mother block. NWARC propagation from the plots derived from Lake-94 material had significantly different levels of total heads, menthofuran, and pulegone than oil from plants propagated from the Plant Tech material in the same nursery.

Table 1. Descriptions of entries in Black Mitcham peppermint propagation evaluation planted at NWARC in 1996.

Source	Propagator	Method	Origin
MIRC-1	Summit Labs	stem cut	parent plant
MIRC-2	Summit Labs	nodal tissue culture	parent plant
MIRC-3	Summit Labs	meristem tissue culture	random selection
MIRC-4	Summit Labs	nodal tissue culture	random selection
MIRC-5	Summit Labs	meristem tissue culture	parent plant
MIRC-6	Summit Labs	stem cut	random selection
MIRC-7	Summit Labs	stem cut	reestablished tissue culture from parent plant
Lake-96	Lake's	nodal tissue culture	bacteria infected culture
Lake-94	NWARC	stem cut	1994 propagation trial - nodal
Roberts-94	NWARC	stem cut	1994 propagation trial-stem-cut
R-5 field	NWARC	stem cut	meristem low vigor field
R-7 field	NWARC	stem cut	meristem high vigor field
Montana-1	NWARC	stem cut	high yielding field-Flathead #1
Montana-2	NWARC	stem cut	high yielding field-Flathead #2
Idaho	NWARC	stem cut	McClelland stolons

Table 2. Stand observations, hay and oil yields, and level* of endophytic bacteria from Black Mitcham propagation lines in 1997.

SOURCE	ROW COVER *(0-5)*[1]	VIGOR *(0-5)*[2]	STOLON SPREAD *(0-5)*[3]	HAY YIELD *tons/acre*	OIL YIELD *lbs/acre*	BACT *level**
MIRC-1	4.5	4.8	5.0	4.68	67.8	2
MIRC-2	4.8	5.0	4.5	4.83	73.2	2
MIRC-3	5.0	5.0	5.0	5.38	59.7	2
MIRC-4	5.0	4.3	4.3	4.63	77.4	1
MIRC-5	5.0	5.0	5.0	5.41	62.2	2
MIRC-6	4.5	4.3	4.0	4.61	81.2	3
MIRC-7	4.6	5.0	4.5	4.93	71.2	2
Lake-96	4.8	4.8	4.5	4.30	77.0	2
Lake-94	3.5	4.0	3.0	4.57	70.7	2
Roberts-94	2.8	3.0	2.3	3.89	83.1	3
R-5 field	3.3	3.3	2.8	4.08	70.9	2
R-7 field	3.5	3.5	3.0	4.27	68.2	3
Montana-1	3.5	3.3	3.0	4.26	72.9	4
Montana-2	2.5	2.8	2.0	3.69	77.1	2
Idaho	3.0	3.3	2.3	4.05	75.5	3
LSD(0.10)	0.6	0.5	0.6	0.60	9.3	
CV(s/mean)%	12.1	9.3	13.8	11.3	10.8	

[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

** number of colony forming units / gm fresh plant weight: 1=100,000-1,000,000; 2=1,000,000-10,000,000; 3=10,000,000-100,000,000; 4=10,000,000-100,000,000*

Table 3. Pearson correlations (r^2) with P-values of vigor, yield, and endophyte levels of Black Mitcham propagation lines at Kalispell in 1997.

		Hay Yield	Oil Yield	Bacteria
Vigor	r^2	0.8777	-0.4722	-0.4494
	P	0.0000	0.0755	0.0928
Hay Yield	r^2		-0.6904	-0.3576
	P		0.0044	0.1907
Oil Yield	r^2			0.2099
	P			0.4528

Table 4. Comparisons among MIRC propagated entries by propagation method and parent plant source for 1997 oil yield (lbs/acre).

	Parent Plant(s)		
Method	**Single**	**Random**	means
Stem cut	67.8	81.2	74.5
Nodal	73.2	77.4	75.3
Meristem	62.2	59.7	61.0
means	67.7	72.7	

LSD(0.10) method=11.2
selection =3.7
interaction=11.8

Table 5. Quality components of Black Mitcham propagation lines at Kalispell, MT (GC%).

Propagation Source	Growth Stage	Total Heads	Total Ketones	Total Alcohol	Menthofuran	Menthone	Menthol	Esters	Pulegone
		%	%	%	%	%	%	%	%
MIRC-1	late bud	10.2	25.3	49.0	1.6	22.9	38.7	4.6	0.3
MIRC-2	full bud	11.0	25.6	49.0	1.7	23.3	38.7	4.5	0.3
MIRC-3	full bud	11.0	24.2	49.7	1.1	21.9	39.7	4.4	0.2
MIRC-4	full bud	10.9	23.2	49.7	1.8	21.0	39.5	4.3	0.3
MIRC-5	full bud	9.8	26.0	49.4	1.5	23.6	39.2	4.5	0.3
MIRC-6	full bud	11.0	23.5	50.0	1.8	21.3	39.7	4.6	0.3
MIRC-7	full bud	10.3	26.3	48.0	1.6	23.9	37.8	4.5	0.3
Lake-96	full bud	11.0	24.7	48.9	1.2	22.3	38.7	4.5	0.2
Lake-94	full bud	10.5	23.2	49.9	2.2	21.0	39.6	4.5	0.4
Roberts-94	full bud	11.6	23.3	50.4	1.7	21.2	39.9	4.6	0.3
R-5 field	full bud	11.2	22.8	50.8	1.9	20.7	40.4	4.3	0.3
R-7 field	full bud	10.5	23.6	50.5	1.8	21.3	40.6	4.1	0.3
Montana-1	full bud	11.4	22.0	50.2	1.8	19.9	39.7	4.7	0.4
Montana-2	full bud	11.8	22.1	50.7	1.9	20.1	40.1	4.7	0.3
Idaho	full bud	11.1	23.1	49.9	1.8	20.8	39.6	4.5	0.3
mean		10.9	23.9	49.7	1.7	21.7	39.5	4.5	0.3
LSD(0.10)		0.6	2.1	NS	0.3	2.0	NS	NS	0.1
CV(s/mean)x100		4.9	7.5	3.4	16.6	7.9	3.6	5.8	23.8

MIRC-1	stem cut, single parent
MIRC-2	nodal culture, single parent
MIRC-3	meristem, random selection
MIRC-4	nodal, random selection
MIRC-5	meristem, single parent
MIRC-6	stem cut, random selection
MIRC-7	stem cut from tissue culture, single parent

Oil analyses by A. M. Todd, Company.

YEAR / PROJECT: 1997 / 758

TITLE: **Stolon Vigor Study**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell , MT

Cropping system in 1995 had no effect on stand vigor, hay or oil yield in 1997. Differences due to stolon source did carry through, however. As in 1996, stands derived from Idaho grown roots were more vigorous than those from Montana, with the eastern Montana source more vigorous than the western Montana source (Table 1). There was no vigor difference between the Idaho field cut at 20% bloom and that cut at 90% bloom in 1997. The superior vigor of the Idaho mint was reflected in higher dry matter production. The Montana-East mint produced slightly less hay than the Montana-West source (Table 2a). Over the 2-year period, mint grown from the Idaho roots produced 14% more dry matter than the Montana roots (Table 2b).

In spite of differences in dry matter production, there were **no differences** among stolon sources in **1997 oil yields** (Table 3a). Variation in oil production due to stolon source in 1996 was reflected in the total yields for the duration of the study (Table 3b). We have evidence now that peppermint root source and cropping history can affect oil production the first year after planting, but "stolon vigor" does not necessarily determine future oil yield potential.

Previous crop had no effect on oil chemistry in 1997. There were no differences in total alcohol content (mean = 45.4%), menthol (mean = 35.8%), or esters (mean = 4.3%). Oil of mint grown from Idaho stolons differed from mint grown from Montana stolons in total heads, ketones, and menthone levels (Table 4). As in 1996, oil from the Montana-East source had lower menthofuran and pulegone levels than the Montana-West source.

Table 1. Spring regrowth vigor ratings (0-5 = poor-high) of Black Mitcham peppermint stands in 1997.

	Stolon Source			
Previous Crop	Idaho 20%	Idaho 90%	Montana-E	Montana-W
Wheat	5.0	5.0	3.8	3.3
Barley	4.5	4.8	4.0	3.3
Fallow	4.8	4.5	3.8	2.5
mean	4.8	4.8	3.8	3.0

LSD(0.10): Previous Crop - NS
Stolon Source = .4
Interaction - NS

Table 2a. Dry matter yields (tons/acre) of Black Mitcham peppermint in 1997.

Previous Crop	Stolon Source Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
wheat	5.88	6.35	5.69	5.78	5.92
barley	6.26	6.38	5.65	6.05	6.08
fallow	6.38	6.23	5.90	6.20	6.17
mean	6.17	6.32	5.74	6.01	

LSD(0.10): Previous Crop - NS
Stolon Source = 0.38
Interaction - NS

Table 2b. Total dry matter yields (tons/acre) of Black Mitcham peppermint from 1996-1997.

Previous Crop	Stolon Source Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
wheat	9.60	10.10	8.89	8.55	9.29
barley	10.43	10.40	9.28	9.00	9.78
fallow	10.32	9.95	9.10	8.53	9.47
mean	10.12	10.15	9.09	8.69	

LSD(0.10): Previous Crop - NS
Stolon Source = 0.44
Interaction - NS

Table 3a. Oil yield (lbs/acre) of Black Mitcham peppermint in 1997.

Previous Crop	Stolon Source Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
wheat	64.1	72.6	71.1	70.6	69.6
barley	64.5	67.0	64.5	65.5	65.3
fallow	72.6	65.0	67.9	71.2	69.2
mean	67.1	68.2	67.8	69.1	

LSD(0.10): Previous Crop - NS
Stolon Source - NS
Interaction - NS

Table 3b. Total oil yield (lbs/acre) of Black Mitcham peppermint from 1996-1997.

Previous Crop	Stolon Source				
	Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
wheat	146.4	148.1	141.1	134.9	142.6
barley	145.3	147.3	144.1	133.4	142.5
fallow	155.5	136.4	138.7	129.2	140.0
mean	149.1	143.9	141.3	132.5	

LSD(0.10): stolon source = 5.8; previous crop, interaction - NS

Table 4. Levels of major quality constituents of Black Mitcham peppermint oil in1997.

Menthol (GC%)

Previous Crop	Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
	Stolon Source				
wheat	36.4	35.9	37.6	36.9	36.7
barley	36.3	36.0	36.6	36.6	36.4
fallow	36.0	36.1	27.5	37.2	34.2
mean	36.2	36.0	33.9	36.9	

LSD(0.10): Previous Crop, stolon source, interaction - NS

Menthone (GC%)

Previous Crop	Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
	Stolon Source				
wheat	27.9	28.3	25.4	26.9	27.1
barley	27.9	28.8	27.0	26.8	27.6
fallow	27.9	28.4	26.3	25.9	27.1
mean	27.9	28.5	26.2	26.5	

LSD(0.10): stolon source = 1.1; previous crop, interaction - NS

Menthofuran (GC%)

Previous Crop	Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
	Stolon Source				
wheat	1.7	1.7	1.0	1.6	1.5
barley	1.6	1.6	1.1	1.6	1.5
fallow	1.6	1.7	1.2	1.6	1.5
mean	1.6	1.7	1.1	1.6	

LSD(0.10): stolon source = .1; previous crop, interaction - NS

Pulegone (GC%)

Previous Crop	Idaho 20%	Idaho 90%	Montana-E	Montana-W	mean
	Stolon Source				
wheat	0.25	0.24	0.17	0.25	0.23
barley	0.24	0.20	0.16	0.22	0.21
fallow	0.24	0.24	0.19	0.24	0.23
mean	0.24	0.23	0.17	0.24	

LSD(0.10): stolon source = .02; previous crop, interaction - NS

YEAR / PROJECT: 1997 / 758

TITLE: **Peppermint Fall Harvest Management Trial**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell , MT

The mint was at the mid-bud stage on the first harvest date and was mature (post-bloom) by the last harvest on Sept. 29. The first frost (32^0 F) did not occur until after the final harvest. The frost-free period was 140 days in 1997, compared to a 48-year average of 114 days. There were 1597 growing degree days (GDD) for mint in 1997 compared to 1526 GDD in 1996. Stolon mass declined over the 1996-97 winter (Figure 1).

Dry matter yield decreased 24% between the first and second harvests dates (Table 1). It remained at this level until 9/19 when it decreased another 26%. The mint was totally lodged by 9/10, and leaf drop and senescence accelerated as the material lay on the ground. There was no increase is dry matter yield between the bud and mid bloom stages as in 1996 (Figure 2). Oil yield followed a similar pattern as the season progressed, with the first harvest having the highest yield and a significant drop occurring after the fifth harvest (Table1). This represented a 36% loss of oil when harvest was delayed from Sept. 10 to Sept.19. In 1996 oil yield increased during August then decreased significantly during the first two weeks in September (Figure 3). There was no direct correlation between spring stolon mass and summer yields (Figures 1&2).

Levels of the oil quality components corresponded with the stage of maturity of the mint at time of harvest. Total ketones and menthone decreased as the mint progressed from bud to full bloom (Table 2). Total alcohol and menthol continued to increase through the last harvest, as did % esters. Menthofuran increased until 9/19 (late bloom) after which it declined slightly as the flowers disappeared (Table 2). Menthofuran levels for prime quality Montana peppermint usually range from 1-4%. Except for the first harvest, before flowering commenced, MF levels exceeded 4% in 1997. Desirable oil contains 45% menthol. Menthol in 1997 did not reach this level until the 9/19 harvest (Table 2). Oil yield remained high from 8/1 to 9/10. The 9/10 harvest yielded oil with 44% menthol but with over 10% menthofuran. The first two harvest dates, where the oil had the most acceptable MF, only contained 37% menthol. It is not possible to find a harvest timing in 1997 which maximizes both oil yield and quality.

Table 1. Hay and oil yields of Black Mitcham peppermint harvested from 8/1 to 9/29 in 1997.

HARVEST DATE	GROWTH STAGE	LODGING %	HAY YIELD t/a	1997 OIL YIELD lbs/a	1996-97 TOTAL OIL lbs/a
8/1	late bud	90	5.66	71.3	119.6
8/12	1st bloom	91	4.30	60.4	120.2
8/22	midbloom	95	4.23	65.6	140.1
8/30	late bloom	93	4.35	59.9	134.8
9/10	late bloom	100	4.02	63.8	126.2
9/19	late bloom	100	2.99	40.8	103.6
9/29	mature	100	2.74	22.1	78.2
MEAN			4.04	54.8	117.5
LSD(0.10)			0.83	13.0	16.2

Table 2. Quality components (GC%) of Black Mitcham peppermint harvested on different dates in 1997.

Harvest Date	Growth Stage	Total Heads	Total Ketones	Total Alcohol	Mentho-furan	Menthone	Menthol	Esters	Pulegone
8/1	bud	10.2	30.8	47.3	2.1	28.3	37.2	4.1	0.3
8/12	full bud	11.1	27.9	46.7	4.7	25.5	36.8	4.0	1.1
8/22	midbloom	10.9	22.7	49.7	7.4	20.7	39.3	4.5	1.2
8/30	full bloom	11.6	16.9	55.2	7.7	15.1	43.2	5.8	1.1
9/10	full bloom	10.6	14.4	56.9	10.3	12.9	44.0	7.0	0.8
9/19	late bloom	9.9	14.5	57.8	10.9	13.2	44.5	7.9	0.4
9/29	mature	10.0	13.5	60.7	10.3	12.3	46.6	8.7	0.3
Mean		10.6	20.1	53.5	7.6	18.3	41.7	6.0	0.7
LSD(0.10)		0.4	1.2	1.3	0.6	1.2	1.1	0.4	0.1

Figure 1. Total dry weight of stolons dug from a one-foot square area from each plot on 10/21/96 and 4/16/97.

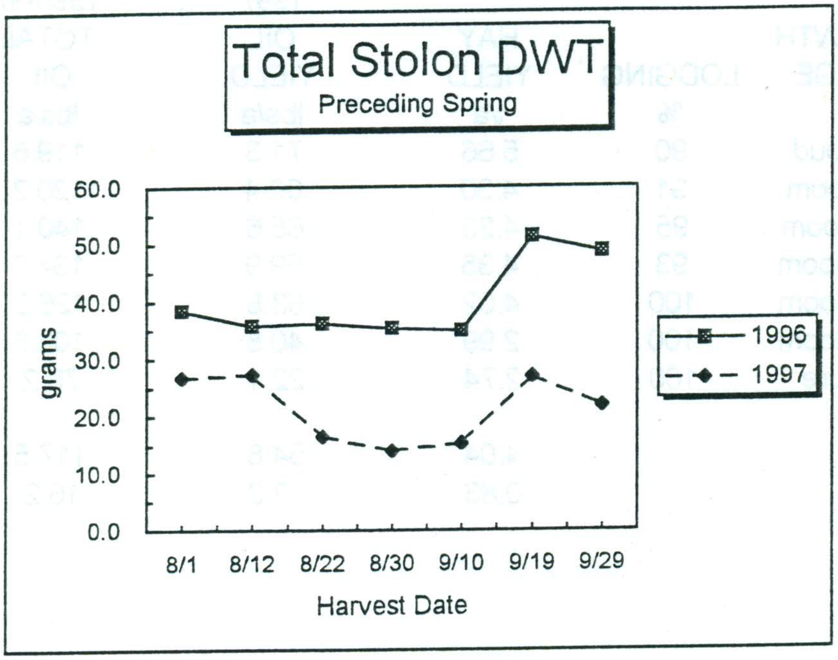


Figure 2. Dry matter yield of mint harvested on 7 dates in 1996 & 1997.

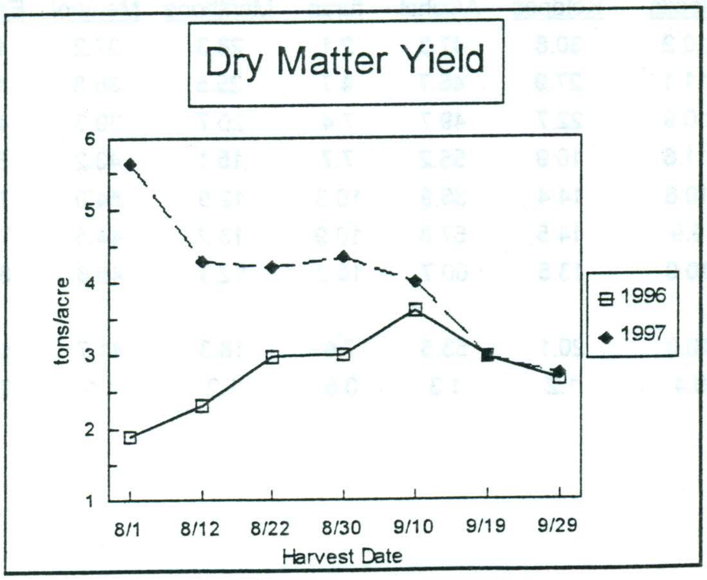
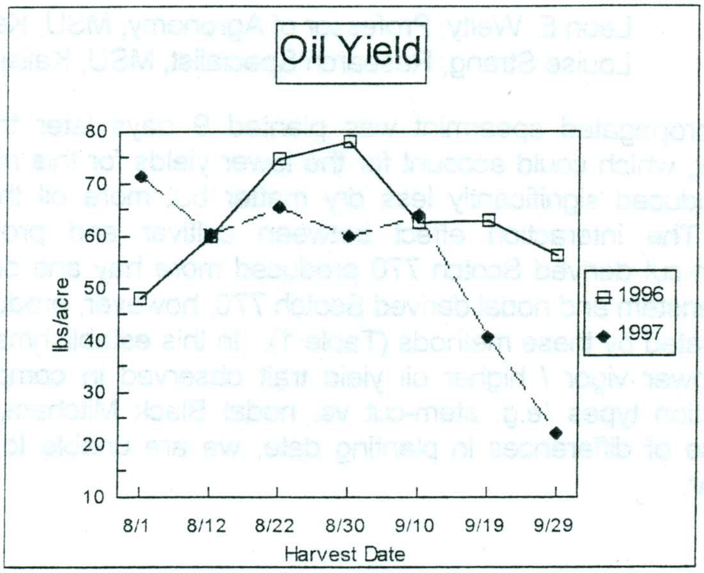


Figure 3. Oil yield (lbs/acre) of mint harvested on 7 dates in 1996 & 1997.



YEAR/PROJECT: 1997 / 758

TITLE: **Spearmint Cultivar/Propagation Trial**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT

The stem-cut propagated spearmint was planted 9 days later than the tissue culture propagated mint, which could account for the lower yields for this method in the first year. Scotch 770 produced significantly less dry matter but more oil than the other cultivars (Tables1&2). The interaction effect between cultivar and propagation source was significant. Stem-cut derived Scotch 770 produced more hay and oil than stem-cut Native and N-83-5. Meristem and nodal derived Scotch 770, however, produced less hay the other cultivars propagated by these methods (Table 1). In this establishment year, Scotch 770 is exhibiting the lower vigor / higher oil yield trait observed in comparisons of other mint cultivar/propagation types (e.g. stem-cut vs. nodal Black Mitcham, Scotch vs. Native in 1997). Because of differences in planting date, we are unable to compare propagation sources this year.

The oil quality analyses revealed variation in oil chemistry among the 3 cultivars (Table 3). Scotch 770 was significantly higher in carvone, limonene, and octanol and lower in pinenes and cineole than Native and N-83-5.

Table 1. Hay yields (tons/acre) of spearmint cultivars of 3 propagation types.

	Stem cut	Meristem	Nodal	means	
Native	2.75	4.19	3.92	3.62	
N-83-5	2.88	3.51	4.28	3.55	
Scotch 770	3.14	3.38	2.73	3.08	
					LSD(0.10)
Means	2.92	3.69	3.64	cultivar:	0.19
				propagation:	0.16
				interaction:	0.79

Table 2. Oil yield (lbs/acre) of spearmint cultivars of 3 propagation types.

Table 2. Oil yield (lbs/acre) of spearmint cultivars of 3 propagation types.

	Stem cut	Meristem	Nodal	means
Native	26.2	34.3	39.4	33.3
N-83-5	31.5	32.1	38.0	33.8
Scotch 770	43.2	46.6	43.5	44.5
means	33.6	37.7	40.3	

LSD(0.10)
cultivar: 5.5
propagation: 3.9
interaction: 7.8

Planting Dates: meristem & nodal - 5/20/97
stem cut - 5/29/97

Table 3. Quality components of 3 spearmint cultivars and 3 propagation types.

Established in 1997

Cultivar	Stage*	A:Pinene	B:Pinene	Limonene	Cineole	Octanol	Dihydro-carvone	Carvone
Stem tip Native	mb	1.2	1.8	10.3	2.4	1.3	1.7	65.7
Stem tip N-83-5	mb	1.4	1.9	10.8	2.6	1.2	0.7	63.6
Stem tip Scotch 770	fb	1.1	1.6	18.1	1.5	2.8	0.6	66.6
Meristem Native	mb	1.3	1.9	12.1	2.3	1.1	1.7	62.0
Meristem N-83-5	mb	1.4	2.0	12.0	2.2	1.0	0.7	61.2
Meristem Scotch 770	mb	1.1	1.6	17.4	1.2	2.6	0.9	67.6
Nodal Native	mb	1.3	1.8	11.9	2.0	1.1	0.7	64.9
Nodal N-83-5	mb	1.4	2.0	11.8	2.5	1.1	0.7	61.5
Nodal Scotch 770	mb	1.0	1.5	17.7	1.3	2.7	0.9	68.1
mean		1.3	1.8	13.6	2.0	1.7	1.0	64.6
LSD(0.10)		0.1	0.2	1.3	0.2	0.1	0.2	2.2
CV(s/mean)x100		7.9	7.2	7.8	9.8	7.2	15.6	2.8

* mb = midbud; fb = full bud

Analysis by A. M. Todd

YEAR/PROJECT: 1997 / 758

TITLE: **Stolon Production Trial**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT

All peppermint at the NWARC survived the 1996-97 winter well. In this trial, stolons from the harvested flat culture mint at Sonstelie Farms and the NWARC harvested flat culture showed some stand loss compared to the Sonstelie non-harvested and the NWARC hill culture mint (Table 1). Spring vigor ratings and mid-summer plant height of mint from the Sonstelie non-harvested (both flat and hill culture) and the NWARC hill culture stolon sources were significantly greater than mint from the other 3 sources (Table 1). Harvesting the mint affected stolon growth potential of the Sonstelie source, while hilling increased the potential of the NWARC mint. This study indicates that hilling non-harvested mint results in a better stolon source for peppermint establishment than stolons from a harvested field or an non-harvested field with no hilling.

Table 1. 1997 stand establishment of peppermint from 1996 stolon sources.

Stolon Source	Row Cover %	Vigor *(0-5)*	Stolon Spread *(0-5)*	Height *inches*
Sonstelie-Flat-Harvested	92	2.5	0.0	33
Sonstelie-Flat-No Harvest	99	4.0	0.8	37
Sonstelie-Hill-No Harvest	98	4.5	0.5	38
NWARC-Hill-No Harvest	96	4.0	0.5	37
NWARC-Flat-Harvested	89	2.8	1.0	34
Idaho-Harvested	96	3.0	0.3	32
Mean	95	3.5	0.5	35
LSD(0.10)	4	0.6	0.5	2

YEAR/PROJECT: 1997 / 758

TITLE: **Peppermint Rhizome Production Trial**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise M. Strang, Research Specialist, MSU, Kalispell, MT
Gail Sharp, Research Aide, MSU, Kalispell, MT
Dale Sonstelie, Producer, Flathead County, MT
Phil Clarke, Producer, Flathead County, MT
Myron Mast, Producer, Flathead County, MT

Black Mitcham rhizomes/stolons derived from *in vitro* nodal propagation (from 1995 nuclear plants - Lake 94 source), generation #1, were dug in May of 1997 from the Myron Mast farm and replanted in 12 X 20 foot replicated plots at the Northwestern Agricultural Research Center. The following cultural treatments were imposed:

Trt	Culture	Operation	Hay Harvest
1	Flat	No hilling	None
2	Flat	Cultivate between rows 7/1, 7/16	9/24
3	Disk Hill	2 coverage on 8/6, 2/3 on 9/2* Stolons covered on 9/17 and 10/8	None
4	Flat	No hilling	8/25
5	Shank/Disk Hill	1/4 shank on 7/1, 7/16, and 8/1 1/3 disk on 8/15, 2 disk on 9/2* Stolons covered on 9/17 and 10/8	None
6	Disk Hill	2 coverage on 7/1	None
7	Disk Hill	2 coverage on 8/6, 2/3 on 9/2* Stolons covered on 9/17	None
8	Disk Hill	2 coverage on 8/6, 2/3 on 9/2* Stolons covered on 10/8	None

* Preceded by rototilling

In spring of 1998, rhizomes/stolons will be dug from a three-foot square area from each plot, cleaned and separated into white and green material, and weighed. In addition, sufficient stolons will be dug and replanted into replicated plots (4 rows, 22 inches apart, and 20 feet in length). Rhizomes/stolons of the same generation will be obtained from Idaho and Oregon (if available) and planted with the above treatments. Vigor, stolon spread, and hay and oil yields will be obtained in 1998.

In fall of 1997, rhizomes/stolons were dug, separated and weighed as described above, and subjected to cold/biofreezer tests. Rhizomes were subjected to the following temperatures for two-hour periods, removed from the freezer, and planted in trays in the lab: (1) 36 degrees F, (2) 20 degrees F, (3) 10 degrees F, and (4) 0 degrees F. Twenty, two-inch rhizome segments used for each treatment were wrapped in moist cheese cloth and aluminum foil. Treatments were placed in the freezer for fourteen hours at 36 degrees F to condition the rhizomes. The temperature was then reduced four degrees F per hour until the desired temperature was achieved. Stolons were held at the desired temperature for two hours, removed, and planted. After two weeks in the lab at 65 degrees F, percentage survival was determined.

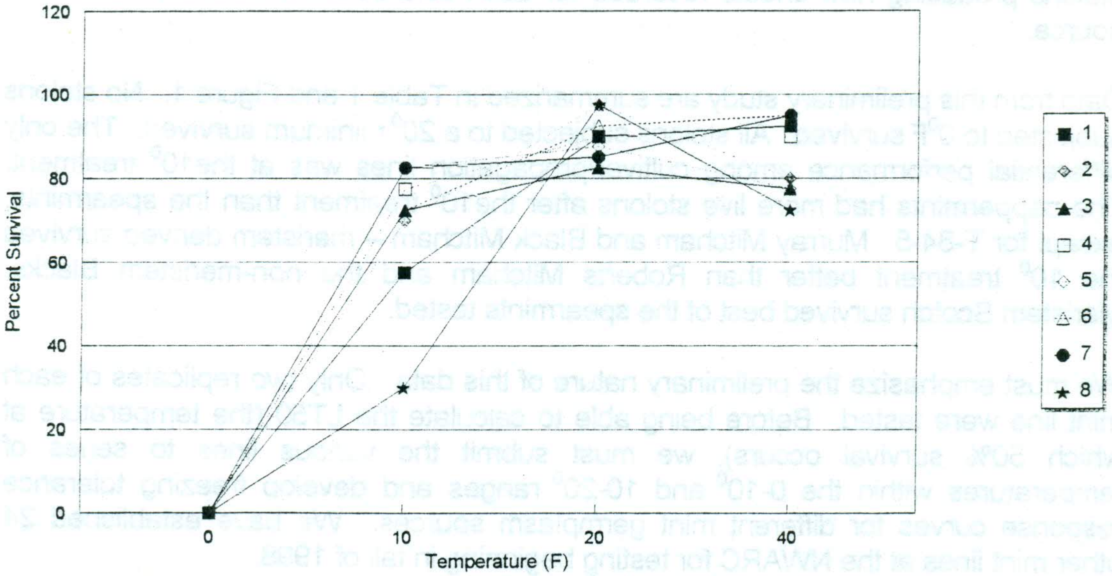
Stolon yield per three foot square area was greatest for Flat/Harvest 9/24, Shank/Disk Hill, and Disk Hilling once on July 1 (Table 1). Weight of stolon segments was greatest for Disk Hilling once on July 1. Responses to cold treatments were variable. Mean survival was lowest for Disk treatment #8 (Table 1), primarily because of poor survival at 10 degrees F (Figure 1).

Table 1. Percentage survival and stolon weight and yield of cold treated rhizomes.

Trt	Mean Survival (%)	Stolon Weight 2" segments (gms)	Stolon Yield 3 sq ft (gms)
1	80	21.8	326
2	83	24.6	579
3	78	23.2	257
4	86	25.3	416
5	83	23.9	611
6	87	29.6	575
7	88	21.6	365
8	67	22.5	271
LSD(0.05)	19	3.6	313

Figure 1. Effects of Hilling Procedures on Cold Tolerance of Mint

Peppermint Rhizome Production Trial - Kalispell, MT



LSD = 19.3

YEAR/PROJECT: 1997 / 758

TITLE: **Effect of freezing on survival of peppermint and spearmint rhizomes/stolons.**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT
Gail Sharp, Research Assistant, MSU, Kalispell, MT

Stolons/rhizomes from 11 mint lines were sampled from an established nursery at the NWARC in fall of 1997. The stolons were cleaned and stored at 40°F until testing. Ten, two-inch stolon pieces for each of four cold treatments were selected from each mint line. Each group of 10 was wrapped in moist cheesecloth and aluminum foil and placed in a biofreezer at 40°F for 12 to 16 hours. After this conditioning period, stolons for the 40° treatment were removed, and the freezer temperature was reduced 4° F/ hour to 20° and held for two hours. Stolons for the 20° treatment were removed and the freezer cooled to 10°. The 10° stolons were removed after 2 hours, and then the temperature reduced to 0° for the remaining stolons. The stolons were planted in the lab at 65°F the following day, and number of stolons producing new shoots recorded for each cold treatment within each stolon source.

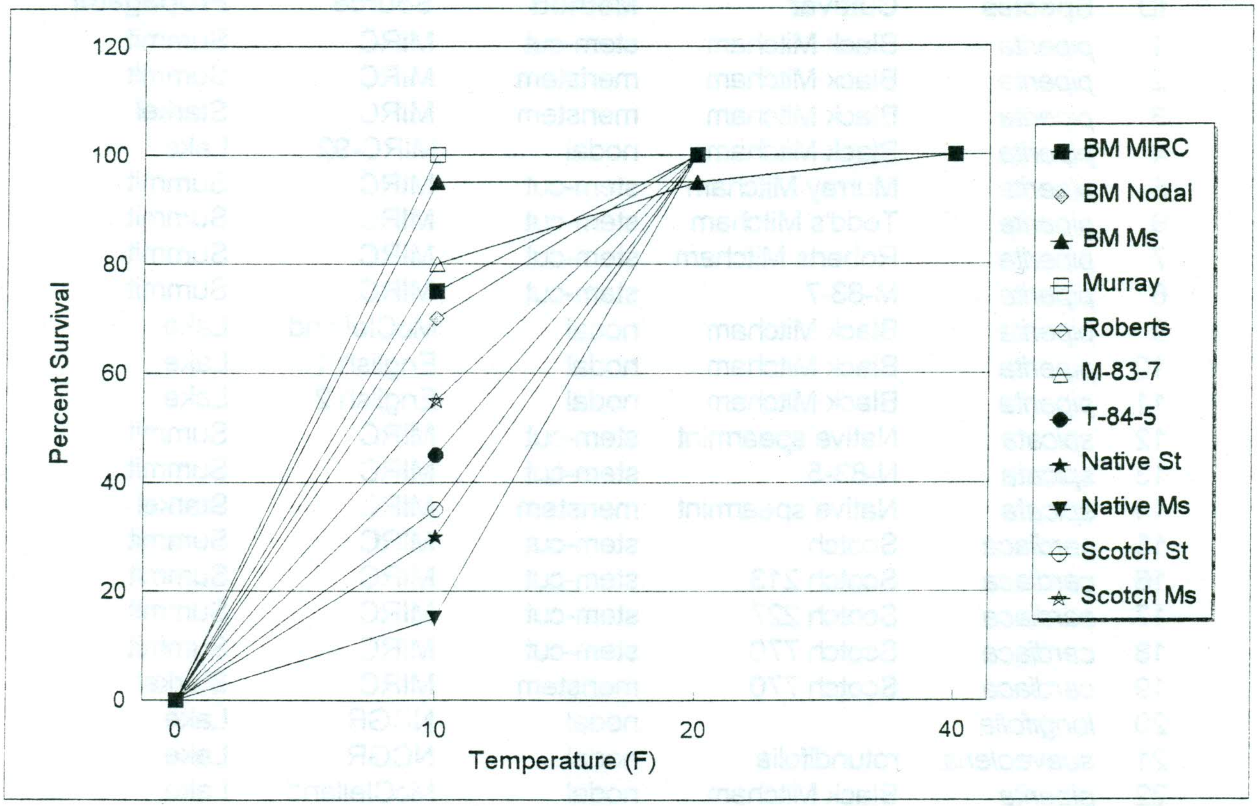
Data from this preliminary study are summarized in Table 1 and Figure 1. No stolons subjected to 0°F survived. All stolons subjected to a 20° minimum survived. The only differential performance among cultivar/propagation lines was at the10° treatment. The peppermints had more live stolons after the10° treatment than the spearmints, except for T-84-5. Murray Mitcham and Black Mitcham – meristem derived survived the 10° treatment better than Roberts Mitcham and the non-meristem Blacks. Meristem Scotch survived best of the spearmints tested.

We must emphasize the preliminary nature of this data. Only two replicates of each mint line were tested. Before being able to calculate the LT50 (the temperature at which 50% survival occurs), we must submit the various lines to series of temperatures within the 0-10° and 10-20° ranges and develop freezing tolerance response curves for different mint germplasm sources. We have established 24 other mint lines at the NWARC for testing beginning in fall of 1998.

Table 1. Percent Survival of Cold Treated Stolons

Cultivar	0	10	20	40
	Temperature (degrees F)			
BM Mirc	0	75	100	100
BM Nodal	0	70	100	100
BM Meristem	0	95	95	100
Murray Mitcham	0	100	100	100
Roberts Mitcham	0	70	100	100
M-83-7	0	80	95	100
T-84-5	0	45	100	100
Native Stem	0	30	100	100
Native Meristem	0	15	100	100
Scotch Stem	0	35	100	100
Scotch Meristem	0	55	100	100
LSD(0.10)		16		

Figure 1. Effect of temperature on survival of mint stolons.



LSD = 16.04

YEAR/PROJECT: 1997 / 758

TITLE: **Effect of freezing on survival of peppermint and spearmint rhizomes/stolons.**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT
Montana Mint Committee

Twenty-four mint species/cultivars/propagation types were established in 2-row plots in a replicated complete block design with 4 replicates, in spring of 1997 (Table 1). Stolons/rhizomes from each plot will be dug in fall of 1998 and subjected to different cold temperatures in the biofreezer as in the preliminary freezing survival test conducted in 1997. Temperatures within the 0-10° and 10-20° ranges will be included and response curves of each mint line to cold temperatures will be developed. This will allow us to estimate the critical temperature at which 50% survival can be expected for each mint line.

Table 1. Mint lines to be tested for cold tolerance in 1998.

ID	Species	Cultivar	Propagation Method	Source	Propagator
1	*piperita*	Black Mitcham	stem-cut	MIRC	Summit
2	*piperita*	Black Mitcham	meristem	MIRC	Summit
3	*piperita*	Black Mitcham	meristem	MIRC	Starkel
4	*piperita*	Black Mitcham	nodal	MIRC-92	Lake
5	*piperita*	Murray Mitcham	stem-cut	MIRC	Summit
6	*piperita*	Todd's Mitcham	stem-cut	MIRC	Summit
7	*piperita*	Roberts Mitcham	stem-cut	MIRC	Summit
8	*piperita*	M-83-7	stem-cut	MIRC	Summit
9	*piperita*	Black Mitcham	nodal	McClelland	Lake
10	*piperita*	Black Mitcham	nodal	English 1	Lake
11	*piperita*	Black Mitcham	nodal	English 2	Lake
12	*spicata*	Native spearmint	stem-cut	MIRC	Summit
13	*spicata*	N-83-5	stem-cut	MIRC	Summit
14	*spicata*	Native spearmint	meristem	MIRC	Starkel
15	*cardiaca*	Scotch	stem-cut	MIRC	Summit
16	*cardiaca*	Scotch 213	stem-cut	MIRC	Summit
17	*cardiaca*	Scotch 227	stem-cut	MIRC	Summit
18	*cardiaca*	Scotch 770	stem-cut	MIRC	Summit
19	*cardiaca*	Scotch 770	meristem	MIRC	Starkel
20	*longifolia*		nodal	NCGR	Lake
21	*suaveolens*	rotundifolia	nodal	NCGR	Lake
22	*piperita*	Black Mitcham	nodal	McClelland	Lake
23	*piperita*	Black Mitcham	nodal	McClelland	Lake
24	*Alaska/Arctic*		nodal	I.P.Callison	Lake

YEAR/PROJECT: 1997 / 758

TITLE: **Effect of Fall Fertilization on Winter Survival of Peppermint**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT
Louise Strang, Research Specialist, MSU, Kalispell, MT

Four nitrogen fertilizer treatments were applied to an established peppermint stand in 3 replicates:

100 lbs N/A after harvest (8/21/96)
100 lbs N/A on 9/15/96
100 lbs N/A + 30 lbs Sulfur/a on 8/21
100 lbs N/A + 30 lbs S/a + 2 lbs Boron/a on 8/21
Check – 0 N

Four P+K fertilizer treatments, with N constant, were applied to an adjacent area of the same field in 3 replicates:

104 lbs P_2O_5 /a + 120 lbs K_2O /a on 8/21/96
208 lbs P_2O_5 /a + 240 lbs K_2O /a on 8/21/96
104 lbs P_2O_5 /a + 120 lbs K_2O /a on 10/1/96
208 lbs P_2O_5 /a + 240 lbs K_2O /a on 10/1/96
Check – no P & K

No differences in stand survival or vigor were observed on 5/15/97; therefore, the study was terminated.

YEAR/PROJECT: 1997 / 758

TITLE: **Peppermint Fluffing/Tedding**

PERSONNEL: Leon E. Welty, Professor of Agronomy, MSU, Kalispell, MT

On three separate occasions in 1997, we borrowed a tedder from Tom Sands and used it in mint production fields at the Northwestern Agricultural Research Center. We fluffed several windrows for each harvest of the double cut field and several windrows in the meristem field. The mint from each treatment was chopped and distilled by Fishers. Procedures for each fluffing are included in Tables 1, 2, and 3.

For the first harvest of the double cut field (Table 1), fluffing increased windrow dry matter percentage and resulted in more oil per tub than non-fluffed mint which would indicate that more dry matter was chopped into fluffed tubs.

For the second harvest of the double cut field, additional parameters were measured, i.e. tub weight, chopper distance covered, break time, and oil yield per acre (Table 2). Fluffing slightly increased windrow dry matter but decreased oil yields, particularly when fluffing occurred three days after swathing.

We also fluffed windrows on the single cut meristem field in early August. Tub weights were less for fluffed mint as compared to non-fluffed mint (Table 3). Break time increased with non-fluffed mint indicating that moisture percentage was higher. It took more field area to fill tubs from fluffed mint as compared to non-fluffed mint. Fluffing reduced oil yield/acre, particularly when the operation was completed the day prior to chopping.

Fluffing reduced windrow moisture and may allow chopping a day earlier as compared to not fluffing. However, fluffing also reduced oil yield. It was evident from the mint smell during fluffing that oil was being lost. However, this loss must be assessed against other factors, such as imminent rainstorms, etc.

Table 1. Effect of fluffing on dry matter percentage for first harvest of Black Mitcham nodal peppermint in 1997.

Date	Non-fluff	Fluff
7/12/97	26	30
7/13/97	27	28
7/14/97	26	32

Mint swathed evening of 7/7.
Received 0.35" rain 7/8 and 7/9.
Fluffed on afternoon of 7/11.
Distilled on 7/16.
Yield = 59.8 lbs oil/a.
2 fluff tubs = 41 and 47 lbs oil.
Non-fluff tub = 35 lbs oil.

Table 2. Effect of fluffing on distillation and oil parameters for second harvest of Black Mitcham nodal peppermint in 1997.

Treatment	DM Yield (%)	Tub wt. (lb)	Break Time (min)	Oil/tub (lb)	Area Chopped (acre)	Oil (lb/a)
Fluff 9/10*	29	12960	47	55	1.05	52
Fluff 9/11*	28	12865	49	45	1.04	43
No Fluff	27	13610	47	55	1.02	54

* Fluffed at 10:00 a.m.
Swath date = 9/8/97 p.m.
Distill date = 9/14/97 p.m.
Rainfall = Trace on 9/11/97

Table 3. Effect of fluffing on distillation and oil parameters for Black Mitcham meristem peppermint in 1997.

Treatment	Tub wt. (lbs)	Break Time (min)	Oil/tub (lbs)	Area Chopped (acre)	Oil Yield (lbs/a)
Fluff 8/4 at 2:30 p.m.	8020	30	52	0.61	85
Fluff 8/5 at 9:00 a.m.	8045	28	49	0.61	81
Fluff 8/6 at 9:00 a.m.	8045	30	50	0.63	79
No Fluff	8570	34	53	0.59	89

Swath on August 3 from 1-4:00 p.m.
Harvest on August 7 from 12-2:00 p.m.
Received 0.36" precipitation on August 4 in p.m.