FIFTIETH ANNUAL REPORT
1998

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

4570 Montana 35
Kalispell, MT 59901

Prepared by

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ADMINISTRATION 750

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

Purchase of Telephone System $4,045.00 (Grants)

Full Time Staff Members	**Years in Service**
Leon E. Welty - Supt. & Prof. Agronomy (Began January 1973)	25
Robert N. Stougaard - Assistant Professor, Weed Science (Began November 1991)	7
Doug L. Holen Jr. - Research Associate (Began April 1996)	2
Gary R. Haaven - Ag Research Spec. (Began April 1982)	16
Louise M. Strang - Ag Research Spec. (Began May 1983)	15
Elaine M. Scott - Administrative Support (Began August 1990)	8
Paul P. Koch - Ag Research Tech (Began May 1995)	3
Vern R. Stewart - Professor Emeritus	

Part Time Employees:

Sarah Gunderson (January 1 through December 31)

Mary Arnold (March 30 through June 5)

Donald E. Burtch (June 15 through August 21)

Jeff T. Patrick (May 18 through May 29)

Zoe D. Rosell (May 19 through May 29)

Student Employees:

Gail Sharp (January 1 through December 31)

Kelly L. Fosbery (May 19 through August 21)

Lusha M. Alzner (June 4 through August 21)

Elizabeth M. McAllister (June 8 through August 25)

Austin O. Bair (July 28 through August 14)

Joseph L. Fekete (July 28 through August 14)

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 1998:

John Deere 6400 tractor	$ 2,460.00
John Deere 870 tractor	$ 1,326.00

PHYSICAL PLANT 752

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

PROFESSIONAL & CLIENTELE PRESENTATIONS 1998

DATE	ACTIVITY	WHO	WHERE
1/5	Flathead Weed Board	Stougaard	Kalispell
1/6	Advisory Committee	Stougaard, Holen	Missoula
1/14	MT Weed Control Assoc.	Stougaard	Butte
1/15	Mint Industry Research Council	Welty	LasVegas
1/22	MT Ag Business Assoc.	Stougaard	Great Falls
1/28	Lecture-Field Crops	Holen	Bozeman
2/5	Montana Mint Committee	Welty	NWARC
2/9-12	Weed Sci. Soc. of America	Stougaard	Chicago
2/12	Lake's Seed, Inc.	Welty, Holen	Ronan
2/16-17	MT Mint Growers Assoc.	Welty, Stougaard	Kalispell
2/16	MT Wheat & Barley Comm.	Stougaard, Holen	Bozeman
2/26	7th-8th Grade Cayuse Prairie Tour	Welty	NWARC
3/6-13	West. Soc. Weed Science	Stougaard	Hawaii
3/16	Mint Research Meeting	Welty	Kalispell
3/18	Pesticide Recertification	Stougaard	Kalispell
3/20	Forage Producers	Welty, Stougaard, Holen	Stevensville
4/1	Weed Management Lecture	Stougaard	Bozeman
4/2	Home Schoolers Tour	Welty	NWARC
4/6-8	Western Regional IPM Meeting	Stougaard	Portland
5/4	Flat. County Weed Board Meeting	Welty, Stougaard	Kalispell
5/8	Flathead Leadership	Welty	NWARC
5/16	Flathead Sci. Symposium	Stougaard	Kalispell
5/27	FVCC Students-Tour	Welty	NWARC
5/27	VoAg Students-Tour	Welty	NWARC
6/7	WSU Weed Tour	Stougaard	NWARC
6/8	Creston Students-Tour	Holen	Pullman
6/9	UI Weed Tour	Stougaard	NWARC
6/10	Grad Student Comm. Meeting	Stougaard	Moscow
6/17	Wheat & Barley Comm.-Tour	Welty, Stougaard, Holen	Moscow
6/18	American Cyanamid	Stougaard	NWARC
6/30	Mint Producers-Tour	Welty, Stougaard	NWARC
7/8	Mint Oil Buyers-Tour	Welty	NWARC
7/9	Citizens-Tour	Welty	NWARC
7/9-10	Cenex Field Tour	Stougaard	Havre
7/13	Tazmanian Dean of Ag-Tour	Welty	NWARC
7/13	UAP Field Tour	Stougaard	Havre
7/15	Tazmanian Dean of Ag-Tour	Welty	WARC
7/15	Havre Field Day	Stougaard	Havre
7/16	Field Day	Holen	WARC
8/3	Australian Farmers-Tour	Welty	NWARC
8/4	West. US Dept. Of Ag-Tour	Welty, Stougaard	NWARC
8/6	Japanese Students-Tour	Welty	NWARC
8/10	Japanese Students-Tour	Welty	NWARC
8/11	Farm Bureau-Tour	Welty, Stougaard, Holen	NWARC
10/7	FFA Students-Tour	Welty	NWARC
10/8	Cayuse Prairie 7th Graders-Tour	Welty	NWARC
10/13	American Cyanamid Meeting	Stougaard	Bozeman
10/20	Amer. Soc. of Agronomy-Poster	Welty	Baltimore, MD
10/29	Mint Research Meeting	Welty	Kalispell
11/5	Mint Research Meeting	Welty	NWARC
11/10	Herbicide Dissipation Lecture	Stougaard	Bozeman
11/10	German Oil Buyers	Welty	NWARC
11/30-12/4	Grain Growers Meeting	Stougaard, Holen	Great Falls
12/14-16	IPM Weed Management	Stougaard	Malta

CLIMATOLOGICAL DATA
NORTHWESTERN AGRICULTURAL RESEARCH CENTER
Kalispell, MT

The 1997/1998 crop year began with dry and warmer than average conditions from October through February, followed by a very wet spring. Total precipitation from September 1997 through August 1998 was 6% above average and accumulated growing degree-days were 9% above average. Most of the excess precipitation occurred in the spring of 1998 (14.22 inches of moisture from March through June). The 1988 growing season (April – August) received 13.48 inches of rain, 34% above average, and the mean temperature for this period was 3% above average. June was the only month with below average mean temperature. The first fall frost did not occur until October 4, 19 days later than normal, resulting in a 25% longer than average frost-free period. Snow cover was absent most of the winter. The only sub-zero air temperatures occurred January 9-13 when there was 1.5-3 inches of snow cover, so winter crop survival was not challenged.

Because of the dry winter, fields could be worked in early spring, and small grain planting was on schedule in mid April. Wet weather prevailed March through June, and the *Pythium* problem affected the crops again this year, particularly the spring barley, which only yielded about 50 Bu/acre. Spring wheat yields averaged 67 Bu/acre. July and August were warmer and drier than normal, providing abundant heat units in mid summer and excellent harvest conditions.

Alfalfa did not experience the waterlogged soils as in the previous season, so early season stands were good. Good yields were obtained throughout the growing season. New seedings yielded about 3 tons/acre (2 cuttings), and the established fields yielded 3-5 tons/acre in the first two cuttings.

The 1997/1998 winter was easy on peppermint. Soil temperature at the peppermint root level never dropped much below the freezing point, and stress on stolons and rhizomes was minimal. The only sub-zero temperatures occurred during 7 days in January at a time when there was 1.25-3.5 inches of snow cover. There were 268 growing degree-days in May, which got the mint off to a good start, followed by warm, sunny weather during the oil maturation period in August. Oil yields were normal for this area. High menthofuran levels affected peppermint quality at some locations in the valley where the mint was allowed to flower and cut at later than optimum growth stage. Market conditions continued poor.

This crop year is beginning with conditions similar to last year's. The first frost occurred 19 days later than normal. Precipitation from September through February was 21% below normal for the period and average temperature was 13% above normal. Snowfall was 58% below normal as of the end of February. We have received 79% of normal precipitation for this period (Sept.-Mar.), and our total snow accumulation is 42% of normal. Abundant mountain snow pack should offset drier conditions in the valley.

Following is a list of tables giving a complete description of the weather for the crop year (September 1997 through August 1998) and 1998 (January through December).

ITEM	Sept. 1997	Oct. 1997	Nov. 1997	Dec. 1997	Jan. 1998	Feb. 1998	Mar. 1998	Apr. 1998	May 1998	June 1998	July 1998	Aug. 1998	Total or Average
Precipitation (inches) Current Year	2.36	0.94	0.33	0.42	0.77	0.33	2.64	1.80	5.14	4.64	1.18	0.72	21.27
Avg. 1949 to 1997-98	1.59	1.38	1.57	1.63	1.49	1.15	1.19	1.52	2.39	2.98	1.62	1.53	20.04
Mean Temperature (F) Current Year	55.6	43.7	33.0	27.9	25.1	33.0	34.9	44.5	54.1	56.0	68.4	65.6	45.2
Avg. 1949 to 1997-98	53.5	43.2	32.5	25.4	22.3	27.7	33.8	43.2	51.7	58.2	64.0	62.9	43.2

Last killing frost in spring

1998	May 16 (29 degrees F)
Avg. 1949-98	May 23

First killing frost in fall

1998	October 4 (28 degrees F)
Avg. 1949-98	September 15

Frost Free Period

1998	141 days
Avg. 1949-98	113 days

Growing Degree Days (base 50):

May 1 - Oct. 31, 1998	2056.5 days
Avg. 1949-98	1880.1 days

Maximum summer temperature 92 degrees F on August 6 & 7, 1998 8/4

Minimum winter temperature -20 degrees F on January 12, 1998

In this summary 32 degrees is considered a killing frost.

Table 2. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis September 1, 1949 through August 31, 1998.

	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
1997-98	55.6	43.7	33.0	27.9	25.1	33.0	34.9	44.5	54.1	56.0	68.4	65.6	45.2
MEAN	53.5	43.2	32.5	25.4	22.3	27.7	33.8	43.2	51.7	58.2	64.0	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, 1998.

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
1997-98	68.5	53.5	42.3	33.4	32.7	41.1	43.9	56.1	67.2	65.7	82.3	82.5	55.8
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, 1998.

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
1997-98	42.8	34.0	23.7	22.4	17.6	25.0	25.9	33.0	41.1	46.3	54.5	48.8	34.6
MEAN	38.6	31.3	24.8	18.7	15.3	19.3	24.0	31.5	38.7	45.1	48.2	46.7	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, 1998.

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
1997-98	2.36	0.94	0.33	0.42	0.77	0.33	2.64	1.80	5.14	4.64	1.18	0.72	21.27
MEAN	1.59	1.38	1.57	1.63	1.49	1.15	1.19	1.52	2.39	2.98	1.62	1.53	20.03

Mean precipitation for all crop years = 20.03

Table 6. Precipitation by day for crop year, September 1, 1997 through August 31, 1998.
Northwestern Agricultural Research Center, Kalispell, MT.

DATE	SEPT. 1997	OCT. 1997	NOV. 1997	DEC. 1997	JAN. 1998	FEB. 1998	MAR. 1998	APR. 1998	MAY 1998	JUNE 1998	JULY 1998	AUG. 1998	YTD
1												0.27	
2										0.69		0.38	
3	0.40				0.01		0.50	0.03					
4	0.08	0.08			0.05		0.65	0.01			0.29		
5		T						0.01			0.04		
6	0.30	0.15								T	0.18		
7			0.01		0.02			0.03					
8		0.03			0.08			0.12					
9				0.11		0.17	0.17			0.10			
10		0.16			0.01	0.02	0.12			T	0.11		
11					0.01	T		0.01		T	0.02		
12	T							0.30		0.22			
13		0.05			0.07	0.03				0.18			
14					0.06				0.13	0.49			
15	0.97	0.02			0.02	0.03			0.30	0.36			
16	0.29						T			0.70			
17	0.05			T	0.02		0.47	0.15	0.16				
18	0.02	0.15	0.16	0.01					0.49	0.28			
19	0.12	0.04		0.02						0.03			
20			0.14		0.21					0.21			
21			T	0.06	0.02				0.10				
22					0.03	0.01	0.25		0.68			0.07	
23				T			0.12		0.79				
24		T		0.02	0.01		0.26	0.37	0.11	0.26			
25						0.04		0.77	0.03	0.07			
26			0.02				0.08		0.37	0.15			
27	0.13			0.05	0.02	0.03	0.02		1.38	0.90			
28					0.13				0.27				
29				0.15							0.54		
30		0.18			T				0.18				
31		0.08							0.15				
TOTAL	2.36	0.94	0.33	0.42	0.77	0.33	2.64	1.80	5.14	4.64	1.18	0.72	21.27

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 thru 1998.

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 21	32	Oct. 8	30	140
1998	May 19	31	Oct. 5	30	139
Mean for years	May 23	30	Sept. 15	30	115

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950-98.

	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
1998	Jan. 12	-20	Aug. 6 & 7	92

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center January 1950 through December 1998.

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
1998	25.1	33.0	34.9	44.5	54.1	56.0	68.4	65.6	59.7	42.3	37.0	27.4	45.7
MEAN	22.3	27.7	33.8	43.2	51.7	58.2	64.0	63.0	53.7	43.3	32.5	25.4	43.2

Table 10. Summary of precipitation records at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 thru December 1998.

	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
1998	0.77	0.33	2.64	1.80	5.14	4.64	1.18	0.72	1.48	0.71	1.11	1.47	21.99
MEAN	1.49	1.15	1.19	1.52	2.39	2.98	1.62	1.53	1.60	1.37	1.55	1.64	20.04

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, May 1, 1949 through October 31, 1998. 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
1998	267.5	243.5	567.5	517.0	375.5	85.5	2056.5
MEAN	234.2	332.1	469.6	457.7	282.2	104.4	1880.1

Mean growing degree days for all years = 1880.1

Table 12. Summary of snow data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1998.

Average snow accumulation by month and year

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL
1949-50	0.00	0.00	1.50	17.40	25.20	7.30	4.00	0.00	0.00	0.00	0.00	0.00	55.40
1950-51	0.00	0.00	4.00	7.00	15.10	14.80	7.80	10.00	T	0.00	0.00	0.00	58.70
1951-52	0.00	5.50	6.60	47.20	0.00	10.00	1.80	0.00	T	0.00	0.00	0.00	71.10
1952-53	0.00	0.00	1.00	7.00	8.40	13.10	0.00	0.00	0.00	0.00	0.00	0.00	29.50
1953-54	0.00	0.00	0.00	9.30	30.90	5.00	5.60	4.00	0.00	0.00	0.00	0.00	54.80
1954-55	0.00	0.00	2.00	2.50	16.30	13.10	4.50	0.00	0.00	0.00	0.00	0.00	38.40
1955-56	0.00	T	14.60	18.40	21.50	19.20	3.20	0.00	0.00	0.00	0.00	0.00	76.90
1956-57	0.00	1.50	2.10	3.40	20.50	15.50	0.00	0.00	0.00	0.00	0.00	0.00	43.00
1957-58	0.00	0.30	5.50	3.70	0.00	27.10	6.20	0.00	0.00	0.00	0.00	0.00	42.80
1958-59	0.00	0.00	2.10	21.50	13.70	15.10	0.00	0.00	0.00	0.00	0.00	0.00	52.40
1959-60	0.00	0.00	27.80	0.00	0.00	16.50	4.50	0.00	0.00	0.00	0.00	0.00	48.80
1960-61	0.00	0.00	1.60	13.40	5.40	1.80	0.00	0.00	0.00	0.00	0.00	0.00	22.20
1961-62	0.00	5.00	20.00	23.50	17.90	8.60	3.80	0.00	0.00	0.00	0.00	0.00	78.80
1962-63	0.00	0.00	0.00	2.70	24.70	8.60	2.00	4.00	0.00	0.00	0.00	0.00	42.00
1963-64	0.00	0.00	1.40	16.80	16.90	5.30	15.00	0.40	2.00	0.00	0.00	0.00	57.80
1964-65	0.00	T	8.10	19.30	17.20	8.00	3.40	1.50	T	0.00	0.00	0.00	57.50
1965-66	T	0.00	3.00	0.00	0.00	9.00	0.70	0.00	0.00	0.00	0.00	0.00	12.70
1966-67	0.00	0.00	19.30	12.00	7.80	6.00	9.30	0.00	0.00	0.00	0.00	0.00	54.40
1967-68	0.00	0.00	5.70	11.00	9.30	2.10	0.00	2.70	0.00	0.00	0.00	0.00	30.80
1968-69	0.00	0.00	7.50	21.00	28.80	8.70	3.00	0.00	0.00	0.00	0.00	0.00	69.00
1969-70	0.00	4.00	1.50	10.30	29.20	5.50	7.50	0.00	0.00	0.00	0.00	0.00	58.00
1970-71	T	0.00	8.50	9.50	0.00	4.00	3.50	T	0.00	0.00	0.00	0.00	25.50
1971-72	0.00	3.00	5.50	18.40	15.50	9.20	8.00	4.00	0.00	0.00	0.00	0.00	63.60
1972-73	0.50	4.50	6.00	8.30	4.50	T	T	0.00	0.00	0.00	0.00	0.00	23.80
1973-74	0.00	0.00	9.50	0.00	6.40	6.00	8.00	T	0.00	0.00	0.00	0.00	29.90
1974-75	0.00	0.00	0.00	10.00	22.70	15.75	12.70	0.00	0.00	0.00	0.00	0.00	61.15
1975-76	0.00	3.00	8.75	16.00	15.25	4.50	0.75	0.00	0.00	0.00	0.00	0.00	48.25
1976-77	0.00	0.00	1.00	5.00	13.00	2.50	11.75	2.00	0.00	0.00	0.00	0.00	35.25
1977-78	0.00	0.00	16.50	48.05	30.10	16.50	6.00	1.50	0.00	0.00	0.00	0.00	118.65
1978-79	0.00	0.00	9.60	18.85	22.35	19.78	8.12	3.10	0.00	0.00	0.00	0.00	81.80
1979-80	0.00	0.00	1.65	4.30	14.30	9.05	9.05	0.05	0.00	0.00	0.00	0.00	38.40
1980-81	0.00	0.00	0.75	9.25	6.00	8.90	3.30	0.00	1.75	0.00	0.00	0.00	29.95
1981-82	0.00	0.00	0.50	19.13	25.70	7.60	4.30	4.00	0.00	0.00	0.00	0.00	61.23
1982-83	0.00	0.00	6.25	17.15	6.40	5.20	0.75	0.00	0.00	0.00	0.00	0.00	35.75
1983-84	0.00	0.00	3.85	28.00	8.60	4.80	0.50	0.00	0.05	0.00	0.00	0.00	45.80
1984-85	0.00	10.55	3.00	17.00	4.25	16.00	5.50	1.00	0.00	0.00	0.00	0.00	57.30
1985-86	0.00	0.00	10.50	7.25	14.50	13.00	3.07	0.00	0.00	0.00	0.00	0.00	48.32
1986-87	0.00	0.00	13.50	4.25	7.00	1.50	13.50	0.00	0.00	0.00	0.00	0.00	39.75
1987-88	0.00	0.00	4.00	11.50	8.50	5.50	4.00	1.00	0.00	0.00	0.00	0.00	34.50
1988-89	0.00	0.00	9.50	15.00	9.50	18.75	6.00	0.00	0.00	0.00	0.00	0.00	58.75
1989-90	0.00	0.00	4.00	15.00	5.50	16.75	8.50	1.00	0.00	0.00	0.00	0.00	50.75
1990-91	0.00	0.00	3.75	32.75	17.00	1.00	1.50	1.00	0.00	0.00	0.00	0.00	57.00
1991-92	0.00	7.25	9.50	3.50	8.75	1.50	0.33	1.00	0.00	0.00	0.00	0.00	31.83
1992-93	0.00	0.00	4.07	23.50	15.00	9.00	1.00	0.00	0.00	0.00	0.00	0.00	52.57
1993-94	0.00	0.00	2.85	9.90	1.50	22.00	0.00	2.00	0.00	0.00	0.00	0.00	38.25
1994-95	0.00	0.50	7.27	13.20	2.04	0.00	9.25	0.50	0.00	0.00	0.00	0.00	32.76
1995-96	0.00	0.00	6.00	10.50	23.30	1.00	13.25	0.00	0.00	0.00	0.00	0.00	54.05
1996-97	0.00	1.50	37.00	42.80	12.50	21.30	11.30	2.60	0.00	0.00	0.00	0.00	129.00
1997-98	0.00	0.00	0.50	5.01	9.00	2.25	9.50	0.00	0.00	0.00	0.00	0.00	26.26
MEAN	0.01	0.95	6.72	14.09	13.02	9.46	5.01	0.97	0.08	0.00	0.00	0.00	50.31

Mean snowfall for all years = 50.31

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 Phoenix Harrow	$3,100.00 (Grants)
Purchase of Laser Printer for Research Associate	$1,090.00 (Grants)

Fidel/Raptor Tolerance Study

Raptor is a new member of the imidazolinone herbicide family. Legumes have demonstrated tolerance toward this product, 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.

Raptor was applied at 1, 2, and 4-times the normal use rate with either a nonionic surfactant (NIS)or methylated seed oil (MSO). Treatments were applied in the fall, early spring and late spring when winter wheat was in the 3 leaf, 4 leaf - 2 tiller, and 2-4 tillering stages, respectively.

Overall, injury increased with rate, and was greatest when Raptor was applied with MSO compared to similar treatments applied with NIS. Crop injury was greatest with the early spring applications, and ranged from 6 to 81 percent as rates increased from the 1X to 4X dose. Late spring applications had the lowest yields, even though crop injury was minor. Treatments applied in the fall or early spring produced yields comparable to the nontreated check, regardless of the degree of crop injury observed.

Fidel/Raptor Tolerance Study

Site Description

Crop: Winter Wheat	Variety: Fidel	Planting Date: 9-24-97
Planting Method: Plot drill		Rate, Unit: 70 Lbs./A
Depth, Unit: 1.5"		Row Spacing, Unit: 6"
Soil Moisture: Good		Emergence Date: 10-3-98
Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT	Reps: 3
Site Location: R-3		Study Design: RCB

Plot Maintenance:

Fertility:	9-23-97	36 Lbs. N and 45 Lbs. P
	3-26-98	50 Lbs. N
Weed Control:	4- 2 98	Bronate at 1.5 pt/A
Irrigation:	5- 6-98	.6" with wheel line

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:	10-20-97	4-10-98	4-28-98
Time of Day:	1:30 PM	11:15 AM	11:15 AM
Application Method:	BACKPACK	BACKPACK	BACKPACK
Application Timing:	2 LEAF	E. SPRING	L. SPRING
Air Temp., Unit:	55 F	52 F	62 F
% Relative Humidity:	45	48	60
Wind Velocity, Unit:	0 MPH	1 MPH	0 MPH
Dew Presence (Y/N):	N	N	N
Soil Temp., Unit:	50 F	48 F	60 F
Soil Moisture:	GOOD	GOOD	GOOD
% Cloud Cover:	0	95	0

Plant Species		Plant Stage
W. wheat	10-20-97	2.5 to 3 Leaf
W. wheat	4-10-98	4 Leaf and 2 Tiller
W. wheat	4-28-98	4.5 and 2-4 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

Fidel/Raptor Tolerance Study

Trt No	Treatment Name	Rate	Rate Unit	Grow Stg	WWT INJURY PERCENT 6-14-98	WWT INJURY PERCENT 6-28-98	WWT PLNT/FT2 TOTAL 6-30-98	WWT DRY WT GRM/FT2 6-30-98	WWT TEST WT LBS/BU 7-30-98	WWT YIELD BU/A
1	RAPTOR	0.04	lb ai/A	FALL	0.0	0.0	11.2	93.8	55.3	71.9
1	NIS	.25	% v/v							
1	UAN 28%	1	qt pr/A							
2	RAPTOR	0.08	lb ai/A	FALL	0.0	0.0	12.8	111.3	55.4	72.9
2	NIS	.25	% v/v							
2	UAN	1	qt pr/A							
3	RAPTOR	0.16	lb ai/A	FALL	0.0	0.0	9.4	97.9	55.2	67.9
3	NIS	.25	% v/v							
3	UAN 28%	1	qt pr/A							
4	RAPTOR	0.04	lb ai/A	E.SPR	0.0	1.7	9.1	101.8	56.0	75.2
4	NIS	.25	% v/v							
4	UAN 28%	1	qt pr/A							
5	RAPTOR	0.08	lb ai/A	E.SPR	3.3	8.3	10.4	95.5	55.3	76.4
5	NIS	.25	% v/v							
5	UAN 28%	1	qt pr/A							
6	RAPTOR	0.16	lb ai/A	E.SPR	16.7	31.7	10.4	98.8	55.2	68.8
6	NIS	.25	% v/v							
6	UAN 28%	1	qt pr/A							
7	RAPTOR	0.04	lb ai/A	E.SPR	8.3	6.7	10.8	100.7	56.3	79.0
7	SUNIT	.75	qt pr/A							
7	UAN 28%	1	qt pr/A							
8	RAPTOR	0.08	lb ai/A	E.SPR	11.7	28.3	9.8	104.8	55.4	81.3
8	SUNIT	.75	qt pr/A							
8	UAN 28%	1	qt pr/A							
9	RAPTOR	0.16	lb ai/A	E.SPR	38.3	81.7	11.5	94.3	54.4	74.4
9	SUNIT	.75	qt pr/A							
9	UAN 28%	1	qt pr/A							
10	RAPTOR	0.04	lb ai/A	L.SPR	0.0	0.0	8.4	96.0	55.3	74.0
10	NIS	.25	% v/v							
10	UAN 28%	1	qt pr/A							
11	RAPTOR	0.08	lb ai/A	L.SPR	3.3	6.7	9.8	91.2	55.0	68.6
11	NIS	.25	% v/v							
11	UAN 28%	1	qt pr/A							
12	RAPTOR	0.16	lb ai/A	L.SPR	0.0	0.0	10.9	102.4	54.8	64.7
12	NIS	.25	% v/v							
12	UAN 28%	1	qt pr/A							

CONTINUED...

Fidel/Raptor Tolerance Study

Trt No	Treatment Name	Rate	Rate Unit	Grow Stg	WWT INJURY PERCENT 6-14-98	WWT INJURY PERCENT 6-28-98	WWT PLNT/FT2 TOTAL 6-30-98	WWT DRY WT GRM/FT2 6-30-98	WWT TEST WT LBS/BU 7-30-98	WWT YIELD BU/A
13	RAPTOR	0.04	lb ai/A	L.SPR	6.7	6.7	11.4	97.6	55.4	64.8
13	SUNIT	.75	qt pr/A							
13	UAN 28%	1	qt pr/A							
14	RAPTOR	0.08	lb ai/A	L.SPR	0.0	3.3	11.3	107.1	53.3	65.1
14	SUNIT	.75	qt pr/A							
14	UAN 28%	1	qt pr/A							
15	RAPTOR	0.16	lb ai/A	L.SPR	10.0	21.7	10.5	88.4	54.4	64.8
15	SUNIT	.75	qt pr/A							
15	UAN 28%	1	qt pr/A							
16	NONTREATED				0.0	0.0	11.1	113.5	55.7	77.1
LSD (.05) =					9.4	8.4	3.4	22.5	2.0	10.1
Standard Dev.=					5.62731	5.03115	2.03569	13.5005	1.22828	6.36213
CV =					91.56	40.93	19.30	13.54	2.23	8.46
Treatment F					9.569	53.284	0.827	0.790	0.988	2.412
Treatment Prob(F)					0.0001	0.0001	0.6422	0.6783	0.4909	0.0195

Raptor Screen on Fidel and Downy Brome

Raptor is a new member of the imidazolinone herbicide family. Legumes have demonstrated tolerance toward this product, but not cereals. The exception being `Fidel', a winter wheat cultivar developed by American Cyanamid. Raptor has been reported to be effective in controlling several grassy weeds in winter wheat. This study was conducted to evaluate the tolerance of Fidel winter wheat as well as downy brome to applications of Raptor as a function of herbicide rate, and crop growth stage.

Raptor was applied at 0, 0.16, 0.33, 0.50, 0.66, 0.83, and 1.0-times the normal use rate. Treatments were applied in the fall and early spring when downy brome plants were at the 2-leaf, and 2-tiller stage of development, respectively.

Overall, winter wheat injury was minor. Winter wheat yield components did not respond to any of the treatments. This is probably related to the low downy brome populations present, which consisted of only 8 plants per square foot in the nontreated check. Nonetheless, the weed population present did provide for an assessment of herbicide activity toward downy brome. Downy brome dry weight reductions of 90 percent were achieved at the 0.66X rate. Generally, fall applications were the most efficacious. This response was most evident at the lower rates. As application rates approached the 0.66X dosage, the difference between application timings became negligible.

Raptor Screen on Fidel and Downy Brome

Site Description

Crop: W. Wheat / Dbrome
Variety: Fidel
Planting Date: 9-24-97
Planting Method: Plot drill
Rate, Unit: 70 / 8 Lbs./A
Depth, Unit: 1.5"
Row Spacing, Unit: 6"
Soil Moisture: Good
Emergence Date: 10-3-97 / 10-9-97

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 3
Site location: R-3
Study Design: RCB
Plot Maintenance:

Fertility:	9-23-97	36 Lbs. N and 40 Lbs. P
	3-26-98	50 Lbs. N
Weed Control:	4- 2-98	Bronate at 1.5 pt/A
Irrigation:	5- 6-98	.6" with wheel line

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:	11-3-97	4-10-98
Time of Day:	1:30 PM	11:15 AM
Application Method:	BACKPACK	BACKPACK
Application Timing:	FALL	SPRING
Air Temp., Unit:	46 F	52 F
% Relative Humidity:	64	48
Wind Velocity, Unit:	1 MPH	2 MPH
Dew Presence (Y/N):	Y	N
Soil Temp., Unit:	42 F	48 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:	10	10

Plant Species		Plant Stage	Density at Application
W. wheat	11- 3-97	2.5 to 3 Leaf	
D. brome	11- 3-97	1.5 to 2 Leaf	10 plants/ft2
W. wheat	4-10-98	4 Leaf and 2 Tiller	
D. brome	4-10-98	4 Leaf and 2 Tiller	7 plants/ft2

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

Raptor Screen on Fidel and Downy Brome

Trt No	Treatment Name	Rate	Grow Stg	DBROME CONTROL PERCENT 5-13-98	DBROME HT INCH 6-11-98	DBROME PLNT/FT2 6-11-98	DBROME HEAD/FT2 6-11-98	DBROME DWT VEG GRMS/F2 6-11-98	DBROME DWT REP GRMS/F2 6-11-98	DBROME DWT TOT GRMS/F2 6-11-98
1	UNTREATED		FALL	0.0	36.3	6.2	13.6	5.6	3.2	8.8
2	RAPTOR	.008	FALL	41.7	31.7	5.5	10.7	2.6	1.4	4.0
2	NIS	.25								
2	UAN 28%	1								
3	RAPTOR	.016	FALL	75.3	26.7	3.4	5.7	1.3	0.6	1.9
3	NIS	.25								
3	UAN 28%	1								
4	RAPTOR	.024	FALL	83.7	25.3	3.1	5.1	0.8	0.3	1.1
4	NIS	.25								
4	UAN 28%	1								
5	RAPTOR	.032	FALL	98.3	26.0	3.7	5.4	0.5	0.2	0.7
5	NIS	.25								
5	UAN 28%	1								
6	RAPTOR	.040	FALL	94.0	20.7	1.6	2.2	0.2	0.1	0.3
6	NIS	.25								
6	UAN 28%	1								
7	RAPTOR	.048	FALL	100.0	18.7	1.7	2.1	0.2	0.0	0.2
7	NIS	.25								
7	UAN 28%	1								
8	HANDWEEDED		FALL	100.0	12.0	0.3	0.0	0.0	0.0	0.0
9	UNTREATED		SPRING	0.0	34.3	8.4	21.7	7.2	3.8	11.0
10	RAPTOR	.008	SPRING	15.0	35.3	11.8	27.1	5.9	3.0	9.0
10	NIS	.25								
10	UAN 28%	1								
11	RAPTOR	.016	SPRING	80.0	23.0	9.3	26.5	2.9	1.3	4.2
11	NIS	.25								
11	UAN 28%	1								
12	RAPTOR	.024	SPRING	93.3	18.7	6.7	15.6	1.5	0.3	1.9
12	NIS	.25								
12	UAN 28%	1								
13	RAPTOR	.032	SPRING	98.0	18.3	4.3	12.7	0.9	0.1	1.1
13	NIS	.25								
13	UAN 28%	1								
14	RAPTOR	.040	SPRING	97.7	19.3	4.9	10.2	0.8	0.2	1.0
14	NIS	.25								
14	UAN 28%	1								

CONTINUED...

Raptor Screen on Fidel and Downy Brome

Trt No	Treatment Name	Rate	Grow Stg	DBROME CONTROL PERCENT 5-13-98	DBROME HT INCH 6-11-98	DBROME PLNT/FT2 6-11-98	DBROME HEAD/FT2 6-11-98	DBROME DWT VEG GRMS/F2 6-11-98	DBROME DWT REP GRMS/F2 6-11-98	DBROME DWT TOT GRMS/F2 6-11-98
15	RAPTOR	.048	SPRING	100.0	13.0	3.6	2.7	0.2	0.0	0.3
15	NIS	.25								
15	UAN 28%	1								
16	HANDWEEDED		SPRING	100.0	30.0	0.2	0.4	0.1	0.0	0.1
17	RAPTOR	.024	FALL	100.0	7.0	1.7	0.8	0.0	0.0	0.0
17	NIS	.25								
17	UAN 28%	1								
17	RAPTOR	.024	SPRING							
17	NIS	.25								
17	UAN 28%	1								
	LSD (.05) =			11.1	10.1	4.6	9.9	1.6	0.9	2.5
	Standard Dev.=			6.68377	6.05566	2.76366	5.96141	.967690	.527725	1.48744
	CV =			8.90	25.97	61.47	62.35	53.59	61.03	55.49
	Treatment F			90.115	5.951	4.065	6.689	16.942	17.235	17.169
	Treatment Prob(F)			0.0001	0.0001	0.0004	0.0001	0.0001	0.0001	0.0001

Raptor Screen on Fidel and Downy Brome

Trt No	Treatment Name	Rate	Grow Stg	WWT CI % 14 DAYS	WWT CI % 56 DAYS	WWT PLANT/ FT2 6-11-98	WWT HEAD/ FT2 6-11-98	WWT DWT/FT2 GRAMS 6-11-98	WWT TEST WT LB/BU	WWT YIELD BU/A
1	UNTREATED		FALL	0.0	0.0	11.3	38.4	74.8	54.6	61.1
2	RAPTOR	.008	FALL	0.0	0.0	10.0	30.2	62.5	53.1	60.6
2	NIS	.25								
2	UAN 28%	1								
3	RAPTOR	.016	FALL	0.0	0.0	10.1	31.7	77.2	54.1	70.7
3	NIS	.25								
3	UAN 28%	1								
4	RAPTOR	.024	FALL	0.0	3.3	10.3	31.5	64.6	51.8	57.5
4	NIS	.25								
4	UAN 28%	1								
5	RAPTOR	.032	FALL	0.0	3.3	10.4	31.4	71.0	52.0	57.0
5	NIS	.25								
5	UAN 28%	1								
6	RAPTOR	.040	FALL	0.0	0.0	8.4	33.9	69.9	53.6	65.9
6	NIS	.25								
6	UAN 28%	1								
7	RAPTOR	.048	FALL	0.0	11.7	11.4	35.1	71.7	54.7	68.0
7	NIS	.25								
7	UAN 28%	1								
8	HANDWEEDED		FALL	0.0	6.7	11.3	37.8	74.1	53.7	64.1
9	UNTREATED		SPRING	0.0	0.0	11.6	37.0	68.4	55.2	63.1
10	RAPTOR	.008	SPRING	0.0	0.0	10.9	35.5	70.6	54.7	60.0
10	NIS	.25								
10	UAN 28%	1								
11	RAPTOR	.016	SPRING	3.3	0.0	10.7	30.7	67.7	55.0	58.8
11	NIS	.25								
11	UAN 28%	1								
12	RAPTOR	.024	SPRING	0.0	11.7	10.8	28.8	63.3	52.3	53.1
12	NIS	.25								
12	UAN 28%	1								
13	RAPTOR	.032	SPRING	0.0	3.3	9.5	30.9	72.1	54.8	59.5
13	NIS	.25								
13	UAN 28%	1								
14	RAPTOR	.040	SPRING	13.3	3.3	10.4	30.7	64.3	54.5	59.0
14	NIS	.25								
14	UAN 28%	1								

CONTINUED...

Raptor Screen on Fidel and Downy Brome

Trt No	Treatment Name	Rate	Grow Stg	WWT CI % 14 DAYS	WWT CI % 56 DAYS	WWT PLANT/ FT2 6-11-98	WWT HEAD/ FT2 6-11-98	WWT DWT/FT2 GRAMS 6-11-98	WWT TEST WT LB/BU	WWT YIELD BU/A
15	RAPTOR	.048	SPRING	6.7	6.7	9.6	32.3	66.4	54.7	62.3
15	NIS	.25								
15	UAN 28%	1								
16	HANDWEEDED		SPRING	0.0	3.3	12.1	36.9	67.1	54.9	64.8
17	RAPTOR	.024	FALL	3.3	3.3	9.2	29.3	62.7	54.9	68.8
17	NIS	.25								
17	UAN 28%	1								
17	RAPTOR	.024	SPRING							
17	NIS	.25								
17	UAN 28%	1								
LSD (.05) =				6.3	6.8	2.9	8.4	16.5	2.9	11.7
Standard Dev.=				3.75408	4.04857	1.74939	5.05290	9.9046	1.75727	7.02117
CV =				239.32	121.46	16.72	15.28	14.41	3.25	11.32
Treatment F				2.696	2.733	0.908	1.136	0.608	1.192	1.301
Treatment Prob(F)				0.0083	0.0076	0.5679	0.3665	0.8535	0.3251	0.2556

Effects of Crop Seeding Rates and Banding Patterns on Wild Oat Management

Weed competition can be lessened by improving the competitiveness of cereal grain crops. Several factors can be reconfigured to aid in this endeavor. Greater crop densities and narrow row spacings increase crop leaf area and canopy development. This in turn shades weeds and suppresses their growth and development. The advent of air drills coupled with openers capable of placing seed in varying band widths offers a means by which row spacings can indirectly be narrowed. The objective of this study was to evaluate the combined effects of greater seeding rates plus wide banded seeding patterns for the suppression of wild oat.

Ernest spring wheat was seeded at 60 and 120 lb/A in band widths of 4, 5, and 6 inches. Planting patterns were achieved by using a Concord air drill and Farmland double shoot openers equipped with various sweep widths and spreader attachments. These treatments were superimposed on wild oat densities of 0, 5, 10, and 15 plants per square foot. Otana tame oat was used to simulate wild oat competition, which also allowed for the determination of wild oat grain yield.

Wild oat dry weight and grain yield decreased as spring wheat density and banding width increased. The impact of band width on wild oat grain yield was most evident at the higher wild oat densities. Spring wheat dry weight, tiller number, plants per square foot and grain yield increased as spring wheat density and band width increased. This response occurred even when wild oat was not present. This indicates that both factors not only improve crop competitiveness, but overall agronomic performance as well. Band width and crop density had no effect on spring wheat protein. However, as wild oat density increased from 0 to 15 plants per square foot, grain protein decreased from 17 to 16 percent.

Effects of Crop Seeding Rates and Banding Patterns on Wild Oat Management

Site Description

Crop: Spring Wheat
Variety: Ernest
Planting Date: 4-30-98
Planting Method: Air Drill
Rate, Unit: 60 & 120 Lbs/A
Depth, Unit: 2"
Row Spacing, Unit: 12"
Soil Moisture: Good
Harvest Date: 8-17-98

Plot Width, Unit: 10 FT
Plot Length, Unit: 50 FT
Reps: 3
Site Location: Havre (NARC)
Study Design: Split-Plot
Plot Maintenance:

Fertility:	4-30-98	70 Lbs. N, 40 Lbs. P, and 25 Lbs. K
Weed Control:		Bronate
Previous Crop:		Fallow
Growing Season Precip:		9.3"

***"Wild oats" seeded parallel to crop rows in 12" rows and Triple K incorporated preplant

Soil Description

Soil Name: Telstead/Joplin Clay-Loam

Effects of Crop Seeding Rates and Banding Patterns on Wild Oat Management

Trt No	Treatment Name	CANOPY LAI 7-13-98	CANOPY DIFN 7-13-98	W. OATS PLANTS / FT2 7-14-98	W. OATS HEADS / FT2 7-14-98	W. OATS DRY WT GRAM/FT2 7-14-98	W. OATS SEED BIO GRAM/FT2	W. OATS TWT LBS/BU 10-27-98
1 1 1	WILD OAT 0 1" BAND BARLEY 60	1.820	0.2720	0.0	0.0	0.0	0.0	0.0
2 2 2	WILD OAT 0 1" BAND BARLEY 120	1.707	0.2780	0.0	0.0	0.0	0.0	0.0
3 3 3	WILD OAT 0 3" BAND BARLEY 60	1.673	0.3283	0.0	0.0	0.0	0.0	0.0
4 4 4	WILD OAT 0 3" BAND BARLEY 120	1.833	0.2913	0.0	0.0	0.0	0.0	0.0
5 5 5	WILD OAT 0 6" BAND BARLEY 60	1.800	0.2700	0.0	0.0	0.0	0.0	0.0
6 6 6	WILD OAT 0 6" BAND BARLEY 120	1.853	0.2400	0.0	0.0	0.0	0.0	0.0
7 7 7	WILD OAT 10 1" BAND BARLEY 60	1.943	0.3063	3.8	8.6	16.5	3.1	29.4
8 8 8	WILD OAT 10 1" BAND BARLEY 120	1.973	0.2867	3.0	5.6	9.4	1.7	30.9
9 9 9	WILD OAT 10 3" BAND BARLEY 60	2.093	0.2543	2.5	5.6	10.4	1.9	29.8
10 10 10	WILD OAT 10 3" BAND BARLEY 120	1.827	0.3320	2.8	4.8	6.9	1.4	31.4
11 11 11	WILD OAT 10 6" BAND BARLEY 60	2.177	0.2393	3.6	7.1	11.8	2.3	30.0
12 12 12	WILD OAT 10 6" BAND BARLEY 120	1.843	0.3080	2.5	4.8	6.3	1.2	29.3
13 13 13	WILD OAT 20 1" BAND BARLEY 60	2.687	0.1687	9.5	17.7	30.6	5.6	28.7

CONTINUED...

Effects of Crop Seeding Rates and Banding Patterns on Wild Oat Management

Trt No	Treatment Name	CANOPY LAI 7-13-98	CANOPY DIFN 7-13-98	W. OATS PLANTS / FT2 7-14-98	W. OATS HEADS / FT2 7-14-98	W. OATS DRY WT GRAM/FT2 7-14-98	W. OATS SEED BIO GRAM/FT2	W. OATS TWT LBS/BU 10-27-98
14 14 14	WILD OAT 20 1" BAND BARLEY 120	2.533	0.1740	8.9	15.7	25.5	4.8	28.8
15 15 15	WILD OAT 20 3" BAND BARLEY 60	2.177	0.2787	7.0	12.3	17.4	3.1	29.8
16 16 16	WILD OAT 20 3" BAND BARLEY 120	2.273	0.2147	9.5	15.0	18.0	3.6	30.2
17 17 17	WILD OAT 20 6" BAND BARLEY 60	2.443	0.1950	8.1	13.1	20.2	3.4	30.0
18 18 18	WILD OAT 20 6" BAND BARLEY 120	2.237	0.2077	9.4	20.1	19.7	4.0	31.0
19 19 19	WILD OAT 30 1" BAND BARLEY 60	2.940	0.1870	18.0	33.5	53.7	9.9	31.9
20 20 20	WILD OAT 30 1" BAND BARLEY 120	2.507	0.1880	14.3	25.6	42.9	7.3	31.6
21 21 21	WILD OAT 30 3" BAND BARLEY 60	2.567	0.1813	17.2	29.1	39.0	7.8	30.7
22 22 22	WILD OAT 30 3" BAND BARLEY 120	2.173	0.2120	15.0	27.7	33.5	7.5	33.1
23 23 23	WILD OAT 30 6" BAND BARLEY 60	2.860	0.1557	17.2	31.6	39.7	7.9	31.4
24 24 24	WILD OAT 30 6" BAND BARLEY 120	2.520	0.1723	11.7	21.7	23.3	5.3	32.4
	LSD (.05) =	0.684	0.1132	4.5	7.3	11.3	1.8	2.3
	Standard Dev.=	.414590	.068575	2.72599	4.43702	6.87153	1.07044	1.39692
	CV =	18.97	28.67	39.93	35.56	38.85	31.43	6.09
	Treatment F	2.428	1.935	15.463	18.994	15.656	23.781	283.026
	Treatment Prob(F)	0.0052	0.0283	0.0001	0.0001	0.0001	0.0001	0.0001

Effects of Crop Seeding Rates and Banding Patterns on Wild Oat Management

Trt No	Treatment Name	W.OATS YIELD BU/ACRE	SPR WHT PLANTS / FT2 7-14-98	SPR WHT HEADS / FT2 7-14-98	SPR WHT DRY WT GRAM/FT2 7-14-98	SPR WHT PROTEIN PERCENT	SPR WHT TST WT LBS/BU 10-6-98	SPR WHT YIELD BU/ACRE
1 1 1	WILD OAT 0 1" BAND BARLEY 60	0.0	10.5	32.4	57.9	17.47	57.3	33.4
2 2 2	WILD OAT 0 1" BAND BARLEY 120	0.0	17.3	36.6	58.1	17.00	58.8	32.1
3 3 3	WILD OAT 0 3" BAND BARLEY 60	0.0	12.4	30.7	55.1	17.00	58.5	33.0
4 4 4	WILD OAT 0 3" BAND BARLEY 120	0.0	17.4	46.8	63.5	16.90	59.4	35.8
5 5 5	WILD OAT 0 6" BAND BARLEY 60	0.0	13.2	35.4	55.0	17.17	58.4	33.3
6 6 6	WILD OAT 0 6" BAND BARLEY 120	0.0	22.5	50.5	68.9	16.47	60.4	37.6
7 7 7	WILD OAT 10 1" BAND BARLEY 60	11.5	10.6	26.2	45.5	17.33	57.5	25.2
8 8 8	WILD OAT 10 1" BAND BARLEY 120	6.3	17.3	34.8	47.0	16.60	60.1	31.0
9 9 9	WILD OAT 10 3" BAND BARLEY 60	8.7	11.9	33.3	51.0	16.93	58.4	26.8
10 10 10	WILD OAT 10 3" BAND BARLEY 120	4.9	24.1	45.4	51.6	16.50	59.8	30.0
11 11 11	WILD OAT 10 6" BAND BARLEY 60	11.0	13.8	34.7	43.5	17.13	58.4	25.3
12 12 12	WILD OAT 10 6" BAND BARLEY 120	4.7	20.3	43.6	57.8	16.80	59.7	32.9
13 13 13	WILD OAT 20 1" BAND BARLEY 60	26.5	9.7	26.0	36.9	16.93	57.9	17.4

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Effects of Crop Seeding Rates and Banding Patterns on Wild Oat Management

Trt No	Treatment Name	W.OATS YIELD BU/ACRE	SPR WHT PLANTS / FT2 7-14-98	SPR WHT HEADS / FT2 7-14-98	SPR WHT DRY WT GRAM/FT2 7-14-98	SPR WHT PROTEIN PERCENT	SPR WHT TST WT LBS/BU 10-6-98	SPR WHT YIELD BU/ACRE
14 14 14	WILD OAT 20 1" BAND BARLEY 120	15.1	15.4	30.0	37.2	16.60	60.1	26.3
15 15 15	WILD OAT 20 3" BAND BARLEY 60	18.0	12.8	32.0	45.5	16.37	60.0	23.3
16 16 16	WILD OAT 20 3" BAND BARLEY 120	14.9	19.8	31.5	46.3	16.40	60.8	26.5
17 17 17	WILD OAT 20 6" BAND BARLEY 60	19.4	10.9	28.9	41.5	16.37	59.8	24.0
18 18 18	WILD OAT 20 6" BAND BARLEY 120	14.2	22.5	31.1	48.0	16.47	60.7	28.1
19 19 19	WILD OAT 30 1" BAND BARLEY 60	41.2	11.1	19.7	27.5	15.90	59.9	14.1
20 20 20	WILD OAT 30 1" BAND BARLEY 120	31.3	18.9	21.9	30.2	16.33	60.6	19.7
21 21 21	WILD OAT 30 3" BAND BARLEY 60	33.9	12.7	24.4	32.6	15.80	60.3	17.9
22 22 22	WILD OAT 30 3" BAND BARLEY 120	25.8	24.2	35.5	39.4	15.83	61.5	22.6
23 23 23	WILD OAT 30 6" BAND BARLEY 60	28.4	14.4	28.4	36.3	16.10	60.5	20.5
24 24 24	WILD OAT 30 6" BAND BARLEY 120	23.4	26.1	37.5	44.3	16.07	61.6	23.4
LSD (.05) =		6.3	5.0	7.4	12.2	0.89	1.9	5.5
Standard Dev.=		3.80672	3.04943	4.46561	7.37044	.538288	1.16476	3.32483
CV =		26.92	18.77	13.44	15.79	3.24	1.95	12.46
Treatment F		31.698	8.134	8.750	6.171	2.288	3.177	10.513
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0084	0.0004	0.0001

Effects of Crop Seeding Rates, Broadcast Seeding Patterns, and Reduced Herbicide Rates for Wild Oat Control

Weed competition can be lessened by improving the competitiveness of cereal grain crops. Several factors can be reconfigured to aid in this endeavor. Greater crop densities and narrow row spacings increase crop leaf area and canopy development. This in turn shades weeds and suppresses their growth and development. The use of pneumatic fertilizer spreaders which broadcast cereal grain seed offers a means by which row spacings can indirectly be narrowed. Higher seeding rates and broadcast seeding patterns should create a more competitive cropping system and may allow for the use of reduced herbicide inputs. The objective of this study was to evaluate the combined effects of greater seeding rates plus broadcast seeding patterns in combination with reduced rates of Assert for the control of wild oat.

Gallatin spring barley was seeded at 60, 110, and 150 lb/A in conventional 6 inch drill row spacings or broadcast patterns. These treatments were superimposed over postemergence applications of Assert at rates of 0, 0.25, 0.50, and 1-times the normal use rate.

Differences between seeding patterns were minor. Spring barley grain yield increased as seeding rates and Assert rates increased. Wild oat dry weight, plants per square foot, and seed yield decreased as spring barley density increased. This effect was amplified when combined with reduced rates of Assert. When combined with the highest barley seeding density, the 0.25 rate of Assert reduced wild oat competition to the same degree as that achieved with the 1.0 Assert rate at the standard seeding density.

Effects of Crop Seeding Rates, Broadcast Seeding Patterns, and Reduced Herbicide Rates for Wild Oat Control

Site Description

Crop: Barley
Variety: Gallatin
Planting Date: 4-15-98
Planting Method: Broadcast & Drill
Rate, Unit: 60, 110, & 150 Lbs/A
Depth, Unit: 0-3"
Row Spacing, Unit: 6"
Soil Moisture: Good
Emergence Date: 4-26-98
Harvest Date: 8-8-98

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 4
Site Location: R-3
Study Design: Factorial
Plot Maintenance:

Fertility:	4- 6-98	64 Lbs. N and 33 Lbs. P
	5-12-98	30 Lbs. N
Weed Control:	Express at .25 oz + 2,4-D at .25 pt/A	
	Stampede at 1.4 lbs + MCPA at .5 pt/A	
Irrigation:	.6" with wheel line	

***Wild oats broadcast seeded at 25 live seeds/ft2 and incorporated with vibershank

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:	5-19-98
Time of Day:	2:00 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	78 F
% Relative Humidity:	46
Wind Velocity, Unit:	1-2 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	75 F
Soil Moisture:	GOOD
% Cloud Cover:	50

Plant Species	Plant Stage
Wild Oats	4 Leaf and 2 Tiller
Barley	5 Leaf and 4 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

Effects of Crop Seeding Rates, Broadcast Seeding Patterns, and Reduced Herbicide Rates for Wild Oat Control

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	W. OAT CONTROL PERCENT 7-30-98	W. OAT PLANTS / FT2 7-22-98	W. OAT DRY WT GRMS/FT2 7-22-98	W. OAT SEED WT 200 SUB 9-16-98	W. OAT SEED # 200 SUB 9-16-98
1	BROADCAST				5.0	12.2	16.7	9.350	389.0
1	60 #/A								
1	NONTREATED								
2	BROADCAST				63.5	10.2	13.7	5.325	254.3
2	60 #/A								
2	ASSERT	2.5	EC	.12					
3	BROADCAST				93.3	9.6	6.5	2.075	105.8
3	60 #/A								
3	ASSERT	2.5	EC	.23					
4	BROADCAST				99.8	7.5	2.8	1.100	62.3
4	60 #/A								
4	ASSERT	2.5	EC	.46					
5	BROADCAST				12.5	11.1	12.8	6.750	266.8
5	110 #/A								
5	NONTREATED								
6	BROADCAST				89.8	6.6	3.7	2.100	98.0
6	110 #/A								
6	ASSERT	2.5	EC	.12					
7	BROADCAST				97.5	9.8	4.1	1.200	59.3
7	110 #/A								
7	ASSERT	2.5	EC	.23					
8	BROADCAST				99.5	7.7	2.6	0.850	48.5
8	110 #/A								
8	ASSERT	2.5	EC	.46					
9	BROADCAST				38.8	12.3	12.5	3.225	129.8
9	150 #/A								
9	NONTREATED								
10	BROADCAST				93.3	10.1	5.0	1.425	69.5
10	150 #/A								
10	ASSERT	2.5	EC	.12					
11	BROADCAST				97.5	4.3	1.6	1.148	52.8
11	150 #/A								
11	ASSERT	2.5	EC	.23					
12	BROADCAST				99.5	8.1	2.4	0.400	22.0
12	150 #/A								
12	ASSERT	2.5	EC	.46					

CONTINUED...

Effects of Crop Seeding Rates, Broadcast Seeding Patterns, and Reduced Herbicide Rates for Wild Oat Control

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	W. OAT CONTROL PERCENT 7-30-98	W. OAT PLANTS / FT2 7-22-98	W. OAT DRY WT GRMS/FT2 7-22-98	W. OAT SEED WT 200 SUB 9-16-98	W. OAT SEED # 200 SUB 9-16-98
13	6" DRILL				0.0	9.8	22.4	6.725	310.3
13	60 #/A								
13	NONTREATED								
14	6" DRILL				70.8	13.4	11.8	3.125	159.3
14	60 #/A								
14	ASSERT	2.5	EC	.12					
15	6" DRILL				96.0	9.6	5.5	1.925	101.8
15	60 #/A								
15	ASSERT	2.5	EC	.23					
16	6" DRILL				98.8	7.7	3.5	1.025	56.5
16	60 #/A								
16	ASSERT	2.5	EC	.46					
17	6" DRILL				23.8	12.0	13.0	5.450	221.0
17	110 #/A								
17	NONTREATED								
18	6" DRILL				88.5	6.8	3.7	1.575	75.5
18	110 #/A								
18	ASSERT	2.5	EC	.12					
19	6" DRILL				95.8	7.1	4.2	1.500	80.3
19	110 #/A								
19	ASSERT	2.5	EC	.23					
20	6" DRILL				99.3	5.0	1.5	0.300	20.8
20	110 #/A								
20	ASSERT	2.5	EC	.46					
21	6" DRILL				28.8	7.8	9.4	3.600	147.0
21	150 #/A								
21	NONTREATED								
22	6" DRILL				94.3	9.3	3.9	1.175	55.3
22	150 #/A								
22	ASSERT	2.5	EC	.12					
23	6" DRILL				98.8	7.3	3.1	1.000	52.0
23	150 #/A								
23	ASSERT	2.5	EC	.23					
24	6" DRILL				100.0	2.6	0.8	0.225	12.0
24	150 #/A								
24	ASSERT	2.5	EC	.46					
	LSD (.05) =				12.5	5.0	4.0	1.197	54.3
	Standard Dev.=				8.80379	3.52401	2.82629	.846539	38.3723
	CV =				11.84	40.75	40.65	32.47	32.32
	Treatment F				63.110	2.237	16.206	32.486	26.977
	Treatment Prob(F)				0.0001	0.0054	0.0001	0.0001	0.0001

Effects of Crop Seeding Rates, Broadcast Seeding Patterns, and Reduced Herbicide Rates for Wild Oat Control

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	BARLEY PLANTS / FT2 7-22-98	BARLEY HEADS / FT2 7-22-98	BARLEY DRY WT GRMS/FT2 7-22-98	BARLEY YIELD BU/A 8-8-98	BARLEY TEST WT LBS/BU	BARLEY PLUMP PERCENT
1	BROADCAST				13.4	58.0	89.0	82.3	51.7	88.0
1	60 #/A									
1	NONTREATED									
2	BROADCAST				8.5	60.6	87.5	89.9	51.2	88.0
2	60 #/A									
2	ASSERT	2.5	EC	.12						
3	BROADCAST				14.9	76.7	115.8	95.4	51.6	91.0
3	60 #/A									
3	ASSERT	2.5	EC	.23						
4	BROADCAST				11.2	60.3	85.5	92.1	51.8	90.3
4	60 #/A									
4	ASSERT	2.5	EC	.46						
5	BROADCAST				18.0	67.9	101.6	87.7	50.3	81.3
5	110 #/A									
5	NONTREATED									
6	BROADCAST				20.7	79.4	107.0	97.4	51.1	86.3
6	110 #/A									
6	ASSERT	2.5	EC	.12						
7	BROADCAST				19.3	56.7	108.2	98.1	50.9	85.5
7	110 #/A									
7	ASSERT	2.5	EC	.23						
8	BROADCAST				17.0	79.3	111.3	101.0	51.2	85.3
8	110 #/A									
8	ASSERT	2.5	EC	.46						
9	BROADCAST				22.7	60.8	88.4	93.3	50.4	82.5
9	150 #/A									
9	NONTREATED									
10	BROADCAST				28.4	76.2	107.2	99.0	50.6	83.0
10	150 #/A									
10	ASSERT	2.5	EC	.12						
11	BROADCAST				25.4	79.4	121.1	97.2	50.3	80.0
11	150 #/A									
11	ASSERT	2.5	EC	.23						
12	BROADCAST				27.3	90.7	113.8	94.2	51.0	84.0
12	150 #/A									
12	ASSERT	2.5	EC	.46						

CONTINUED...

Effects of Crop Seeding Rates, Broadcast Seeding Patterns, and Reduced Herbicide Rates for Wild Oat Control

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	BARLEY PLANTS / FT2 7-22-98	BARLEY HEADS / FT2 7-22-98	BARLEY DRY WT GRMS/FT2 7-22-98	BARLEY YIELD BU/A 8-8-98	BARLEY TEST WT LBS/BU	BARLEY PLUMP PERCENT
13	6" DRILL				9.8	47.8	79.2	86.9	51.2	84.3
13	60 #/A									
13	NONTREATED									
14	6" DRILL				9.3	42.7	68.1	93.3	51.3	86.5
14	60 #/A									
14	ASSERT	2.5	EC	.12						
15	6" DRILL				10.7	48.8	72.7	97.0	51.6	91.8
15	60 #/A									
15	ASSERT	2.5	EC	.23						
16	6" DRILL				11.8	67.1	95.7	94.7	51.8	88.3
16	60 #/A									
16	ASSERT	2.5	EC	.46						
17	6" DRILL				16.8	56.6	82.8	94.0	50.7	84.0
17	110 #/A									
17	NONTREATED									
18	6" DRILL				18.7	64.3	97.9	101.1	51.0	84.8
18	110 #/A									
18	ASSERT	2.5	EC	.12						
19	6" DRILL				17.5	75.9	113.3	104.0	51.4	87.0
19	110 #/A									
19	ASSERT	2.5	EC	.23						
20	6" DRILL				15.7	60.3	84.7	110.6	51.5	89.0
20	110 #/A									
20	ASSERT	2.5	EC	.46						
21	6" DRILL				25.0	57.3	86.8	98.7	50.6	82.8
21	150 #/A									
21	NONTREATED									
22	6" DRILL				21.5	70.4	99.4	105.3	50.8	64.0
22	150 #/A									
22	ASSERT	2.5	EC	.12						
23	6" DRILL				22.9	63.3	87.1	107.0	50.6	83.5
23	150 #/A									
23	ASSERT	2.5	EC	.23						
24	6" DRILL				18.9	65.0	97.5	108.0	50.9	81.8
24	150 #/A									
24	ASSERT	2.5	EC	.46						
LSD (.05) =					6.7	17.7	24.6	10.9	0.7	12.9
Standard Dev.=					4.76116	12.5476	17.4082	7.72827	.515335	9.10377
CV =					26.88	19.24	18.15	7.97	1.01	10.75
Treatment F					5.958	3.411	2.682	3.191	3.231	1.407
Treatment Prob(F)					0.0001	0.0001	0.0009	0.0001	0.0001	0.1402

Effects of Crop Seeding Rates and Broadcast Seeding Patterns on Wild Oat Management

Weed competition can be lessened by improving the competitiveness of cereal grain crops. Several factors can be reconfigured to aid in this endeavor. Greater crop densities and narrow row spacings increase crop leaf area and canopy development. This in turn shades weeds and suppresses their growth and development. The use of pneumatic fertilizer spreaders which broadcast cereal grain seed offers a means by which row spacings can indirectly be narrowed. The objective of this study was to evaluate the combined effects of greater seeding rates plus broadcast seeding patterns for the suppression of wild oat.

Gallatin spring barley was seeded at 60, 110, and 150 lb/A in conventional 6 inch drill row spacings or broadcast patterns. These treatments were superimposed on wild oat densities of 0, 5, 10, and 15 plants per square foot.

Wild oat dry weight, plants per square foot, and seed yield decreased as spring barley density increased. Spring barley grain yield increased as seeding rates increased. Differences between seeding patterns were minor. However, drilled patterns appeared to be slightly more competitive in suppressing wild oat.

Effects of Crop Seeding Rates and Broadcast Seeding Patterns on Wild Oat Management

Site Description

Crop: Barley
Variety: Gallatin
Planting Date: 4-15-98
Planting Method: Broadcast & Drill
Rate, Unit: 60, 110, & 150 Lbs/A
Depth, Unit: Brdcst= 0-3", Drill= 1.5"
Row Spacing, Unit: Drill= 6"
Soil Moisture: Good
Emergence Date: 4-26-98

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 4
Site Location: R-3
Study Design: Split-Plot
Plot Maintenance:

Fertility:	4- 6-98	64 Lbs. N and 33 Lbs. P
	5-12-98	30 Lbs. N
Weed Control:	5- 7-98	Express at .25 oz. + 2, 2-D at .25 pt./A
	5- 9-98	Stampede at 1.4 Lbs. + MCPA at .5 pt./A
Irrigation:	5- 6-98	.6" with wheel line delivery

*** Wild oats broadcast seeded by hand at desired plants/ft2

Soil Description

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

Effects of Crop Seeding Rates and Broadcast Seeding Patterns on Wild Oat Management

Trt No	Treatment Name	WILD OAT PLANTS / FT2 7-27-98	WILD OAT DRY WT GRAMS/FT2 7-27-98	WILD OAT HARVEST #/SUB	WILD OAT HARVEST GRAMS/SUB	BARLEY HD DATE PERCENT 6-23-98	BARLEY H2O PERCENT 8-7-98
1 1 1	WILD OAT 0 BROADCAST BARLEY 16	0.0	0.0	3.8	0.100	65.0	10.4
2 2 2	WILD OAT 0 BROADCAST BARLEY 26	0.0	0.0	7.3	0.130	82.5	10.0
3 3 3	WILD OAT 0 BROADCAST BARLEY 36	0.0	0.0	4.6	0.059	92.5	10.1
4 4 4	WILD OAT 0 DRILL BARLEY 16	0.0	0.0	3.0	0.038	75.0	10.9
5 5 5	WILD OAT 0 DRILL BARLEY 26	0.0	0.0	1.5	0.015	86.3	10.0
6 6 6	WILD OAT 0 DRILL BARLEY 36	0.0	0.0	4.3	0.098	92.5	10.0
7 7 7	WILD OAT 8 BROADCAST BARLEY 16	4.9	5.1	114.8	2.688	46.3	10.6
8 8 8	WILD OAT 8 BROADCAST BARLEY 26	4.5	2.1	49.3	1.113	65.0	10.6
9 9 9	WILD OAT 8 BROADCAST BARLEY 36	2.9	2.7	33.3	0.743	85.0	10.5
10 10 10	WILD OAT 8 DRILL BARLEY 16	2.6	3.6	118.0	2.758	61.3	10.1
11 11 11	WILD OAT 8 DRILL BARLEY 26	4.4	4.0	55.0	1.232	83.8	9.8
12 12 12	WILD OAT 8 DRILL BARLEY 36	4.4	2.5	37.5	0.898	87.0	9.8
13 13 13	WILD OAT 16 BROADCAST BARLEY 16	9.5	17.6	184.5	4.228	41.3	10.2

CONTINUED...

Effects of Crop Seeding Rates and Broadcast Seeding Patterns on Wild Oat Management

Trt No	Treatment Name	WILD OAT PLANTS / FT2 7-27-98	WILD OAT DRY WT GRAMS/FT2 7-27-98	WILD OAT HARVEST #/SUB	WILD OAT HARVEST GRAMS/SUB	BARLEY HD DATE PERCENT 6-23-98	BARLEY H2O PERCENT 8-7-98
14 14 14	WILD OAT 16 BROADCAST BARLEY 26	7.1	8.2	123.0	2.865	82.5	10.0
15 15 15	WILD OAT 16 BROADCAST BARLEY 36	4.8	4.7	78.8	1.875	82.5	9.9
16 16 16	WILD OAT 16 DRILL BARLEY 16	6.6	8.4	144.8	3.248	63.8	9.8
17 17 17	WILD OAT 16 DRILL BARLEY 26	6.0	5.4	136.0	2.113	90.0	9.7
18 18 18	WILD OAT 16 DRILL BARLEY 36	7.2	5.3	101.8	2.423	94.0	9.8
19 19 19	WILD OAT 32 BROADCAST BARLEY 16	14.1	20.4	467.8	10.773	43.8	10.1
20 20 20	WILD OAT 32 BROADCAST BARLEY 26	12.3	13.0	272.3	6.275	66.3	9.8
21 21 21	WILD OAT 32 BROADCAST BARLEY 36	13.0	10.2	160.8	3.618	73.8	10.2
22 22 22	WILD OAT 32 DRILL BARLEY 16	11.7	13.2	279.3	6.455	65.0	9.9
23 23 23	WILD OAT 32 DRILL BARLEY 26	12.6	10.7	183.0	4.293	81.3	9.8
24 24 24	WILD OAT 32 DRILL BARLEY 36	9.4	6.0	105.3	2.378	92.5	9.7
	LSD (.05) =	4.2	5.1	70.6	1.566	15.9	0.600
	Standard Dev.=	2.96129	3.59633	49.8874	1.10713	11.2433	.424093
	CV =	51.56	60.44	44.86	43.99	15.00	4.20
	Treatment F	9.964	10.218	19.902	21.518	7.973	2.303
	Treatment Prob(F)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0046

Effects of Crop Seeding Rates and Broadcast Seeding Patterns on Wild Oat Management

Trt No	Treatment Name	BARLEY PLANTS / FT2 7-27-98	BARLEY HEADS / FT2 7-27-98	BARLEY DRY WT GRMS/FT2 7-27-98	BARLEY PLUMP PERCENT	BARLEY PROTEIN PERCENT	BARLEY TEST WT LBS/BU	BARLEY YIELD BU/A 8-7-98
1 1 1	WILD OAT 0 BROADCAST BARLEY 16	14.2	90.6	150.4	91.75	11.58	52.8	108.4
2 2 2	WILD OAT 0 BROADCAST BARLEY 26	15.3	68.8	110.8	89.00	11.42	52.2	102.0
3 3 3	WILD OAT 0 BROADCAST BARLEY 36	20.7	70.2	110.0	88.70	11.40	51.9	110.0
4 4 4	WILD OAT 0 DRILL BARLEY 16	9.6	61.3	98.0	93.50	11.53	52.5	96.2
5 5 5	WILD OAT 0 DRILL BARLEY 26	16.0	55.5	88.1	89.50	11.35	52.0	103.2
6 6 6	WILD OAT 0 DRILL BARLEY 36	21.5	56.8	88.1	89.25	11.33	52.0	108.5
7 7 7	WILD OAT 8 BROADCAST BARLEY 16	14.2	69.6	118.9	89.75	11.60	52.7	91.4
8 8 8	WILD OAT 8 BROADCAST BARLEY 26	21.1	62.4	102.9	91.00	11.63	52.5	100.5
9 9 9	WILD OAT 8 BROADCAST BARLEY 36	18.3	66.0	116.2	89.50	11.57	52.1	106.3
10 10 10	WILD OAT 8 DRILL BARLEY 16	10.5	55.2	93.4	86.50	11.75	51.5	89.4
11 11 11	WILD OAT 8 DRILL BARLEY 26	12.8	53.1	81.3	83.86	11.73	51.4	95.7
12 12 12	WILD OAT 8 DRILL BARLEY 36	19.5	49.8	76.4	84.01	11.29	51.4	109.4
13 13 13	WILD OAT 16 BROADCAST BARLEY 16	8.2	53.8	82.8	89.75	11.60	52.2	90.9

CONTINUED...

Effects of Crop Seeding Rates and Broadcast Seeding Patterns on Wild Oat Management

Trt No	Treatment Name	BARLEY PLANTS / FT2 7-27-98	BARLEY HEADS / FT2 7-27-98	BARLEY DRY WT GRMS/FT2 7-27-98	BARLEY PLUMP PERCENT	BARLEY PROTEIN PERCENT	BARLEY TEST WT LBS/BU	BARLEY YIELD BU/A 8-7-98
14 14 14	WILD OAT 16 BROADCAST BARLEY 26	16.9	72.6	106.8	89.00	11.18	51.6	93.0
15 15 15	WILD OAT 16 BROADCAST BARLEY 36	13.2	69.6	94.3	83.21	11.83	51.4	95.2
16 16 16	WILD OAT 16 DRILL BARLEY 16	9.9	53.0	86.7	85.75	11.73	51.5	86.3
17 17 17	WILD OAT 16 DRILL BARLEY 26	15.3	44.7	73.5	87.25	11.55	51.5	97.7
18 18 18	WILD OAT 16 DRILL BARLEY 36	16.3	65.9	93.8	84.25	11.35	51.5	94.1
19 19 19	WILD OAT 32 BROADCAST BARLEY 16	11.0	51.8	91.6	84.75	11.95	51.4	65.9
20 20 20	WILD OAT 32 BROADCAST BARLEY 26	12.5	49.5	79.1	84.00	11.53	50.9	78.4
21 21 21	WILD OAT 32 BROADCAST BARLEY 36	15.3	62.5	104.2	85.25	11.25	51.1	86.3
22 22 22	WILD OAT 32 DRILL BARLEY 16	10.5	48.0	82.2	87.25	11.70	51.8	81.2
23 23 23	WILD OAT 32 DRILL BARLEY 26	18.5	43.9	80.7	88.25	11.65	51.8	86.2
24 24 24	WILD OAT 32 DRILL BARLEY 36	20.5	51.0	83.3	82.50	11.38	50.8	86.6
LSD (.05) =		6.0	19.5	26.5	6.35	0.66	1.1	10.8
Standard Dev.=		4.26346	13.8095	18.7313	4.49127	.464529	.753652	7.63112
CV =		28.30	23.25	19.60	5.14	4.03	1.46	8.09
Treatment F		3.474	2.482	3.441	1.743	0.707	2.112	8.196
Treatment Prob(F)		0.0001	0.0020	0.0001	0.0419	0.8209	0.0098	0.0001

Spring Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Favorable environmental conditions make pre-harvest sprouting in small grains an annual concern for District 1 producers. Sprout damaged grain results in substantial economic losses as kernels are no longer agronomically sound and the functional quality of the flour is negatively affected. This study was conducted to evaluate spring wheat class and cultivar susceptibility to pre-harvest sprouting and the effect of sprout damage on seed characteristics and quality.

Included in the study were five hard red (McNeal, Amidon, WPB 926, Hi-Line, and Scholar), five soft white (Owens, Vanna, Sprite, Wawawai, and Penawawa), and five hard whites (Klassic, 377S, MTHW8182, MTHW9420, and MTHW9520) cultivars. In an attempt to initiate some level of sprouting in all cultivars, irrigation was applied daily beginning at physiological maturity to augment natural precipitation. Harvests began one week after the earliest cultivar reached physiological maturity and continued weekly for a total of six. Harvests were made over time to document when and to what degree sprout was occurring in each cultivar. The presence or absence of sprout damage was assessed with visible sprout observations and falling number determinations (FN) conducted by inspectors at the State Grain Lab. Other measured responses included test weight, % germination, protein, lodging, heading date, and physiological maturity.

Harvest maturity was identified on 9-2-97 for all three classes of wheat. Based on percent visible sprout, hard red cultivars displayed strong resistance whereas soft whites were found to be very susceptible. Hard white results put this class at a midpoint between the other two. All hard red cultivars were equally as resistant. Sprite, Penawawa, and Klassic were identified as significantly susceptible in their respective classes. Test weights decreased in all cultivars over time but at a faster rate in the soft whites in response to sprout damage. Falling numbers also decreased over harvest dates. Again, hard reds performed best follow by the hard whites and soft whites.

Site Description

Crop: Spring Wheat
Variety: 5 Hard Red, 5 Hard White, and 5 Soft White
Planting Date: 4-25-97
Planting Method: Disc Drill
Rate, Unit: 80 Lbs/A
Depth, Unit: 1.5"
Row Spacing, Unit: 6"
Soil Moisture: Good
Emergence Date: 5-6-97

Plot Width, Unit: 4.2 FT
Plot Length, Unit: 10 FT
Reps: 3
Site Location: X-5
Study Design: RCB

Plot Maintenance:

Fertility:	9-23-96	24 Lbs. N, 30 Lbs. P, 16 Lbs. K, 21 Lbs. S, & 15 Lbs. Cl
	5- 2-97	51 Lbs. N
Weed Control:		Hand weeded throughout season
Irrigation:	7-28-97	.1" daily thru 9-22-97
Harvest Dates:	8-19-97	Harvest #1
	8-26-97	Harvest #2
	9- 2-97	Harvest #3
	9- 9-97	Harvest #4
	9-16-97	Harvest #5
	9-23-97	Harvest #6

Soil Description

Texture: SiL　% OM: 5.1　pH: 7.6　Soil Name: Creston Silt Loam

Spring Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	SPR WHT HEADING JULIAN	SPR WHT PHYS MAT JULIAN	SPR WHT LODGING 0-9 8-28-97	SPR WHT LODGING 0-9 9-15-97
1	McNEAL	174.3	227.3	1.3	3.3
2	AMIDON	173.7	229.3	1.3	2.7
3	WESTBRED 926	169.7	227.3	1.3	3.3
4	HI-LINE	172.7	225.7	2.3	4.7
5	MT9433	174.7	229.0	2.0	3.0
6	OWENS	173.0	229.7	5.3	7.7
7	VANNA	174.7	227.3	3.0	6.3
8	SPRITE	173.7	225.7	4.7	7.0
9	WAWAWAI	172.3	229.0	6.0	7.7
10	PENAWAWA	173.3	229.7	3.3	5.3
11	KLASIC	168.0	220.7	2.0	2.7
12	377 S	171.0	229.7	2.3	5.7
13	MTHW8182	173.0	232.7	2.0	5.0
14	MTHW9420	171.0	231.3	1.7	5.7
15	MTHW9520	173.7	229.0	2.0	4.0
	LSD (.05) =	1.0	1.8	1.5	1.8
	Standard Dev.=	.596285	1.04805	.914609	1.06234
	CV =	0.35	0.46	33.74	21.53
	Treatment F	30.598	21.705	7.962	8.068
	Treatment Prob(F)	0.0001	0.0001	0.0001	0.0001

Spring Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	SPR WHT SPROUT PERCENT 8-19-97	SPR WHT SPROUT PERCENT 8-26-97	SPR WHT SPROUT PERCENT 9-2-97	SPR WHT SPROUT PERCENT 9-9-97	SPR WHT SPROUT PERCENT 9-16-97	SPR WHT SPROUT PERCENT 9-23-97
1	McNEAL	0.00	0.00	0.00	0.00	1.13	0.40
2	AMIDON	0.00	0.07	0.00	0.67	0.70	0.47
3	WESTBRED 926	0.00	0.53	0.43	0.70	0.63	1.33
4	HI-LINE	0.07	0.00	0.00	0.40	1.10	0.17
5	MT9433	0.00	0.00	0.00	0.77	0.83	0.33
6	OWENS	1.43	3.83	7.20	18.57	30.30	21.10
7	VANNA	1.07	4.03	2.27	10.83	18.60	25.13
8	SPRITE	2.63	6.70	8.70	21.73	39.83	42.37
9	WAWAWAI	1.67	7.53	9.27	23.60	33.67	22.70
10	PENAWAWA	1.97	4.37	7.13	28.33	41.50	39.63
11	KLASIC	5.03	24.57	21.83	33.77	37.20	29.60
12	377 S	0.57	0.77	1.17	4.73	7.40	6.33
13	MTHW8182	1.37	2.23	3.17	5.67	11.07	13.70
14	MTHW9420	1.13	4.03	2.17	7.70	13.30	13.40
15	MTHW9520	0.10	0.77	0.50	3.17	6.60	5.87
	LSD (.05) =	1.74	5.20	5.85	9.91	8.55	8.72
	Standard Dev.=	1.04345	3.10705	3.50057	5.92448	5.11180	5.21366
	CV =	91.89	78.42	82.26	55.32	31.44	35.14
	Treatment F	5.167	12.040	8.586	11.231	28.926	23.467
	Treatment Prob(F)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Spring Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	SPR WHT TEST WT LB/BU 8-19-97	SPR WHT TEST WT LB/BU 8-26-97	SPR WHT TEST WT LB/BU 9-2-97	SPR WHT TEST WT LB/BU 9-9-97	SPR WHT TEST WT LB/BU 9-16-97	SPR WHT TEST WT LB/BU 9-23-97
1	McNEAL	62.10	61.37	60.93	59.40	58.73	58.93
2	AMIDON	61.53	61.03	59.77	58.50	57.63	58.20
3	WESTBRED 926	60.80	60.20	59.47	57.87	57.63	57.27
4	HI-LINE	62.03	61.50	60.33	59.10	58.60	58.60
5	MT9433	62.27	61.83	60.83	59.57	59.10	59.47
6	OWENS	60.77	59.90	58.17	55.30	53.23	54.53
7	VANNA	60.27	59.73	58.33	56.07	55.20	53.97
8	SPRITE	60.10	58.97	57.60	55.77	54.13	53.23
9	WAWAWAI	62.17	61.23	59.47	56.07	53.13	55.93
10	PENAWAWA	61.17	60.67	58.40	55.50	53.60	53.87
11	KLASIC	58.80	56.83	55.67	53.90	52.23	53.37
12	377 S	61.90	61.30	60.40	58.37	57.07	58.33
13	MTHW8182	59.33	59.03	58.57	56.30	55.77	55.30
14	MTHW9420	61.80	61.33	59.73	58.10	56.83	56.90
15	MTHW9520	61.57	61.53	60.43	58.50	57.70	58.23
LSD (.05) =		1.03	1.50	1.28	1.35	1.82	1.55
Standard Dev.=		.618171	.897545	.762492	.806190	1.09009	.928974
CV =		1.01	1.49	1.29	1.41	1.95	1.65
Treatment F		9.098	6.839	10.533	14.131	13.321	17.010
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Spring Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	SPR WHT FN 8-19-97	SPR WHT FN 8-26-97	SPR WHT FN 9-2-97	SPR WHT FN 9-9-97	SPR WHT FN 9-16-97	SPR WHT FN 9-23-97
1	McNEAL	494.7	469.0	491.7	366.3	355.7	285.7
2	AMIDON	388.3	365.0	389.7	304.3	241.3	167.7
3	WESTBRED 926	396.3	361.7	353.7	269.0	185.7	172.7
4	HI-LINE	502.7	501.7	466.0	267.3	238.7	241.0
5	MT9433	381.3	345.3	327.7	258.0	194.0	221.0
6	OWENS	241.3	161.7	125.7	60.0	46.0	46.0
7	VANNA	292.3	186.7	161.0	76.3	48.0	46.0
8	SPRITE	192.3	93.0	76.3	47.3	46.0	45.3
9	WAWAWAI	291.3	207.0	120.7	59.7	47.0	46.0
10	PENAWAWA	222.3	147.7	84.7	47.3	46.0	45.3
11	KLASIC	106.0	51.0	48.3	47.0	45.7	46.0
12	377 S	302.3	222.0	229.0	142.7	63.7	81.3
13	MTHW8182	243.0	188.0	154.0	87.3	49.3	48.0
14	MTHW9420	290.7	196.7	181.3	103.3	51.0	55.7
15	MTHW9520	365.0	364.0	272.3	198.3	95.0	90.7
LSD (.05) =		43.8	50.9	67.1	74.4	95.9	50.1
Standard Dev.=		26.1806	30.4429	40.1022	44.4679	57.3376	29.9681
CV =		8.34	11.83	17.28	28.57	49.06	27.44
Treatment F		51.937	58.758	38.601	18.597	9.125	23.938
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Spring Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	SPR WHT GERM PERCENT 8-19-97	SPR WHT GERM PERCENT 8-26-97	SPR WHT GERM PERCENT 9-2-97	SPR WHT GERM PERCENT 9-9-97	SPR WHT GERM PERCENT 9-16-97	SPR WHT GERM PERCENT 9-23-97
1	McNEAL	90.7	89.3	84.0	91.3	91.3	84.0
2	AMIDON	92.0	88.0	77.3	94.0	90.7	73.3
3	WESTBRED 926	76.7	78.0	76.7	92.0	83.3	75.3
4	HI-LINE	95.3	88.0	88.0	92.7	97.3	87.3
5	MT9433	96.7	90.7	86.0	95.3	91.3	74.7
6	OWENS	89.3	78.7	87.3	76.0	76.0	84.0
7	VANNA	85.3	91.3	92.7	87.3	83.3	83.3
8	SPRITE	80.7	74.7	84.7	77.3	69.3	65.3
9	WAWAWAI	87.3	86.0	84.0	72.0	62.0	84.0
10	PENAWAWA	85.3	84.7	84.7	82.0	70.7	74.7
11	KLASIC	82.7	66.0	78.0	50.0	61.3	70.7
12	377 S	92.7	85.3	84.0	82.0	79.3	82.7
13	MTHW8182	94.7	88.7	86.7	83.3	75.3	80.7
14	MTHW9420	90.0	92.7	92.7	90.0	76.0	76.7
15	MTHW9520	94.7	89.3	86.7	92.0	88.0	92.7
	LSD (.05) =	7.8	8.8	10.0	9.2	11.4	11.3
	Standard Dev.=	4.65577	5.25659	5.95965	5.50959	6.80429	6.74807
	CV =	5.24	6.20	7.02	6.57	8.54	8.51
	Treatment F	4.752	5.872	1.923	13.757	7.792	3.340
	Treatment Prob(F)	0.0002	0.0001	0.0685	0.0001	0.0001	0.0032

Winter Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Favorable environmental conditions make pre-harvest sprouting in small grains an annual concern for District 1 producers. Sprout damaged grain results in substantial economic losses as kernels are no longer agronomically sound and the functional quality of the flour is negatively affected. This study was conducted to evaluate winter wheat class and cultivar susceptibility to pre-harvest sprouting and the effect of sprout damage on seed characteristics and quality.

Included in the study were five hard red (Judith, Rocky, Neeley, Tiber, and Kestrel), five soft white (Lewjain, Cashup, Malcolm, Stevens, and Daws), and one hard white (NuWest) cultivar. In an attempt to initiate some level of sprouting in all cultivars, irrigation was applied daily beginning at physiological maturity to augment natural precipitation. Harvests began one week after the earliest cultivar reached physiological maturity and continued weekly for a total of six. Harvests were made over time to document when and to what degree sprout was occurring in each cultivar. The presence or absence of sprout damage was assessed with visible sprout observations and falling number determinations (FN) conducted by inspectors at the State Grain Lab. Other measured responses included test weight, % germination, protein, lodging, heading date, and physiological maturity.

Harvest maturity was identified on 8-18 for the hard red and hard white cultivars and 8-25 for the soft whites. Based on percent visible sprout, hard reds were more resistant to sprout damage than soft whites. With the exception of Rocky, red cultivars performed equally as well. Malcolm was considerably better than the other four soft whites. In general, as % sprout increased, test weight, and falling numbers decreased. These decreases were more rapid and severe in soft whites. Percent germination declined steadily over time in the soft whites but held constant in the hard reds and hard white.

Site Description

Crop: Winter Wheat
Variety: 5 Hard Red, 5 Soft Whites, and 1 Hard White
Planting Date: 9-26-96
Planting Method: Disc Drill
Rate, Unit: 77 Lbs/A
Depth, Unit: 1.5"
Row Spacing, Unit: 6"
Soil Moisture: Good
Emergence Date: 10-6-96

Plot Width, Unit: 4.2 FT
Plot Length, Unit: 10 FT
Reps: 3
Site Location: X-5
Study Design: RCB
Plot Maintenance:

Fertility:	9-23-96	24 Lbs. N, 30 Lbs. P, 16 Lbs. K, 21 Lbs. S, & 15 Lbs.Cl
	5- 2-97	51 Lbs. N
Weed Control:		Hand weeded throughout season
Irrigation:	7-28-97	.1" daily thru 9-9-97
Harvest Dates:	8- 4-97	Harvest #1
	8-11-97	Harvest #2
	8-18-97	Harvest #3
	8-25-97	Harvest #4
	9- 1-97	Harvest #5
	9-10-97	Harvest #6

Soil Description

Texture: SiL   % OM: 5.1   pH: 7.6   Soil Name: Creston Silt Loam

Winter Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	WNTR WHT GERM PERCENT 8-4-97	WNTR WHT GERM PERCENT 8-11-97	WNTR WHT GERM PERCENT 8-18-97	WNTR WHT GERM PERCENT 8-25-97	WNTR WHT GERM PERCENT 9-1-97	WNTR WHT GERM PERCENT 9-10-97
1	JUDITH	94	95	93	92	94	96
2	ROCKY	98	95	97	98	95	94
3	NEELEY	82	95	91	86	83	93
4	TIBER	90	91	92	89	84	94
5	KESTREL	96	95	94	93	98	98
6	NuWEST	87	86	85	81	75	83
7	LEWJAIN	87	80	80	71	65	67
8	CASHUP	86	78	83	67	63	73
9	MALCOLM	86	76	68	70	66	76
10	STEVENS	93	84	83	83	80	81
11	DAWS	86	77	78	70	64	60
LSD (.05) =		7	6	9	7	10	8
Standard Dev.=		3.96500	3.68412	5.25299	4.16552	6.10886	4.62667
CV =		4.43	4.26	6.12	5.09	7.75	5.56
Treatment F		4.552	14.000	8.007	20.760	14.055	23.423
Treatment Prob(F)		0.0019	0.0001	0.0001	0.0001	0.0001	0.0001

Winter Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	WNTR WHT HD DATE JULIAN	WNTR WHT PHYS MAT JULIAN	WNTR WHT LODGING 0-9 8-28-97
1	JUDITH	159.7	211.7	4.7
2	ROCKY	159.0	207.7	5.3
3	NEELEY	161.0	213.3	6.3
4	TIBER	162.0	214.0	3.0
5	KESTREL	161.3	216.0	5.0
6	NuWEST	160.7	213.0	4.7
7	LEWJAIN	166.0	222.3	4.3
8	CASHUP	163.3	218.3	6.0
9	MALCOLM	161.0	217.3	2.3
10	STEVENS	161.3	218.7	4.0
11	DAWS	163.0	217.3	6.3
	LSD (.05) =	0.9	1.6	1.6
	Standard Dev.=	.539360	.953463	.917837
	CV =	0.33	0.44	19.42
	Treatment F	37.813	53.100	5.921
	Treatment Prob(F)	0.0001	0.0001	0.0004

Winter Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	WNTR WHT SPROUT PERCENT 8-4-97	WNTR WHT SPROUT PERCENT 8-11-97	WNTR WHT SPROUT PERCENT 8-18-97	WNTR WHT SPROUT PERCENT 8-25-97	WNTR WHT SPROUT PERCENT 9-1-97	WNTR WHT SPROUT PERCENT 9-10-97
1	JUDITH	0.07	0.00	0.33	1.63	1.23	3.23
2	ROCKY	0.03	0.00	0.03	4.27	2.60	9.53
3	NEELEY	0.00	0.00	0.00	0.93	0.70	1.40
4	TIBER	0.20	0.00	0.03	0.00	0.10	0.50
5	KESTREL	0.00	0.00	0.10	0.53	0.93	1.17
6	NuWEST	0.10	0.00	0.00	3.27	2.37	5.60
7	LEWJAIN	0.87	2.10	8.50	26.63	28.70	45.90
8	CASHUP	4.17	2.20	2.90	22.33	29.63	49.73
9	MALCOLM	1.47	1.93	3.83	6.60	7.60	11.63
10	STEVENS	1.13	1.50	2.37	6.10	9.53	25.83
11	DAWS	2.87	2.77	6.03	22.73	26.73	62.20
LSD (.05) =		1.59	0.79	1.52	7.38	4.96	9.17
Standard Dev.=		.935884	.466645	.893749	4.33582	2.91157	5.38217
CV =		94.45	48.89	40.74	50.19	29.08	27.32
Treatment F		6.515	17.730	31.748	16.235	52.295	53.001
Treatment Prob(F)		0.0002	0.0001	0.0001	0.0001	0.0001	0.0001

Winter Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	WNTR WHT TEST WT LBS/BU 8-4-97	WNTR WHT TEST WT LBS/BU 8-11-97	WNTR WHT TEST WT LBS/BU 8-18-97	WNTR WHT TEST WT LBS/BU 8-25-97	WNTR WHT TEST WT LBS/BU 9-1-97	WNTR WHT TEST WT LBS/BU 9-10-97
1	JUDITH	60.77	59.97	59.17	58.37	57.53	56.80
2	ROCKY	62.00	62.20	60.57	59.63	58.23	56.93
3	NEELEY	61.40	61.80	60.97	59.67	58.80	57.13
4	TIBER	62.23	62.80	61.33	60.17	59.70	58.57
5	KESTREL	60.73	61.23	60.67	59.40	58.37	57.03
6	NuWEST	61.27	61.10	60.67	58.33	58.07	56.67
7	LEWJAIN	57.23	56.13	55.43	52.70	52.10	48.90
8	CASHUP	57.23	57.20	56.50	54.23	52.83	50.33
9	MALCOLM	56.60	55.93	54.60	54.03	54.17	52.73
10	STEVENS	57.20	56.30	56.13	54.87	54.20	52.13
11	DAWS	57.63	56.60	56.07	54.30	53.33	49.83
LSD (.05) =		1.32	1.27	0.86	0.99	1.14	1.81
Standard Dev.=		.775577	.744662	.507303	.581736	.667142	1.06074
CV =		1.30	1.26	0.87	1.02	1.19	1.95
Treatment F		25.455	41.279	79.469	71.023	52.258	33.189
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Winter Wheat Cultivar Susceptibility to Preharvest Sprouting at Kalispell in 1997

Trt No	Treatment Name	WNTR WHT FN 8-4-97	WNTR WHT FN 8-11-97	WNTR WHT FN 8-18-97	WNTR WHT FN 8-25-97	WNTR WHT FN 9-1-97	WNTR WHT FN 9-10-97
1	JUDITH	431.3	387.3	284.7	211.0	156.7	82.7
2	ROCKY	399.7	417.3	364.3	141.7	133.0	61.3
3	NEELEY	440.7	446.0	388.0	254.0	247.0	98.7
4	TIBER	397.7	407.0	393.3	401.3	345.0	238.0
5	KESTREL	382.3	382.3	345.7	255.0	185.3	145.0
6	NuWEST	360.0	406.0	400.7	208.0	144.3	102.0
7	LEWJAIN	228.7	176.0	100.0	53.3	45.7	46.0
8	CASHUP	218.0	232.3	161.0	50.0	46.0	46.0
9	MALCOLM	233.0	203.7	162.0	95.3	67.0	47.3
10	STEVENS	227.0	251.7	191.0	97.0	57.7	45.7
11	DAWS	284.7	199.7	149.0	52.0	46.0	45.7
LSD (.05) =		72.2	50.8	79.1	92.5	65.7	58.5
Standard Dev.=		42.3944	29.8411	46.4296	54.3051	38.5771	34.3488
CV =		12.94	9.35	17.37	32.85	28.80	39.43
Treatment F		13.421	37.000	18.689	12.647	18.980	9.041
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

ACHIEVE/FERTILIZER SURFACTANT STUDY

The objective of this study was to determine if the efficacy of Achieve to wild oat could be enhanced by the addition of various fertilizer additives.

Achieve was applied at 0.25, 0.18, 0.125, 0.06, and 0.03 lb ai/A with the surfactant Turbo Charge alone or in combination with either ammonium sulfate (AMS), or 32% urea ammonium nitrate (UAN) fertilizer. The wild oat herbicides Hoelon, Assert, Puma, and Horizon were included for comparison.

The only noticeable barley injury occurred with applications of Horizon which resulted in a 50% crop injury rating. This result is not surprizing as Horizon is not labled for use in barley.

Achieve provided excellent control of wild oat up to the 0.125 application rate. There after, the effects of fertilizer additives were apparent, especially at the 0.03 rate. The addition of either 32% UAN or AMS improved wild oat control compared to Achieve applied only with Turbo Charge.

Barley yields were unaffected by herbicide treatments. Overall barley yields were low for this region. Excessive rainfall resulted in anerobic soil conditions and also resulted in a severe incidence of pythium.

Achieve/Fertilizer Surfactant Study

Site Description

Crop: Barley
Planting Method: Broadcast
Soil Moisture: Good

Variety: Gallatin
Rate, Unit: 90 Lbs./A

Planting Date: 4-20-98
Depth, Unit: 0-3"
Emergence Date: 4-29-98

Plot Width, Unit: 10 FT
Site Location: R-13

Plot Length, Unit: 15 FT

Reps: 3
Study Design: RCB

Field Preparation/Plot Maintenance:

Fertility:	4-20-98	92 Lbs. N and 42 Lbs. P
Weed Control:	5- 7-98	Express at .25 oz. + 2, 4-D at .25 pt.
	5- 9-98	Stampede at 1.4 Lbs. + MCPA at .5 pt.
****		Seed and fertilizer broadcasted with "Floater" and incorporated with a field cultivator then packed

Soil Description

Texture: Coarse Silty Mixed % OM: 4.2 % Sand: 40 % Silt: 50 % Clay: 10
pH: 7.7 Soil Name: Creston Silt Loam

Application Information

Application Date:	5-20-98
Time of Day:	11:30 AM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	60 F
% Relative Humidity:	88
Wind Velocity, Unit:	0-3 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	60 F
Soil Moisture:	EXCELLENT
% Cloud Cover:	20

Plant Species	Plant Stage
Barley	3 to 4 Tiller
Wild Oat	3 Leaf to 2 Tiller

Application Equipment

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

Achieve/Fertilizer Surfactant Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY CROP INJ PERCENT 6-4-98	WILD OAT CONTROL PERCENT 7-17-98	BARLEY YIELD BU/A 8-9-98
1	ACHIEVE	40	WG	.25	lb ai/A	0.0	99.7	50.0
1	TURBO	8.34	SL	.5	% v/v			
2	ACHIEVE	40	WG	.25	lb ai/A	0.0	99.7	44.7
2	TURBO	8.34	SL	.5	% v/v			
2	AMMON SULF (D)	100	WG	1.5	lb pr/A			
3	ACHIEVE	40	WG	.18	lb ai/A	0.0	100.0	56.6
3	TURBO	8.34	SL	.5	% v/v			
3	AMMON SULF (L)	1	SL	15	pt pr/A			
4	ACHIEVE	40	WG	.18	lb ai/A	0.0	98.3	50.4
4	TURBO	8.34	SL	.5	% v/v			
5	ACHIEVE	40	WG	.18	lb ai/A	0.0	99.7	68.6
5	TURBO	8.34	SL	.5	% v/v			
5	32%	1	EC	2.5	% v/v			
6	ACHIEVE	40	WG	.18	lb ai/A	0.0	100.0	45.4
6	TURBO	8.34	SL	.5	% v/v			
6	AMMON SULF (D)	100	WG	1.5	lb pr/A			
7	ACHIEVE	40	WG	.125	lb ai/A	0.0	98.3	64.4
7	TURBO	8.34	SL	.5	% v/v			
8	ACHIEVE	40	WG	.125	lb ai/A	0.0	99.0	65.6
8	TURBO	8.34	SL	.5	% v/v			
8	32 %	1	EC	2.5	% v/v			
9	ACHIEVE	40	WG	.125	lb ai/A	0.0	99.7	46.2
9	TURBO	8.34	SL	.5	% v/v			
9	AMMON SULF (D)	100	WG	1.5	lb pr/A			
10	ACHIEVE	40	WG	.06	lb ai/A	0.0	87.7	63.7
10	TURBO	8.34	SL	.5	% v/v			
11	ACHIEVE	40	WG	.06	lb ai/A	3.3	99.0	48.2
11	TURBO	8.34	SL	.5	% v/v			
11	32 %	1	EC	2.5	% v/v			
12	ACHIEVE	40	WG	.06	lb ai/A	0.0	93.3	53.7
12	TURBO	8.34	SL	.5	% v/v			
12	AMMON SULF (D)	100	WG	1.5	lb pr/A			
13	ACHIEVE	40	WG	.03	lb ai/A	0.0	69.7	52.9
13	TURBO	8.34	SL	.5	% v/v			
14	ACHIEVE	40	WG	.03	lb ai/A	0.0	91.3	46.6
14	TURBO	8.34	SL	.5	% v/v			
14	32 %	1	EC	2.5	% v/v			

CONTINUED...

Achieve/Fertilizer Surfactant Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY CROP INJ PERCENT 6-4-98	WILD OAT CONTROL PERCENT 7-17-98	BARLEY YIELD BU/A 8-9-98
15	ACHIEVE	40	WG	.03	lb ai/A	0.0	91.0	55.4
15	TURBO	8.34	SL	.5	% v/v			
15	AMMON SULF (D)	100	WG	1.5	lb pr/A			
16	Hoelon	3	EC	1.0	lb ai/A	0.0	97.3	49.2
17	Assert	2.5	EC	.46	lb ai/A	0.0	93.3	50.7
17	NIS	1	EC	.25	% v/v			
18	PUMA	1.56	EC	.1287	lb ai/A	0.0	98.3	44.2
19	HORIZON	2.09	EC	.06	lb ai/A	50.0	98.7	39.5
19	COC	8.35	SL	1	% v/v			
20	UNTREATED					0.0	0.0	43.9
	LSD (.05) =					2.1	9.5	21.8
	Standard Dev.=					1.29099	5.73753	13.0992
	CV =					48.41	6.33	25.19
	Treatment F					224.421	46.080	1.162
	Treatment Prob(F)					0.0001	0.0001	0.3392

ACHIEVE/BROADLEAF TANKMIX STUDY

The objective of this study was to confirm tankmix compatibility and efficacy on wild oat with Achieve and commonly used broadleaf herbicides.

Wild oat antagonism was not observed with any of the broadleaf tankmix combinations. Water-logged conditions coupled with a severe pythium outbreak made crop injury assessments difficult. This fact is reflected in the high CV's. Few treatments demonstrated any significant barley injury during the first crop injury rating. The exception being the tankmix combinations with Buctril. Injury was minor when Buctril was applied without AMS. However, the addition of AMS with Buctril resulted in significantly greater injury.

There were no significant differences in crop injury during the second rating, and the crop appeared to have recovered from the Buctril treatments. However, there was a trend for greater injury when Achieve was tankmixed with Harmony Extra. This response is somewhat reflected in the yield data, but the yield data was also nonsignificant based on Fisher's protected LSD procedure.

Achieve/Broadleaf Tankmix Study

Site Description

Crop: Barley	Variety: Gallatin	Planting Date: 4-20-98
Planting Method: Broadcast	Rate, Unit: 90 Lbs./A	Depth, Unit: 0-3"
Soil Moisture: Good		Emergence Date: 4-29-98
Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT	Reps: 3
Site Location: R-13		Study Design: RCB

Field Preparation/Plot Maintenance:

Fertility:	4-20-98	92 Lbs. N and 42 Lbs. P
Weed Control:	5- 7-98	Express at .25 oz. + 2, 4-D at .25 pt.
	5- 9-98	Stampede at 1.4 lbs. + MCPA at .5 pt.
****		Seed and fertilizer broadcasted with "Floater" and incorporated with a field cultivator then packed

Soil Description

Texture: Coarse Silty Mixed   % OM: 4.2   % Sand: 40   % Silt: 50   % Clay: 10
pH: 7.7   Soil Name: Creston Silt Loam

Application Information

Application Date:	5-20-98
Time of Day:	1:30 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	69 F
% Relative Humidity:	66
Wind Velocity, Unit:	0-5 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	62 F
Soil Moisture:	EXCELLENT
% Cloud Cover:	20

Plant Species	Plant Stage
Barley	3-4 Tiller
Wild Oat	2 Leaf to 2 Tiller

Application Equipment

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

Achieve/Broadleaf Tankmix Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY CROP INJ PERCENT 6-4-98	BARLEY CROP INJ PERCENT 7-17-98	WILD OAT CONTROL PERCENT 7-17-98	BARLEY YIELD BU/A 8-8-98
1	UNTREATED					0.0	0.0	0.0	71.1
2	ACHIEVE	40	WG	.18	lb ai/A	0.0	3.3	99.3	74.3
2	TF8035	8.34	SL	.5	% v/v				
3	ACHIEVE	40	WG	.18	lb ai/A	0.0	0.0	100.0	79.9
3	TF8035	8.34	SL	.5	% v/v				
3	AMMON SULF	100	WG	1.5	lb pr/A				
4	ACHIEVE	40	WG	.18	lb ai/A	3.3	0.0	99.0	79.0
4	TF8035	8.34	SL	.5	% v/v				
4	BRONATE	4	EC	.7511	lb ai/A				
5	ACHIEVE	40	WG	.18	lb ai/A	3.3	6.7	100.0	76.4
5	TF8035	8.34	SL	.5	% v/v				
5	BRONATE	4	EC	.7511	lb ai/A				
5	AMMON SULF	100	WG	1.500	lb pr/A				
6	ACHIEVE	40	WG	.18	lb ai/A	3.3	6.7	100.0	74.8
6	TF8035	8.34	SL	.5	% v/v				
6	BUCTRIL	2	EC	.5	lb ai/A				
7	ACHIEVE	40	WG	.18	lb ai/A	11.7	8.3	100.0	67.2
7	TF8035	8.34	SL	.5	% v/v				
7	BUCTRIL	2	EC	.5	lb ai/A				
7	AMMON SULF	100	WG	1.5	lb pr/A				
8	ACHIEVE	40	WG	.18	lb ai/A	3.3	3.3	97.7	72.9
8	TF8035	8.34	SL	.5	% v/v				
8	STARANE	1.63	EC	2	oz ai/A				
8	MCPA-Ester	4	EC	.5	lb ai/A				
9	ACHIEVE	40	WG	.18	lb ai/A	3.3	0.0	100.0	72.4
9	TF8035	8.34	SL	.5	% v/v				
9	STARANE	1.63	EC	2	oz ai/A				
9	MCPA-Ester	4	EC	.5	lb ai/A				
9	AMMON SULF	100	WG	1.5	lb pr/A				
10	ACHIEVE	40	WG	.18	lb ai/A	0.0	3.3	99.7	69.9
10	TF8035	8.34	SL	.5	% v/v				
10	PEAK	57	WG	.285	oz ai/A				
10	AMMON SULF	100	WG	1.5	lb pr/A				
11	ACHIEVE	40	WG	.25	lb ai/A	0.0	5.0	99.3	72.0
11	TF8035	8.34	SL	.5	% v/v				
11	PEAK	57	WG	.285	oz ai/A				
11	AMMON SULF	100	WG	1.5	lb pr/A				

CONTINUED...

Achieve/Broadleaf Tankmix Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	BARLEY CROP INJ PERCENT 6-4-98	BARLEY CROP INJ PERCENT 7-17-98	WILD OAT CONTROL PERCENT 7-17-98	BARLEY YIELD BU/A 8-8-98
12	ACHIEVE	40	WG	.18	lb ai/A	6.7	33.0	100.0	66.5
12	TF8035	8.34	SL	.5	% v/v				
12	HARMONY	75	WG	.375	oz ai/A				
12	AMMON SULF	100	WG	1.5	lb pr/A				
13	ACHIEVE	40	WG	.25	lb ai/A	3.3	11.7	100.0	60.0
13	TF8035	8.34	SL	.5	% v/v				
13	HARMONY	75	WG	.375	oz ai/A				
13	AMMON SULF	100	WG	1.5	lb pr/A				
14	UNTREATED					0.0	3.3	0.0	64.1
	LSD (.05) =					6.5	27.3	1.3	12.0
	Standard Dev.=					3.86944	16.2891	0.77625	7.14378
	CV =					141.32	269.35	0.91	10.00
	Treatment F					2.193	0.818	6512.806	1.830
	Treatment Prob(F)					0.0428	0.6381	0.0001	0.0919

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 rates increased. The lowest rate tested reduced all wild oat parameters by approximately one half compared to the nontreated control. The 0.75 and 1.0X rates provided complete control. Spring wheat yield increased as Achieve rates increased. However, yield differences among Achieve rates were nonsignificant, possibly due to the low wild oat population present. The nontreated check was the only treatment to yield significantly less than the handweeded check.

Achieve Reduced Rate Study

Site Description

Crop: Spring Wheat	Variety: McNeal	Planting Date: 4-16-98
Planting Method: Plot Drill		Rate, Unit: 69 Lbs/A
Depth, Unit: 1.5"		Row Spacing, Unit: 6"
Soil Moisture: Good	Emergence Date: 4-27-98	Harvest Date: 8-12-98
Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT	Reps: 3
Site Location: R-3		Study Design: RCB

Plot Maintenance:

Fertility:	4- 6-98	64 Lbs. N and 33 Lbs. P
	5-12-98	30 Lbs. N
Weed Control:	5- 7-98	Express at .25 oz + 2,4-D at .25 pt/A
	5- 9-98	Stampede at 1.4 lbs + MCPA at .5 pt/A
Irrigation:	5- 6-98	.6" applied with wheel line

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:	5-19-98
Time of Day:	4:00 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	78 F
% Relative Humidity:	46
Wind Velocity, Unit:	2-3 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	75 F
Soil Moisture:	GOOD
% Cloud Cover:	50

Plant Species	Plant Stage
Wild Oats	3.5 Leaf and 1 Tiller
Spring Wheat	4 Leaf and 2 Tiller

Application Equipment

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

Achieve Reduced Rate Study

Trt No	Treatment Name	Rate	Rate Unit	Grow Stg	W. OAT CONTROL PERCENT 7-17-98	W. OAT PLANTS / FT2 7-21-98	W. OAT HEADS / FT2 7-21-98	W. OAT DRY WT GRMS/FT2 7-21-98	W. OAT QUAD TKW	W. OAT QUAD TOTAL#
1	UNTREATED				0.0	11.5	18.6	24.7	16.70	2130.0
2	ACHIEVE	.022	lb ai/A	3-LF	42.0	6.0	9.4	12.9	13.40	1334.0
2	TF 8035	0.5	% v/v	3-LF						
3	ACHIEVE	.046	lb ai/A	3-LF	86.0	3.8	6.7	3.9	12.83	374.0
3	TF 8035	0.5	% v/v	3-LF						
4	ACHIEVE	.067	lb ai/A	3-LF	93.0	0.5	0.7	0.1	11.80	8.0
4	TF 8035	0.5	% v/v	3-LF						
5	ACHIEVE	.089	lb ai/A	3-LF	94.7	0.7	0.6	0.3	4.87	42.0
5	TF 8035	0.5	% v/v	3-LF						
6	ACHIEVE	.134	lb ai/A	3-LF	100.0	0.0	0.0	0.0	0.00	0.0
6	TF 8035	0.5	% v/v	3-LF						
7	ACHIEVE	.178	lb ai/A	3-LF	100.0	0.0	0.0	0.0	0.00	0.0
7	TF 8035	0.5	% v/v	3-LF						
8	HAND WEEDED				100.0	0.0	0.0	0.0	0.00	0.0
LSD (.05) =					31.7	4.2	6.8	12.1	8.22	
Standard Dev.=					17.9938	2.39369	3.90168	6.92805	4.69183	
CV =					23.38	85.24	86.78	132.70	62.98	
Treatment F					12.429	8.927	8.962	5.100	6.659	
Treatment Prob(F)					0.0001	0.0003	0.0003	0.0047	0.0014	

Achieve Reduced Rate Study

Trt No	Treatment Name	Rate	Rate Unit	Grow Stg	W. OAT SUBSMPL TKW	W. OAT SUBSMPL TOTAL#	S. WHT PLANTS / FT2 7-21-98	S. WHT HEADS / FT2 7-21-98	S. WHT DRY WT GRMS/FT2 7-21-98	S. WHT YIELD BU/A 8-12-98	S. WHT TEST WT LBS/BU
1	UNTREATED				25.40	405.0	15.4	31.9	78.5	61.6	59.9
2	ACHIEVE	.022	lb ai/A	3-LF	25.63	286.0	18.2	38.9	92.5	68.3	60.6
2	TF 8035	0.5	% v/v	3-LF							
3	ACHIEVE	.046	lb ai/A	3-LF	23.40	54.0	12.6	35.7	92.4	74.9	60.8
3	TF 8035	0.5	% v/v	3-LF							
4	ACHIEVE	.067	lb ai/A	3-LF	24.67	27.0	14.4	39.6	108.5	79.5	60.8
4	TF 8035	0.5	% v/v	3-LF							
5	ACHIEVE	.089	lb ai/A	3-LF	12.70	6.0	15.3	36.4	93.4	74.9	60.7
5	TF 8035	0.5	% v/v	3-LF							
6	ACHIEVE	.134	lb ai/A	3-LF	1.77	5.0	18.7	38.1	98.6	72.2	60.4
6	TF 8035	0.5	% v/v	3-LF							
7	ACHIEVE	.178	lb ai/A	3-LF	7.87	0.0	17.2	38.9	100.9	75.4	60.1
7	TF 8035	0.5	% v/v	3-LF							
8	HAND WEEDED				0.00	0.0	19.9	38.5	107.5	78.2	61.0
LSD (.05) =					8.64		5.9	8.5	22.4	10.3	1.3
Standard Dev.=					4.93574		3.37953	4.84213	12.7867	5.86648	.727909
CV =					32.52		20.53	13.00	13.25	8.02	1.20
Treatment F					14.800		1.579	0.828	1.724	2.930	0.857
Treatment Prob(F)					0.0001		0.2208	0.5807	0.1826	0.0413	0.5614

Assert Reduced Rate Study

This study was conducted to evaluate the efficacy of reduced rate applications of Assert to wild oat. 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 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.

Assert rates did not affect wild oat population or panicle numbers, but dry weight and seed yields did decrease as Assert rates increased. Wild oat dry weight was reduced by 50% at the 0.37 rate and continued to decline steadily with the higher rates tested. However, there was not a corresponding increase in spring wheat yield.

Assert Reduced Rate Study

Site Description

Crop: Spring Wheat
Planting Method: Plot Drill
Depth, Unit: 1.5"
Soil Moisture: Good

Variety: McNeal

Emergence Date: 4-27-98

Planting Date: 4-16-98
Rate, Unit: 69 Lbs/A
Row Spacing, Unit: 6"
Harvest Date: 8-12-98

Plot Width, Unit: 10 FT
Site Location: R-3

Plot Length, Unit: 15 FT

Reps: 3
Study Design: RCB

Plot Maintenance:

Fertility:	4- 6-98	64 Lbs. N and 33 Lbs. P
	5-12-98	30 Lbs. N
Weed Control:	5- 7-98	Express at .25 oz + 2,4-D at .25 pt/A
	5- 9-98	Stampede at 1.4 lbs + MCPA at .5 pt/A
Irrigation:	5- 6-98	.6" applied with wheel line

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:	5-19-98
Time of Day:	3:00 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	78 F
% Relative Humidity:	46
Wind Velocity, Unit:	2-3 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	75 F
Soil Moisture:	GOOD
% Cloud Cover:	50

Plant Species	Plant Stage
Wild Oats	3.5 Leaf and 1 Tiller
Spring Wheat	4 Leaf and 2 Tiller

Application Equipment

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

Assert Reduced Rate Study

Trt No	Treatment Name	Rate	Rate Unit	Grow Stg	W. OAT CONTROL PERCENT 7-17-98	W. OAT PLANTS / FT2 7-21-98	W. OAT HEADS / FT2 7-21-98	W. OAT DRY WT GRMS/FT2 7-21-98	W. OAT QUADS TKW	W. OAT QUADS TOTAL #
1	UNTREATED				0.0	12.3	18.1	24.9	16.67	1836.0
2	ASSERT	.046	lb ai/A	3-LF	30.0	17.1	20.3	15.4	16.07	591.0
2	NIS	.25	% v/v	3-LF						
3	ASSERT	.089	lb ai/A	3-LF	77.7	12.5	17.7	11.2	14.03	1052.0
3	NIS	.25	% v/v	3-LF						
4	ASSERT	.134	lb ai/A	3-LF	70.0	15.3	22.7	12.8	12.80	1305.0
4	NIS	.25	% v/v	3-LF						
5	ASSERT	.178	lb ai/A	3-LF	76.3	11.9	19.9	8.1	11.30	477.0
5	NIS	.25	% v/v	3-LF						
6	ASSERT	.268	lb ai/A	3-LF	93.7	13.6	22.0	8.2	11.80	631.0
6	NIS	.25	% v/v	3-LF						
7	ASSERT	.357	lb ai/A	3-LF	98.0	12.0	16.8	4.8	10.15	246.0
7	NIS	.25	% v/v	3-LF						
8	HANDWEEDED				100.0	0.0	0.0	0.0	0.00	0.0
LSD (.05) =					16.0	6.3	10.4	11.9	1.10	
Standard Dev.=					9.14532	3.61813	5.96200	6.78903	.623202	
CV =					13.41	30.58	34.70	63.60	5.37	
Treatment F					45.182	6.003	4.424	3.644	209.415	
Treatment Prob(F)					0.0001	0.0022	0.0087	0.0189	0.0001	

Assert Reduced Rate Study

Trt No	Treatment Name	Rate	Rate Unit	Grow Stg	W. OAT SUBSMPL TKW	W. OAT SUBSMPL TOTAL #	S. WHT PLANTS / FT2 7-21-98	S. WHT HEADS / FT2 7-21-98	S. WHT DRY WT GRMS/FT2 7-21-98	S. WHT YIELD BU/A 8-12-98	S. WHT TEST WT LBS/BU
1	UNTREATED				24.77	654.0	15.3	30.7	79.6	61.2	60.3
2	ASSERT	.046	lb ai/A	3-LF	23.90	460.0	17.7	32.9	86.2	58.2	60.0
2	NIS	.25	% v/v	3-LF							
3	ASSERT	.089	lb ai/A	3-LF	26.23	918.0	15.5	31.7	75.6	52.2	58.8
3	NIS	.25	% v/v	3-LF							
4	ASSERT	.134	lb ai/A	3-LF	22.57	563.0	12.0	27.6	70.2	61.3	60.3
4	NIS	.25	% v/v	3-LF							
5	ASSERT	.178	lb ai/A	3-LF	21.23	176.0	19.5	39.3	103.3	68.3	60.4
5	NIS	.25	% v/v	3-LF							
6	ASSERT	.268	lb ai/A	3-LF	22.30	192.0	18.8	41.4	103.9	64.7	59.5
6	NIS	.25	% v/v	3-LF							
7	ASSERT	.357	lb ai/A	3-LF	16.63	125.0	14.5	36.6	88.4	65.1	59.6
7	NIS	.25	% v/v	3-LF							
8	HANDWEEDED				18.35	5.0	19.2	41.5	100.3	77.5	60.9
	LSD (.05) =				4.86		5.6	7.4	17.1	11.3	1.5
	Standard Dev.=				2.75735		3.18844	4.20165	9.75170	6.45326	.849012
	CV =				12.53		19.26	11.94	11.03	10.15	1.42
	Treatment F				4.076		2.051	4.702	5.321	4.013	1.763
	Treatment Prob(F)				0.0140		0.1196	0.0067	0.0039	0.0130	0.1736

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 is to determine what level of 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 1997. The study area was recropped to spring wheat in 1998. Different wild oat populations were generated in 1998 as a result of the previous years treatments. During 1997, wild oat control increased as herbicide rate increased. As would be expected, wild oat densities in 1998 were lowest where control the previous year was greatest. Although Assert reduced wild oat dry matter in 1997, the surviving plants produced viable seed, causing an increase in wild oat densities the following year. Based on the previous years wild oat densities, the highest rate of Assert was the only treatment which did not result in an increase in wild oat populations.

Wild Oat Population Dynamics with Reduced Assert Rates

Site Description

Crop: Spring Wheat
Planting Method: Disc Drill
Depth, Unit: 1.5"
Soil Moisture: Good
Harvest Date: 8-6-98

Variety: McNeal

Planting Date: 4-8-98
Rate, Unit: 74 Lbs/A
Row Spacing, Unit: 7"
Emergence Date: 4-25-98

Plot Width, Unit: 10 FT
Site Location: R-3
Plot Maintenance:

Plot Length, Unit: 15 FT

Reps: 3
Study Design: RCB

Fertility:	4- 8-98	58 Lbs. N and 28 Lbs. P with seed
	5-12-98	30 Lbs. N
Weed Control:	5- 7-98	Express at .25 oz + 2,4-D at .25 pt
	5- 9-98	Stampede at 1.4 Lbs + MCPA at .5 pt
Irrigation:	5- 6-98	.6" applied with wheel line

Soil Description

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

Wild Oat Population Dynamics with Reduced Assert Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	W. OAT PLANTS / FT2 4-13-98	W. OAT PLANTS / FT2 4-14-98	W. OAT PLANTS / FT2 4-17-98	W. OAT PLANTS / FT2 4-20-98	W. OAT PLANTS / FT2 4-22-98	W. OAT PLANTS / FT2 4-28-98	W. OAT PLANTS / FT2 7-8-98
1	UNTREATED					0.3	0.7	4.3	17.8	39.2	102.2	140.3
2	ASSERT	2.5	EC	.046	lb ai/A	0.2	0.1	2.4	13.0	26.5	84.0	108.5
2	NIS	1	EC	.25	% v/v							
3	ASSERT	2.5	EC	.089	lb ai/A	0.1	0.4	1.9	11.9	25.4	63.1	94.5
3	NIS	1	EC	.25	% v/v							
4	ASSERT	2.5	EC	.134	lb ai/A	0.1	0.1	1.3	7.2	18.0	52.1	54.9
4	NIS	1	EC	.25	% v/v							
5	ASSERT	2.5	EC	.178	lb ai/A	0.1	0.1	1.2	8.3	21.9	53.8	51.3
5	NIS	1	EC	.25	% v/v							
6	ASSERT	2.5	EC	.268	lb ai/A	0.2	0.2	1.9	6.9	19.5	46.9	51.8
6	NIS	1	EC	.25	% v/v							
7	ASSERT	2.5	EC	.357	lb ai/A	0.1	0.1	1.2	5.8	16.8	29.6	30.7
7	NIS	1	EC	.25	% v/v							
8	HANDWEEDED					0.0	0.0	0.0	0.1	3.7	3.1	0.0
LSD (.05) =						0.4	0.6	2.0	7.0	10.9	33.5	43.3
Standard Dev.=						.229519	.340081	1.14046	4.02056	6.22388	19.1392	24.7088
CV =						157.38	156.96	63.65	45.26	29.11	35.22	37.16
Treatment F						0.614	1.301	3.528	5.276	7.842	7.650	10.024
Treatment Prob(F)						0.7364	0.3188	0.0213	0.0040	0.0006	0.0007	0.0002

Wild Oat Population Dynamics with Reduced Achieve Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	W. OAT DRY WT GRM/FT2 7-8-98	W. OAT SUBSMPL GRAMS	W. OAT SUBSMPL TOTAL#	S. WHT PLANTS / FT2 7-8-98	S. WHT HEADS / FT2 7-8-98	S. WHT DRY WT GRM/FT2 7-8-98	S. WHT YIELD BU/A 8-6-98
1	UNTREATED					54.0	52.13	3130.0	16.1	18.6	23.6	14.3
2	ACHIEVE	40	WG	.022	lb ai/A	49.3	35.33	1698.0	13.9	17.0	29.2	17.6
2	TF 8035	1	EC	0.5	% v/v							
3	ACHIEVE	40	WG	.046	lb ai/A	40.2	38.73	1282.0	16.3	19.8	36.8	20.4
3	TF 8035	1	EC	0.5	% v/v							
4	ACHIEVE	40	WG	.067	lb ai/A	40.0	35.93	1517.0	16.1	18.7	34.8	22.2
4	TF 8035	1	EC	0.5	% v/v							
5	ACHIEVE	40	WG	.089	lb ai/A	32.5	34.53	1564.0	15.5	21.1	37.9	25.1
5	TF 8035	1	EC	0.5	% v/v							
6	ACHIEVE	40	WG	.134	lb ai/A	36.2	41.80	1757.0	13.5	22.6	45.1	26.3
6	TF 8035	1	EC	0.5	% v/v							
7	ACHIEVE	40	WG	.178	lb ai/A	23.5	27.17	1315.0	14.8	27.5	57.1	37.6
7	TF 8035	1	EC	0.5	% v/v							
8	HAND WEEDED					0.0	0.37	24.0	15.5	42.8	108.6	60.8
LSD (.05) =						11.3	16.60		5.3	6.9	15.2	6.3
Standard Dev.=						6.42957	9.47750		3.01129	3.94185	8.70399	3.58885
CV =						18.65	28.50		19.82	16.76	18.66	12.80
Treatment F						20.488	7.592		0.367	13.758	28.821	52.109
Treatment Prob(F)						0.0001	0.0007		0.9065	0.0001	0.0001	0.0001

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 is to determine what level of 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 1997. The study area was recropped to spring wheat in 1998. Different wild oat populations were generated in 1998 as a result of the previous years treatments. During 1997, wild oat control increased as herbicide rate increased. As would be expected, wild oat densities in 1998 were lowest where control the previous year was greatest. Although Achieve reduced wild oat dry matter in 1997, the surviving plants produced viable seed, causing an increase in wild oat densities the following year. Based on the previous years wild oat densities, the highest rate of Achieve was the only treatment which did not result in an increase in wild oat populations.

Wild Oat Population Dynamics with Reduced Achieve Rates

Site Description

Crop: Spring Wheat
Variety: McNeal
Planting Date: 4-8-98
Planting Method: Disc Drill
Rate, Unit: 74 Lbs/A
Depth, Unit: 1.5"
Row Spacing, Unit: 7"
Soil Moisture: Good
Emergence Date: 4-25-98
Harvest Date: 8-6-98

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

Fertility:	4- 8-98	58 Lbs. N and 28 Lbs. P with seed
	5-12-98	30 Lbs. N
Weed Control:	5- 7-98	Express at .25 oz + 2,4-D at .25 pt
	5- 9-98	Stampede at 1.4 Lbs + MCPA at .5 pt
Irrigation:	5- 6-98	.6" applied with wheel line

Soil Description

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

Wild Oat Population Dynamics with Reduced Achieve Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	W. OAT PLANTS / FT2 4-13-98	W. OAT PLANTS / FT2 4-14-98	W. OAT PLANTS / FT2 4-17-98	W. OAT PLANTS / FT2 4-20-98	W. OAT PLANTS / FT2 4-22-98	W. OAT PLANTS / FT2 4-28-98	W. OAT PLANTS / FT2 7-8-98
1	UNTREATED					0.4	0.6	2.5	15.9	39.1	93.1	114.5
2	ACHIEVE	40	WG	.022	lb ai/A	0.1	0.2	2.4	10.2	25.6	74.5	72.1
2	TF 8035	1	EC	0.5	% v/v							
3	ACHIEVE	40	WG	.046	lb ai/A	0.3	0.6	2.1	10.9	27.3	65.4	71.8
3	TF 8035	1	EC	0.5	% v/v							
4	ACHIEVE	40	WG	.067	lb ai/A	0.0	0.1	2.0	10.3	24.0	61.5	67.7
4	TF 8035	1	EC	0.5	% v/v							
5	ACHIEVE	40	WG	.089	lb ai/A	0.0	0.1	1.4	7.4	18.8	40.0	47.9
5	TF 8035	1	EC	0.5	% v/v							
6	ACHIEVE	40	WG	.134	lb ai/A	0.0	0.1	1.4	5.9	14.5	29.9	34.0
6	TF 8035	1	EC	0.5	% v/v							
7	ACHIEVE	40	WG	.178	lb ai/A	0.0	0.1	0.5	4.9	14.3	25.7	25.7
7	TF 8035	1	EC	0.5	% v/v							
8	HAND WEEDED					0.0	0.0	0.0	0.1	6.0	3.9	0.1
LSD (.05) =						0.5	0.6	2.5	8.6	11.9	17.2	31.3
Standard Dev.=						.268927	.348210	1.4556	4.91428	6.77228	9.84309	17.9001
CV =						248.24	160.71	94.16	59.99	31.93	19.99	33.02
Treatment F						1.274	1.225	1.138	2.791	6.676	26.734	11.537
Treatment Prob(F)						0.3303	0.3521	0.3945	0.0484	0.0013	0.0001	0.0001

Wild Oat Population Dynamics with Reduced Assert Rates

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	W. OAT DRY WT GRM/FT2 7-8-98	W. OAT SUBSMPL GRAMS	W. OAT SUBSMPL TOTAL #	S. WHT PLANTS / FT2 7-8-98	S. WHT HEADS / FT2 7-8-98	S. WHT DRY WT GRM/FT2 7-8-98	S. WHT YIELD BU/A 8-6-98
1	UNTREATED					44.9	39.17	2255.0	12.9	14.5	22.4	12.6
2	ASSERT	2.5	EC	.046	lb ai/A	47.2	32.07	1579.0	14.2	15.1	24.1	15.5
2	NIS	1	EC	.25	% v/v							
3	ASSERT	2.5	EC	.089	lb ai/A	37.1	38.23	1457.0	15.5	17.0	30.2	19.0
3	NIS	1	EC	.25	% v/v							
4	ASSERT	2.5	EC	.134	lb ai/A	29.0	25.23	845.0	15.0	19.6	39.8	26.3
4	NIS	1	EC	.25	% v/v							
5	ASSERT	2.5	EC	.178	lb ai/A	28.7	25.60	714.0	13.8	23.4	48.4	30.1
5	NIS	1	EC	.25	% v/v							
6	ASSERT	2.5	EC	.268	lb ai/A	18.6	15.83	417.0	13.1	21.7	48.4	43.1
6	NIS	1	EC	.25	% v/v							
7	ASSERT	2.5	EC	.357	lb ai/A	10.3	9.73	245.0	13.4	24.5	54.6	45.2
7	NIS	1	EC	.25	% v/v							
8	HANDWEEDED					0.0	1.33	98.0	10.1	28.0	71.2	58.4
LSD (.05) =						13.6	12.48		6.6	7.6	21.3	11.1
Standard Dev.=						7.78984	7.12499		3.74392	4.33920	12.1792	6.36069
CV =						28.86	30.45		27.77	21.19	28.72	20.34
Treatment F						13.534	10.830		0.582	3.627	5.603	19.522
Treatment Prob(F)						0.0001	0.0001		0.7599	0.0192	0.0031	0.0001

ALFALFA STUDY

The objective of this study was to compare weed control and alfalfa crop injury with Pursuit and imazamox as a function of use rate and application timing.

All treatments provided excellent control of the weeds present (PC= penny cress, HB= henbit, TM= tansy mustard, COLQ= common lambsquarters, and Canola). As a note, quackgrass was also present. Low populations prevented a meaningful assessment of control. However, it appeared that there was some activity with the imazamox treatments.

Crop injury was observed with both products and increased as rates increased. Alfalfa tolerance with imazamox treatments improved when applications were delayed to the 4-trifoliate stage.

The observed crop injury was reflected in the yield data. Yields decreased as use rate increased with both products, but there appeared to be no yield effect associated with the different application timings. While crop injury was observed, all treatments produced significantly greater yields than the nontreated control.

Alfalfa Study

Site Description

Crop: Alfalfa
Planting Method: Disk Drill
Depth, Unit: .5"
Soil Moisture: Good

Variety: Pioneer 54053

Planting Date: 4-23-98
Rate, Unit: 15.6 Lbs/A
Row Spacing, Unit: 7"

Plot Width/Area, Unit: 10 FT
Site Location: D-5
Reps: 3
Plot Length, Unit: 15 FT
Study Design: RCB
Plot Maintenance:
Fertility: 4-23-98 46 Lbs. N and 216 Lbs. P with seed

Soil Description

% OM: 2.6 % Sand: 10 % Silt: 55 % Clay: 35 pH: 5.9
Soil Name: Swims Silty Clay

Application Information

Application Date:	5-19-98	5-26-98
Time of Day:	4:30 PM	11:00 AM
Application Method:	BACKPACK	BACKPACK
Application Timing:	POST 2-TR	POST 4-TR
Air Temp., Unit:	75 F	73 F
% Relative Humidity:	48	58
Wind Velocity, Unit:	0 MPH	2.5 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	72 F	68 F
Soil Moisture:	GOOD	Excellent
% Cloud Cover:	10	10

Weed Species
- Pennycress
- Henbet
- Tansy Mustard
- Lambsquarters
- Canola

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

Alfalfa Study

Trt No	Treatment Name	Rate	Grow Stage	ALFALFA INJURY PERCENT 6-4-98	PCRESS CONTROL PERCENT 7-21-98	HENBET CONTROL PERCENT 7-21-98	TMUSTRD CONTROL PERCENT 7-21-98	LAMBSQR CONTROL PERCENT 7-21-98	CANOLA CONTROL PERCENT 7-21-98	ALFALFA YIELD TON/A 7-21-98
1	PURSUIT	.047	2-Tri	10.0	100.0	100.0	100.0	100.0	100.0	1.92
1	NIS	.25								
1	UAN 32%	2								
2	PURSUIT	.063	2-Tri	18.3	100.0	100.0	100.0	100.0	100.0	1.89
2	NIS	.25								
2	UAN 32%	2								
3	PURSUIT	.094	2-Tri	23.3	100.0	100.0	100.0	100.0	100.0	1.84
3	NIS	.25								
3	UAN 32%	2								
4	AC 299263	.032	2-Tri	13.3	100.0	100.0	100.0	100.0	100.0	1.94
4	NIS	.25								
4	UAN 32%	2								
5	AC 299263	.048	2-Tri	21.7	100.0	100.0	100.0	100.0	100.0	1.81
5	NIS	.25								
5	UAN 32%	2								
6	AC 299263	.063	2-Tri	31.7	100.0	100.0	100.0	100.0	100.0	1.72
6	NIS	.25								
6	UAN 32%	2								
7	AC 299263	.032	4-Tri	0.0	100.0	100.0	100.0	100.0	100.0	1.88
7	NIS	.25								
7	UAN 32%	2								
8	AC 299263	.048	4-Tri	0.0	100.0	100.0	100.0	100.0	100.0	1.73
8	NIS	.25								
8	UAN 32%	2								
9	AC 299263	.063	4-Tri	10.0	100.0	100.0	100.0	100.0	100.0	1.74
9	NIS	.25								
9	UAN 32%	2								
10	NONTREATED			0.0	0.0	0.0	0.0	0.0	0.0	1.52
	LSD (.05) =			10.6	0	0	0	0	0	0.18
	Standard Dev.=			6.17642	0	0	0	0	0	.104866
	CV =			48.13	0	0	0	0	0	5.83
	Treatment F			9.468	0.000	0.000	0.000	0.000	0.000	4.327
	Treatment Prob(F)			0.0001	1.0000	1.0000	1.0000	1.0000	1.0000	0.0040

ASSURE II SURFACTANT STUDY

The objective of this study was to determine if the efficacy of Assure II to wild oat could be enhanced by the addition of various surfactants.

Assure II was applied at either 8 or 4 oz/A. Assure II treatments were applied with either a nonionic surfactant (NIS), crop oil concentrate (COC), or methylated seed oil (MSO). In addition, the 4 oz treatments were applied with the above mentioned surfactants alone or in combination with 28% urea ammonium nitrate liquid fertilizer (UAN).

All treatments provided greater than 95% wild oat control regardless of the surfactant used. This indicates that lower rates should be used in future experiments in order to evaluate the benefits of the surfactants used. Pea yield data was not obtained due to an extremely high infestation of catchweed bedstraw which confounded the yield results and made hand-harvesting impossible.

Assure II/Surfactant Study

Site Description

Crop: Field Peas
Variety: Columbian Greens
Planting Method: Disk Drill
Depth, Unit: 1.5"
Soil Moisture: Good

Planting Date: 4-11-98
Rate, Unit: 190 Lbs/A
Row Spacing, Unit: 7"
Emergence Date: 4-18-98

Plot Width, Unit: 10 FT
Reps: 3

Plot Length, Unit: 15 FT
Site Location: Offstation

Study Design: RCB
Plot Maintenance:
Fertility: None
Moisture: Dryland

Application Information

Application Date:	5-19-98
Time of Day:	11:00 AM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	63 F
% Relative Humidity:	38
Wind Velocity, Unit:	0-5 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	58 F
Soil Moisture:	EXCELLENT
% Cloud Cover:	0

Plant Species	Plant Stage	Density at Application
Wild Oats	2 leaf to 4 tiller	25/ft2
Peas	6 inch and 5 nodes	

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

Assure II/Surfactant Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	WILD OAT CONTROL PERCENT 6-19-98	WILD OAT CONTROL PERCENT 7-20-98
1	ASSURE II	.8	EC	8	oz pr/A	98.9	99.4
1	NIS	1	EC	.25	% v/v		
2	ASSURE II	.8	EC	8	oz pr/A	96.6	99.6
2	COC	1	EC	1	% v/v		
3	ASSURE II	.8	EC	8	oz pr/A	99.2	99.7
3	MSO	1	EC	1	% v/v		
4	ASSURE II	.8	EC	4	oz pr/A	99.3	99.8
4	NIS	1	EC	.25	% v/v		
5	ASSURE II	.8	EC	4	oz pr/A	96.8	99.8
5	COC	1	EC	1	% v/v		
6	ASSURE II	.8	EC	4	oz pr/A	98.3	100.0
6	MSO	1	EC	1	% v/v		
7	ASSURE II	.8	EC	4	oz pr/A	100.0	100.0
7	NIS	1	EC	.25	% v/v		
7	UAN 28%	1	EC	1	gal pr/A		
8	ASSURE II	.8	EC	4	oz pr/A	100.0	100.0
8	COC	1	EC	1	% v/v		
8	UAN 28%	1	EC	1	gal pr/A		
9	ASSURE II	.8	EC	4	oz pr/A	96.7	100.0
9	MSO	1	EC	1	% v/v		
9	UAN 28%	1	EC	1	gal pr/A		
10	UNTREATED					0.0	0.0
	LSD (.05) =					3.5	0.8
	Standard Dev.=					1.99933	.440066
	CV =					2.26	0.49
	Treatment F					728.286	15431.19
	Treatment Prob(F)					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 toward 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% urea ammonium nitrate liquid fertilizer (UAN). These treatments were applied either in the fall or spring when 6 to 8 inches of quackgrass regrowth was present. Sequential applications also were included which consisted of fall plus spring treatments applied to the same plots.

The first series of treatments were applied during the 1996/1997 season. Fall treatments were applied on 9/23/96. Single spring treatments were applied on 5/6/97 and sequential spring treatments were applied on 5/29/97. Treatments were then reapplied to the same plots during the 1997/1998 season. Fall treatments were made on 9/8/97 and all spring treatments were applied on 4/21/98. This report details the results of the 1997/1998 treatments.

The effect of quackgrass competition on mint hay yields is apparent in the nontreated check. Left uncontrolled, quackgrass developed into a sod, completely eliminating the mint crop. Initially, control was most complete with fall applications. However, long-term control appeared to be most affected by rate and surfactant type. Sequential fall plus spring treatments provided the greatest control, with no significant differences in control being observed among Assure II rates. In contrast, control increased as Assure II rates increased for single applications made in the fall or spring. The effect of surfactants was slight, but control appeared to be greater when Assure II was applied with MSO plus 28% UAN.

Long-Term Quackgrass Control in Peppermint with Assure II

Site Description

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

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 3
Study Design: RCB
Site Location: R-7

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, and 90 Lbs. K
	3- 2-98	101 Lbs. N and 36 Lbs. S
Weed Control:	4-17-97	Stinger at .5 pt/A
	5-14-97	Basagran at 2 qt/A + Buctril at .5 pt/A
	4-29-98	Stinger at 1 pt/A

Soil Description

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

Application Information

Application Date:	9-23-96	5-6-97	5-29-97	9-8-97	4-21-98
Time of Day:	1:30 PM	11:00 AM	10:00 AM	11:00 AM	11:00 AM
Application Method:	BACKPACK	BACKPACK	BACKPACK	BACKPACK	BACKPACK
Application Timing:	POST	POST	POST	POST	POST
Air Temp., Unit:	54 F	55 F	68 F	68 F	63 F
% Relative Humidity:	58	51	55	48	41
Wind Velocity, Unit:	7 MPH	3 MPH	3 MPH	0 MPH	0-3 MPH
Dew Presence (Y/N):	N	Y	Y	Y	N
Soil Temp., Unit:	50 F	50 F	62 F	68 F	60 F
Soil Moisture:	GOOD	GOOD	GOOD	GOOD	GOOD
% Cloud Cover:	0	85	30	0	10

	Weed Species	Weed Stage
9-23-96	Quackgrass	4-8"
5- 6-97	Quackgrass	6-8"
5-29-97	Quackgrass	6-9"
9- 8-97	Quackgrass	4-8"
4-21-98	Quackgrass	4-8"

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	H2O	20

Long-Term Quackgrass Control in Peppermint with Assure II

Trt No	Treatment Name	Rate Unit	Grow Stg	QUACK CONTROL PERCENT 4-22-98	QUACK CONTROL PERCENT 5-26-98	QUACK CONTROL PERCENT 7-29-98	QUACK DRY MAT TON/ACRE 7-29-98	MINT DRY MAT TON/ACRE 7-29-98	MINT OIL YLD LBS/ACRE 7-29-98
1	ASSURE II	7 oz pr/A	FALL	91.0	50.0	58.3	2.24	0.96	28.9
1	NIS	1 qt pr/A	FALL						
2	ASSURE II	7 oz pr/A	FALL	95.7	74.3	75.0	1.42	1.39	36.8
2	MSO	1 qt pr/A	FALL						
2	UAN 28%	2 qt pr/A	FALL						
3	ASSURE II	10 oz pr/A	FALL	96.3	86.7	80.0	1.42	1.42	43.6
3	NIS	1 qt pr/A	FALL						
4	ASSURE II	10 oz pr/A	FALL	97.0	86.7	83.3	1.96	1.07	48.7
4	MSO	1 qt pr/A	FALL						
4	UAN 28%	2 qt pr/A	FALL						
5	ASSURE II	15 oz pr/A	FALL	97.7	94.7	95.7	0.34	2.07	45.1
5	NIS	1 qt pr/A	FALL						
6	ASSURE II	15 oz pr/A	FALL	99.0	97.0	94.7	0.03	2.30	56.8
6	MSO	1 qt pr/A	FALL						
6	UAN 28%	2 qt pr/A	FALL						
7	ASSURE II	7 oz pr/A	SPRING	33.3	36.7	30.0	2.40	0.68	27.5
7	NIS	1 qt pr/A	SPRING						
8	ASSURE II	7 oz pr/A	SPRING	25.0	53.3	30.0	2.72	0.77	29.5
8	MSO	1 qt pr/A	SPRING						
8	UAN 28%	2 qt pr/A	SPRING						
9	ASSURE II	10 oz pr/A	SPRING	56.7	63.3	63.3	1.49	1.36	50.6
9	NIS	1 qt pr/A	SPRING						
10	ASSURE II	10 oz pr/A	SPRING	72.0	87.7	86.0	1.30	1.56	61.2
10	MSO	1 qt pr/A	SPRING						
10	UAN 28%	2 qt pr/A	SPRING						
11	ASSURE II	15 oz pr/A	SPRING	73.3	95.3	95.7	0.94	1.78	57.7
11	NIS	1 qt pr/A	SPRING						
12	ASSURE II	15 oz pr/A	SPRING	80.0	97.3	96.0	0.25	2.15	62.3
12	MSO	1 qt pr/A	SPRING						
12	UAN	2 qt pr/A	SPRING						
13	ASSURE II	7 oz pr/A	FALL	97.7	96.7	98.0	0.01	2.33	66.7
13	NIS	1 qt pr/A	FALL						
13	ASSURE II	7 oz pr/A	SPRING						
13	NIS	1 qt pr/A	SPRING						
14	ASSURE II	10 oz pr/A	FALL	98.3	97.0	97.3	0.17	2.30	67.5
14	NIS	1 qt pr/A	FALL						
14	ASSURE II	10 oz pr/A	SPRING						
14	NIS	1 qt pr/A	SPRING						
15	ASSURE II	15 oz pr/A	FALL	99.3	97.7	99.7	0.00	2.12	65.1
15	NIS	1 qt pr/A	FALL						
15	ASSURE II	15 oz pr/A	SPRING						
15	NIS	1 qt pr/A	SPRING						
16	NONTREATED			0.0	0.0	0.0	3.82	0.01	1.7
LSD (.05) =				16.2	15.3	21.3	1.44	0.85	22.0
Standard Dev.=				9.74501	9.16144	12.7642	.866418	.511647	13.1501
CV =				12.86	12.07	17.26	67.58	33.73	28.07
Treatment F				30.720	28.584	16.700	5.164	5.453	5.760
Treatment Prob(F)				0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

1996 Mint Carryover Study

Establishing a new stand of mint requires a significant investment in labor as well as dollars. As such, questions have arose regarding herbicide carryover injury to baby mint. This study was conducted to investigate the carryover potential of three ALS inhibitors - Assert, Pursuit, and Imazamox.

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 evaluate 12 and 24 month recropping intervals. Baby mint was planted in the spring of 1997 in those plots designated for the 12 month rotation interval. These plots were harvested first in 1997 and again in 1998. The plots designated for the 24 month recrop interval were planted to baby mint on April 28, 1998 and were harvested in the fall of the same year.

There were no significant yield reductions associated with the 24 month rotational interval. The plots associated with the 12 month rotation interval treatments continued to demonstrate yield reductions related to the injury observed during the 1997 year of establishment. Pursuit treatments resulted in the greatest yield reductions followed by Assert and Imazamox, respectively. This observation demonstrates the importance of optimizing inputs and management considerations for the establishment of new plantings. A stand that is less than ideal will never recover from the initial stress.

1996 Mint Carryover Study

Site Description

Crop: Peppermint	Variety: Black Mitchum	Planting Date: 4-28-98
Planting Method: Hand		Depth, Unit: 4"
Row Spacing, Unit: 22"	Soil Moisture: Good	Emergence Date: 5-19-98
Plot Width, Unit: 10 FT	Plot Length, Unit: 15 FT	Reps: 3
Site Location: R-3		Study Design: RCB

Plot Maintenance:

Fertility:	4- 2-98	100 Lbs. N, 52 Lbs. P, 60 Lbs. K, and 24 Lbs. S
	5-20-98	100 Lbs. N and 10 Lbs. S
	7-29-98	50 Lbs. N
Weed Control:	4-21-98	Assure II at 15 oz/A
	6-24-98	Sinbar at .5 lb

**** Planting of 12 month treatments was on 4-24-97

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 DRY MAT TON/ACRE 7-17-98	MINT DRY MAT TON/ACRE 8-26-98
1	ASSERT	2.5	EC	.92	2.62	
1	BARLEY					
1	12 MO					
2	ASSERT	2.5	EC	.46	3.33	
2	BARLEY					
2	12 MO					
3	NONTREATED				3.32	
3	BARLEY					
3	12 MO					
4	PURSUIT	2	EC	.092	2.33	
4	LENTILS					
4	12 MO					
5	PURSUIT	2	EC	.046	2.69	
5	LENTILS					
5	12 MO					
6	NONTREATED				3.04	
6	LENTILS					
6	12 MO					
7	AC299263	2	EC	.063	2.94	
7	LENTILS					
7	12 MO					
8	AC299263	2	EC	.032	3.12	
8	LENTILS					
8	12 MO					
9	NONTREATED				3.03	
9	LENTILS					
9	12 MO					
10	ASSERT	2.5	EC	.92		1.15
10	BARLEY					
10	24 MO					
11	ASSERT	2.5	EC	.46		1.24
11	BARLEY					
11	24 MO					
12	NONTREATED					1.10
12	BARLEY					
12	24 MO					
13	PURSUIT	2	EC	.092		1.16
13	LENTILS					
13	24 MO					

CONTINUED...

1996 Mint Carryover Study

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	MINT DRY MAT TON/ACRE 7-17-98	MINT DRY MAT TON/ACRE 8-26-98
14	PURSUIT	2	EC	.046		1.13
14	LENTILS					
14	24 MO					
15	NONTREATED					1.10
15	LENTILS					
15	24 MO					
16	AC299263	2	EC	.063		1.12
16	LENTILS					
16	24 MO					
17	AC299263	2	EC	.032		1.21
17	LENTILS					
17	24 MO					
18	NONTREATED					1.19
18	LENTILS					
18	24 MO					
	LSD (.05) =				0.55	0.21
	Standard Dev.=				.316211	.118561
	CV =				10.77	10.26
	Treatment F				3.304	0.506
	Treatment Prob(F)				0.0200	0.8348

Dormant Spring Goal Applications for Toadflax Control

Yellow toadflax is a perennial broadleaf weed which is extremely difficult to control in mint production fields. Preliminary findings indicated that Goal applied postemergence did `burn back' established toadflax plants. Unfortunately, similar injury was noted with the mint crop. This study was established to determine if early dormant spring applications of Goal would control toadflax and provide the needed crop selectivity.

Goal was applied as the liquid formulation as well as impregnated on dry fertilizer. The liquid did have slightly greater activity, but the effects were minor. Although control improved as rates increased, control was inadequate and only temporary regardless of the formulation used.

Site Description

Crop: Peppermint

Plot Width, Unit: 10 FT		Plot Length, Unit: 15 FT	Reps: 6
Site Location : Tutvedt Farm			Study Design: RCB
Plot Maintenance:			
Fertility:	4- 3-98	157 Lbs. N, 100 Lbs. P, 120 Lbs. K, 36 Lbs. S, 2 Lbs. B, and 4 Lbs. Zn Applied to granular treatments as impregnated fertilizer	
	4- 3-98	100 Lbs. N, 52 Lbs. P, 60 Lbs. K, and 24 Lbs. S Applied to liquid Goal treatments and non-treated checks	
Weed Control:	4-22-98	Buctril at 1.5 pts + Stinger at 1 pt/A	

*** Study conducted on established stand of mint

Application Information

Application Date:	4-3-98
Time of Day:	9:00 AM
Application Method:	BACKPACK
Application Timing:	DORMANT
Air Temp., Unit:	52 F
% Relative Humidity:	71
Wind Velocity, Unit:	1 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	44 F
Soil Moisture:	GOOD
% Cloud Cover:	100

Plant Species	Plant Stage
Toadflax	1"
Mint	Dormant

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

Dormant Spring Goal Applications for Toadflax

Trt No	Treatment Name	TOADFLAX CONTROL PERCENT 6-19-98
1	GOAL 2EC 2.0	35.8
2	GOAL 2EC 1.0	19.2
3	GOAL 2EC 0.5	8.3
4	GOAL FERT 2.0	24.2
5	GOAL FERT 1.0	20.0
6	GOAL FERT 0.5	8.3
7	NONTREATED	0.0

LSD (.05) =	13.4
Standard Dev.=	11.3983
CV =	68.88
Treatment F	6.600
Treatment Prob(F)	0.0002

Toadflax Control with Basagran Tankmix Combinations

Yellow toadflax is a perennial broadleaf weed which is extremely difficult to control in mint production fields. This study was established to determine if basagran, tough, or buctril would control toadflax and provide the needed crop selectivity.

Basagran, tough, and buctril were applied as single or sequential treatments alone or in all possible combinations. Of the herbicides evaluated, basagran caused the greatest injury. Control and fresh weight reductions were greatest with sequential applications. Including either tough or buctril along with basagran did not dramatically increase control compared to basagran applied alone.

Site Description

Crop: Peppermint

Plot Width/Area, Unit: 10 FT   Plot Length, Unit: 15 FT   Reps: 3
Study Design: RCB
Site location: Tutvedt Farm
Field Preparation/Plot Maintenance:
***Conducted on established mint stand under center pivot irrigation

Application Information

Application Date:	5-6-98	5-12-98
Time of Day:	1:30 PM	10:00 AM
Application Method:	BACKPACK	BACKPACK
Application Timing:	POST	POST
Air Temp., Unit:	82 F	63 F
% Relative Humidity:	18	55
Wind Velocity, Unit:	3 MPH	0 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	69 F	58 F
Soil Moisture:	GOOD	EXCELLENT
% Cloud Cover:	0	0

Plant Species	Plant Stage
5- 6-98	
Toadflax	3 to 4"
Mint	1 to 2"
5-12-98	
Toadflax	3 to 6"
Mint	1 to 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	H20	20

Toadflax Control with Basagran Tankmix Combinations

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	TOADFLAX INJURY PERCENT 5-18-98	TOADFLAX FRESH WT GRM/FT2 6-4-98
1	BASAGRAN	4	EC	2	qt pr/A	E POST	23.3	59.7
1	MSO	1	EC	1	qt pr/A			
1	28%	1	EC	2	qt pr/A			
2	TOUGH	3.75	EC	3	pt pr/A	E POST	3.3	95.5
2	MSO	1	EC	1	qt pr/A			
2	28%	1	EC	2	qt pr/A			
3	BUCTRIL	2	EC	1.5	pt pr/A	E POST	0.0	138.6
4	BASAGRAN	4	EC	2	qt pr/A	E POST	63.3	23.8
4	MSO	1	EC	1	qt pr/A			
4	28%	1	EC	2	qt pr/A			
4	BASAGRAN	4	EC	2	qt pr/A	1 WEEK		
4	MSO	1	EC	1	qt pr/A			
4	28%	1	EC	2	qt pr/A			
5	TOUGH	3.75	EC	3	pt pr/A	E POST	21.7	34.1
5	MSO	1	EC	1	qt pr/A			
5	28%	1	EC	2	qt pr/A			
5	TOUGH	3.75	EC	3	pt pr/A	1 WEEK		
5	MSO	1	EC	1	qt pr/A			
5	28%	1	EC	2	qt pr/A			
6	BUCTRIL	2	EC	1.5	pt pr/A	E POST	21.7	73.3
6	BUCTRIL	2	EC	1.5	pt pr/A	1 WEEK		
7	BASAGRAN	4	EC	2	qt pr/A	E POST	28.3	55.0
7	TOUGH	3.75	EC	3	pt pr/A			
7	MSO	1	EC	1	qt pr/A			
7	28%	1	EC	2	qt pr/A			
8	BUCTRIL	2	EC	1.5	pt pr/A	E POST	21.7	54.6
8	TOUGH	3.75	EC	3	pt pr/A			
8	MSO	1	EC	1	qt pr/A			
8	28%	1	EC	2	qt pr/A			
9	BASAGRAN	4	EC	2	qt pr/A	E POST	25.0	73.3
9	BUCTRIL	2	EC	1.5	pt pr/A			
9	TOUGH	3.75	EC	3	pt pr/A			
9	MSO	1	EC	1	qt pr/A			
9	28%	1	EC	2	qt pr/A			

CONTINUED...

Toadflax Control with Basagran Tankmix Combinations

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	TOADFLAX INJURY PERCENT 5-18-98	TOADFLAX FRESH WT GRM/FT2 6-4-98
10	BASAGRAN	4	EC	2	qt pr/A	E POST	63.3	21.1
10	TOUGH	3.75	EC	3	pt pr/A			
10	MSO	1	EC	1	qt pr/A			
10	28%	1	EC	2	qt pr/A			
10	BASAGRAN	4	EC	2	qt pr/A	1 WEEK		
10	TOUGH	3.75	EC	3	pt pr/A			
10	MSO	1	EC	1	qt pr/A			
10	28%	1	EC	2	qt pr/A			
11	BUCTRIL	2	EC	1.5	pt pr/A	E POST	51.7	24.4
11	TOUGH	3.75	EC	3	pt pr/A			
11	MSO	1	EC	1	qt pr/A			
11	28%	1	EC	2	qt pr/A			
11	BUCTRIL	2	EC	1.5	pt pr/A	1 WEEK		
11	TOUGH	3.75	EC	3	pt pr/A			
11	MSO	1	EC	1	qt pr/A			
11	28%	1	EC	2	qt pr/A			
12	BASAGRAN	4	EC	2	qt pr/A	E POST	85.0	13.0
12	BUCTRIL	2	EC	1.5	pt pr/A			
12	TOUGH	3.75	EC	3	pt pr/A			
12	MSO	1	EC	1	qt pr/A			
12	28%	1	EC	2	qt pr/A			
12	BASAGRAN	4	EC	2	qt pr/A	1 WEEK		
12	BUCTRIL	2	EC	1.5	pt pr/A			
12	TOUGH	3.75	EC	3	pt pr/A			
12	MSO	1	EC	1	qt pr/A			
12	28%	1	EC	2	qt pr/A			
13	NONTREATED						0.0	136.3
LSD (.05) =							24.6	49.8
Standard Dev.=							14.6195	29.5798
CV =							46.54	47.91
Treatment F							9.922	5.885
Treatment Prob(F)							0.0001	0.0001

Goal Tolerance Study

Goal controls several troublesome weeds in mint production fields. Treatments are restricted to dormant applications as severe injury results if the mint crop has even a few leaves present. Preliminary results indicate that crop injury can be avoided with nondormant applications if Goal is impregnated on dry fertilizer. This study was conducted to evaluate the mint crop tolerance to impregnated Goal applications relative to conventionally applied dormant treatments.

Goal was applied impregnated on dry fertilizer either as a spring dormant treatment or when the mint crop was four inches tall. No differences were observed in either mint hay yields or oil production, suggesting that post dormant impregnated application of Goal are safe to the mint plant.

Site Description

Crop: Peppermint
Variety: Black Mitchum
Planting Date: 4-15-93
Harvest: 7-8-98

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

Fertility:	3-30-98	157 Lbs. N, 100 Lbs. P, 120 Lbs. K, 36 Lbs. S, 2 Lbs. B, and 4 Lbs. Zn Applied as Goal impregnated fertilizer
	6- 1-98	157 Lbs. N, 100 Lbs. P, 120 Lbs. K, 36 Lbs. S, 2 Lbs. B, and 4 Lbs. Zn Applied as Goal impregnated fertilizer
	6-12-98	50 Lbs. N applied as fertigation
	7- 8-98	50 Lbs. N applied as fertigation
Weed Control:	4-21-98	Assure II at 15 oz/A
	4-21-98	Buctril at 1.5 pt/A
	6- 1-98	Assure II at 15 oz/A
Irrigation:		Throughout season as needed with wheel line

Soil Description

Texture: SiL % OM: 2.8 % Sand: 40 % Silt: 50 % Clay: 10
pH: 6.4 Soil Name: Creston Silt Loam

Application Information

Application Date:	3-30-98	6-1-98
Time of Day:	2:30 PM	1:00 PM
Application Method:	HAND	HAND
Application Timing:	DORMANT	4"
Air Temp., Unit:	62 F	74 F
% Relative Humidity:	48	45
Dew Presence (Y/N):	N	N
Soil Temp., Unit:		72 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:		60

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

Goal Tolerance Study

Trt No	Treatment Name	MINT DRY WT TONS/A 7-28-98	MINT OIL YIELD LBS/A
1	FERT DORM 2.0	2.2	60.6
2	FERT DORM 1.0	2.4	61.1
3	FERT DORM 0.5	2.6	64.2
4	FERT 4" 2.0	2.8	61.9
5	FERT 4" 1.0	2.7	64.4
6	FERT 4" 0.5	2.6	66.6
7	NONTREATED	2.6	63.7
	LSD (.05) =	0.6	10.7
	Standard Dev.=	.329258	6.00644
	CV =	12.85	9.50
	Treatment F	0.978	0.369
	Treatment Prob(F)	0.4803	0.8851

Post Harvest Goal Applications for Toadflax Control

Yellow toadflax is a perennial broadleaf weed which is extremely difficult to control in mint production fields. Preliminary findings indicated that Goal applied postemergence did `burn back' established toadflax plants. Unfortunately, similar injury was noted with the mint crop. This study was established to determine if post harvest applications of Goal would control toadflax and provide the needed crop selectivity.

Goal was applied as the liquid formulation at different rates as either single or sequential treatments. Two impregnated treatments were also included. Sequential treatments provided the best control and there were few differences among the rates tested. Although initial control was excellent, weed regrowth had occurred by the next spring. In addition, mint injury was unacceptable.

Site Description

Crop: Peppermint

Plot Width/Area, Unit: 10 FT   Plot Length, Unit: 15 FT   Reps: 3
Site Type: Tutvedt Farm   Study Design: RCB
Plot Maintenance:

Weed Control:	10-21-97	Stinger at 1 pt/A
	4-22-98	Buctril at 1.5 pt and Stinger at 1 pt/A

Application Information

Application Date:	8-27-98	9-9-98
Time of Day:	10:30	9:30
Application Method:	BACKPACK	BACKPACK
Application Timing:	POST-HARV	POST-HARV
Air Temp., Unit:	74 F	55 F
% Relative Humidity:	38	74
Wind Velocity, Unit:	0 MPH	0 MPH
Dew Presence (Y/N):	N	N
Soil Temp., Unit:	66 F	58 F
Soil Moisture:	GOOD	GOOD
% Cloud Cover:	20	0

Plant Species	Plant Stage
8-27-98	
Toadflax	2-4"
Mint	1"

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

Post Harvest Goal Applications for Toadflax Control

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit		TOADFLAX INJURY PERCENT 10-20-97	MINT INJURY PERCENT 10-20-97	TOADFLAX CONTROL PERCENT 6-19-98
1	GOAL	.005	G	2.0	lb ai/A		41.7	6.7	5.0
2	GOAL	.005	G	1.0	lb ai/A		30.0	23.3	41.7
3	GOAL	2.0	EC	0.25	lb ai/A		50.0	63.3	3.3
3	MSO	1	EC	1	qt pr/A				
3	UAN	1	EC	2	qt pr/A				
4	GOAL	2	EC	.125	lb ai/A		43.3	70.0	11.7
4	MSO	1	EC	1	qt pr/A				
4	UAN	1	EC	2	qt pr/A				
5	GOAL	2	EC	0.06	lb ai/A		53.3	60.0	16.7
5	MSO	1	EC	1	qt pr/A				
5	UAN	1	EC	2	qt pr/A				
6	GOAL	2	EC	0.25	lb ai/A		96.3	95.0	53.3
6	MSO	1	EC	1	qt pr/A				
6	UAN	1	EC	2	qt pr/A				
6	GOAL	2	EC	0.25	lb ai/A	1 WEEK			
6	MSO	1	EC	1	qt pr/A				
6	UAN	1	EC	2	qt pr/A				
7	GOAL	2	EC	0.125	lb ai/A		93.3	95.0	46.7
7	MSO	1	EC	1	qt pr/A				
7	UAN	1	EC	2	qt pr/A				
7	GOAL	2	EC	0.125	lb ai/A	1 WEEK			
7	MSO	1	EC	1	qt pr/A				
7	UAN	1	EC	2	qt pr/A				
8	GOAL	2	EC	0.06	lb ai/A		76.7	90.0	10.0
8	MSO	1	EC	1	qt pr/A				
8	UAN	1	EC	2	qt pr/A				
8	GOAL	2	EC	0.06	lb ai/A	1 WEEK			
8	MSO	1	EC	1	qt pr/A				
8	UAN	1	EC	2	qt pr/A				
9	NONTREATED						16.7	0.0	10.0
LSD (.05) =							46.0	29.0	39.5
Standard Dev.=							26.5761	16.7774	22.8268
CV =							47.71	30.00	103.58
Treatment F							3.228	14.789	2.186
Treatment Prob(F)							0.0220	0.0001	0.0871

Mint Tolerance and Wild Pansy Control with Roundup

Wild pansy in an annual broadleaf weed which is occasionally found in peppermint fields. Wild pansy can form dense patches and competes successfully with peppermint. No herbicide options are known. Therefore research was conducted to evaluate Roundup for the potential to control this pest.

Roundup did injury wild pansy. The 8 oz rate provided 90 percent control and control increased as rates increased. Unfortunately, wild pansy and peppermint have the same level of tolerance toward Roundup, and crop injury was unacceptable.

Site Description

Crop: Peppermint

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 3
Study Design: RCB
Site Location: Jaquette Farm
Field Preparation/Plot Maintenance:
***Study conducted on established stand of mint

Application Information

Application Date:	6-4-98
Time of Day:	11:30 AM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	63 F
% Relative Humidity:	45
Wind Velocity, Unit:	0-3 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	60 F
Soil Moisture:	EXCELLENT
% Cloud Cover:	20

Weed Species	Weed Stage	Density at Application
Wild Pansy	8"	60% of total area

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

Mint Tolerance and Wild Pansy Control with Roundup

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	PANSY CONTROL PERCENT 6-29-98	MINT CROP INJ PERCENT 6-29-98
1	Roundup	4	AS	4 oz/A	68.3	75.0
2	Roundup	4	AS	8 oz/A	90.0	90.7
3	Roundup	4	AS	12 oz/A	100.0	97.3
4	Roundup	4	AS	16 oz/A	100.0	100.0
5	Nontreated				0.0	0.0
	LSD (.05) =				17.2	12.5
	Standard Dev.=				9.13601	6.65332
	CV =				12.75	9.16
	Treatment F				63.698	118.014
	Treatment Prob(F)				0.0001	0.0001

Wild Pansy Control in Peppermint

Wild pansy in an annual broadleaf weed which is occasionally found in peppermint fields. Wild pansy can form dense patches and competes successfully with peppermint. No herbicide options are known. Therefore research was conducted to evaluate Vin-der and basagran for the potential to control this pest.

Basagran had no impact on wild pansy, regardless of the rate used. Vin-der did injury wild pansy. The activity of Vin-der was enhanced with the addition of methylated seed oil (MSO) as a surfactant. Unfortunately, wild pansy and peppermint have the same level of tolerance toward Vin-der, and crop injury was unacceptable.

Site Description

Crop: Peppermint

Plot Width, Unit: 10 FT
Plot Length, Unit: 15 FT
Reps: 3
Study Design: RCB
Site Location: Jaquette Farm
Field Preparation/Plot Maintenance:
***Study conducted on established stand of mint

Application Information

Application Date:	6-2-98
Time of Day:	2:30 PM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	70 F
% Relative Humidity:	29
Wind Velocity, Unit:	5 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	66 F
Soil Moisture:	GOOD
% Cloud Cover:	30

Plant Species	Plant Stage	Density at Application
Wild Pansy	8" at full bloom	60% of total area
Mint	5"	

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 Pansy Control in Peppermint

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	PANSY CONTROL PERCENT	MINT CROP INJ PERCENT
1	Vineder			3	pt pr/A	46.7	45.0
2	Vineder			3	pt pr/A	62.7	63.3
2	MSO			2	pt pr/A		
3	Basagran			1	qt pr/A	0.0	0.0
3	MSO			2	pt pr/A		
3	28%			4	pt pr/A		
4	Basagran			2	qt pr/A	0.0	0.0
4	MSO			2	pt pr/A		
4	28%			4	pt pr/A		
5	Nontreated					0.0	0.0
LSD (.05) =						24.6	39.9
Standard Dev.=						13.0652	21.1936
CV =						59.75	97.82
Treatment F						16.319	6.160
Treatment Prob(F)						0.0006	0.0145

Horsetail Control in Baby Mint

Horsetail is a perennial weed which is adapted to high moisture areas with high water tables. No herbicide options are known for mint production. Therefore research was conducted to evaluate mint herbicides for the potential to control this pest.

Gramoxone and Goal both resulted in complete control. Tough also demonstrated good activity, providing 88 percent control. Buctril and Vin-der were ineffective.

Site Description

Crop: Peppermint

Plot Width, Unit: 10 FT
Site Location: Offstation

Plot Length, Unit: 15 FT

Reps: 3
Study Design: RCB

Application Information

Application Date:	5-7-98
Time of Day:	11:00 AM
Application Method:	BACKPACK
Application Timing:	POST
Air Temp., Unit:	70 F
% Relative Humidity:	50
Wind Velocity, Unit:	0 MPH
Dew Presence (Y/N):	N
Soil Temp., Unit:	69 F
Soil Moisture:	GOOD
% Cloud Cover:	0

Weed Species	Weed Stage	Density at Application
Horsetail	1 to 1.5"	30/ft2

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

Horsetail Control in Baby Mint

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	HORSETAIL CONTROL PERCENT 5-12-98
1	GRAMOXONE EXTRA	2.5	EC	2.4	pt pr/A	100.0
1	NIS	1	EC	.25	% v/v	
2	TOUGH	3.75	EC	3	pt pr/A	88.3
2	MSO	1	EC	1	qt pr/A	
2	28%	1	EC	2	qt pr/A	
3	BUCTRIL	2	EC	1.5	pt pr/A	33.3
3	NIS	1	EC	.25	% v/v	
4	VINE-DER	2	SC	3	pt pr/A	48.3
5	GOAL	2	EC	2	lb ai/A	100.0
5	MSO	1	EC	1	qt pr/A	
5	28%	1	EC	2	qt pr/A	
6	NONTREATED					0.0

LSD (.05) =	34.5
Standard Dev.=	18.9517
CV =	30.73
Treatment F	14.088
Treatment Prob(F)	0.0003

PROJECT TITLE: Intrastate Spring Barley Evaluation.

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Tom Blake and Pat Hensleigh, Plant Sciences, Bozeman, MT.

OBJECTIVE:
To evaluate spring barley cultivars and experimental lines for yield, lodging, quality, and disease resistance in northwestern Montana.

RESULTS:
The 1998 growing season was good for spring sown small grains. Abundant rainfall through heading and heat with good soil moisture during grain fill resulted in high spring barley yields. All but five of the 64 entries topped 100 bu/A with MT960170 exceeding 134 bu/A and BZ594-33 the lowest at 92 bu/A. Test weight and percent plump were also exceptional, averaging 52.0 lbs/bu and 85% respectively across the nursery. The cultivar BZ594-33 had the highest test weight at 55.1 lbs/bu and MT960170 lowest at 48.5 lbs/bu. Percent plumps ranged from 94% (Stark, MT940121, and Coors 37) to 59% (BZ594-33). Heavy yields and a late wind storm contributed to moderate lodging throughout the nursery. Some cultivars displayed tolerance to lodging while eight appeared to be more susceptible. Scald pressure was severe with cultivars MT960170, MT960198, MTLB 30, and Stanuwax showing some resistance. The onset of Scald was quick and complete but did not appear to have any agronomic consequences.

SUMMARY:
Favorable climatic conditions resulted in excellent cultivar performance in terms of yield, test weight, and kernel plumpness. Good documentation of lodging susceptibility was recorded as well as identifying those cultivars most susceptible to Scald.

FUTURE PLANS:
Continued spring barley evaluations for the purpose of identifying those cultivars suitable for successful production in Montana.

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

Planted: April 10, 1998 Harvested: August 13, 1998

VARIETY	YLD 13% BU/A	TEST WT LBS/BU	PLUMP PERCENT	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	SCALD 0-3 1/
MT960170	134.35	48.50	72.00	9.47	168.52	37.40	2.87	.33
GS 1750	133.59	52.33	93.00	10.27	172.15	37.80	3.55	2.31
Nebula	125.43	49.38	91.00	10.09	174.02	35.40	2.25	1.84
MTLB 57	123.04	51.79	80.00	9.88	169.94	41.30	2.98	1.95
MT940082	122.76	53.65	84.00	10.40	172.47	37.80	1.78	.90
Baronesse	121.49	52.21	88.00	9.67	173.27	39.80	3.23	2.03
MT960222	120.82	52.60	93.00	10.11	173.10	39.40	3.37	1.75
MT960228	120.78	52.30	90.00	9.95	172.62	39.40	3.98	1.77
MT960198	118.93	51.97	73.00	9.78	170.29	39.00	2.63	.94
MT960101	118.70	53.12	86.00	10.08	175.49	39.40	3.22	2.23
MTLB 13	118.67	51.32	86.00	9.82	171.78	42.50	2.63	1.04
MT960225	117.34	52.69	88.00	10.08	171.32	46.10	3.03	2.60
MT960045	116.88	53.07	79.00	10.34	180.04	34.60	1.81	2.36
H1851195	115.71	51.50	89.00	9.83	170.31	41.30	2.35	1.34
Stark	114.99	53.43	94.00	10.01	168.15	43.30	2.20	2.37
MT940121	114.43	52.31	94.00	10.35	174.97	37.80	3.25	2.41
MT960140	114.40	50.23	74.00	9.58	173.77	42.10	3.78	1.38
MT960226	114.21	53.19	89.00	9.87	170.89	38.20	4.11	3.06
MT960082	114.02	52.00	92.00	10.31	174.03	28.00	2.59	2.38
MT950186	113.84	53.25	87.00	9.96	172.62	37.80	4.24	2.29
MTLB 6	113.78	51.56	88.00	9.93	170.81	39.00	2.78	1.60
MT920059	113.72	53.29	90.00	10.41	172.37	42.90	2.99	1.64
MT910189	113.00	52.33	85.00	10.17	169.53	39.40	2.72	1.70
MTLB 30	112.77	52.01	83.00	10.24	172.91	42.10	3.71	.78
MT950155	112.62	51.92	87.00	9.86	171.18	40.20	1.69	1.75
BA 1614	112.04	50.88	93.00	9.52	168.34	46.50	2.00	1.33
MTLB 2	111.77	52.64	90.00	10.15	171.79	39.80	1.87	1.25
MT940053	111.40	53.19	85.00	10.32	174.96	39.80	1.93	1.06
MT940218	111.31	51.83	90.00	10.07	168.93	35.40	2.00	3.10
WPB BZ594-19	111.02	52.60	91.00	10.14	171.79	43.30	2.83	1.25
BA 1202	110.92	52.08	91.00	9.67	173.10	41.30	2.93	1.86
MT960152	110.92	51.26	83.00	9.90	179.02	42.10	3.46	2.04
MT920073	110.66	53.01	92.00	9.83	169.68	39.40	2.59	1.67
Merit	110.51	51.44	92.00	9.92	172.71	38.20	3.93	2.58
AC 96/1114	110.34	49.30	77.00	9.55	176.54	35.40	3.31	2.39
MT960154	110.23	50.65	79.00	9.64	175.82	39.40	3.44	2.31
BA 2B94-5602	109.25	52.43	88.00	10.45	175.20	40.20	2.29	2.29
MTLB 5	109.06	53.79	87.00	10.32	173.81	41.70	3.47	1.00
MT940177	108.67	51.07	86.00	9.76	172.35	42.10	2.80	2.43
Lewis	108.61	52.73	90.00	10.40	171.57	40.60	3.03	1.50
BA 2B94-5328	108.30	52.03	92.00	9.60	171.74	44.10	3.24	2.40
MT940214	108.28	52.64	90.00	9.64	170.90	39.00	3.61	2.98
MT950102	108.05	53.08	90.00	9.72	173.47	39.40	3.80	2.63
STANUWAX	107.89	57.57	79.00	11.35	167.47	37.40	3.11	.27
MT950156	107.17	50.81	87.00	10.14	170.06	38.20	1.99	2.59
Logan	107.17	52.43	90.00	9.71	167.89	40.60	2.97	2.31

CONTINUED...

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

Planted: April 10, 1998 Harvested: August 13, 1998

VARIETY	YLD 13% BU/A	TEST WT LBS/BU	PLUMP PERCENT	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	SCALD 0-3 1/
MT960174	107.04	49.42	70.00	10.06	174.37	40.90	2.94	1.78
MT960104	106.66	52.59	86.00	10.08	169.75	43.30	4.43	2.34
MT960178	106.16	51.98	90.00	10.31	175.47	42.10	3.41	2.67
MT920053	105.96	51.84	81.00	10.23	171.50	42.10	2.53	1.38
Morex	105.85	50.11	85.00	9.36	168.54	44.50	4.92	1.57
MT960175	105.82	52.10	86.00	10.26	174.94	42.50	3.40	2.55
MT960099	105.63	52.14	82.00	10.11	174.53	35.80	4.10	1.70
Coors C37	105.35	53.62	94.00	10.38	175.60	38.20	2.42	2.28
Chinook	105.32	51.76	82.00	10.17	172.44	41.30	2.71	.96
Stratus	104.05	49.73	70.00	9.54	175.13	31.50	4.23	1.70
MT960089	103.61	51.21	78.00	9.97	170.40	40.90	4.30	1.65
MT960199	102.16	52.41	83.00	10.32	171.86	41.70	2.68	1.63
Gallatin	101.64	52.08	82.00	9.59	170.26	42.10	3.67	2.60
Coors C22	96.89	50.44	87.00	9.80	177.60	34.60	2.86	2.63
Harrington	96.79	50.45	86.00	9.86	175.16	39.00	2.95	2.08
H3860224	95.41	51.34	78.00	9.77	174.41	41.30	3.75	1.94
Galena	94.01	50.90	76.00	9.74	180.17	38.20	1.90	2.75
WPB BZ594-33	91.61	55.06	59.00	10.43	172.50	36.20	3.47	1.18
MEAN	111.00	52.00	85.20	10.00	172.60	39.70	3.05	1.90
C.V.	9.07			3.35	0.49		34.76	33.65
LSD (.05)	17.48			0.57	1.47		1.85	1.07

1/ Disease rating 0=Highly Resistant, 3=Highly Susceptible

PROJECT TITLE: Early Yield Spring Barley Evaluation.

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Tom Blake and Pat Hensleigh, Plant Sciences, Bozeman, MT.

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

RESULTS:
The 1998 growing season was good for spring sown small grains. Abundant rainfall through heading and heat with good soil moisture during grain fill resulted in high spring barley yields. All 64 entries topped 100 bu/A with MT970229 exceeding 135 bu/A and MT970120 the lowest at 103 bu/A. Test weight and percent plump were also exceptional, averaging 52.7 lbs/bu and 88% respectively across the nursery. The cultivar MT970086 had the highest test weight at 54.7 lbs/bu and MT970023 lowest at 50.1 lbs/bu. Percent plumps ranged from 96% (MT970021) to 69% (MT970023). Heavy yields and a late wind storm contributed to moderate lodging throughout the nursery. The cultivars Stander and MT970177 displayed the highest level of lodging resistance. Scald pressure was severe with no cultivars having resistance but a few showing tolerance. The onset of Scald was quick and complete but did not appear to have any agronomic consequences.

SUMMARY:
Favorable climatic conditions resulted in excellent cultivar performance in terms of yield, test weight, and kernel plumpness. Good documentation of lodging susceptibility was recorded as well as identifying those cultivars most susceptible to Scald.

FUTURE PLANS:
Continued spring barley evaluations for the purpose of identifying those cultivars suitable for successful production in Montana.

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

Planted: April 10, 1998 Harvested: August 14, 1998

VARIETY	YIELD BU/A	TEST WT LBS/BU	PLUMP PERCENT	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	SCALD 0-3 1/
MT970229	135.2	53.6	90.0	10.8	172.7	35.4	2.89	3.00
Stander	133.7	52.5	94.0	11.2	169.5	39.4	1.35	2.00
MT970177	132.8	52.7	91.0	10.6	169.2	39.4	1.92	2.00
MT970053	132.4	53.5	93.0	10.6	171.9	39.4	4.25	2.00
MT970054	130.9	52.6	88.0	11.1	174.2	42.9	3.79	2.00
MT970110	130.6	53.0	92.0	11.0	173.6	37.4	3.33	2.67
MT970107	130.3	53.5	87.0	10.9	172.4	37.8	4.94	2.67
MT970245	129.0	52.7	95.0	11.1	169.2	41.7	3.41	1.67
MT970248	127.8	52.9	91.0	10.4	170.2	38.2	4.83	2.33
MT970180	127.7	52.7	86.0	10.2	171.3	41.7	4.52	2.33
MT970148	127.4	52.0	92.0	10.3	170.0	35.4	3.57	2.00
MT970125	127.3	52.3	92.0	10.8	173.0	39.0	2.54	2.00
MT970231	127.0	52.9	86.0	10.5	170.3	40.6	3.98	3.00
MT970139	126.0	52.1	86.0	10.9	170.7	39.4	3.98	1.67
MT970035	126.0	51.6	85.0	10.6	169.1	37.4	3.90	2.33
MT970155	125.3	53.8	95.0	10.5	173.5	34.6	3.35	2.00
MT970218	125.2	53.1	95.0	6.8	170.6	39.4	3.78	2.67
MT970113	124.9	54.3	90.0	10.4	172.0	38.6	4.24	3.00
MT970041	124.1	51.5	78.0	10.4	169.6	38.2	5.35	2.00
MT970228	123.8	52.7	91.0	11.4	171.3	35.8	3.25	2.67
MT970241	123.6	52.4	87.0	10.2	166.9	37.8	4.02	2.33
MT970143	122.7	52.8	83.0	10.5	169.9	36.2	3.81	3.00
MT970086	122.7	54.7	93.0	10.5	173.6	38.6	3.03	2.00
MT970226	122.6	52.7	81.0	10.4	174.2	37.8	3.40	2.67
MT970105	122.5	53.6	84.0	10.5	167.8	37.4	4.99	2.67
MT970050	122.4	50.8	84.0	10.2	169.0	38.2	4.54	1.67
MT970205	122.4	51.2	87.0	9.7	173.2	39.4	4.01	2.67
MT970244	122.1	53.1	92.0	11.0	168.6	40.2	2.56	2.33
MT970172	121.9	53.4	87.0	10.5	170.8	36.6	5.97	3.00
MT970029	121.9	52.3	93.0	10.2	171.9	39.8	3.79	3.00
MT970116	121.7	53.1	89.0	10.6	169.0	40.9	4.39	3.00
MT970214	121.5	51.5	88.0	10.0	172.3	37.4	2.65	2.67
MT970227	120.7	52.9	89.0	10.7	173.9	36.6	2.70	2.33
MT970023	120.5	50.1	69.0	7.3	170.6	36.2	3.86	2.67
MT970176	119.7	53.3	92.0	10.1	170.3	35.8	3.08	2.33
MT970196	119.7	53.4	88.0	11.4	170.9	37.8	5.27	2.33
Morex	119.1	50.4	84.0	9.6	167.3	43.7	6.19	2.00
MT970240	119.1	52.6	83.0	10.1	169.1	37.8	4.18	2.67
MT970026	118.8	54.6	94.0	10.4	171.9	38.6	4.98	2.67
MT970027	118.5	52.7	82.0	10.3	172.0	35.8	5.00	2.67
MT970230	118.0	53.7	87.0	10.2	169.8	38.6	3.08	2.67
Baronesse	117.5	52.5	82.0	10.5	172.2	33.1	4.29	2.67
MT970065	116.5	51.8	87.0	10.4	172.5	39.8	5.08	2.33
Harrington	116.0	50.3	76.0	7.1	172.5	36.2	4.92	2.67
MT970207	115.6	53.1	90.0	9.8	171.5	36.2	3.35	3.00
MT970217	114.8	51.7	95.0	10.3	177.3	40.6	3.97	1.67

CONTINUED...

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

Planted: April 10, 1998 Harvested: August 14, 1998

VARIETY	YIELD BU/A	TEST WT LBS/BU	PLUMP PERCENT	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	SCALD 0-3 1/
MT970025	114.7	53.2	92.0	11.5	169.6	39.8	4.52	2.67
Hector	114.6	52.4	74.0	10.2	171.1	40.9	5.01	2.00
Gallatin	114.5	52.4	77.0	10.4	169.5	37.4	3.70	3.00
MT970158	114.0	53.3	90.0	10.5	174.7	38.6	3.01	2.67
MT970063	113.7	52.0	78.0	10.2	172.3	42.5	4.46	2.33
MT970219	113.7	52.1	90.0	11.2	171.0	37.0	5.13	3.00
Chinook	113.6	52.6	85.0	11.3	171.7	37.4	4.59	1.67
MT970021	113.0	52.9	96.0	10.7	170.2	35.4	3.49	3.00
Stark	112.6	52.9	93.0	10.2	167.8	39.4	2.95	2.33
MT970091	111.9	52.0	82.0	11.0	171.6	37.8	4.80	2.33
MT970126	111.6	53.2	92.0	10.6	172.4	40.6	3.16	2.00
MT970034	111.2	53.5	93.0	10.4	169.3	37.4	4.41	2.33
MT970194	111.1	53.7	90.0	10.7	168.4	35.8	3.14	2.00
MT970019	111.1	53.4	95.0	11.6	170.1	40.9	3.08	3.00
MT970129	108.7	53.0	76.0	10.0	173.7	33.9	3.60	3.00
MT970224	108.6	53.5	91.0	10.3	170.5	37.4	4.81	3.00
MT970048	106.8	51.2	76.0	10.7	174.1	28.7	5.76	2.33
MT970120	103.0	53.5	94.0	10.1	170.4	41.3	2.75	3.00
MEAN	118.6	52.7	88.0	10.4	171.2	38.1	3.95	2.46
C.V.	8.1			12.9	0.4		24.31	18.07
LSD (.05)	16.5			2.3	1.1		1.63	0.72

1/ Disease ratings 0=Highly Resistant, 3=Highly Susceptible

PROJECT TITLE: Montana Statewide Spring Oat Variety Performance

PROJECT LEADER: Bob Stougaard and Doug Holen, Kalispell, MT
Tom Blake and Pat Hensleigh, Plant Sciences, Bozeman, MT

OBJECTIVE:
To evaluate the agronomic performance of oat varieties and experimental lines grown in northwestern Montana.

RESULTS:
Yields in 1998 varied from 235 (Celsia) to 163 bu/A (ND860416). Growing conditions were ideal for spring sown small grains. Test weights ranged from 40.4 (Celsia) down to 36.0 lbs/bu (Prairie), with a nursery mean of 38.0 lbs/bu. Lodging was severe due to excessive vegetative growth, high yields, and a late season windstorm. Most cultivars were severely lodged at harvest with the exception of Celsia and Prarie which demonstrated good straw strength. The disease Septoria was prevalent throughout the nursery with all cultivars showing some susceptibility.

SUMMARY:
Favorable climatic conditions resulted in excellent yields and above average test weights in 1998. Severe lodging was documented along with susceptibility differences to Septoria.

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

Planted: April 10, 1998 Harvested: August 18, 1998

VARIETY	YIELD BU/A	TEST WT LB/BU	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	SEPTORA 0-3 1/
Celsia	235.44	40.42	177.67	48.00	1.67	1.00
Monida	212.55	38.70	181.00	48.57	8.67	1.67
90Ab1322	200.56	38.22	174.67	39.90	5.00	1.67
Rio Grande	200.56	37.98	172.33	41.87	8.00	1.33
87AB5125	192.93	38.08	177.00	41.23	7.67	2.00
Ajay	190.75	36.85	175.33	37.93	4.33	1.67
ABSP 9-2	189.66	37.81	173.67	45.40	9.00	2.33
86AB664	187.48	37.86	177.67	45.67	7.67	3.00
86AB4582	186.39	35.95	175.33	45.13	9.00	2.33
Powell	184.21	37.50	180.00	38.60	8.00	2.00
Prairie	182.03	37.29	171.33	42.77	.67	1.67
Otana	174.40	39.36	175.33	49.47	7.67	2.33
Whitestone	168.95	39.41	175.33	40.17	8.00	1.33
ND860416	163.50	36.96	176.00	46.47	8.00	2.33
MEAN	190.67	38.03	175.90	43.65	6.67	1.90
C.V.	6.94		0.20	2.55	11.22	0.85
LSD (.05)	38.45		1.00	3.24	2.17	0.85

1/ Disease rating 0=Highly Resistant, 3=Highly Susceptible

PROJECT TITLE: Advanced Spring Wheat Nursery.

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Luther Talbert and Susan Lanning, Plant Sciences, Bozeman, MT.

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

RESULTS:
The 1998 growing season was good for spring sown small grains. Abundant rainfall through heading and heat with good soil moisture during grain fill resulted in high spring wheat yields. MT9675 yielded best at 113 bu/A while Thatcher was at the bottom with 84 bu/A. Test weights were also high, ranging from 63.7 (MT9653) to 60.1 lbs/bu (MT9754). Mid season moisture and cool temperatures contributed to light levels of Leaf Rust and moderate to high levels of Tan Spot. While no cultivars stood alone for Leaf Rust and Tan Spot resistance or susceptibility, genetic differences did exist and were recorded. Many cultivars displayed good resistance to lodging under high yielding conditions with the exceptions of Thatcher, Fortuna, Lew, and MT9631.

SUMMARY:
Favorable climatic conditions resulted in excellent variety performance in terms of yield and test weight. Disease ratings were recorded which indicated varietal differences in susceptibility to Leaf Rust and Tan Spot. Lodging notes identified cultivar differences in straw strength.

FUTURE PLANS:
Continued spring wheat evaluations for the purpose of identifying those varieties suitable for successful production in Montana.

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

Planted: April 10, 1998 Harvested: August 17, 1998

VARIETY	YLD 13% BU/A	TEST WT LBS/BU	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	LF RUST 0-3 1/	TANSPOT 0-3 1/
MT 9675	113.06	61.43	12.64	172.34	36.87	.78	1.02	1.70
BZ987331	111.02	61.68	10.62	165.72	35.24	2.11	1.65	1.97
AMIDON	110.75	61.56	11.29	171.72	39.73	.24	.01	1.36
MT 9738	110.57	62.08	11.90	171.11	42.08	.21	.02	.99
BZ991408	108.99	62.63	10.95	163.82	35.10	.22	2.09	2.99
BR 2306	106.54	60.92	12.53	168.40	37.32	.11	2.02	1.34
MCNEAL	106.03	62.61	11.45	171.68	35.54	.24	1.67	.99
MT 9653	103.82	63.71	12.36	172.42	41.17	1.97	0.00	.97
NEWANA	103.27	62.48	12.00	172.70	34.04	.18	1.62	1.69
MT 9709	102.92	62.15	12.69	172.24	39.60	.34	.97	1.30
MT 9772	102.70	62.56	11.44	171.25	40.10	1.86	.06	1.63
MT 9712	102.56	62.91	12.22	170.48	39.13	1.46	.66	2.00
MT 9758	102.50	60.59	11.60	172.89	39.61	.18	0.00	1.36
MT 9721	101.41	61.70	11.16	172.18	37.63	.03	1.34	1.32
MT 9433	100.98	62.27	12.21	172.01	36.74	.66	2.01	1.31
MT 9715	100.26	62.40	11.12	170.21	34.01	2.38	1.68	1.63
MT 9706	99.93	62.74	11.51	170.93	40.41	.55	1.25	1.02
MT 9755	99.77	61.53	10.51	165.92	33.89	1.31	1.09	1.33
MT 9631	99.75	63.28	11.88	171.62	40.95	3.12	.26	2.33
MT 9756	99.74	62.75	11.24	170.53	40.62	1.15	.36	1.32
MT 9770	99.69	62.61	11.58	169.18	40.34	.46	1.03	1.36
MT 9627	99.09	62.96	11.99	170.49	32.73	.25	0.00	2.06
MT 9704	99.07	63.37	11.85	171.98	34.54	0.00	1.99	1.64
MT 9739	98.98	62.29	11.89	170.85	40.02	1.58	.02	1.67
MT 9539	98.79	63.58	13.56	169.39	34.75	1.94	1.70	1.65
MT 9771	98.26	62.34	11.33	170.90	39.70	1.53	.05	1.31
WESTBRED 926	97.99	60.96	10.52	166.65	33.52	.23	1.70	1.97
MT 9754	97.66	60.08	10.16	170.53	32.15	2.70	1.93	2.02
MT 9609	97.31	63.05	11.80	170.05	40.91	1.89	.01	1.68
ERNEST	97.29	63.39	12.31	170.41	40.48	.18	.40	1.69
LEN	97.28	61.02	11.52	170.49	35.47	0.00	.02	2.01
MT 9759	96.84	60.83	11.13	170.97	34.19	.13	1.03	1.34
MT 9750	96.60	60.24	10.54	168.52	35.22	.15	1.81	1.98
MT 9748	96.07	63.01	11.37	171.32	38.96	1.14	1.26	1.01
MT 9735	95.87	62.07	11.22	170.75	32.45	1.41	1.67	.99
MT 9720	95.58	63.53	11.46	170.84	32.42	.00	1.72	1.02
GRANDIN	95.32	61.64	11.79	168.48	36.71	.31	.02	2.01
MT 9719	95.13	64.37	11.74	170.53	33.71	1.16	1.96	.99
MT 9757	93.95	61.24	11.51	172.14	40.75	.54	.28	1.05
MT 9736	92.37	60.38	10.49	169.57	32.77	0.00	1.53	1.37
LEW	91.70	63.31	11.70	173.66	41.81	4.44	1.29	1.37
MT 9754	91.14	62.16	11.02	170.29	33.03	0.00	2.04	1.34
MT 9716	89.95	61.81	10.82	171.33	37.86	.51	1.35	1.99
MT 9742	88.94	62.72	11.46	171.45	34.82	2.94	2.02	1.30
MT 9728	88.42	62.04	11.00	168.16	32.32	.41	1.24	1.35
FORTUNA	88.11	63.51	11.75	170.29	41.19	3.98	1.02	1.99
HI-LINE	86.79	61.10	10.09	168.01	33.89	.65	.60	2.64
MT 9558	84.25	61.18	10.49	171.96	33.99	1.27	1.69	2.65
THATCHER	83.53	61.33	11.21	173.96	45.58	3.32	1.67	1.01
MEAN	98.34	62.17	11.48	170.48	37.06	1.07	1.08	1.54
C.V.	4.46		5.28	0.51	3.40	69.10	49.97	26.54
LSD (.05)	7.71		1.07	1.47	2.19	1.28	0.90	0.69

1/ Disease ratings 0=Highly Resistant, 3=Highly Susceptible

PROJECT TITLE: Preliminary Hard White Spring Wheat Evaluation.

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Luther Talbert and Susan Lanning, Plant Sciences, Bozeman, MT.

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

RESULTS:
The 1998 growing season was good for spring sown small grains. Abundant rainfall through heading and heat with good soil moisture during grain fill resulted in high spring wheat yields. MTHW9750 yielded best at 114 bu/A while MTHW9805 was at the bottom with 82 bu/A. Test weights were also high, ranging from 63.6 (MTHW9715) to 59.9 lbs/bu (MTHW9421). The included hard red check Hi-Line performed at 89 bu/A and 61.6 lbs/bu. Mid season moisture and cool temperatures contributed to light levels of Leaf Rust and moderate to high levels of Tan Spot. With light pressure from Leaf Rust, most entries demonstrated genetic tolerance with the exception of Klassic and MTHW9604 which were moderately to highly susceptible. Most entries were severely infested with Tan Spot with the following cultivars displaying a high level of tolerance; MTHW9520, MTHW9705, and MTHW9707. Overall lodging was defined as light to non-existent.

SUMMARY:
Favorable climatic conditions resulted in excellent variety performance in terms of yield and test weight. Disease ratings were recorded which indicated varietal differences in susceptibility to Leaf Rust and Tan Spot.

FUTURE PLANS:
Continued hard white spring wheat evaluations for the purpose of identifying those varieties suitable for successful production in Montana.

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

Planted: April 10, 1998 Harvested: August 13, 1998

VARIETY	YIELD BU/A	TEST WT LBS/BU	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	LF RUST 0-3 1/	TAN SPOT 0-3 1/
MTHW9520	113.9	61.5	18.6	172.0	34.7	.00	.00	1.00
ID377S	109.8	63.1	15.8	169.0	36.0	.00	1.00	2.00
MTHW9708	105.1	61.2	17.3	169.0	36.3	.00	.33	2.67
MTHW9603	103.4	60.0	18.3	171.0	34.7	.00	1.00	1.33
MTHW9420	103.0	61.7	17.8	168.3	32.1	.00	.33	2.00
MTHW9705	101.0	61.0	16.2	168.0	30.9	.00	.33	1.00
MTHW9716	99.8	62.5	11.8	165.0	32.9	.00	1.00	3.00
MTHW9709	99.7	60.8	11.4	168.0	34.6	.67	.67	2.00
MTHW9604	99.4	60.2	14.2	169.0	35.1	.00	2.67	2.00
MTHW9711	98.8	59.9	17.1	168.0	32.1	.00	.00	1.67
MTHW9713	96.7	62.6	12.0	168.0	31.6	1.67	.00	2.00
MTHW9804	96.3	63.5	11.8	168.0	34.1	.00	1.00	2.00
MTHW9706	96.1	61.2	18.0	168.6	33.4	.00	.67	1.67
MTHW9701	92.5	61.5	14.2	168.3	32.7	.00	.00	1.33
MTHW9715	92.4	63.6	12.2	166.6	35.5	.00	.33	3.00
MTHW9421	91.4	59.9	13.1	167.3	34.0	.00	.00	2.67
MTHW9803	91.2	62.1	11.7	169.6	35.0	.33	1.67	3.00
MTHW9710	91.0	61.6	11.8	165.0	32.3	.00	1.00	2.00
KLASIC	90.1	61.2	11.0	163.6	26.1	.00	2.33	3.00
MTHW9703	89.5	61.4	12.7	166.6	30.9	.00	.67	3.00
HI-LINE	88.9	61.6	11.6	169.3	31.7	.00	.67	2.67
MTHW9707	87.8	61.0	13.2	167.6	30.1	.00	.00	1.00
MTHW9802	86.5	62.1	11.7	165.3	31.5	.33	1.33	3.00
MTHW9714	86.0	63.3	12.8	166.3	39.1	1.33	.67	2.00
MTHW9702	85.7	60.7	11.9	166.6	32.5	.00	.00	3.00
MTHW9801	84.1	61.7	11.7	169.6	34.9	.00	.67	3.00
MTHW9805	82.0	63.5	12.1	171.0	36.0	.00	1.67	2.67
MEAN	94.9	61.6	13.8	167.9	33.4	0.16	0.74	2.21
C.V.	5.2		6.0	0.4	5.6	231.21	64.25	14.26
LSD (.05)	8.2		1.3	1.0	3.1	0.61	0.78	0.52

1/ Disease ratings 0=Highly Resistant, 3= Highly Susceptible

PROJECT TITLE: Intrastate Winter Wheat Nursery

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Phil Bruckner and Jim Berg, Plant Sciences, Bozeman, MT.

OBJECTIVE:
To evaluate Montana adapted cultivars and experimental lines for yield, lodging, quality, and disease resistance. With special attention and documentation given to dwarf bunt, stripe rust, and leaf rust reactions which are common production concerns in northwest Montana.

RESULTS:
Rhizoctonia Root Rot (Bare Patch) was identified in April throughout the nursery. Approximately 20% of the nursery area was affected, resulting in yields 50% of normal. Injury symptoms were expressed as thin stands, reduced height, hastened maturity, and poor seed fill. True varietal resistance is not believed to exist and was not witnessed to any degree. Moderate to high infestations of Tan Spot were documented in May which also contributed to the low yields. MTW9441 displayed good resistance to Tan Spot while Promontory, Neeley, Windstar, Morgan, Utah 100, Norstar, and Redwin were identified as highly susceptible. Documentation of genetic TCK responses was not possible as winter conditions were not conducive for spore germination and plant infection. Leaf and Stripe Rust were also absent in 1998.

SUMMARY:
The severity and randomness in which Rhizoctonia appeared across the nursery made measurements and determinations difficult. Yields ranged from 71 to 42 bu/A while test weights dropped from 60.7 to 54.3 lbs/bu. Winter and growing season climatic conditions were not conducive for the targeted disease documentation.

FUTURE PLANS:
Winter wheat cultivars will continue to be evaluated at Kalispell to identify those with high yield potential and needed disease resistance for production in this region as well as 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, 1997 Harvested: July 31, 1998

VARIETY	YIELD BU/A	TEST WT LB/BU	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	RHIZOCT PERCENT 1/	TAN SPOT 0-3 2/
H1881	71.41	57.49	12.33	141.67	32.70	.00	18.33	1.00
QT 542	64.85	58.66	13.33	145.00	37.93	.67	10.00	2.00
XNH1824	64.81	58.29	12.63	141.67	31.10	.00	21.67	1.33
MT 9409	62.63	57.69	12.40	148.00	32.03	.00	15.00	2.33
NUWEST	62.20	59.55	13.00	150.33	35.80	.00	8.33	1.00
MTS9720	61.33	58.62	12.60	151.33	37.30	.33	13.33	2.00
MTS9719	60.98	58.65	12.23	152.33	38.03	.00	11.67	2.00
PROMONTORY	59.38	58.45	12.00	146.33	31.50	.00	18.33	3.00
TIBER	59.11	59.00	12.40	149.33	36.37	.33	28.33	2.00
ROCKY	59.09	58.62	12.43	145.67	36.37	2.33	15.00	1.33
AKRON	58.50	57.67	13.40	144.00	32.17	1.33	15.00	1.00
NEELEY	58.44	57.41	12.50	152.67	34.40	1.00	28.33	3.00
WINDSTAR	58.44	57.68	11.63	145.67	33.23	.00	11.67	3.00
MTW9441	56.98	58.33	12.93	151.00	35.17	.00	21.67	.67
MT9524	56.94	60.48	13.03	148.00	37.67	.00	23.33	1.00
NIOBRARA	56.88	56.90	12.20	140.67	32.43	1.00	21.67	1.33
MT9514	56.37	57.43	13.07	149.67	34.90	1.00	26.67	1.67
HALT	56.27	56.43	11.33	140.00	30.43	.67	11.67	1.00
BLIZZARD	56.05	58.99	11.70	150.67	34.17	.67	26.67	2.00
ELKHORN	55.66	58.90	12.33	153.67	40.57	2.33	18.33	2.00
RAMPART	55.55	58.45	12.50	146.33	33.33	1.67	13.33	2.00
JULES	55.53	56.78	12.37	146.33	30.97	1.00	40.00	2.00
ALLIANCE	55.38	57.17	11.83	139.00	29.67	1.00	23.33	1.33
MANNING	55.29	55.93	11.00	146.67	31.50	.33	31.67	1.33
KESTREL	55.03	56.37	12.33	149.33	34.37	.67	26.67	2.67
JUDITH	54.95	56.82	12.53	146.00	33.33	.33	25.00	1.67
BOUNDARY	54.13	54.33	10.97	149.67	29.10	.00	30.00	2.00
MT 9432	54.11	59.91	12.90	148.33	37.27	.00	15.00	1.00
PRONGHORN	53.99	58.57	13.13	142.33	34.90	2.33	15.00	1.67
BIGHORN	53.55	57.46	13.03	148.67	28.73	1.33	30.00	1.00
MORGAN	53.53	59.48	12.90	152.00	33.60	1.33	13.33	3.00
CRIMSON	53.51	60.68	12.93	147.33	34.27	.00	21.67	1.00
UTAH 100	53.49	59.00	12.03	150.00	35.30	.00	18.33	3.00
TANDEM	53.47	57.96	12.07	142.67	34.00	1.00	28.33	1.00
NEKOTA	53.43	57.20	12.10	140.00	29.67	.00	33.33	1.33
ND9272	53.38	57.72	12.23	145.67	31.50	.33	25.00	2.67
NORSTAR	53.15	60.04	13.53	156.33	44.20	3.00	11.67	1.00
ROUGHRIDER	53.00	59.59	13.80	148.67	41.60	3.00	13.33	3.00
SD93267	52.76	58.82	13.13	141.67	35.97	1.00	21.67	1.67
ID479	52.46	58.01	11.73	145.67	35.03	.67	18.33	1.33
VANGUARD	52.36	57.94	11.93	145.33	32.97	1.00	31.67	1.33
ND9257	52.04	56.87	12.50	148.00	32.83	1.67	30.00	2.00
REDWIN	52.02	58.25	12.53	148.00	38.17	.00	15.00	3.00
SD93380	51.79	56.93	11.93	143.33	32.43	.33	21.67	2.00
S93-7	51.57	57.99	13.30	142.67	33.10	1.67	31.67	1.00
SD92107	49.16	56.30	12.43	147.00	34.13	.00	20.00	1.33
MCGUIRE	47.24	58.34	12.77	143.67	32.83	.00	25.00	2.67
S86-1533	46.35	56.78	12.23	146.00	29.90	1.00	51.67	2.67
ERHARDT	42.53	59.80	12.80	147.33	31.50	.00	28.33	1.67
MEAN	55.54	59.06	12.47	146.77	34.09	0.74	21.94	1.80
C.V.	11.45		2.03	0.26	2.57	37.70	35.57	11.24
LSD (.05)	10.30		0.71	1.05	2.46	0.78	21.91	0.57

1/ Rhizoctonia rated as percent of plot affected

2/ Disease rating 0=Highly Resistant, 3=Highly Susceptible

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

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Phil Bruckner and Jim Berg, Plant Sciences, Bozeman, MT.

OBJECTIVE:
To evaluate predominately Montana experimental cultivars for yield, lodging, quality, and disease resistance. With special attention and documentation given to dwarf bunt, stripe rust, and leaf rust reactions which are common production concerns in northwest Montana.

RESULTS:
Rhizoctonia Root Rot (Bare Patch) was identified in April throughout the nursery. Approximately 20% of the nursery area was affected, resulting in yields 60% of normal. Injury symptoms expressed were thin stands, reduced height, hastened maturity, and poor seed fill. True varietal resistance is not believed to exist and was not witnessed to any degree. Moderate to high infestations of Tan Spot were documented in May which also contributed to the low yields. Varietal susceptibility differences existed and were recorded. Documentation of genetic TCK responses was not possible as winter conditions were not conducive for spore germination and plant infection. Leaf and Stripe Rust were also absent in 1998.

SUMMARY:
The severity and randomness in which Rhizoctonia appeared across the nursery made measurements and determinations difficult. Winter and growing season climatic conditions were not conducive for the targeted disease documentation.

FUTURE PLANS:
Experimental winter wheat cultivars will continue to be evaluated at Kalispell to identify those with high yielding and disease resistance genetics for production in this region as well as across the state.

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

Planted: September 25, 1997 Harvested: July 31, 1998

VARIETY	YIELD BU/A	TEST WT LB/BU	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	RHIZOCT PERCENT 1/	TAN SPOT 0-3 2/
MT9726	74.5	58.9	14.6	148.6	37.9	.33	13.3	1.00
MT9535	74.1	60.0	13.8	146.6	32.7	.00	18.3	2.00
NEELEY	68.1	58.7	14.2	152.6	36.2	2.00	15.0	3.00
MT 9426	67.0	58.7	14.0	147.3	30.0	.67	26.6	2.00
MT9513	66.6	60.2	13.7	149.3	35.0	.00	16.6	1.00
MTR9748	66.1	57.1	14.4	147.0	36.6	.67	23.3	1.33
MTW9752	66.1	58.1	13.7	146.0	36.0	.67	18.3	1.00
MTS97104	65.9	58.4	14.0	153.0	32.5	.67	23.3	2.33
MTW9727	65.8	61.1	14.8	148.0	36.1	.33	16.6	2.67
MT9712	64.1	57.6	13.2	144.6	34.1	2.00	21.6	1.67
MTS97110	63.6	58.5	15.4	151.0	33.4	.33	20.0	1.33
ND8955-A	63.2	59.5	14.5	146.6	34.7	1.67	11.6	1.33
MTW9722	62.7	60.4	14.3	147.0	34.1	.00	15.0	1.00
MTW9730	62.7	58.8	13.6	146.6	33.8	.33	21.6	1.00
MTW9724	62.7	58.9	15.2	146.3	32.5	1.33	26.6	1.33
ND9454	61.6	59.0	13.5	146.3	32.9	.33	13.3	3.00
KESTREL	60.8	57.8	14.6	148.3	34.5	1.00	21.6	2.67
MT 9403	60.5	58.7	15.1	147.0	33.0	.00	23.3	1.00
ERHARDT	60.4	60.6	14.5	147.6	33.2	.33	23.3	2.00
MT9729	59.8	59.7	15.2	148.0	36.3	.67	15.0	1.00
MT9717	59.5	60.5	14.2	147.6	33.8	.00	18.3	2.00
MT9526	58.9	59.4	16.6	152.3	36.2	.00	13.3	1.00
MTR9749	58.3	59.1	14.2	146.6	36.6	.00	11.6	2.00
RAMPART	57.5	59.9	12.8	146.0	34.1	2.00	20.0	2.00
MT9731	57.3	59.6	14.7	147.3	34.2	.33	30.0	1.00
MT9506	56.6	59.7	13.2	147.3	34.6	.33	25.0	2.33
ND9497	56.6	60.7	15.0	146.3	37.5	2.00	13.3	1.67
JUDITH	56.2	57.7	13.9	146.0	33.9	1.00	25.0	2.00
MTR9745	55.7	59.0	15.6	146.3	32.9	.67	16.6	1.67
MT9710	54.4	58.7	14.9	149.0	34.1	.33	25.0	.67
MT9523	54.0	60.3	13.7	146.6	33.7	.00	25.0	1.00
MTW9723	52.1	57.5	13.9	150.0	32.0	.00	41.6	1.00
MT9701	52.1	56.4	15.0	148.6	35.2	.00	35.0	1.00
ND9374	49.9	59.4	13.9	146.0	34.1	2.00	41.6	2.00
ND94108	48.8	58.2	13.7	146.6	34.5	2.00	33.3	1.33
MT9706	47.7	58.8	14.7	151.0	33.7	.67	35.0	3.00
MEAN	60.4	59.1	14.4	147.8	34.4	0.7	22.1	1.7
C.V.	14.5	1.6	5.2	0.5	5.3	68.5	66.8	26.6
LSD (.05)	14.2	1.6	1.2	1.3	2.9	24.0	24.0	0.7

1/ Rhizoctonia disease rating as percent of plot affected
2/ Tan Spot ratings 0=Highly Resistant, 3=Highly Susceptible

PROJECT TITLE: Soft White Winter Wheat Evaluation.

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Phil Bruckner and Jim Berg, Plant Sciences, Bozeman, MT.

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

RESULTS:
Mild winter conditions resulted in healthy and full stands of winter wheat at the beginning of the 1998 growing season. However, by the end of April, Rhizoctonia Root Rot was prevalent across approximately 35% of this nursery. Injury symptoms expressed included thin stands, reduced height, hastened maturity, and poor seed fill. Yields were 50% of normal and test weights very poor. True varietal resistance is not believed to exist and was not witnessed to any degree. Yields ranged from 67 (Macvicar) to 45 bu/A (Madsen). Test weights varied from 55.5 (Daws) to 50.3 lbs/bu (Kmor). Lodging throughout the nursery was minimal with no varietal separation apparent. Good documentation of Tan Spot disease responses were recorded.

SUMMARY:
Rhizoctonia Root Rot made evaluations difficult as the genetic potential of these cultivars was severely hindered. Measured characteristics may reflect more disease pressure response than genetic and environment.

FUTURE PLANS:
Continued soft white winter wheat evaluations with this 18 entry nursery in an attempt to identify cultivars best adapted to the soft white production areas in Montana and specifically the northwest region.

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

Planted: September 25, 1997 Harvested: August 6, 1998

VARIETY	YIELD BU/A	TEST WT BU/LB	MOIST PERCENT	HD DATE JULIAN	HEIGHT INCH	LODGE 0-9	RHIZOCT PERCENT 1/	TAN SPOT 0-3 2/
MACVICAR	66.5	54.2	10.0	148.0	28.4	.33	33.3	1.67
LAMBERT	66.1	54.8	9.7	147.3	31.3	.67	18.3	1.33
MALCOLM	63.9	54.4	10.3	147.6	29.2	.00	28.3	1.33
DAWS	63.0	55.5	10.7	149.6	28.2	.00	30.0	2.00
ROD	61.4	52.6	9.6	154.3	27.8	.00	26.6	1.00
STEPHENS	56.9	53.4	10.0	155.0	30.3	.67	33.3	1.67
BU6393-477	56.1	54.1	10.4	150.0	29.6	.67	30.0	2.00
CASHUP	54.6	51.3	8.8	153.6	27.8	.67	48.3	1.00
LEWJAIN	54.4	52.1	9.1	159.0	27.9	.00	25.0	1.00
HILL 81	53.1	53.7	10.4	154.6	29.9	.00	26.6	1.00
NEELEY	53.1	56.7	10.5	150.0	33.6	1.00	38.3	1.00
ELTAN	52.0	50.5	9.1	158.0	29.0	.67	35.0	1.00
BRUNDAGE	51.9	50.9	9.4	143.6	25.6	.00	18.3	1.00
W301	51.1	51.4	6.0	147.3	26.6	.33	45.0	2.33
KMOR	50.9	50.3	9.0	155.6	29.0	.00	48.3	2.00
BU6W93-481	50.0	52.8	10.6	147.6	28.9	1.00	36.6	2.67
MADSEN	44.9	50.5	8.9	156.0	28.5	.33	35.0	2.33
MEAN	55.9	52.9	9.6	151.6	28.9	.37	32.7	1.55
C.V.	10.2		14.2	0.4	3.5	101.64	49.0	22.60
LSD (.05)	9.5		2.3	1.0	1.7	.63	26.7	0.58

1/ Rhizoctonia disease rating as percent of plot affected
2/ Tan Spot ratings 0=Highly Resistant, 3=Highly Susceptible

PROJECT TITLE: Winter Wheat Early Generation Screening for TCK.

PROJECT LEADERS: Bob Stougaard and Doug Holen, NWARC-Kalispell, MT.
Phil Bruckner and Jim Berg, Plant Sciences, Bozeman, MT.

OBJECTIVE:
To evaluate winter wheat germplasm responses to introduced and natural TCK (Dwarf Bunt) infection. Agronomic characteristics and additional disease reactions will be documented as well.

RESULTS:
Rhizoctonia Root Rot (Bare Patch) was identified in April throughout the nursery. Approximately 30% of the nursery area was affected, resulting in yields 50% of normal. Injury symptoms expressed were thin stands, reduced height, hastened maturity, and poor seed fill. True varietal resistance is not believed to exist and was not witnessed to any degree. Moderate to high infestations of Tan Spot were documented in May which also contributed to the low yields. Varietal susceptibility differences existed and were recorded. Documentation of genetic TCK responses was not possible as winter conditions were not conducive for spore germination and plant infection.

SUMMARY:
Yield and test weights were poor in response to severe Rhizoctonia and Tan Spot pressure. The winter of 1997 was not favorable for TCK infection in that days of continuous snowcover never approached the approximated 60 days needed to begin the fungus' life-cycle.

FUTURE PLANS:
NWARC will continue to conduct this nursery in an attempt to identify those early generation cultivars with tolerance or resistance to TCK while also evaluating all agronomic attributes.

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

Planted: September 25, 1997 Harvested: August 4, 1998

		YIELD BU/A	TEST WT LBS/BU	LODGE 0-9	HEIGHT INCH	HEADING JULIAN	RHIZOCT PERCENT 1/	TAN SPOT 0-3 2/
1	PROMONTORY	56.1	57.8	0.0	32	143.0	3.0	2.0
2	BLIZZARD	63.5	57.9	1.0	35	148.0	5.0	1.0
3	WINRIDGE	67.3	57.6	0.0	37	148.0	10.0	2.0
4	YUMA	59.3	56.7	1.0	28	140.0	20.0	1.0
5	5	62.5	58.4	1.0	33	142.0	0.0	1.0
6	6	65.9	59.6	2.0	35	144.0	5.0	1.0
7	7	50.7	60.1	1.0	33	140.0	5.0	1.0
8	8	52.7	59.5	1.0	34	146.0	10.0	1.0
9	9	51.3	59.6	2.0	36	145.0	15.0	1.0
10	10	57.3	58.2	1.0	34	146.0	0.0	2.0
11	11	62.1	59.8	2.0	36	147.0	5.0	2.0
12	12	62.9	58.7	1.0	35	145.0	10.0	1.0
13	13	52.0	58.6	0.0	33	146.0	10.0	1.0
14	14	49.5	58.9	2.0	34	147.0	25.0	3.0
15	15	50.9	56.6	1.0	34	146.0	10.0	2.0
16	16	53.8	59.4	2.0	32	146.0	5.0	1.0
17	17	43.4	58.3	1.0	33	147.0	10.0	2.0
18	18	55.1	56.8	1.0	33	146.0	10.0	2.0
19	19	55.9	57.9	1.0	34	147.0	10.0	2.0
20	20	48.1	59.3	0.0	33	146.0	10.0	1.0
21	21	56.1	60.1	3.0	35	145.0	10.0	1.0
22	22	56.9	59.1	1.0	33	146.0	10.0	2.0
23	23	50.4	59.0	1.0	31	145.0	15.0	1.0
24	24	61.9	58.7	0.0	35	148.0	5.0	1.0
25	25	62.4	58.0	1.0	37	150.0	5.0	2.0
26	26	54.8	59.5	0.0	35	148.0	5.0	2.0
27	27	49.7	57.0	1.0	31	146.0	10.0	2.0
28	28	51.1	57.1	0.0	31	146.0	10.0	2.0
29	29	53.4	59.6	0.0	35	147.0	5.0	2.0
30	30	57.9	60.7	1.0	39	154.0	0.0	2.0
31	31	50.7	58.8	0.0	39	153.0	5.0	2.0
32	32	50.8	58.5	0.0	37	152.0	10.0	1.0
33	33	47.9	59.7	0.0	38	154.0	5.0	1.0
34	34	35.1	56.3	0.0	29	148.0	30.0	1.0
35	35	48.4	58.3	0.0	33	150.0	20.0	2.0
36	36	29.6	50.3	0.0	26	147.0	60.0	1.0
37	37	33.5	50.9	0.0	23	147.0	40.0	1.0
38	38	32.3	58.1	0.0	21	148.0	60.0	2.0
39	39	34.0	57.4	0.0	22	150.0	35.0	2.0
40	40	40.0	58.6	0.0	29	149.0	30.0	1.0
41	41	40.8	58.4	2.0	37	155.0	15.0	2.0
42	42	40.4	58.5	2.0	30	155.0	25.0	3.0
43	43	46.3	57.3	0.0	30	141.0	10.0	1.0
44	PROMONTORY	48.4	58.8	0.0	29	144.0	25.0	2.0
45	BLIZZARD	53.7	58.1	0.0	31	149.0	25.0	1.0
46	WINRIDGE	46.8	58.1	0.0	33	149.0	35.0	2.0
47	YUMA	46.6	57.0	0.0	27	140.0	30.0	1.0

CONTINUED...

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

Planted: September 25, 1997 Harvested: August 4, 1998

		YIELD BU/A	TEST WT LBS/BU	LODGE 0-9	HEIGHT INCH	HEADING JULIAN	RHIZOCT PERCENT 1/	TAN SPOT 0-3 2/
48	48	46.7	57.1	0.0	29	142.0	10.0	2.0
49	49	47.2	58.6	1.0	33	142.0	10.0	1.0
50	50	54.1	58.8	1.0	30	141.0	40.0	1.0
51	51	51.0	58.9	0.0	31	148.0	30.0	1.0
52	52	43.3	56.0	1.0	28	147.0	30.0	2.0
53	53	45.2	56.5	0.0	29	146.0	45.0	1.0
54	54	46.5	58.4	0.0	32	144.0	20.0	3.0
55	55	48.0	58.8	1.0	33	145.0	40.0	2.0
56	56	51.1	60.6	0.0	40	146.0	20.0	1.0
57	57	45.0	57.9	1.0	39	145.0	5.0	1.0
58	58	41.5	56.2	0.0	33	152.0	10.0	3.0
59	59	40.4	55.8	0.0	23	145.0	40.0	1.0
60	60	56.6	58.6	0.0	36	150.0	5.0	2.0
61	61	61.5	58.2	1.0	35	156.0	5.0	1.0
62	62	56.7	59.0	0.0	37	150.0	25.0	2.0
63	63	55.6	59.5	0.0	33	146.0	15.0	2.0
64	64	51.3	60.0	0.0	30	141.0	5.0	1.0
65	65	51.8	57.7	0.0	31	140.0	0.0	2.0
66	66	55.7	58.1	1.0	35	147.0	10.0	1.0
67	67	60.3	60.7	0.0	33	146.0	25.0	2.0
68	68	52.5	56.5	0.0	32	143.0	20.0	2.0
69	69	46.8	56.8	1.0	31	149.0	25.0	1.0
70	70	50.8	57.5	0.0	31	146.0	15.0	2.0
71	72	39.6	54.6	0.0	30	146.0	60.0	1.0
72	72	33.3	52.7	0.0	29	148.0	80.0	1.0
73	73	31.4	53.8	0.0	28	148.0	85.0	2.0
74	74	39.9	55.5	1.0	30	147.0	75.0	1.0
75	75	43.8	55.5	1.0	30	147.0	60.0	2.0
76	76	46.3	58.5	0.0	29	140.0	45.0	1.0
77	77	51.0	57.7	1.0	32	146.0	15.0	2.0
78	PROMONTORY	61.2	59.8	0.0	31	144.0	40.0	3.0
79	BLIZZARD	57.8	58.8	0.0	33	148.0	25.0	2.0
80	WINRIDGE	66.7	57.5	1.0	37	150.0	30.0	3.0
81	YUMA	59.9	57.9	0.0	28	140.0	15.0	2.0
	MEAN	50.5	57.9	0.5	32	146.6	20.5	1.6

1/ Rhizoctonia disease rating as percent of plot affected
2/ Tan Spot ratings 0=Highly Resistant, 3=Highly Susceptible

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.

Purchase of Computer for Ag Research Specialist	$2,045.00 (Grants)

YEAR / PROJECT: 1998 / 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 at dryland and irrigated sites from 1995 to 1998. The dryland trials planted in 1996 and 1997 and the 1997 irrigated trial were harvested four times: in late May/early June, early July, early-mid August, and late September (just before first frost). Both 1995 trials were harvested three times: late May, early July, and mid August. and the studies terminated. The 1996 irrigated trial, which was still recovering from poor stands the previous year, was harvested mid June, late July, and then left until late September. The 1998 irrigated nursery established excellent stands and was harvested three times (July, August, and late September), but the dryland nursery, which was less vigorous, was only harvested twice.

Precipitation from April through August was 13.48 inches (34%above average), with 9.78 inches falling in May and June. Because of drier than average weather from October through February, moisture was absorbed and we did not have the over-saturated soil conditions of 1997. The new trials were seeded the third week of April.

The 1995 irrigated trial was terminated after the third harvest in 1998. Mean dry matter production for the 4-year duration was 15.45 tons/acre (Table 1a). The most productive cultivar was 'Oneida VR' with 17.52 tons/acre, and the lowest was 'Ladak 65' with 12.39 tons/acre. The 1995 dryland trial showed vigorous spring growth due to abundant spring moisture. Over the 4-year life of the nursery, mean total yield was 19.11 tons/acre, with WI95-1 the top yielding variety overall (21.34 tons/acre) (Table 1b). Because this was a sandier dryland site, *Vert* wilt resistance was not as important as at the irrigated site.

The 1996 irrigated trial, which had suffered considerable stand loss in 1997 due to excessive water, recovered well in 1998, with help from Pursuit and Poast for weed control. Mean total dry matter yield for 1998 was 5.29 tons/acre, with Oneida VR having the highest (Table 1c). The dryland nursery averaged 6.20 tons/acre, with XAL 46 having the highest yields in 1998 with over 7 tons/acre (Table 1d).

The 1997 irrigated trial had good spring stands and fairly healthy, vigorous spring growth, with the exception of Riley which established poorly the previous year (Table 1e). Total 1998 production (4 cuttings) averaged 5.61 tons/acre, with DK 140 and 142 and Pioneer 5396 having the highest yields. The 1997 dryland trial averaged 5.73 tons/acre in 1998 (Table 1f). Pioneer 5396 was most productive, with 6.57 tons/acre.

Spring stand establishment was variable in the 1998 dryland trial (Table 1h). Forage was harvested July 22 and Sept. 28. Yields averaged 1.63 tons/acre over the two cuttings. The 1998 irrigated trial established better stands and was harvested July 22, Aug.17, and Sept.30 (Table 1g). The three cuttings produced an average of 2.87 tons/acre.

Table 1a. 1995 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED – 1998

				Dry Matter Yield				
				5/29/98	7/8/98	8/18/98	1998	1995-98
VARIETY	MTNo	FD[1]	VW[2]	Harvest-1	Harvest-2	Harvest-3	TOTAL	TOTAL
				t/a	t/a	t/a	t/a	t/a
DK 127	302	3	R	1.94	1.11	1.29	4.35	17.33
Oneida VR	309	3	HR	1.95	1.09	1.19	4.23	17.52
Key	305	4	HR	1.82	1.06	1.21	4.08	17.18
Stamina	296	4	HR	1.74	1.03	1.24	4.01	16.43
5454	263	4	MR	1.79	0.98	1.21	3.98	16.49
ABI 9231	306	4	HR	1.87	1.00	1.11	3.98	16.07
Accord	298	4	R	1.64	1.04	1.22	3.89	16.93
FGEXP	313	-	-	1.75	1.00	1.15	3.89	16.40
ZX9345A	301	4	R	1.74	0.92	1.13	3.78	15.92
3L102	311	-	-	1.63	0.97	1.16	3.76	16.28
5472	221	4	MR	1.67	0.93	1.08	3.68	15.43
WI95-1	310	2	LR	1.82	0.88	0.97	3.67	16.45
ZX9345B	307	4	HR	1.66	0.92	1.08	3.66	15.26
3L103	312	-	-	1.63	0.85	1.08	3.55	15.04
Defiant	299	2	HR	1.71	0.90	0.94	3.55	15.00
Aspen	308	4	R	1.55	0.91	1.07	3.54	14.94
Viking 1	232	2	HR	1.62	0.82	1.07	3.50	15.10
5312	297	3	HR	1.58	0.89	0.97	3.44	15.13
526	214	2	LR	1.63	0.85	0.94	3.42	15.19
Proof	303	3	R	1.50	0.90	1.01	3.40	15.39
Leafmaster	304	4	HR	1.48	0.87	0.99	3.34	13.96
Haygrazer	300	4	R	1.43	0.74	0.76	2.93	13.88
Riley	122	4	LR	1.38	0.69	0.72	2.79	13.11
Vernal	8	2	-	1.21	0.61	0.59	2.41	13.44
Ladak 65	2	1	-	1.11	0.52	0.50	2.13	12.39
mean				1.63	0.90	1.03	3.56	15.45
LSD(0.05)				0.31	0.17	0.18	0.63	1.77
CV(s/mean) x100				13.4	13.7	12.8	12.6	8.1

[1] Fall Dormancy
[2] Vert Wilt

Seeding date: 4/25/95
Pesticides: Pursuit - 6 oz/a, Poast - 2 pt/a, Dash - 2 pt/a

Table 1b. 1995 INTRASTATE ALFALFA YIELD TRIAL

KALISPELL - DRYLAND - 1998

				Dry Matter Yield				
				5/28/98	*7/7/98*	*8/7/98*	1998	1995-98
Variety	MTNo	FD[1]	VW[2]	Harvest-1	Harvest-2	Harvest-3	TOTAL	TOTAL
				t/a	*t/a*	*t/a*	*t/a*	*t/a*
5472	221	4	MR	2.68	1.85	1.63	6.16	20.36
5454	263	4	MR	2.56	1.79	1.50	5.85	19.79
Oneida VR	309	3	HR	2.52	1.66	1.52	5.70	20.64
DK 127	302	3	R	2.37	1.72	1.58	5.67	20.05
Stamina	296	4	HR	2.42	1.66	1.51	5.59	19.94
WI95-1	310	2	LR	2.47	1.69	1.40	5.56	21.34
3L 102	311	-	-	2.35	1.68	1.50	5.53	20.32
FGEXP	313	-	-	2.31	1.68	1.51	5.50	19.76
5312	297	3	HR	2.45	1.59	1.40	5.44	18.66
Key	305	4	HR	2.31	1.58	1.51	5.39	19.50
Aspen	308	4	R	2.18	1.55	1.42	5.15	20.11
Accord	298	4	R	2.22	1.52	1.40	5.13	19.15
3L 103	312	-	-	2.14	1.51	1.39	5.03	17.76
ZX9345A	301	4	R	2.03	1.56	1.41	4.99	19.14
ABI 9231	306	4	HR	2.18	1.48	1.32	4.98	18.59
Defiant	299	2	HR	2.14	1.48	1.31	4.92	19.25
Viking 1	232	2	HR	2.17	1.44	1.31	4.92	18.18
5262	214	2	LR	2.19	1.42	1.29	4.90	19.70
ZX9345B	307	4	HR	2.13	1.43	1.32	4.88	18.11
Haygrazer	300	4	R	2.07	1.41	1.30	4.77	18.38
Leafmaster	304	4	HR	1.94	1.41	1.39	4.74	18.85
Proof	303	3	R	1.99	1.39	1.28	4.66	17.99
Riley	122	4	LR	1.90	1.20	1.21	4.31	18.13
Vernal	8	2	-	1.83	1.16	1.13	4.12	16.95
Ladak 65	2	1	-	1.83	1.09	1.09	4.01	17.05
mean				2.21	1.52	1.38	5.11	19.11
LSD(0.05)				0.22	0.16	0.14	0.48	2.58
CV (s/mean)*100				7.2	7.7	7.3	6.7	9.6

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

Seeding date: 4/25/95
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5 preplant
Soil series: Flathead Very Fine Sandy Loam
Elevation: 2,940 ft.

Table 1c. 1996 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED - 1998

VARIETY	MTNo	FD[1]	VW[2]	Stand	Dry Matter Yield 6/19/98 Harvest-1	7/30/98 Harvest-2	9/29/98 Harvest-3	1998 TOTAL	1996-98 TOTAL
				%	t/a	t/a	t/a	t/a	t/a
Oneida VR	309	3	HR	80	3.00	1.70	1.32	6.02	9.21
Wrangler	146	2	LR	66	3.00	1.57	1.33	5.91	9.41
Ultra	229	3	R	70	2.99	1.51	1.33	5.83	10.25
Hyland	322	3	R	74	2.89	1.51	1.42	5.82	9.97
WL 325 HQ	319	3	R	73	2.74	1.63	1.37	5.74	9.49
MT 9321	333	-	-	68	2.98	1.37	1.27	5.61	8.91
Oasis 371	324	-	-	61	2.88	1.46	1.25	5.59	9.53
Rainier	320	3	R	66	2.68	1.58	1.31	5.57	9.60
329	317	3	HR	76	2.77	1.51	1.29	5.57	9.36
Magnum III	238	4	MR	71	2.73	1.46	1.26	5.46	9.43
WL 324	318	3	R	56	2.65	1.49	1.25	5.39	8.95
XAL 46	314	-	-	48	2.51	1.49	1.35	5.35	8.67
MT 9503	335	-	-	66	2.69	1.40	1.26	5.34	8.92
Excalibur II	248	-	-	71	2.66	1.46	1.21	5.33	8.86
Magnagraze	323	3	R	55	2.57	1.43	1.29	5.29	9.23
Legendairy 2.0	321	3	R	75	2.57	1.46	1.25	5.28	9.00
Bighorn	316	4	R	50	2.62	1.40	1.26	5.28	8.36
5454	263	4	MR	73	2.60	1.41	1.23	5.24	8.36
MT 9310	332	-	-	59	2.79	1.33	1.11	5.22	8.56
MT 9304	327	-	-	56	2.71	1.25	1.16	5.13	8.31
Ladak 65	2	1	-	51	2.83	1.24	1.05	5.12	7.88
MT 9305	328	-	-	60	2.58	1.28	1.23	5.09	9.15
MT 9303	326	-	-	55	2.68	1.24	1.10	5.02	8.16
Affinity+Z	315	4	HR	69	2.45	1.30	1.17	4.92	8.25
MT 9316	334	-	-	69	2.47	1.26	1.19	4.92	7.95
MT 9302	325	-	-	39	2.49	1.15	1.24	4.88	8.14
MT 9306	329	-	-	56	2.44	1.22	1.16	4.82	8.04
MT 9309	331	-	-	48	2.55	1.17	1.06	4.78	7.94
MT 9308	330	-	-	53	2.42	1.15	1.14	4.71	8.47
Riley	122	4	LR	54	2.25	1.11	1.06	4.42	7.73
mean				62	2.67	1.38	1.23	5.29	8.80
LSD(0.05)				19	0.27	0.17	0.16	0.54	1.20
CV(s/mean) x100				21.4	7.1	8.8	9.4	7.3	9.7

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

Seeding date: 5/10/96
Pesticides: Pursuit - 6 oz/a, Poast -2 pt/a, Dash-2 pt/a

Table 1d. 1996 INTRASTATE ALFALFA YIELD TRIAL

KALISPELL - DRYLAND - 1998

				Dry Matter Yield					
				5/26/98	7/6/98	8/6/98	9/28/98	1998	1996-98
VARIETY	MTNo	FD[1]	VW[2]	Harvest-1	Harvest-2	Harvest-3	Harvest-4	TOTAL	TOTAL
				t/a	t/a	t/a	t/a	t/a	t/a
XAL 46	314	-	-	2.51	1.84	1.72	1.39	7.45	15.86
5454	263	4	MR	2.36	1.70	1.61	1.27	6.93	15.15
Rainier	320	3	R	2.34	1.63	1.66	1.20	6.83	15.20
Hyland	322	3	R	2.33	1.71	1.53	1.26	6.82	15.03
Bighorn	316	4	R	2.28	1.53	1.62	1.28	6.70	15.40
Magnagraze	323	3	R	2.24	1.63	1.55	1.22	6.64	14.11
WL 324	318	3	R	2.28	1.60	1.55	1.19	6.62	15.09
Magnum III	238	4	MR	2.25	1.57	1.52	1.21	6.55	14.15
WL 325 HQ	319	3	R	2.13	1.68	1.58	1.13	6.51	14.45
Oasis 371	324	-	-	2.26	1.59	1.57	1.07	6.48	13.87
Excalibur II	248	-	-	2.23	1.54	1.58	1.12	6.47	14.35
MT 9304	327	-	-	2.25	1.55	1.42	1.15	6.36	14.84
MT 9321	333	-	-	2.29	1.38	1.46	1.14	6.26	14.23
Oneida VR	309	3	HR	2.34	1.46	1.44	1.01	6.25	13.87
Affinity+Z	315	4	HR	2.17	1.47	1.47	1.04	6.15	14.36
MT 9503	335	-	-	2.18	1.38	1.45	1.12	6.14	13.99
329	317	-	-	2.12	1.52	1.48	1.01	6.13	13.18
Ultra	229	3	R	2.23	1.46	1.46	0.94	6.09	14.73
Legendairy 2.0	321	3	R	2.13	1.49	1.46	0.99	6.07	13.31
MT 9316	334	-	-	2.25	1.33	1.46	1.02	6.05	13.17
Wrangler	146	2	LR	2.18	1.41	1.44	1.02	6.05	13.62
MT 9305	328	-	-	2.09	1.39	1.39	0.98	5.85	13.90
Riley	122	4	LR	2.13	1.27	1.40	1.06	5.85	13.93
MT 9310	332	-	-	2.18	1.32	1.40	0.93	5.83	13.50
MT 9306	329	-	-	2.06	1.32	1.37	1.00	5.76	13.52
MT 9308	330	-	-	2.04	1.31	1.39	1.03	5.76	13.86
MT 9302	325	-	-	1.97	1.30	1.32	1.01	5.60	13.66
MT 9309	331	-	-	2.05	1.27	1.36	0.89	5.56	13.40
Ladak 65	2	1	-	2.01	1.18	1.27	0.77	5.23	12.52
MT 9303	326	-	-	1.97	1.19	1.21	0.78	5.15	12.07
mean				2.19	1.47	1.47	1.07	6.20	14.08
LSD(0.05)				0.17	0.17	0.12	0.16	0.55	1.49
CV(s/mean) x100				5.4	8.0	5.8	10.8	6.3	7.55

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

Seeding date: 4/26/96
Seeding rate: 8 lbs PLS/acre
Fertilizer: 25 lbs N + 120 lbs P_2O_5 preplant
Pesticides: Pursuit - 6 oz/a, Poast - 2 pt/a, Dash -2 pt/a

Table 1e. 1997 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED - 1998

						Dry Matter Yield					
						5/28/98	*7/8/98*	*8/17/98*	*9/29/98*		**1997-98**
VARIETY	**MTNo**	**FD[1]**	**VW[2]**	**Stand**	**Vigor**	**Harvest-1**	**Harvest-2**	**Harvest-3**	**Harvest-4**	**TOTAL**	**TOTAL**
				%	*0-5[3]*	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*
DK 140	342	4	R	100	4	2.82	1.31	1.35	1.04	6.51	9.65
5396	345	--	--	99	5	2.71	1.30	1.31	1.02	6.34	9.26
DK 142	343	4	R	100	4	2.64	1.25	1.37	1.00	6.26	9.30
3L 102	336	--	--	100	4	2.71	1.13	1.25	0.91	5.99	8.99
DK 143	344	3	R	96	4	2.62	1.20	1.25	0.88	5.94	8.88
5301	340	--	--	100	3	2.62	1.11	1.20	0.95	5.88	9.14
ACE	337	4	R	100	4	2.48	1.22	1.23	0.94	5.87	8.78
ONEIDA VR	309	3	HR	96	4	2.71	1.10	1.14	0.85	5.80	8.54
RHINO	339	3	R	100	4	2.53	1.06	1.09	0.85	5.53	8.48
645	341	3	R	99	4	2.53	1.11	1.08	0.78	5.49	8.27
CIMMARON 3I	338	4	LR	96	3	2.41	1.00	0.96	0.84	5.20	8.12
WRANGLER	146	2	LR	99	3	2.51	1.00	0.96	0.70	5.17	7.72
LADAK 65	2	--	--	100	3	2.27	0.90	0.82	0.59	4.58	7.03
RILEY	122	4	LR	85	2	1.98	0.73	0.66	0.59	3.95	6.00
mean				98	3	2.54	1.10	1.12	0.85	5.61	8.44
LSD(0.05)				4	1	0.20	0.10	0.11	0.09	0.42	0.64
CV(s/mean) x100				2.8	15.4	5.4	6.1	6.7	7.2	5.3	5.3

[1] Fall Dormancy rating
[2] Vert Wilt resistance
[3] 5=high vigor; 0=dead

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

Fertilizer: Fall, 1996 - 44 lbs/a N + 208 lbs/a P-d2-0dO-d5
Pesticide: 6/3/97 - Pursuit, 6 oz/a
5/25/98: Pursuit - 6 oz/a, Poast - 2 pt/a, Dash - 2 pt/a

Table 1f. 1997 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND - 1998

				Dry Matter Yield					
				6/2/98	*7/7/98*	*8/6/98*	*9/28/98*	**1998**	**1997-98**
VARIETY	**MTNo**	**FD[1]**	**VW[2]**	**Harvest-1**	**Harvest-2**	**Harvest-3**	**Harvest-4**	**TOTAL**	**TOTAL**
				t/a	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*
5396	345	--	--	2.41	1.77	1.38	1.02	6.57	9.62
DK 140	342	4	R	2.35	1.65	1.42	0.89	6.30	9.72
DK 142	343	4	R	2.30	1.64	1.38	0.96	6.27	9.69
645	341	3	R	2.27	1.52	1.29	0.93	6.01	9.26
ACE	337	4	R	2.18	1.56	1.35	0.91	6.00	8.88
RHINO	339	3	R	2.26	1.44	1.30	0.95	5.95	9.33
3L102	336	--	--	2.19	1.50	1.31	0.94	5.93	9.16
DK 143	344	3	R	2.19	1.52	1.32	0.81	5.83	9.03
ONEIDA VR	309	3	HR	2.34	1.40	1.24	0.82	5.79	8.92
WRANGLER	146	2	LR	2.25	1.32	1.23	0.89	5.68	8.62
5301	340	--	--	1.96	1.40	1.27	0.70	5.33	8.39
CIMMARON 3I	338	4	LR	1.98	1.31	1.19	0.82	5.29	8.53
LADAK 65	2	--	--	2.16	1.22	1.11	0.66	5.14	8.05
RILEY	122	4	LR	1.53	0.91	0.96	0.75	4.15	6.32
mean				2.17	1.44	1.27	0.86	5.73	8.82
LSD(0.05)				0.20	0.11	0.09	0.19	0.47	0.69
CV(s/mean) x100				6.4	5.1	4.9	15.6	5.7	5.5

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

Seeding date: 5/2/97
Seeding rate: 8 lbs PLS/acre
Fertilizer: 44 lbs N + 208 lbs P2O5 preplant
Pesticides: Pursuit - 6 oz/a, Poast - 2 pt/a, Dash - 2 pt/a

Table 1g. 1998 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - IRRIGATED

					Dry Matter Yield			
					7/22/98	8/17/98	9/30/98	1998
VARIETY	MTNo	FD[1]	VW[2]	Stand	Harvest-1	Harvest-2	Harvest-3	TOTAL
				%	t/a	t/a	t/a	t/a
Magnum V	347	--	--	96	1.65	1.07	0.68	3.40
Ripin	349	--	--	98	1.65	1.01	0.66	3.32
631	350	4	R	98	1.51	1.00	0.67	3.17
Millennia	354	--	--	95	1.26	1.04	0.87	3.17
Enhancer	348	4	R	93	1.47	0.95	0.63	3.05
Rebound	356	--	--	96	1.50	0.97	0.54	3.00
NL 90732	360	--	--	96	1.48	0.91	0.60	2.99
Reno	357	--	--	96	1.40	0.95	0.58	2.93
Oneida VR	309	3	HR	94	1.45	0.90	0.58	2.93
53V08	346	--	--	96	1.43	0.93	0.57	2.92
Emperor	351	--	--	99	1.47	0.93	0.52	2.91
PS595-106	361	--	--	97	1.53	0.88	0.50	2.91
ZX9852	352	--	--	96	1.28	0.94	0.67	2.89
A-395	362	3	R	98	1.57	0.83	0.47	2.87
Imperial	280	3	R	97	1.38	0.91	0.55	2.84
TMF Multiplier II	359	--	--	95	1.43	0.89	0.49	2.81
3L115	355	--	--	98	1.38	0.88	0.50	2.76
Rambo	353	--	--	96	1.42	0.87	0.44	2.73
3L171	358	--	--	95	1.28	0.90	0.53	2.71
Innovator+Z	281	3	HR	96	1.36	0.85	0.49	2.70
NL 91229	363	--	--	94	1.35	0.80	0.55	2.69
Wrangler	146	2	LR	98	1.37	0.81	0.46	2.64
Ladak 65	2	2	--	95	1.36	0.65	0.35	2.35
Riley	122	4	LR	89	1.05	0.68	0.44	2.16
mean				96	1.42	0.90	0.55	2.87
LSD(0.05)				4	0.25	0.11	0.10	0.41
CV(s/mean) x100				2.9	12.5	8.6	13.4	10.2

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

Seeding Date: 4/27/98
Seeding rate: 8 lbs/a
Fertilizer: 44 lbs/a N + 208 lbs/a P_2O_5
Pesticides: Poast - 2 pt/a + Dash; Pursuit - 6 oz/a

Table 1h. 1998 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL - DRYLAND - 1998

					Dry Matter Yield		
				6/10/98	*7/22/98*	*9/28/98*	**1998**
VARIETY	**MTNo**	**FD[1]**	**VW[2]**	**Stand**	**Harvest-1**	**Harvest-2**	**TOTAL**
				% of plot	*t/a*	*t/a*	*t/a*
Enhancer	348	4	R	88	1.20	0.98	2.18
Magnum V	347	--	--	91	1.32	0.78	2.10
Ripin	349	--	--	86	1.11	0.82	1.93
Millennia	354	--	--	83	0.98	0.93	1.91
Rambo	353	--	--	90	1.12	0.76	1.88
Emperor	351	--	--	91	1.12	0.72	1.84
631	350	4	R	88	1.03	0.73	1.76
Innovator+Z	281	3	HR	85	0.96	0.75	1.71
Imperial	280	3	R	92	1.03	0.68	1.71
3L115	355	--	--	88	0.87	0.75	1.61
ZX9852	352	--	--	90	0.90	0.69	1.59
Rebound	356	--	--	89	0.97	0.62	1.59
NL 90732	360	--	--	88	0.93	0.65	1.58
53V08	346	--	--	88	0.91	0.62	1.53
Wrangler	146	2	LR	84	0.89	0.64	1.53
Reno	357	--	--	81	0.80	0.70	1.50
A-395	362	3	R	85	0.82	0.68	1.50
Oneida VR	309	3	HR	88	0.89	0.60	1.49
3L171	358	--	--	92	0.86	0.60	1.47
Ladak 65	2	--	--	83	0.84	0.59	1.43
NL 91229	363	--	--	79	0.77	0.63	1.40
PS595-106	361	--	--	84	0.74	0.62	1.36
TMF Multiplier II	359	--	--	75	0.72	0.60	1.32
Riley	122	4	LR	59	0.61	0.70	1.31
mean				85	0.93	0.70	1.63
LSD(0.05)				12	0.30	0.21	0.47
CV(s/mean) x100				10.1	23.0	21.6	20.5

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

Seeding date: 4/23/98
Seeding rate: 8 lbs/a
Fertilizer: 44 lbs/a N + 208 lbs/a P2O5
Pesticides: Poast - 2 pt/a + Dash; Pursuit - 6 oz/a

YEAR / PROJECT: 1998 / 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 1998 all cultivars were vigorous and without stand loss. The trial was harvested four times between late May and late September. Total yields from the four harvests averaged 5.39 tons/acre and were similar for all cultivars.

1996 MEADOW BROMEGRASS TRIAL
KALISPELL, 1998

		Dry Matter Yield					
CULTIVAR	**Vigor**	**Harvest-1**	**Harvest-2**	**Harvest-3**	**Harvest-4**	**1998 TOTAL**	**1996-98 TOTAL**
	*(0-5)**	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*	*t/a*
Mb-1	3.5	3.30	0.68	1.02	0.44	5.44	13.14
Mb-2	3.5	3.15	0.68	1.06	0.45	5.33	13.40
Mb-3	4.3	3.09	0.72	1.07	0.43	5.30	13.05
Regar	5.0	3.12	0.81	1.09	0.39	5.41	13.07
Fleet	3.8	3.21	0.70	1.08	0.44	5.42	13.20
Paddock	3.5	3.20	0.68	1.09	0.46	5.42	13.55
Mean	3.9	3.18	0.71	1.07	0.43	5.39	13.24
LSD(0.05)	0.8	NS	NS	NS	NS	NS	NS
CV(s/mean)	13.2						

Seeded 5/10/96 @ 12 lb/acre.
Fertilizer: 5/24/97: 60 lbs N/a

** 5=very vigorous growth; 0=dead*

YEAR / PROJECT: 1998 / 755

TITLE: **CEREAL FORAGE NITRATE TRIAL**

PROJECT LEADER: D. Wichman, MSU-CARC

COOPERATORS: L. Welty / L. Strang, MSU-NWARC
M. Westcott, MSU-WARC

Two cultivars of triticale, 2 barley, 2 oat, 2 wheat, and 2 spelt cultivars were seeded April 28, 1998, in a split plot design with 4 replicates. Main plots were 3 N fertilizer rates randomized within each replicate, and subplots were the 10 cultivars randomized within each fertilizer treatment. Cultivars were sampled for nitrate concentration at heading, anthesis, and soft dough stage and compared for forage dry matter yield.

All entries had vigorous stands, except for the oats, which were accidentally sprayed out. Pronghorn triticale was the first to head out (July 1), while the spelts were the latest (July 15) (Table 1a). Haybet barley was first to reach soft dough (85 days after planting) and the triticales and spelts were the slowest to mature (95 days) (Table 1c). N-rate did not affect maturity rate.

McNeal wheat was the shortest variety (38.7 inches) and the Pierre Hucl spelt was tallest (56.3 inches) (Table 2). N-rate affected varieties differently. Haybet responded to the increase from 60 to 120 lbs N/a with an increase of over 3 inches. P. Hucl decreased in height when the N-rate was increased from 60 to 180 lbs/acre.

Yield response to N-rate was not significant (Table 3). Pronghorn triticale produced the most dry matter when harvested at soft dough stage. Haybet barley produced significantly less forage than any other entry in the trial.

The forage was sampled for nitrate content at heading, anthesis, and soft dough. The cultivars which showed the least response to increased fertilizer N were Haybet barley, P. Hucl spelt, and Pronghorn triticale (Table 4a). This stability over 3 N environments indicates that these cultivars are the most reliable for predicting forage nitrate level. These varieties also had the lowest mean nitrate levels across the 3 growth stages tested (Table 4c).

Table 1a. Heading (days after planting)

ENTRY	RATE (lbs N/acre) 60	120	180	mean	
Pronghorn	64	64	64	64	
Fortuna	68	68	68	68	
Haybet	69	68	68	68	
McNeal	69	69	69	69	
Sunland	69	69	69	69	
Westford	75	75	75	75	
P. Hucl	78	78	78	78	
PI 760	78	78	78	78	
mean	71	71	71	LSD(0.05):	entry = 1 N-rate - NS interaction - NS

Table 1b. Anthesis (days after planting)

ENTRY	RATE (lbs N/acre) 60	120	180	mean	
McNeal	71	71	71	71	
Fortuna	71	71	71	71	
Pronghorn	72	72	72	72	
Haybet	74	74	74	74	
Sunland	78	78	78	78	
Westford	82	82	82	82	
P. Hucl	83	83	83	83	
PI 760	83	83	83	83	
mean	77	77	77	LSD(0.05):	entry = 1 N-rate - NS interaction - NS

Table 1c. Soft dough (days after planting)

ENTRY	RATE (lbs N/acre) 60	120	180	mean	
Haybet	85	85	85	85	
Westford	89	89	89	89	
McNeal	90	90	90	90	
Fortuna	90	90	90	90	
Sunland	95	95	95	95	
Pronghorn	95	95	95	95	
P. Hackle	95	95	95	95	
PI 760	95	95	95	95	
mean	91.8	91.8	91.8	LSD(0.05):	entry = 1 N-rate - NS interaction - NS

Table 2. Height (inches)

ENTRY	RATE (lbs N/acre) 60	120	180	mean	
McNeal	38.3	39.3	38.5	38.7	
Haybet	37.7	41.2	40.5	39.8	
Westford	41.5	42.3	43.0	42.3	
Sunland	44.0	43.5	43.8	43.8	
Fortuna	44.0	45.0	44.0	44.3	
Pronghorn	46.3	47.0	45.0	46.1	
PI 760	53.6	54.8	54.3	54.2	
P. Hucl	57.7	56.1	55.0	56.3	
mean	45.4	46.1	45.5	LSD(0.05):	entry = 1.0 N-rate - NS interaction = 2.1

Table 3. Dry Matter Yield (tons/acre)

ENTRY	RATE (lbs N/acre) 60	120	180	mean	
Pronghorn	5.40	5.21	5.67	5.43	
McNeal	4.64	4.79	4.24	4.55	
P. Hackle	4.38	4.11	5.19	4.56	
Fortuna	4.12	4.34	4.66	4.37	
Sunland	3.80	4.75	4.38	4.31	
PI 760	3.83	4.43	4.38	4.21	
Westford	3.83	4.81	3.88	4.17	
Haybet	3.22	3.59	4.01	3.61	
mean	4.15	4.50	4.55	LSD(0.05):	entry = 0.52 N-rate - NS interaction - NS

Table 4a. Nitrate content of cereal forages grown at 3 N-fertilizer rates (means across growth stages).

ENTRY	RATE (lbs N/acre) 60	120	180	mean
McNeal	369	551	534	485
PI 760	414	775	550	580
Sunland	359	512	644	505
Fortuna	348	527	629	502
Haybet	330	409	497	412
Westford	376	813	843	677
P. Hackle	322	411	491	408
Pronghorn	417	341	493	417
mean	367	542	585	

LSD(0.05): entry = 169
N-rate = 172
interaction = 179

Table 4b. Nitrate content of cereal forages grown at 3 N-fertilizer rates. (means across cultivars)

Growth Stage	RATE (lbs N/acre) 60	120	180	mean
Heading	508	776	833	706
Anthesis	411	583	609	534
Soft dough	182	269	291	247
mean	367	542	578	

LSD(0.05): growth stage = 101
N-rate = 172
interaction = 450

Table 4c. Nitrate content of cereal forages at 3 growth stages.

ENTRY	Heading	Anthesis	Soft Dough	mean
McNeal	638	541	275	485
PI 760	818	677	245	580
Sunland	791	563	160	505
Fortuna	822	489	193	501
Haybet	566	340	331	412
Westford	877	758	398	678
P. Hackle	627	434	163	408
Pronghorn	567	470	214	417
mean	713	534	247	

LSD(0.05): entry = 98
growth stage = 59
interaction = 166

YEAR / PROJECT: 1998 / 755

TITLE: CHICORY/ORCHARDGRASS HARVEST TIMING TRIAL – IRRIGATED

PROJECT LEADER: M. Westcott, MSU-WARC

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

Puna chicory and 'Potomac' orchardgrass were seeded alone and in mixtures on May 7, 1997, 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 week intervals). 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 orchardgrass for the mixture. The harvest timing treatments were begun in 1998.

Chicory alone produced the least total dry forage for the season. Mean yields across species increased with increased time between cuttings. There was no significant interaction between species and harvest interval.

CHICORY/ORCHARDGRASS HARVEST TIMING TRIAL

Kalispell, 1998

Total Dry Matter Yield (t/a)

	HARVEST INTERVAL (wks)			
SPECIES	2	3	4	mean
Chicory	3.31	4.45	5.81	4.52
Orchard	4.20	6.03	6.65	5.63
Orch+Chic	3.71	5.93	7.00	5.54
Mean	3.74	5.47	6.48	

LSD(0.05): species/timing means=0.44
interaction-NS

YEAR / PROJECT: 1998/ 755

TITLE: **PEA FORAGE TRIAL**

PROJECT LEADER: D. Wichman, MSU-CARC

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

Four varieties of forage-type peas were seeded 4/23/98 at 19 lbs./a. Plots consisted of four 15' rows spaced one foot apart in a randomized complete block design with 4 replicates. Basagran and Poast + Dash were applied 5/25/98 for weed control. Irrigation was applied 4/24 and 5/4 to aid establishment.

Excellent stands were established. All plots were harvested 7/16/98 while in the vegetative stage. 'Glacier' Austrian winter pea had the shortest stature, while the other entries were the long-vine type. Due to variation in the data, differences in forage yield were not significant, but 'Arvika' did produce the most dry matter, with over 3000 lbs./acre.

PEA FORAGE TRIAL

Kalispell, 1998

CULTIVAR	STAND	HEIGHT	FORAGE YIELD
	%	*in*	*lbs/ac*
Arvika	95	50	3360
MTWP-EB(1996)	90	57	2570
Sioux (MTWP-7,1996)	96	56	2770
Glacier AWP	95	31	2600
mean	94	48	2825
F-value (Trt)	6.51	50.69**	1.89
LSD(0.05)	5	8	NS
CV(s/mean)%	2.3	7.0	18.9

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 colelction to publications.

Purchase of Boiler and Mini-Still	$25,000 (Grants)

YEAR/PROJECT: 1998 / 758

TITLE: **1996 BLACK MITCHAM PROPAGATION TRIAL**

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

COOPERATORS: W.Grey, MSU-Bozeman
Cathy & Tom Smith, Summit Labs, Fort Collins,

Nuclear plants representing stem-cut, *in vitro* nodal and meristem culture were propagated from a single plant or from a randomly selected group of plants from the Black Mitcham mother block by Summit Labs. These seven entries plus plants from a contaminated culture of Lake's were planted on June 4 and 5, 1996. Seven lines from various sources were stem-cut propagated at the NWARC and planted on June 17, 1996.

The MIRC 1, 2, 5, and 7 entries came from a cutting off a single plant from the Black Mitcham mother bed at Summit Plant Laboratories, Inc.(Table 1.) Entries MIRC 3, 4, and 6 originated from a group of plants randomly selected from the mother bed. Stem cut plants (MIRC 1, 6, 7) were grown directly from cuttings off the original parent or the random plant selection group.

The NWARC lines consisted of material obtained from two meristem fields located at the NWARC (R-5 and R-7), material obtained from the 1994 cultivar evaluation trial (Lake 94 and Plant Tech 94), material from two productive Black Mitcham fields in the Flathead (Montana 1, Montana 2), and material obtained from George McClelland (Idaho) (Table 1). Stolons from this material were planted in our lab and stem cuttings taken and rooted from emerged shoots.

All propagation lines were successfully established in a randomized block design. Appropriate management practices (irrigation, fertility, weed and pest control) were employed to insure maximum mint growth and oil production.

Entries were evaluated for stand vigor indicators May 29, 1998. All plots were harvested August 5. Hay yield was measured, and 20 pounds green material from each plot was dried and the oil separated by steam distillation to determine oil yield. Oil samples from each plot were sent to A.M.Todd Co. for quality component analysis.

The seven MIRC entries 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.). As in 1997, plants propagated from meristem culture produced significantly more dry matter than non-meristem plants (Fig.1). 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.

Unlike 1997, oil yield was not affected by propagation method directly. Parental selection, however, and its interaction with propagation method were significant (Fig.2). Non-meristem propagated plants derived from a randomly selected parental group produced more oil than meristem propagated plants from the random selection. Meristem-propagated plants cloned from a single plant yielded slightly more oil than those from the random group. The superiority of using a random selection of parental plants reinforces the previous indication that there is 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.

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 produced slightly more dry matter and 14% less oil than that derived from the Plant Tech 94 stem cut material (Table 2). This is the same relationship observed in 1997, except the difference in dry matter production is not significant. This confirms the persistence of the high oil yield trait associated with the Plant Tech material.

In 1997, correlations between response variables revealed a strong negative correlation between dry matter production and oil yield. This relationship was no longer significant in 1998 (Table 3). Oil yield and early season stand vigor are not significantly related.Oil quality analysis revealed variation among entries in certain components (Table 4). All plots were in the late bud stage of development. The oil was characteristic of immature oil, being low in menthol and esters and high in menthone. The menthofuran levels are high for this region considering no blossoms were present.

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 trial - nodal
Plant Tech 94	NWARC	stem cut	1994 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	stem-cut high yield field
Montana 2	NWARC	stem cut	stem-cut high yield field
Idaho	NWARC	stem cut	McClelland stolons

Table 3. Pearson correlations (r^2) with P-values of vigor, yield, and oil content levels of Black Mitcham propagation lines at Kalispell in 1998.

		Hay Yield	Oil Yield	Oil Content
Vigor	r^2	0.6463	-0.2845	-0.5677
	P	0.0092	0.3041	0.0273
Hay Yield	r^2		-0.2724	-0.7055
	P		0.3260	0.0033
Oil Yield	r^2			0.8568
	P			0.0000

Table 4. Quality components of Black Mitcham propagation lines at Kalispell, MT (GC%).

Propagation Source	Total Heads	Total Ketones	Total Alcohol	Menthofuran	Menthone	Menthol	Ester	Pulegone
	%	%	%	%	%	%	%	%
stem/single	8.5	30.0	36.7	3.6	26.9	34.1	1.9	1.01
nodal/single	9.5	30.4	35.8	3.6	27.2	33.3	1.8	0.91
ms/random	9.7	30.4	36.2	2.3	27.3	33.7	2.0	0.50
nodal/random	9.9	29.0	36.7	3.4	26.0	34.1	1.9	0.73
ms/single	8.8	30.3	36.6	3.4	27.2	34.0	2.3	0.72
stem/random	9.6	28.2	37.7	2.9	25.1	35.1	2.3	0.62
st/nod/single	8.5	30.4	34.7	3.8	27.3	32.1	2.0	0.95
Lake 96	9.8	30.7	35.5	2.8	27.6	33.1	1.9	0.67
Lake 94	9.6	28.6	37.1	3.7	25.8	34.3	2.1	0.79
Plant Tech	9.9	29.3	36.7	3.1	26.2	34.2	1.8	0.76
R-5 field	9.3	28.3	38.2	3.4	25.3	35.6	1.9	0.71
R-7 field	9.4	29.7	36.5	3.4	26.6	34.0	1.9	0.77
Montana 1	10.0	30.1	35.6	3.5	25.9	33.9	2.0	0.81
Montana 2	10.1	28.8	36.6	3.4	25.8	34.1	1.9	0.75
Idaho	9.8	29.0	37.2	3.4	25.2	35.1	2.0	0.74
Mean	9.5	29.5	36.5	3.3	26.3	34.0	2.0	0.76
LSD(0.10)	0.7	NS	1.4	0.4	NS	1.4	NS	0.15
CV(s/mean)%	6.0	1.8	3.2	9.8	5.7	3.4	0.3	16.4

Growth stage: late bud
Oil analyses by A.M. Todd Company

Figure 1. Comparisons among MIRC propagated entries by propagation method and parent plant source for 1998 dry matter yield (tons/a).

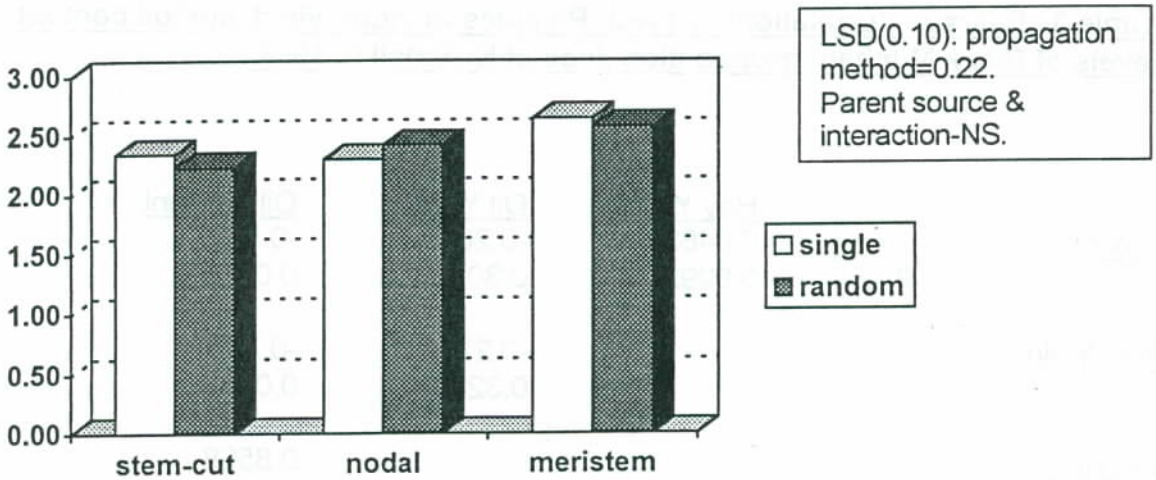


Figure 2. Comparisons among MIRC propagated entries by propagation method and parent plant source for 1998 oil yield (lbs/a).

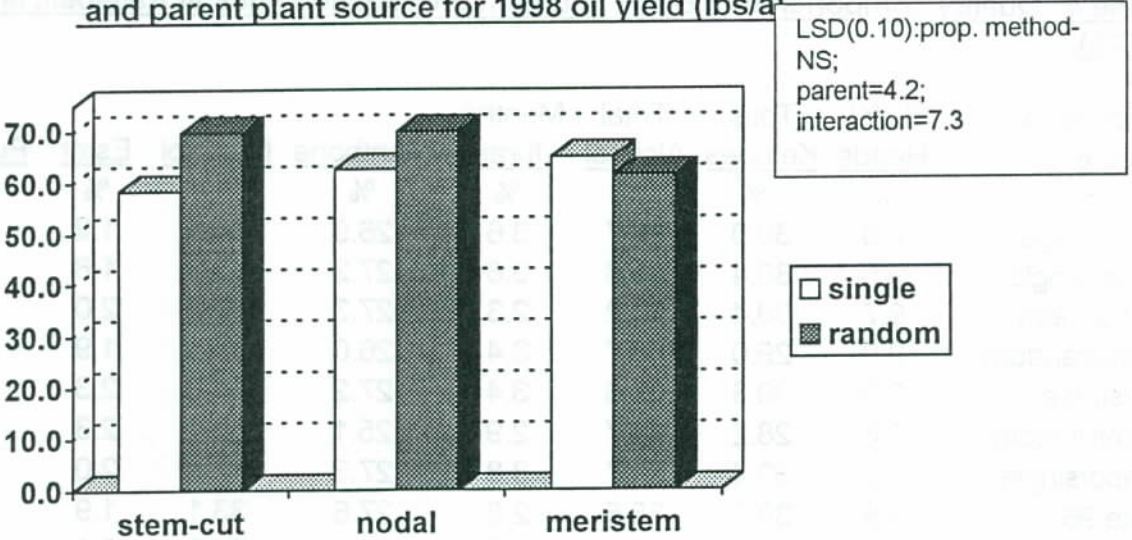
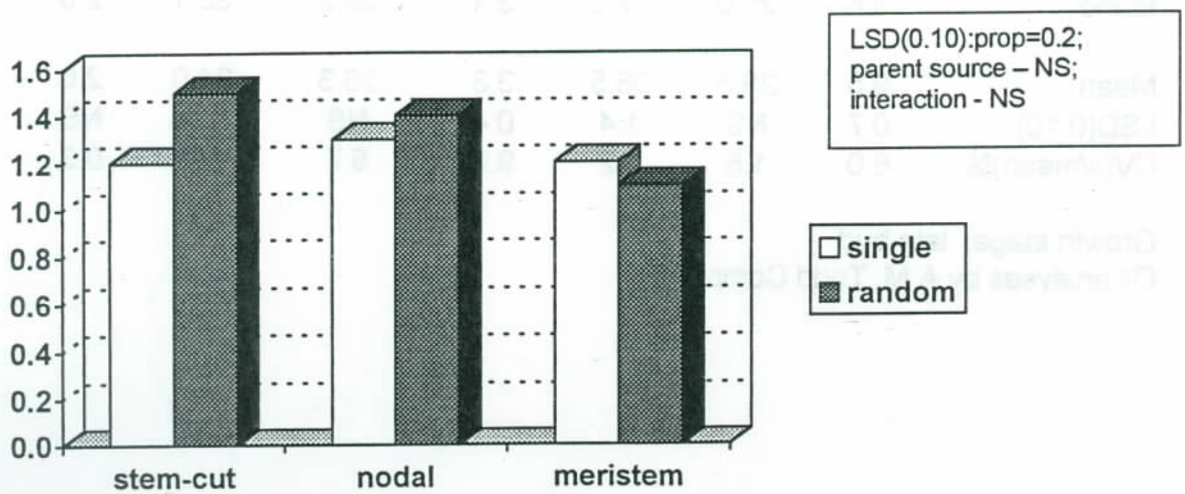


Figure 3. Comparisons among MIRC propagated entries by propagation method and parent plant source for 1998 oil content (% of dry matter).



YEAR / PROJECT: 1998 / 758

TITLE: **PEPPERMINT FALL HARVEST MANAGEMENT TRIAL**

PROJECT LEADER: L. Welty, MSU-NWARC
L. Strang, Research Specialist, MSU-NWARC
G. Sharp, Research Assistant, MSU-NWARC

The study was initiated in 1996. Plots (10' x 30') were laid out in an established stand of Black Mitcham, meristem derived, and treatments assigned in a randomized complete block design with 4 replicates. Treatments in were 7 harvest dates at 10-day intervals (July 31-Sept.30) and an uncut check. Stolons were dug from a one-foot square area in each plot on 3/25-27/98 and weighed to determine the effect of 1997 harvest timing on stolon mass. The same harvest dates were imposed on each plot in 1998. At each harvest, morphological stage, height, lodging, and dry matter yield were determined. Approximately 20 pounds of herbage from each plot was air-dried and the oil removed by steam distillation. Oil yield was calculated and samples sent to A.M. Todd Co. for chemical analyses.

In 1998, 250 lbs/a N, 52 lbs/a P_2O_5, 100 lbs/a K_2O and 34 lbs/a S were applied. Assure II (15 oz/a) was applied on 5/13/98. Sinbar was applied in May at one lb. AI/acre.

The mint was at the full bud stage on the first harvest date and was senescent by the last harvest on Sept. 30. The first frost (28^0 F) did not occur until after the final harvest.

Maximum stolon mass was found in plots harvested 8/11/97 and minimum stolon mass in plots harvested 9/30/97, which was one week before the first killing frost (Figure 1).

Dry matter yield increased to 3.30 tons/acre on 8/31, when the mint reached the full bloom stage (Table 1c). It decreased to 2.79 tons/acre by 9/30 (Figure 2). Oil yield increased to 95.3 lbs/acre on 9/10 when the mint had reached full bloom, and then declined to 65.1 lbs/acre by the time leaves senesced (Table1c). This represented a 51% increase in oil yield when harvest was delayed from July 31 to Sept. 10. In 1997 oil yield decreased after the first harvest. There was no relationship between spring stolon mass and oil yields (Figures 1 & 3).

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, with the exception of the 8/31 harvest (Table 2c). Total alcohols and menthol continued to increase through the last harvest, as did % esters. Menthofuran increased until 8/20 (85% bloom) and then leveled off at approximately 10% (Table2c). 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 1998 as in 1997. MF levels from the research still are somewhat higher than production stills. In 1998, we compared whole vs. chopped mint in the research still and found that chopped hay had higher menthol and lower MF levels than whole hay. To date the mint research plots are cooked whole. Desirable oil contains 45% menthol. Menthol in 1998 did not reach this level until the 9/23 harvest, when the plants were approaching maturity (Table 2c). Oil yield increased from 7/31 to 8/31 and 9/10 and then declined as the mint senesced.

Optimum harvest date is affected by environment/year. In 1996 and 1998, later harvests produced the most oil, whereas in 1997 early harvests produced the most oil (Figure 3). The relationship between oil production and Growing Degree-Days (GDD) was not very consistent (Tables 1a, 1b, 1c). In 1996 oil production peaked at about 1300 GDD, whereas in 1998 yields were not maximized until GDD 1600. Total GDD was low in 1996 because May and August were below normal. June, however, was close to normal and July exceeded the norm by 31 GDD. This may explain why later harvests in 1996 produced more oil.

Table 1a. Hay and oil yields for peppermint harvested in 1996.

Date	Accum GDD	Growth Stage	Hay Yield	Oil Content	Oil Yield
			tons/ac	*% DM*	*lbs/ac*
8/1	925.5	20% bud	1.89	1.3	48.1
8/12	1060.5	full bud	2.33	1.3	59.8
8/22	1211.0	10% bloom	2.98	1.3	74.5
8/30	1336.0	20% bloom	3.01	1.3	77.9
9/10	1442.0	mid bloom	3.61	0.9	62.4
9/19	1526.0	90% bloom	2.98	1.1	62.9
9/27	1526.0	frozen	2.67	1.0	56.1
mean			2.78	1.2	63.1
LSD(0.10)			0.27	0.1	6.5

Table 1b. Hay and oil yields for peppermint harvested in 1997.

Date	Accum GDD	Growth Stage	Hay Yield	Oil Content	Oil Yield
			tons/ac	*% DM*	*lbs/ac*
8/1	948.0	mid bud	5.66	0.6	71.3
8/12	1140.5	full bud	4.30	0.7	60.4
8/22	1283.0	mid bloom	4.23	0.8	65.6
8/30	1394.5	late bloom	4.35	0.9	59.9
9/10	1539.0	late bloom	4.02	0.8	63.8
9/19	1597.0	late bloom	2.99	0.7	40.8
9/29	1597.0	mature	2.74	0.4	22.1
mean			4.04	0.7	54.8
LSD(0.10)			0.83	0.1	13.0

Table 1c. Hay and oil yields for peppermint harvested in 1998.

Date	Accum GDD	Growth Stage	Hay Yield	Oil Content	Oil Yield
			tons/ac	*% DM*	*lbs/ac*
7/31	1064.0	full bud	2.32	1.4	63.0
8/10	1257.5	mid bloom	2.23	1.5	65.8
8/20	1433.5	85% bloom	2.73	1.1	61.5
8/31	1602.0	full bloom	3.30	1.4	92.7
9/10	1796.0	full bloom	3.20	1.5	95.3
9/23	1872.5	seed set	3.07	1.3	79.5
9/30	1872.5	leaf drop	2.79	1.2	65.1
mean			2.80	1.3	74.7
LSD(0.10)			0.25	0.2	8.3

Table 2a. Quality components of peppermint harvested on different dates in 1996.

DATE	Menthol	Neo-menthol	Menthone	D-iso-menthone	Esters	MF	Pulegone
				GC%			
8/1	38.9	3.2	24.8	2.9	3.7	1.9	0.15
8/12	43.1	3.6	20.1	2.6	3.7	2.3	0.19
8/22	42.9	3.5	19.1	2.3	3.6	3.3	0.47
8/30	42.2	3.5	18.9	2.2	3.9	4.2	0.57
9/10	43.7	3.6	16.8	1.9	5.2	4.6	0.38
9/19	45.4	3.7	14.4	1.7	6.3	4.9	0.21
9/27	47.2	3.7	13.4	1.7	6.2	4.4	0.17
MEAN	43.3	3.5	18.2	2.2	4.6	3.7	0.30
LSD(0.10)	1.3	0.1	1.7	0.1	0.5	0.3	0.05

Table 2b. Quality components of peppermint harvested on different dates in 1997.

DATE	Menthol	Total Alcohol	Menthone	Total Ketones	Esters	MF	Pulegone
				GC%			
8/1	37.2	47.3	28.3	30.8	4.1	2.1	0.3
8/12	36.8	46.7	25.5	27.9	4.0	4.7	1.1
8/22	39.3	49.7	20.7	22.7	4.5	7.4	1.2
8/30	43.2	55.2	15.1	16.9	5.8	7.7	1.1
9/10	44.0	56.9	12.9	14.4	7.0	10.3	0.8
9/19	44.5	57.8	13.2	14.5	7.9	10.9	0.4
9/29	46.6	60.7	12.3	13.5	8.7	10.3	0.3
MEAN	41.7	53.5	18.3	20.1	6.0	7.6	0.7
LSD(0.10)	1.1	1.3	1.2	1.2	0.4	0.6	0.1

Table 2c. Quality components of peppermint harvested on different dates in 1998.

DATE	Menthol	Total Alcohol	Menthone	Total Ketones	Total Ester	MF	Pulegone	Cineole
				GC%				
7/31	36.6	45.5	25.3	29.3	3.4	3.8	0.7	4.9
8/10	39.4	49.6	18.7	22.7	4.2	6.1	1.7	4.8
8/20	38.7	49.4	15.8	19.5	4.8	9.8	2.4	5.2
8/31	39.2	49.8	17.6	21.1	4.9	9.7	1.3	4.8
9/10	41.5	53.0	15.8	19.0	6.1	9.9	0.6	4.7
9/23	44.6	57.5	12.7	15.7	7.7	9.9	0.4	4.5
9/30	46.3	59.6	10.7	13.5	8.1	10.1	0.3	4.5
MEAN	40.9	52.0	16.7	20.1	5.6	8.5	1.1	4.8
LSD(0.10)	1.3	1.6	1.1	1.2	0.3	0.6	0.1	0.3

Figure 1. Stolon masses of mint harvested on different dates in 1997.

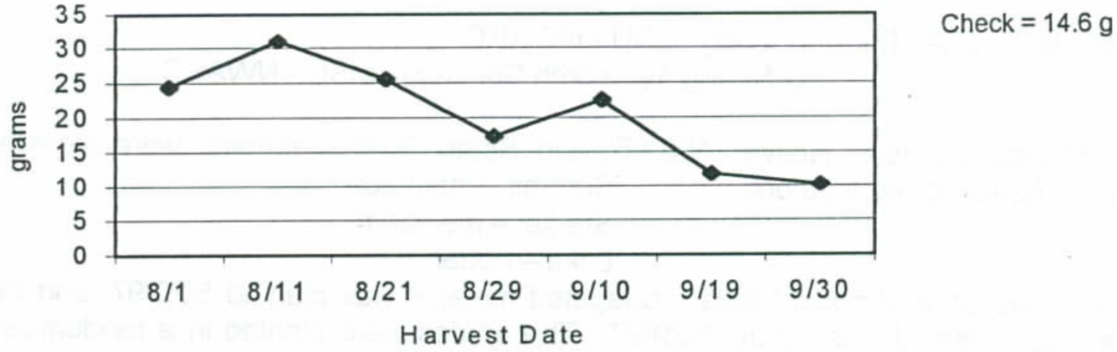


Figure 2. Hay yields of peppermint harvested at 7 dates in 1998.

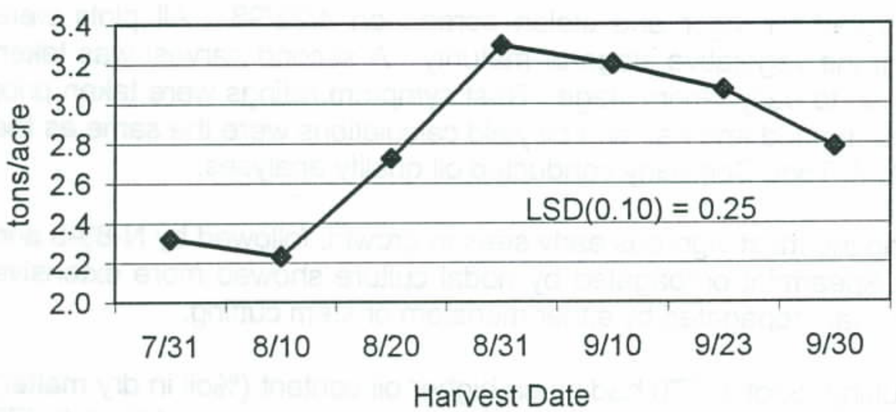
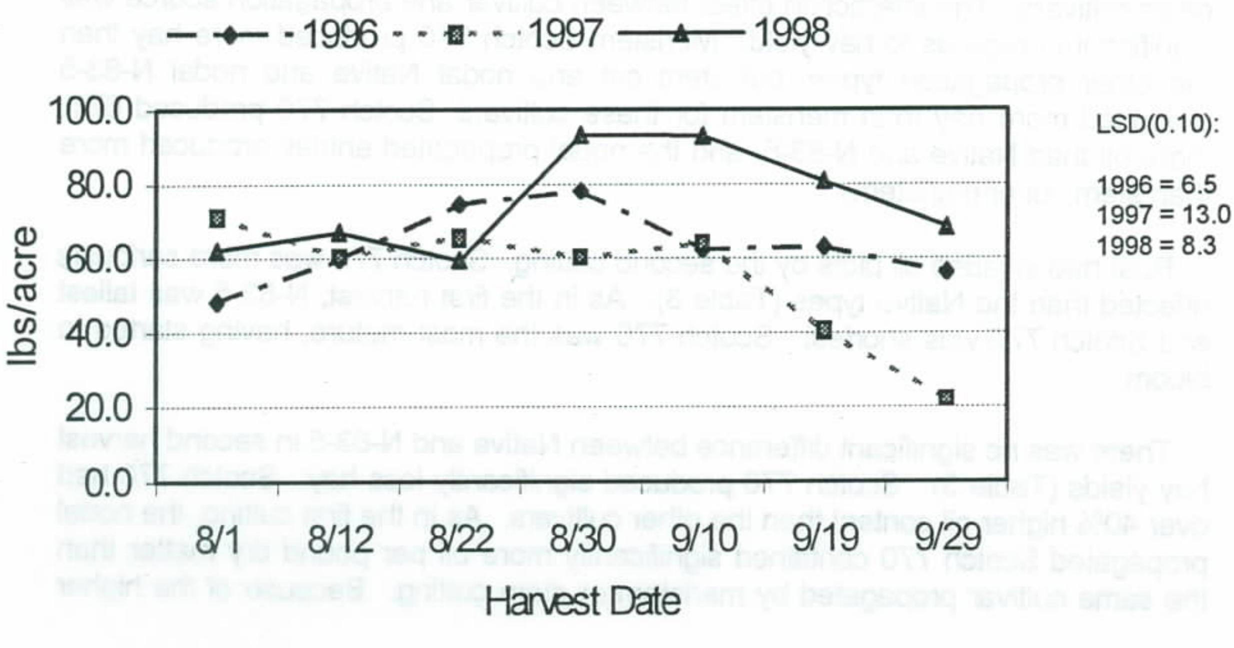


Figure 3. Oil yields of peppermint harvested at 7 dates in 1996, 1997, and 1998.



YEAR / PROJECT: 1998 / 758

TITLE: **1997 SPEARMINT CULTIVAR/PROPAGATION TRIAL**

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

Nuclear plants of 'Native', 'N-83-5', and 'Scotch 770' spearmint were provided by the following propagators:
Summit – stem-cut
Starkel – meristem
Lake – nodal

The meristem and nodal tissue propagated material was planted 5/20/97, and the stem-cut material was planted5/29/97. The entries were planted in a randomized complete block design in 20-ft long plots consisting of 4 rows of 20 plants with 20-inch row spacing.

Stands were rated for vigor and stolon spread on 4/22/98. All plots were harvested 7/1/98 at the vegetative stage of maturity. A second harvest was taken 9/2/98 at the late bud to early bloom stage. Rust symptom ratings were taken prior to harvest. Harvest method and hay and oil yield calculations were the same as the other mint trials. A.M. Todd Company conducted oil quality analyses.

Scotch 770 had the most vigorous early season growth, followed by N-83-5 and Native (Table 1). Spearmint propagated by nodal culture showed more extensive stolon spread than that propagated by either meristem or stem cutting.

For the first cutting, Scotch 770 had much higher oil content (%oil in dry matter) than Native and its derivative N-83-5 (Table 2). The nodal propagated Scotch 770 had a higher concentration of oil than meristem propagated. Native produced significantly more dry matter but Scotch 770 produced significantly more oil than the other cultivars. The interaction effect between cultivar and propagation source was significant in regards to hay yield. Meristem Scotch 770 produced more hay than the other propagation types, but stem cut and nodal Native and nodal N-83-5 produced more hay than meristem for these cultivars. Scotch 770 produced 67% more oil than Native and N-83-5, and the nodal propagated entries produced more than stem cut or meristem.

Rust had invaded all plots by the second cutting. Scotch 770 was more seriously affected than the Native types (Table 3). As in the first harvest, N-83-5 was tallest and Scotch 770 was shortest. Scotch 770 was the most mature, having started to bloom.

There was no significant difference between Native and N-83-5 in second harvest hay yields (Table 3). Scotch 770 produced significantly less hay. Scotch 770 had over 40% higher oil content than the other cultivars. As in the first cutting, the nodal propagated Scotch 770 contained significantly more oil per pound dry matter than the same cultivar propagated by meristem or stem cutting. Because of the higher concentration, Scotch 770 also had the highest oil yield of the three cultivars. The nodal propagated line produced over 114 lbs/acre in the second harvest.

Total oil yields are displayed graphically in Figure 1. The superiority of Scotch 770 nodal propagated material is obvious. Scotch 770 produced on the average 45% more oil than Native or N-83-5, and the nodal line produced 25% more oil than the meristem or stem cut lines. Since the nuclear plants came from three different propagators, there may have been variation in the parent material from which these lines were derived.

Differences in major quality components in first cutting oil were mainly due to species differences. None of the entries had reached the budding stage. Scotch 770 had higher carvone and limonene levels than Native or N-83-5 (Table 4). At the second cutting, Scotch 770 was slightly more mature than the Native lines. Carvone levels were significantly higher in the meristem-derived plots, but only slightly higher in the stem cut and nodal lines (Table 5). Scotch was again higher in limonene content than Native and N-83-5.

Table 1. Stand ratings for spearmint cultivars/propagation sources on 4/22/98.

VIGOR(1-5)

	Stem cut	Meristem	Nodal	means
Native	3.0	3.0	2.8	2.9
N-83-5	3.0	3.0	3.3	3.1
Scotch 770	4.0	4.0	4.3	4.1
Means	3.3	3.3	3.4	LSD(0.10): cultivar: 0.2 propagation & interaction: NS

STOLON SPREAD (1-5)

	Stem cut	Meristem	Nodal	means
Native	3.3	3.5	4.0	3.6
N-83-5	3.3	3.5	4.0	3.6
Scotch 770	3.3	3.8	4.3	3.8
Means	3.3	3.6	4.1	LSD(0.10) propagation: 0.5 cultivar&interaction:NS

Table 2. Height, hay yield, oil content, and oil yield of cultivars at the first cutting – 7/1/98.

HEIGHT (inches)

	Stem cut	Meristem	Nodal	means	
Native	37	35	35	35	
N-83-5	37	36	38	37	
Scotch 770	31	31	30	31	
				LSD(010)	
Means	35	34	34	cultivar:	1
				propagation:	NS
				interaction:	NS

HAY YIELD (tons/acre)[1/]

	Stem cut	Meristem	Nodal	means	
Native	4.05	3.64	4.10	3.93	
N-83-5	3.44	3.35	4.03	3.60	
Scotch 770	3.15	3.94	3.28	3.46	
means	3.54	3.64	3.81	LSD(0.10)	
				factor means:	0.19
				interaction:	0.32

OIL CONTENT (%dm)

	Stem cut	Meristem	Nodal	means	
Native	.36	.38	.42	.38	
N-83-5	.42	.46	.44	.44	
Scotch 770	.76	.59	.87	.74	
means	.51	.48	.57	LSD(0.10)	
				factor means:	0.08
				interaction:	0.11

OIL YIELD (lbs/acre)[1/]

	Stem cut	Meristem	Nodal	means	
Native	29.2	27.2	33.2	29.9	
N-83-5	28.5	30.3	34.7	31.1	
Scotch 770	47.0	46.5	57.9	50.4	
means	34.9	34.6	41.9	LSD(0.10)	
				factor means:	4.5
				interaction:	NS

[1/] All spearmints were in the vegetative stage on 7/1/98.

Table 3. Height, disease, growth stage, hay yield, oil content, and oil yield of cultivars at the second cutting – 9/2/98.

HEIGHT (inches)

	Stem cut	Meristem	Nodal	means	
Native	27	26	27	27	
N-83-5	29	29	29	29	
Scotch 770	27	24	23	25	
				LSD(0.10)	
Means	28	26	27	cultivar:	1
				propagation:	1
				interaction:	2

RUST (0-5)*

	Stem cut	Meristem	Nodal	means	
Native	2.8	2.3	3.3	2.8	
N-83-5	3.3	3.3	2.8	3.1	
Scotch 770	4.3	4.8	3.8	4.3	
				LSD(0.10)	
Means	4	3.4	3.3	cultivar:	0.6
				propagation:	NS
				interaction:	NS

*0=no symptoms; 5=heavily infested

GROWTH STAGE

	Stem cut	Meristem	Nodal
Native	late bud	full bud	late bud
N-83-5	late bud	late bud	prebloom
Scotch 770	early bloom	prebloom	early bloom

HAY YIELD (tons/acre)

	Stem cut	Meristem	Nodal	means	
Native	2.89	2.89	3.09	2.96	
N-83-5	3.08	2.90	3.03	3.00	
Scotch 770	2.65	2.62	2.47	2.58	
Means	2.87	2.80	2.86	LSD(0.10)	
				factor means:	0.13
				interaction:	NS

OIL CONTENT (%dm)

	Stem cut	Meristem	Nodal	means	
Native	1.3	1.3	1.3	1.3	
N-83-5	1.4	1.3	1.3	1.3	
Scotch 770	1.7	1.7	2.2	1.9	
Means	1.5	1.5	1.6	LSD(0.10)	
				factor means:	0.1
				interaction:	0.2

Table 3. (cont.)

OIL YIELD (lbs/acre)

	Stem cut	Meristem	Nodal	means
Native	70.9	75.1	78.4	74.8
N-83-5	82.6	75.7	78.3	78.9
Scotch 770	89.9	91.4	114.4	98.5
Means	81.1	80.7	90.4	LSD(0.10)
				factor means: 6.8
				interaction: 11.7

Table 4. Quality components of 3 spearmint cultivars and 3 propagation types for the first harvest, 1998.

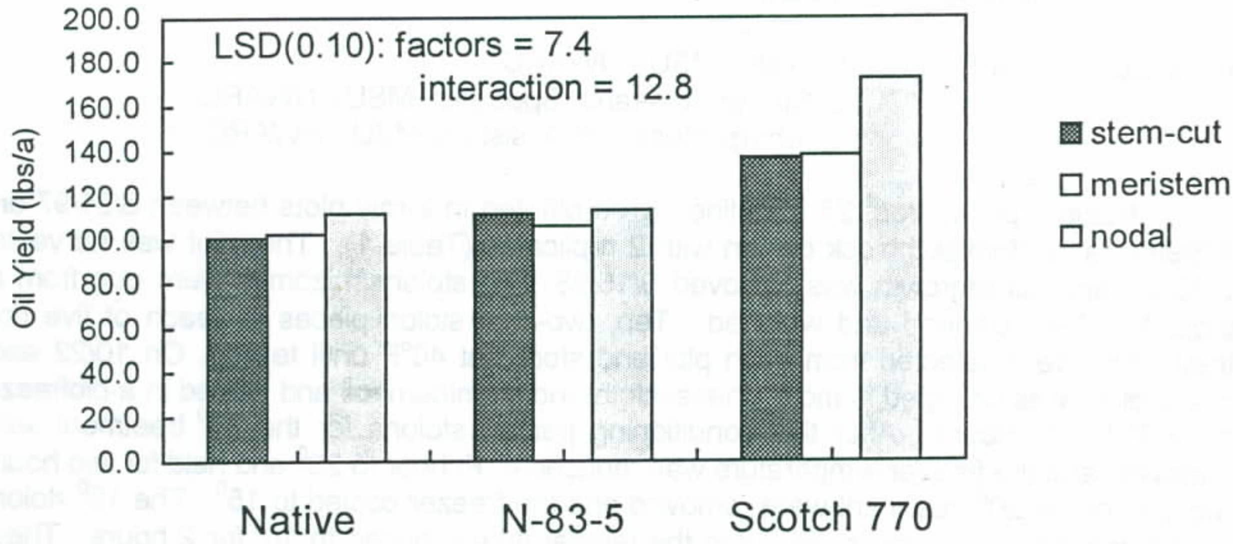
	Dihydro-carvone	Carvone	a-Pinene	b-Pinene	Limonene	Cineole	3-Octanol
Stem cut Native	1.30	49.9	0.84	1.43	15.8	1.01	0.83
Stem cut N-83-5	0.80	50.2	0.81	1.29	11.5	1.20	0.72
Stem cut Scotch 770	0.55	59.5	0.84	1.37	17.9	1.04	1.58
Meristem Native	1.17	49.9	0.88	1.41	13.4	1.03	0.73
Meristem N-83-5	0.82	47.4	0.92	1.41	12.7	1.19	0.67
Meristem Scotch 770	0.80	61.0	0.86	1.39	16.6	0.89	1.46
Nodal Native	0.89	47.7	0.92	1.44	14.0	0.85	0.71
Nodal N-83-5	1.06	49.0	1.04	1.54	13.2	0.97	0.86
Nodal Scotch 770	0.82	63.7	0.83	1.32	17.1	0.85	1.58
Mean	0.91	53.1	0.88	1.40	14.7	1.00	1.01
LSD(0.10)	0.26	3.5	NS	NS	2.4	0.20	0.16
CV(s/mean)	23.5	5.5	13.5	11.0	13.3	16.2	12.9

Table 5. Quality components of 3 spearmint cultivars and 3 propagation types for the second harvest, 1998.

	Dihydro-carvone	Carvone	a-Pinene	b-Pinene	Limonene	Cineole	3-Octanol
Stem cut Native	1.88	61.4	1.11	1.60	11.6	2.24	0.93
Stem cut N-83-5	1.11	61.1	1.14	1.62	11.4	2.32	0.97
Stem cut Scotch 770	0.68	63.0	1.07	1.57	16.1	1.94	1.85
Meristem Native	1.27	62.1	1.10	1.58	13.5	1.99	1.26
Meristem N-83-5	0.87	60.6	1.16	1.61	11.6	2.31	1.00
Meristem Scotch 770	0.84	65.7	0.99	1.48	16.7	1.51	2.12
Nodal Native	0.92	62.6	1.10	1.53	11.9	1.74	0.91
Nodal N-83-5	0.91	62.3	1.10	1.59	13.5	2.18	1.34
Nodal Scotch 770	0.85	64.7	1.04	1.51	16.0	1.73	1.84
Mean	1.04	62.6	1.09	1.56	13.6	1.99	1.36
LSD(0.10)	0.34	2.3	NS	NS	2.6	0.48	0.51
CV(s/mean)	26.8	3.0	7.7	5.8	16.1	19.9	31.3

Analysis by A. M. Todd

Figure 1. Total oil yield of spearmint cultivars/propagation types at NWARC in 1998.



YEAR / PROJECT: 1998 / 758

TITLE: **EFFECT OF FREEZING ON SURVIVAL OF PEPPERMINT AND SPEARMINT RHIZOMES/STOLONS**

PROJECT LEADER: L. Welty, MSU - NWARC
L. Strang, Research Specialist, MSU - NWARC
G. Sharp, Research Assistant, MSU - NWARC

Nuclear plants from 27 mint lines were planted in 2-row plots between 5/21/97 and 6/3/98 in a randomized block design with 2 replicates (Table 1). The mint was harvested 7/23/98, and fall regrowth was removed 9/15/98. The stolons/rhizomes were dug from all plots 10/16/98, cleaned and weighed. Ten, two-inch stolon pieces for each of five cold treatments were selected from each plot and stored at 40°F until testing. On 10/22 each group of 10 was wrapped in moist cheesecloth and aluminum foil and placed in a biofreezer at 36°F for 14 hours. After this conditioning period, stolons for the 36° 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 15°. The 15° stolons were removed after 2 hours, and then the temperature reduced to 10° for 2 hours. These stolons were removed and the remaining stolons cooled to 5° for 2 hours. The stolons were planted in the lab at 65°F on 10/26/98. Emergence dates and the number of live plants produced were recorded for each cold treatment within each stolon source for 3 weeks. The stolons were then removed from the planting trays and biomass recorded.

Stolon survival data are summarized in Table 2 and Figure 1. There was variation among cultivar/propagation lines for all treatments. Because of the small number of replicates, these results should be viewed as a suggestion of which mint lines may have special cold temperature tolerance. Black Mitcham from the 1992 Lake propagated line and the McClelland selection should be considered, as should Todd's Mitcham. The Scotch spearmint parental line and the *longifolia* line from the Netherlands also exhibited greater tolerance to freezing. Surprisingly, the Arctic mint (*M. canadensis*) did not demonstrate more cold tolerance than many other species.

The mint was harvested 7/23/98 (Table 3). Plant heights ranged from 28 inches (2 Black Mitcham lines) to 58 inches (the *longifolia* from the NCGR). Rust symptoms were found in all plots except the polyadenia *longifolia* and the *suaveolens*. Symptoms were most severe in the Scotch experimental lines and the UK-1 peppermint. The Native spearmints, S227, NCGR *longifolia*, and Arctic produced the most dry matter. Oil content was highest in Black Mitcham–stem cut–Summit, the McClelland selections, and S770-stem cut. The *longifolia*s and *suaveolens* contained almost no oil. Of the Black Mitcham entries, the stem-cut propagated line from Summit, the MIRC92 line, the McClelland lines, Todd's Mitcham and M-83-7 produced the most oil. The Scotch spearmint lines S213 and S770-stemcut propagated were among the top producers, as was the *M.canadensis* "Arctic" entry.

Table 1. Entries in the *Mentha* cold tolerance study at NWARC.

Species	Cultivar	Propagation Method	Source	Propagator
Piperita	Black Mitcham	meristem	MIRC	Summit
Piperita	Black Mitcham	meristem	MIRC	Starkel
Piperita	Black Mitcham	nodal	MIRC-92	Lake
Piperita	Black Mitcham	nodal	McClelland	Lake
Piperita	Black Mitcham	nodal	English 1	Lake(Margetts-Roberts)
Piperita	Black Mitcham	nodal	English 2	Lake
Piperita	Black Mitcham	nodal	McClelland	Lake(Mc96-7)
Piperita	Black Mitcham	nodal	McClelland	Lake(Mc96-19)
Piperita	Black Mitcham	stem-cut	MIRC	Summit
Piperita	Black Mitcham	stem-cut	McClelland	Clarke
Piperita	M-83-7	stem-cut	MIRC	Summit
Piperita	Murray Mitcham	stem-cut	MIRC	Summit
Piperita	Roberts Mitcham	stem-cut	MIRC	Summit
Piperita	Todd's Mitcham	stem-cut	MIRC	Summit
Cardiaca	Scotch	stem-cut	MIRC	Summit
Cardiaca	Scotch 213	stem-cut	MIRC	Summit
Cardiac	Scotch 227	stem-cut	MIRC	Summit
Cardiaca	Scotch 770	meristem	MIRC	Starkel
Cardiaca	Scotch 770	stem-cut	MIRC	Summit
Spicata	N-83-5	stem-cut	MIRC	Summit
Spicata	Native	meristem	MIRC	Starkel
Spicata	Native	stem-cut	MIRC	Summit
Canadensis	Arctic	nodal	I.P.Callison	Lake
Longifolia	*hymaliensis*	stem-cut	Davis	Grey
Longifolia	*polyadenia*	stem-cut	Davis	Lake (S.Africa)
Longifolia		nodal	NCGR	Lake (Netherlands)
Suaveolens	rotundifolia	nodal	NCGR	Lake (Minnesota)

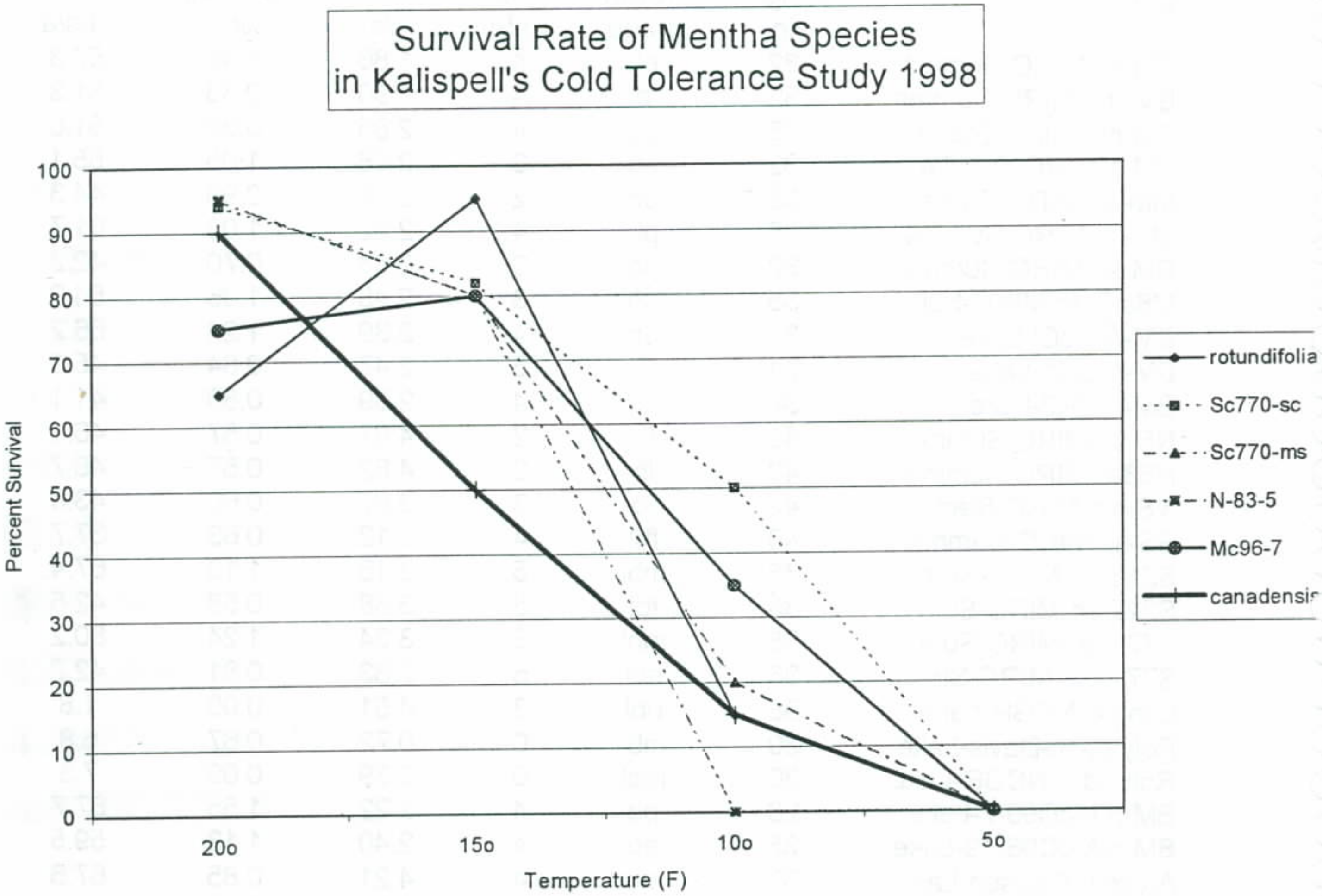
Table 2. Survivorship of stolon segments at four freezing treatments.

	36°check	20°	15°	10°	5°
BM-ms-MIRC-Summit	85	85	70	0	0
BM-sc-MIRC-Summit	100	95	85	5	0
BM-ms-MIRC-Starkel	95	80	95	25	0
BM-n-MIRC92-Lake	95	95	100	85	0
BM-McClelland/Clarke	100	90	80	30	0
BM-n-McC96-19-Lake	79	70	55	15	0
BM-n-McC96-7-Lake	95	75	80	35	0
BM-n-McC-Lake	85	95	95	30	5
BM-n-UK1-Lake	95	90	85	0	0
BM-n-UK2-Lake	95	80	75	0	0
M83-7-sc-MIRC-Sum	95	75	80	0	0
MM-sc-MIRC-Summit	95	95	95	10	0
RM-sc-MIRC-Summit	100	90	90	0	0
TM-sc-MIRC-Summit	95	85	100	75	0
N83-5-MIRC-Summit	100	95	80	0	0
NS-ms-MIRC-Starkel	95	75	85	0	0
NS-sc-MIRC-Summit	100	60	65	35	0
S770-ms-MIRC-Starkel	95	95	80	20	0
S770-sc-MIRC-Sum	40	94	82	50	0
S213-sc-MIRC-Sum	95	80	80	0	0
S227-sc-MIRC-Sum	96	35	80	0	0
SS-sc-MIRC-Summit	60	75	70	35	20
Hymal-sc-Davis-Grey	100	95	85	0	0
Long-n-NCGR-Lake	100	100	100	30	0
Poly-sc-Davis-Lake	85	50	75	15	0
Arctic-n-Callison-Lake	95	90	50	15	0
Rotund-n-NCGR-Lake	95	65	95	15	0
Mean	91	80	80	18	1
CV(s/mean)%	15	17	24	141	

Table 3. Heights, growth stage, rust symptoms and yield components of entries.

Entry	Height in	Growth[4/] stage	Rust (0-5)	Hay Yield t/a	Oil Content %dm	Oil Yield Lbs/a
BM-sc-MIRC-Summit	32	eb	4	1.86	1.49	57.3
BM-ms-MIRC-Summit	32	b	4	2.90	0.83	51.3
BM-ms-MIRC-Starkel	28	pb	4	2.85	0.89	51.0
BM-n-MIRC92-Lake	32	eb	3	2.58	1.05	55.1
MM-sc-MIRC-Summit	33	eb	2	2.28	0.90	44.3
TM-sc-MIRC-Summit	35	pb	4	2.82	1.03	61.7
RM-sc-MIRC-Summit	32	pb	3	2.83	0.70	42.2
M83-7-sc-MIRC-Sum	35	pb	3	2.45	1.06	54.2
BM-n-McCl-Lake	32	eb	4	2.39	1.24	56.2
BM-n-UK1-Lake	34	v	5	2.47	0.84	45.5
BM-n-UK2-Lake	34	pb	4	2.39	0.80	41.1
NS-sc-MIRC-Summit	40	fb	2	4.07	0.57	46.1
N83-5-MIRC-Summit	40	lb	2	4.82	0.57	48.7
NS-ms-MIRC-Starkel	42	fb	3	3.87	0.60	43.6
SS-sc-MIRC-Summit	40	fbl	4	3.12	0.63	37.7
S213-sc-MIRC-Sum	38	mbl	5	3.15	1.13	67.4
S227-sc-MIRC-Sum	35	fbl	5	3.68	0.58	42.5
S770-sc-MIRC-Sum	35	mbl	5	3.34	1.24	80.2
S770-ms-MIRC-Star	36	ebl	5	2.83	0.81	42.2
Long-n-NCGR-Lake	58	pbl	3	4.51	0.00	1.8
Polyad-sc-Davis-Lake	30	mbl	0	0.72	0.67	6.8
Rotund-n-NCGR-Lake	30	mbl	0	3.39	0.09	7.3
BM-n-McC96-7-Lake	28	pb	4	2.22	1.55	67.7
BM-n-McC96-19-Lake	35	eb	4	2.40	1.13	59.5
Arctic-n-Callison-Lake	37	mb	4	4.21	0.85	67.6
Mean				2.96	0.85	47.2
LSD(0.10)				1.16	0.37	26.4
CV(s/mean)%				22.9	19.6	25.4

Figure 1. Survival of stolons from various *Mentha* species subjected to freezing treatments.



YEAR / PROJECT: 1998 / 758

TITLE: **1998 MINT CULTIVAR TRIAL**

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

The following cultivars/selection lines were planted May 18 and 19, 1998:

1) Black Mitcham peppermint, stem-cut propagated by MIRC
2) B-90-9 peppermint, stem-cut propagated by MIRC
3) Murray Mitcham peppermint, stem-cut propagated by MIRC
4) M-83-14 peppermint, stem-cut propagated by MIRC
5) 92(B-37 x M0110) peppermint, stem-cut propagated by MIRC
6) Lewis McKellip selection, nodal propagated by MIRC
7) UK-1 peppermint, nodal propagated by Lake
8) UK-2 peppermint, nodal propagated by Lake
9) McClelland selection, meristem propagated by Starkel
10) Plant Tech-94 selection, stem-cut propagated by Grey
11) Native spearmint, stem-cut propagated by MIRC
12) N-83-22 spearmint, stem-cut propagated by MIRC
13) Scotch spearmint, stem-cut propagated by MIRC
14) Scotch 770 spearmint, stem-cut propagated by MIRC
15) S-90-9 spearmint, stem-cut propagated by MIRC

Experimental design was two side-by-side randomized complete blocks (peppermint and spearmint) with four replicates. Each plot consisted of four 20-ft long rows spaced 22 inches apart with 3 ft between plots. Plant spacing was one foot within each row. Appropriate management practices (irrigation, fertility, and weed and pest control) were employed to insure maximum mint oil production. Stand vigor was rated August 7. Plots were harvested August 25, 1998, when peppermint entries were at the full bud to midbloom stage and spearmint entries were at full bloom. Some entries were exhibiting severe rust symptoms. Rust severity was estimated by visual ratings on August 19. Plant height and growth stage was determined the day before harvest. Yields were determined by swathing a 92 ft^2 area of each plot, drying a 500 g subsample to determine dry matter content, and drying a 20 lb. sample for distillation. Oil was distilled and collected by steam distillation with a research still at the NWARC. Oil samples were analyzed for quality by gas chromatography at A.M. Todd company, and the data compiled and statistical analyses performed at NWARC using MSUSTAT (Version 5.22, R.E. Lund, 1994).

All entries established well with very good transplant survival. Mid summer stand evaluation indicated M-83-14 and the McClelland peppermints and Native spearmint were most vigorous, while Scotch 770 was least vigorous (Table 1). Brownish-red spots typical of the rust uredial stage were seen in all plots to different extents. At this time, symptoms were most severe in Scotch spearmint and least in the 92(B-37 x M0110) and UK-1 peppermints.

By harvest time in late August, rust symptoms had increased in severity and extent, particularly in the spearmints (both *M.cardiaca* and *M.spicata*) and in B-90-9 peppermint (Table 2). Obviously both strains of *Puccinia menthae* were active at NWARC in 1998.

In this establishment year of the study, there was variation in yield parameters among cultivars and selection groups (Table 2). No peppermint entry produced significantly more dry matter than Black Mitcham, and (B-37 x M0110), UK-2 and Plant Tech 94 produced significantly less. Of the spearmint entries, the derived line N-83-22 produced less dry matter than the parent Native, while Scotch 770 and S-90-9 produced less than the parent Scotch did.

B-37 x M0110 was lower in oil content (% of dry matter) than Black Mitcham. N-83-22 produced less oil per unit dry matter than Native, while S-90-9 had less than Scotch (Table 2). B-90-9, M-83-14, and the McKellip selection matched the Black Mitcham check entry in oil yield, while the other peppermint lines were less productive. N-83-22 spearmint produced significantly less oil than Native. S-90-9 spearmint produced significantly less oil than Scotch and Scotch770 (Table 2). None of the new cultivars or selections showed improvement over the checks in oil yield during the first year of this study.

In comparing levels of seven major components of peppermint oil to the Black Mitcham check entry, the highest menthol levels were found in Black Mitcham, B-90-9, B-37 x M0110, and the McClelland selection. (Table 3). Menthol is usually maximized when the mint approaches the full bloom stage. Black Mitcham, B-90-9, and B-37 x M0110 were at the early to mid bloom stage, but the McClelland entry had only reached full bud.

Of the spearmints, carvone levels were similar except for N-83-22, which was lower than the other entries (Table 3). For the other components listed, the Scotch and its derivations differed in content from the Native and N-83-22.

Table 1. Stand establishment evaluation of peppermint and spearmint entries in the Mint Cultivar Trial at Kalispell, MT on August 7, 1998.

Selection/Cultivar	Source	Cover	Vigor	Stolon Spread	Rust
		(0-5)[1/]	*(0-5)*[2]	*(0-5)*[3]	*(0-5)*[4/]
PEPPERMINT					
Black Mitcham	stem-cut/MIRC	4.5	.5	.5	1.5
B-90-9	stem-cut/MIRC	5.0	4.5	3.0	1.0
Murray Mitcham	stem-cut/MIRC	4.0	4.0	3.5	2.5
M-83-14	stem-cut/MIRC	5.0	5.0	3.5	1.0
92 (B-37 x M0110)	stem-cut/MIRC	3.0	3.5	2.0	0.5
Lewis McKellip	nodal/MIRC	4.5	4.5	4.5	1.0
UK-1	nodal/Lake	5.0	4.0	3.5	0.5
UK-2	nodal/Lake	4.0	3.5	3.0	1.0
McClelland	meristem/Starkel	5.0	5.0	4.5	1.5
Plant Tech 94	stem-cut/Grey	3.0	3.0	3.5	1.0
SPEARMINT					
Native	stem-cut/MIRC	4.0	5.0	2.5	2.5
N-83-22	stem-cut/MIRC	3.0	3.0	1.5	2.5
Scotch	stem-cut/MIRC	5.0	4.5	1.5	3.5
Scotch 770	stem-cut/MIRC	3.0	2.5	1.0	1.0
S-90-9	stem-cut/MIRC	3.0	3.0	1.0	2.0
	LSD(0.10)	0.5	1.1	1.1	2.1

Planted 5/19/98
Harvested 8/25/98

1/ 0=empty; 5=total plot coverage
2/ 0=dead; 5=very healthy, vigorous growth
3/ 0=no visible spread from crowns; 5=extensive spreading
4/ 0=no rust symptoms; 5=very severe, leaf necrosis

Table 2. Heights, rust severity, total dry matter and oil yields for entries in the Mint Cultivar Trial established at Kalispell, MT in 1998.

Selection/Cultivar	Source	Height	Rust	Hay Yield	Oil Content	Oil Yield
		inches	*(0-5)**	*t/a*	*%dm*	*lbs/a*
PEPPERMINT						
B-90-9	stem-cut/MIRC	24	5	1.98	1.5	59.8
Black Mitcham	stem-cut/MIRC	23	4	1.98	1.4	59.3
M-83-14	stem-cut/MIRC	23	3	2.05	1.4	56.7
Lewis McKellip	nodal/MIRC	22	4	2.15	1.3	55.3
McClelland	meristem/Starkel	22	4	1.98	1.3	51.0
Plant Tech-94	stem-cut/Grey	18	3	1.73	1.4	49.5
UK-1	nodal/Lake	21	4	1.83	1.4	49.5
Murray Mitcham	stem-cut/MIRC	24	4	1.87	1.3	48.0
UK-2	nodal/Lake	20	4	1.60	1.5	46.5
92 (B-37 x M0110)	stem-cut/MIRC	25	4	1.67	1.1	38.4
SPEARMINT						
Scotch	stem-cut/MIRC	26	5	1.76	1.3	44.5
Scotch 770	stem-cut/MIRC	20	5	1.39	1.3	38.0
Native	stem-cut/MIRC	26	5	1.84	1.0	34.6
S-90-9	stem-cut/MIRC	22	5	1.41	1.0	26.3
N-83-22	stem-cut/MIRC	26	5	1.57	0.5	17.7
	LSD(0.10)	3	1	0.27	0.2	7.4
	CV(s/mean x100)	10.2	12.5	12.5	2.5	13.7

Planted 5/19/98
Harvested 8/25/98

Table 3. Oil quality components (GC%) of entries in the Mint Cultivar Trial established at Kalispell, MT in 1998.

Selection/Cultivar	Stage*	Total Ketones %	Total Alcohol %	MF %	Menthone %	Menthol %	Ester %	Pulegone %
Black Mitcham	ebl	28.4	46.4	3.89	24.6	38.4	2.09	0.46
B-90-9	mbl	28.0	46.8	4.42	24.2	38.8	1.82	0.47
Murray Mitcham	mbl	31.5	44.5	3.16	27.6	35.2	1.81	0.45
M-83-14	mbl	32.3	44.2	3.89	27.6	36.3	1.99	0.75
92 (B-37 x M0110)	mbl	30.5	46.3	3.54	27.0	38.3	1.82	0.44
Lewis McKellip	lb	30.1	44.7	3.77	26.2	36.9	1.77	0.36
UK-1	fb	30.5	44.5	4.68	26.6	36.7	1.97	0.38
UK-2	mbl	30.7	44.5	4.53	26.9	36.7	1.91	0.39
McClelland	fb	28.3	47.2	3.28	24.4	39.2	2.09	0.30
Plant Tech 94	ebl	32.0	43.3	4.23	28.1	35.8	1.63	0.35
mean		30.2	45.2	3.94	26.3	37.2	1.89	0.43
LSD(0.10)		1.5	1.6	0.44	1.3	1.2	0.20	0.11
CV(s/mean)x100		4.1	2.9	9.4	4.2	2.7	8.6	21.6

SPEARMINT

Selection/Cultivar	Stage*	A:Pinene	B:Pinene	Limonene	Cineole	Octanol	Dihydro-carvone	Carvone
Native	fbl	0.96	1.39	12.80	2.54	0.91	2.31	61.53
N-83-22	fbl	1.03	1.42	15.45	2.53	0.73	0.92	55.65
Scotch	fbl	0.89	1.27	20.58	1.72	2.11	0.71	62.64
Scotch 770	fbl	0.87	1.26	21.29	1.51	1.93	0.53	62.49
S-90-9	fbl	0.90	1.34	20.89	1.83	1.73	0.51	61.36
mean		0.93	1.33	18.20	2.02	1.48	1.00	60.73
LSD(0.10)		0.05	0.07	1.09	0.15	0.09	0.18	1.81
CV(s/mean)x100		4.0	4.2	4.7	5.8	4.7	14.5	2.4

* mb = midbud; fb = full bud; lb = late bud; ebl = early bloom; mbl - midbloom; fbl = full bloom

YEAR / PROJECT: 1998 / 758

TITLE: **PEPPERMINT HILLING STUDY**

PROJECT LEADER: L. Welty, MSU - NWARC
L. Strang, Research Specialist, MSU - NWARC
G. Sharp, Research Assistant, MSU - NWARC

COOPERATORS: 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 replicated plots at NWARC. The following cultural treatments were imposed:

Trt	Culture	Operation	Harvest
1	Flat	No hilling	None
2	Flat	Cultivate between rows 7/1, 7/16	9/24
3	Disk Hill	½ coverage 8/6, 2/3 on 9/2, Stolons covered 9/17 & 10/8	None
4	Flat	No hilling	8/25
5	Shank/Disk	¼ shank 7/1, 7/16, 8/1 1/3 disk 8/15, ½ disk 9/2 Stolons covered 9/17 and 10/8	None
6	Disk Hill	½ coverage 7/1	None
7	Disk Hill	½ coverage 8/6, 2/3 on 9/2 Stolons covered 9/17	None
8	Disk Hill	½ coverage 8/6, 2/3 on 9/2 Stolons covered 10/8	None

Stolons/rhizomes were dug from a 3-foot square area in each plot between 4/6 and 4/8/98. The entire mass was rinsed and weighed, and 20 two-inch segments from the healthiest looking stolons were removed. The remainder of the stolon mass was air dried and weighed. Another 3-square-foot area was dug from each plot and 20 segments chosen at random (not selected for "quality"). The stolons were planted in a randomized complete block design with 3 replicates, with the "best" segments on one side and the "random" segments on the other side of the plot.

On 7/21 and 7/22/98 plant height was measured and all plants dug from each plot. Number of live rhizomes were counted, and the top growth separated from the crowns and underground growth. These components were weighed wet and then air dried and weighed again. Hilling treatments were submitted to ANOVA and mean effects separated by LSD (student's t) at the 0.10 significance level.

There were no significant differences in total dry weight or in the wet weight of the 2" pieces selected from the "best" stolons (Table 1). Treatments having the highest stolon mass (wet) were the non-harvested flat culture and the flat culture harvested 8/25. The shank/disk and disk hill treatment covered once on 7/1 also had good stolon mass. The flat culture harvested 9/24 had approximately half the stolon mass of that harvested earlier in the season, indicating that a late harvest just before the first frost had a detrimental effect on stolon vigor the following spring.

There were no significant differences in plant height or root mass among the treatments planted in 1998 (Table 2). The unharvested flat culture, the early harvest flat, and two of the disking treatments had the greatest number of live rhizomes. These two flat culture treatments and three of the disk treatments produced the most topgrowth. The differerence between the two harvest dates on the flat cultures can be explained by the the greater amount of regrowth on the early harvest providing more carbohydrate reserves to the roots as well as the insulating protection of the residue. Differences among the disk treatments are harder to explain. Perhaps the 3 shanking treatments early in the season damaged the stolons.

Table 1. Stolon/rhizome weights for various cultural methods for peppermint root production.

1997 Treatment*	Total Wet	Total Dry	Best 2" Stolen Segments Wet	Random 2" Stolon Segments Wet
		gms		
Flat-1	359.4	66.7	22.2	17.5
Flat-2	224.5	48.3	22.3	13.0
Disk Hill-1	233.8	36.4	20.4	14.7
Flat-3	434.3	58.7	23.3	19.9
Shank/Disk	363.7	38.6	20.5	12.0
Disk Hill-2	458.5	48.9	24.8	14.0
Disk Hill-3	217.4	51.5	20.6	11.6
Disk Hill-4	256.1	37.6	23.3	14.4
mean	318.5	48.3	22.2	14.6
LSD(0.10)	127.5	NS	NS	3.8
CV(s/mean)%	27.8	55.0	10.6	18.2

Table 2. Height and biomass yield of plants grown from stolon segments from the peppermint hilling study in 1997.

1997 TREATMENT*	HEIGHT	RHIZOMES	TOP$_{wet}$	TOP$_{dry}$	ROOT$_{wet}$	ROOT$_{dry}$
	in	#	gms	gms	gms	gms
Flat-1	24.4	17.2	562.3	113.1	240.7	52.1
Flat-2	22.3	13.3	431.2	88.7	188.4	42.4
Disk Hill-1	22.0	12.5	389.2	79.6	164.2	37.6
Flat-3	22.8	15.2	531.4	107.9	225.9	52.6
Shank/Disk	23.1	12.5	461.5	91.5	195.1	41.2
Disk Hill-2	22.7	15.2	485.3	98.3	195.2	43.0
Disk Hill-3	23.0	12.8	525.6	104.8	225.9	50.3
Disk Hill-4	21.7	16.3	514.1	104.4	208.1	44.5
mean	22.8	14.4	487.6	98.5	205.4	45.5
LSD(0.10)	NS	2.8	92.2	18.9	NS	NS
CV(s/mean)%		20.3	19.4	19.7	22.2	25.2

*1997 TREATMENTS

Flat-1	No Harv
Flat-2	Harv 9/24
Disk Hill-1	1/2 on 8/6, 2/3 on 9/2, cover 9/17 & 10/8
Flat-3	Harv 8/25
Shank/Disk	1/4 shank on 7/1, 7/16, & 8/1; 1/3 disk on 8/15,
Disk Hill-2	1/2 cover on 7/1
Disk Hill-3	1/2 cover on 8/6, 2/3 cover on 9/2, cover on 9/17
Disk Hill-4	1/2 cover on 8/6, 2/3 cover on 9/2, covered on 10/8.

YEAR / PROJECT: 1998 / 758

TITLE : **1998 REGIONAL DRY PEA AND LENTIL YIELD TRIALS - DRYLAND**

PROJECT LEADERS: F. Muehlbauer, WSU
D. Wichman, MSU - CARC
S. Druffel, Spokane Seed Co.

COOPERATORS: L. Welty, MSU - NWARC

Thirty-seven dry pea and eighteen lentil varieties were seeded on April 21 and 23, 1998. Excellent stands were obtained. Precipitation from April through August was 12.76 inches, 50% above average and 46% higher than in 1997. Except for the month of June, temperatures during this period were slightly above normal for this location. Although spring weather was wetter than normal, dry winter conditions allowed soil preparation and planting two weeks earlier than in 1997. Abundant moisture from April through June promoted good establishment and vegetative growth but retarded pod and seed development in the lentils, thereby reducing yields 16% compared to 1996. The presence of more afila and dwarf type pea cultivars (Table 1), which are more resistant to lodging and its associated disease problems, contributed to high yields in 1998. Some of the newer entries in the trial produced over 3500 lbs/acre (Table 2). Some white mold was observed in the lentil plots.

The highest yielding pea cultivar was `Croma', a semi-leaf large yellow pea that produced 4219 lbs/acre (Table 2). 'Crimson' was the highest yielding lentil variety with 1454 lbs/acre (Table 6). The experimental varieties did not perform as well as the older cultivars this year.

Table 1. VARIETY DESCRIPTIONS

Name	Color	Seed Size	Growth Habit	Other
PEAS				
Alaska 81	green	large	long vine	early maturing
Astina	green	large	semi-dwarf	semi-leafless
Athos	yellow	large	semi-dwarf	semi-leafless
Carnival	yellow	medium	semi-dwarf	semi-leafless
Carrera	yellow	large	semi-dwarf	semi-leafless
CEB 1149	green	large	semi-dwarf	semi-leafless
CEB 1154	green	large	semi-dwarf	semi-leafless
Columbian	dk. green	large	long vine	
Common	yellow	medium	long vine	
Croma	yellow	large	semi-dwarf	semi-leafless
Fallon	yellow	large	semi-dwarf	semi-leafless
Grande	yellow	medium	long vine	
Granger	Aus. winter type		vining	
Guido	marrowfat type		semi-dwarf	
Integra	yellow	large	semi-dwarf	semi-leafless
Joel	dk. green	large	long vine	
Majoret	green	medium	semi-dwarf	
Maro	marrowfat type		vine	
Melrose	Austrian winter type		long vine	
Pekisko (NZ 66)	green	large	semi-dwarf	
Phantom	green	medium	tall	semi-leafless
PRO 2100	green	medium	long vine	
PS510664	green	large	medium	
PS510691	green	medium	medium	
PS510718	green	large	medium	
PS510939	marrowfat type		medium	
PS510947	marrowfat type		medium	
Rex	yellow	medium	medium	
Shawnee	yellow	medium	long vine	
Spitfire	yellow	medium	medium	semi-leafless
Supra	marrowfat type		semi-dwarf	semi-leafless
Swing	yellow	large	semi-dwarf	semi-leafless
Trapper	yellow	small	long vine	
TSG 982	green	large	semi-dwarf	
Umatilla	yellow	medium	long vine	
LENTILS				
Brewer	yellow	large		
Crimson	red	small		
Eston	yellow	small		
French Green	green	medium		
Indianhead	black	small		
Laird	yellow	ex-large	tall; indeterminate	
LC460053	yellow	large		
LC460212	yellow	large		
LC460266	yellow	large		
LC560069	yellow	small		
LC560071	yellow	small		
Mason	yellow	large	strong, bushy	
Palouse	yellow	large		
Pardina	brown	small		
Red Chief	red	medium	tall; indeterminate	
Richlea	yellow	large		

Table 2. WESTERN REGIONAL PEA YIELD TRIAL - KALISPELL, MT - 1998

SELECTION/ CULTIVAR	STAND	1st BLOOM	NODES	MATURITY	HEIGHT	SEED SIZE	YIELD
	Pl/ft	days*	to 1st blm	days*	inches	#/lb	lbs/a
Croma	14.6	61	13	98	29	1484	4219
Astina	11.3	61	14	98	36	1748	3906
CEB 1149	12.6	60	13	97	24	1461	3840
CEB 1154	12.0	61	11	98	28	1721	3760
Integra	15.1	61	15	97	36	1690	3591
Fallon	17.6	60	14	97	35	1683	3427
Athos	10.0	56	11	95	22	1450	3399
Rex	13.0	58	14	97	46	1717	3212
Swing	6.5	60	15	98	36	1863	3047
Supra	9.8	64	12	99	33	1275	2959
Spitfire	13.4	65	17	98	38	2072	2802
Guido	7.4	64	13	99	32	1344	2648
PS510664	15.5	63	13	99	38	1957	2607
Maro	9.8	63	13	99	38	1404	2556
PS510939	10.3	63	14	99	39	1685	2352
PS510691	15.6	64	14	98	36	2259	2303
PRO 2100	17.0	61	13	94	67	2303	2269
PS510947	12.4	64	14	99	40	1709	2254
PS510718	15.9	64	14	99	40	2372	2240
Shawnee	18.6	51	9	94	58	1981	1911
Columbian	16.4	45	8	96	64	2180	1771
Umatilla	17.8	57	14	94	62	1927	1728
Joel	16.0	55	12	94	57	1990	1704
Alaska 81	16.3	50	8	94	68	2466	1337
mean	13.5	60	13	97	42	1823	2743
LSD(0.05)	3.8	1	1	1	7	89	404
CV(s/mean)	19.7	1.1	4.8	0.7	12.4	3.5	10.4

* days after seeding
Seeding date: 4/21/98
Seeding rate: 17 seeds/ft^2

Table 3. STATEWIDE PEA TRIAL - KALISPELL, MT - 1998

SELECTION/ CULTIVAR	STAND pl/ft	1st BLOOM days*	NODES to 1st blm	MATURITY days*	HEIGHT inches	SEED #/lb	YIELD lbs/a
Carrera	19.3	59	13	96	21	1650	3625
TSG 982	15.8	62	15	100	33	1757	3230
Pekisko (NZ 66)	20.4	49	9	93	29	2521	2590
Grande	16.4	65	15	100	44	2259	2499
Common-Captan+Allegiance	13.9	66	15	101	54	3723	1659
Common-Maxim(0.04oz)+Apron	14.6	66	15	101	55	3586	1523
Common-Apron(0.16oz/cwt)	15.6	66	15	101	54	3640	1461
Trapper	19.0	67	15	100	54	3823	1291
Granger	17.1	67	15	101	52	3513	1189
Melrose	17.9	67	16	101	63	4643	1043
Mean	17.0	63	14	99	46	3112	2011
LSD(0.05)	4.0	1	1	1	5	205	459
CV(s/mean)	16.0	0.9	2.8	0.9	8.1	4.5	15.7

* days after seeding
Seeding date: 4/21/98
Seeding rate: 20 seeds/ft^2

Table 4. PEA SEED TRIAL - SPOKANE SEED ENTRIES - KALISPELL, 1998

CULTIVAR	STAND pl/ft	1st BLOOM Days	NODES to 1st blm	MATURITY days	HEIGHT inches	SIZE #/lb	YIELD lbs/a
Carnival	7.4	64	16	99	30.0	2191	2659
Majoret	6.4	65	15	99	28.0	1932	2589
Rebel	6.9	59	12	99	45.0	1989	2561
Code 230	6.0	61	12	96	21.0	1615	2234
Phantom	7.1	54	10	92	56.8	2149	1295
mean	6.7	60	13	97	36.2	1975	2268
LSD(0.05)	NS	1	1		5.4	88	352
CV(s/mean)	21.3	1.2	4.7		9.5	2.9	10.0

Seeding date: 4/23/98
Seeding rate: 7seeds/ft^2

Table 5. WESTERN REGIONAL PEA YIELD TRIAL - KALISPELL, MT - 1997-98

VARIETY	1998	1997	mean
	-lbs/a-		
Croma	4219		4219
Astina	3906		3906
CEB 1149	3840		3840
CLM Carrera	3625	3963	3794
CEB 1154	3760		3760
Integra	3591		3591
Athos	3399		3399
Fallon	3427	3361	3394
Solara		3344	3344
Rex	3212	3387	3300
CDN Express		3091	3091
Swing	3047		3047
Supra	2959		2959
PS210370		2922	2922
CDN Carnival	2659	3065	2862
Spitfire	2802		2802
Radley		2679	2679
Guido	2648		2648
PS510664	2607		2607
Maro	2556		2556
CDN Grande	2499	2543	2521
Capella		2426	2426
PS510939	2352		2352
PS510691	2303		2303
PRO 2100	2269		2269
PS510947	2254		2254
PS510718	2240		2240
Shawnee	1911	1792	1852
Joel	1704	1875	1790
Columbian	1771	1694	1733
Umatilla	1728	1693	1711
Latah		1453	1453
Alaska 81	1337	1463	1400
mean	2764	2547	2758
LSD(0.05)	404	454	
CV(s/mean)	10.4	12.5	

Table 6. WESTERN REGIONAL LENTIL YIELD TRIAL - KALISPELL, MT - 1998

CULTIVAR	STAND	1st BLOOM	MATURITY	HEIGHT	SIZE	YIELD
	pl/ft	days*	days*	inches	#/lb	Lbs/a
Crimson	17.6	62	106	21	14590	1454
Brewer	17.8	55	107	26	8099	1430
Eston	22.7	61	107	25	15680	1353
Palouse	18.1	58	104	25	6919	1340
Pardina	19.1	59	107	25	12540	1338
Mason	20.5	59	104	23	6922	1264
LC460266	18.3	55	107	26	7656	1207
LC460212	23.1	63	106	24	7434	1197
LC460053	17.9	59	107	28	7313	1147
LC560069	22.9	57	107	25	13220	852
Richlea	19.5	60	107	27	9977	783
LC560071	22.3	58	107	21	13630	636
MEAN	20.0	59	106	24	10332	1167
LSD(0.05)	4.1	3	1	2	574	235
CV(s/mean)	14.1	3.0	0.4	6.9	3	14.0

Seeding date: 4/21/98
Seeding rate: 20 seeds/ft^2

Table 7. STATEWIDE LENTIL TRIAL – DRYLAND – KALISPELL, MT - 1998

CULTIVAR	STAND	1st BLOOM	MATURITY	HEIGHT	SIZE	YIELD
	plants/ft	days*	days*	inches	#/lb	Lbs/a
French Green	33.0	61.0	107	26.5	16740	1303
Pardina	36.3	58.5	107	27.0	13530	1123
Red Chief	29.0	55.0	106	24.8	9225	1101
Richlae	29.3	61.0	107	28.5	9689	926
Laird	22.0	61.0	108	29.5	7413	880
Indianhead	32.3	61.0	113	29.0	24070	683
mean	30.3	59.6	108	27.5	13445	1003
LSD(0.05)	4.6	0.4		2.7	770	260
CV(s/mean)	10.1	0.4		6.5	3.8	17.1

* days after seeding
Seeding date: 4/21/98
Seeding rate: 39 seeds/ft^2

Table 8. WESTERN REGIONAL LENTIL YIELD TRIAL - KALISPELL, MT - 1997-98

VARIETY	1998	1997	Mean
	---lbs/a---		
Eston	1353	1888	1621
Crimson	1454	1568	1511
Brewer	1430	1563	1497
Palouse	1340	1394	1367
Mason	1264	1415	1340
Pardina	1338	1297	1318
LC460266	1207		1207
LC460212	1197		1197
LC460053	1147		1147
Richlea	783	1159	971
LC560069	852		852
LC560071	636		636
mean	1167	1469	1222
LSD(0.05)	235	218	
CV(s/mean)	14.0	11.0	