FORTYFIFTH ANNUAL REPORT
1993

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

4570 Montana 35
Kalispell, MT 59901

Prepared by

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758 MISCELLANEOUS AND PULSE CROP INVESTIGATIONS

DISTRIBUTION OF THE 1993 NORTHWESTERN AGRICULTURAL RESEARCH CENTER REPORT

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1 Agricultural Stabilization and Conservation, Kalispell

1 Flathead Chapter Future Farmers of America

1 Soil Conservation Service, Kalispell

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Westland Seeds, Inc., Ronan
Lake Glacier View Farm, Ronan

1 MSU Western Agricultural Research Center

ADMINISTRATION 750

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

Full Time Staff Members — **Years in Service**

Leon E. Welty - Supt. & Prof. Agronomy (Began January 1973) 20

Robert N. Stougaard - Assistant Professor, Weed Science 2
(Began November 1991)

Todd K. Keener - Ag Research Spec. II (Began March 1978) 15

Gary R. Haaven - Ag Research Spec. I (Began April 1982) 11

Louise S. Prestbye - Ag Research Spec. I (Began May 1983) 10

Elaine M. Scott - Administrative Support (Began August 1990) 3

James R. Bates - Farm/Ranch Hand III (began June 1993) . . . . . 6 mos.

Christopher M. Steele - Farmer (Began February 1991 resigned April 1993)

Vern R. Stewart - Professor Emeritus

Part Time Employees:

Michael J. Hayden (April 14 through August 18)

Paul Ausenhus (June 7 through August 27)

Tim Waccholz (July 1 through September 30)

Student Employees:

Gail Sharp (January 1 through December 31)

Jason Volkman (May 3 through June 3)

Helen Hedstrom (May 18 through August 13)

David Alzner (June 3 through August 20)

Ray Owens Jr. (June 7 through August 20)

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 purchased in 1992:

Lease John Deere 6400 tractor	$2,075.10
Lease John Deere 870 tractor	$ 871.78
Irrigation Wheel Line	$6,050.00
TOTAL.....	$8,996.88

PHYSICAL PLANT 752

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

PROFESSIONAL & CLIENTELE PRESENTATIONS 1993

Date	Activity	Who	Where
1/6	Triangle Cropping Seminar	Stougaard	Shelby, Cutbank
1/7	Triangle Cropping Seminar	Stougaard	Conrad, Choteau
1/13	Montana Weed Control Assoc.	Stougaard	Butte
1/14	Advisory Committee	Welty Stougaard	Missoula
1/21	Mint Industry Research Council	Welty Stougaard	Las Vegas, NV
2/9	Western Montana Mint Growers Assoc.	Welty Stougaard	Kalispell
2/15	Alfalfa Growers	Welty	Spokane, WA
2/17	Alfalfa Growers	Welty	Pasco, WA
2/17	Crop Production Clinic-Equity	Stougaard Keener	Kalispell
2/19	Pesticide Recertification Clinic	Stougaard	Ronan
2/22	Wild Oat Workshop	Stougaard	Kalispell
3/16	Lentil Production	Stougaard	Kalispell
3/16	County Agents	Welty Stougaard	Missoula
4/6	Dayton School students	Welty	NWARC
4/22	State Dept. Director & Assoc.	Welty Stougaard	NWARC
4/23	Cayuse School students	Welty	NWARC
4/26	P & S - 500	Welty	Bozeman
5/10	A.M. Todd Representatives	Welty	NWARC
5/14	Flathead Leadership	Welty	Creston Grange
5/15	University of Wyoming Grad. Students	Welty Stougaard	NWARC
5/18	Cayuse School students	Welty	NWARC
6/2	Canadian Ag Specialists	Welty Stougaard	NWARC
6/21	WSCS Scientists	Welty Stougaard	NWARC
7/10	Canadian Farmers	Welty	NWARC
7/12	Great Falls Ag students	Welty	NWARC
7/15	Field Day	Welty Stougaard	NWARC
7/21	Mint Producers	Welty Stougaard	NWARC
7/22	Church group	Welty	NWARC
7/27	Field Day	Welty Stougaard	WARC
7/28	Summer Conference	Welty	WARC
8/14	Cenex Agronomists	Welty Stougaard	NWARC
8/20	Montana Farmer Editor	Welty	NWARC
9/16	Iowa Farmers	Welty Stougaard	NWARC

CLIMATOLOGICAL DATA
NORTHWESTERN AGRICULTURAL RESEARCH CENTER
Kalispell, MT

Northwestern Agricultural Research Center climatological data is recorded and sent to the Atmospheric Administration to be published in the Climatological Data. Daily maximum and minimum temperatures, soil temperatures at four and eight inches and precipitation are recorded. This data has been recorded since January 1949.

The weather of the 1992-93 growing season was cooler than most, had significantly higher precipitation, and due to foliar diseases induced by the climatic conditions was a poor harvest year for many farmers.

Total precipitation for the 1992/93 season was 27.37 inches, 7.54 inches above the long time average of 19.83 inches. There were some months in the fall and winter that had less than normal accumulations yet by the end of March the Flathead Valley had 93% of the normal and by May 1 were 14% above normal. August also was lower in rainfall but this fact did not facilitate an already miserable harvest season. High moisture in June and July (38% and 314% above normal, respectively) contributed to severe lodging, sprouting, high moisture in grain and delayed harvest. Quality suffered throughout the area as yields, test weights, and percent plump numbers reflected the poor climatic conditions of the summer.

The mean temperatures for the growing season were lower than the long term average. Lower temperatures were experienced during the months of September, December, January, and February. The lower temperatures in December, January, and February (5.9, 7.4, and 11.4 degrees less than monthly long term averages) may have been a significant factor in high percentage of winter kill in soft white winter wheats. Deficient July temps complicated already poor ripening conditions for cereals in Northwest Montana.

Although the frost free period for 1992/93 was 20 days longer than the 44 year average cereals were not combined until later than normal as farmers waited on rain-delayed harvest and immature grain. Lodging was severe in many spring barley or winter wheat varieties and in many cases caused late tillers to emerge resulting in variable maturation.

There were 105 days of continuous snow cover in the Flathead Valley from December 4 through March 18. There were 15 additional nonsequential snow days in November. Total days of snow cover were 120. Snow depth averaged about 4 inches and was greatest at the end of December with a 14" accumulation. The last day of snow accumulation was on March 18 with 1" of snow. The extended period of snow cover induced TCK dwarf smut infection that was evident in many susceptible varieties.

Cereal diseases were severe throughout Northwestern Montana in both fall and spring planted cereals. Weather factors were believed to have induced moderate to severe levels of scald and net blotch in barley. Septoria and leaf or stripe rust were prevalent in spring and winter wheats. Lower levels of powdery mildew were observed on various wheat varieties throughout the season.

Following is a list of tables giving a complete description of the weather for the crop year (September 1992 through August 1993) and 1993 (January through December).

Table 1. Summary of climatic data by months for 1992-93 crop year (September through August) and averages for the period 1949-93 at the Northwestern Agricultural Research Center, Kalispell, MT.

Table 2. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1993. (Average)

Table 3. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1993. (Maximum)

Table 4. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1993. (Minimum)

Table 5. Summary of precipitation records at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1993.

Table 6. Precipitation by day for crop year September 1, 1992 through August 31, 1993, Northwestern Agricultural Research Center, Kalispell, MT.

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 through 1993.

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950-1993.

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center, January 1950 through December 1993.

Table 10. Summary of precipitation records at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 through December 1993.

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, Kalispell, MT, May 1, 1949 through October 31, 1993.

Table 1. Summary of climatic data by months for 1992–93 crop year (September thru August) and averages for the period 1949–93 at the Northwestern Agricultural Research Center, Kalispell, MT.

ITEM	Sept. 1992	Oct. 1992	Nov. 1992	Dec. 1992	Jan. 1993	Feb. 1993	Mar. 1993	Apr. 1993	May 1993	June 1993	July 1993	Aug. 1993	Total or Average
Precipitation (inches)													
Current Year	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
Avg. 1949 to 1992–93	1.59	1.35	1.52	1.63	1.50	1.15	1.16	1.44	2.31	2.90	1.69	1.59	19.83
Mean Temperature (F)													
Current Year	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
Avg. 1949 to 1992–93	53.5	43.2	32.7	25.3	22.1	29.8	33.8	43.3	51.7	58.3	63.8	63.0	43.4
Last killing frost in spring													
1993					May 4 (32 degrees F)								
Avg. 1949–93					May 25								
First killing frost in fall													
1993					September 13 (29 degrees F)								
Avg. 1949–93					September 14								
Frost Free Period													
1993					132 days								
Avg. 1949–93					112 days								
Maximum summer temperature					91 degrees F on May 13, 1993								
Minimum winter temperature					–19 degrees F on February 18, 1993								

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, 1993.

	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
MEAN	53.5	43.2	32.7	25.3	22.1	27.7	33.8	43.3	51.7	58.3	63.8	63.0	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 through August 31, 1993.

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
MEAN	68.5	55.5	40.2	32.1	29.6	36.1	43.6	55.1	64.9	71.7	79.7	79.3	54.7

Mean temperature for all years = 54.7

Table 4. Summary of temperature data at the Northwestern Agricultural Research Center on crop year basis September 1, 1949 through August 31, 1993.

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
MEAN	38.5	31.2	25.1	18.6	15.1	19.3	24.0	31.4	38.6	45.0	47.9	46.6	31.8

Mean temperature for all years = 31.8

Table 5. Summary of precipitation records at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 through August 31, 1993.

	Total precipitation in inches by month and year												
YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	MEAN
1949–50	1.03	1.05	1.67	0.92	2.62	1.13	2.31	0.84	0.15	3.90	3.12	0.75	19.49
1950–51	0.52	2.30	1.16	2.48	0.94	1.29	0.62	2.32	3.77	2.26	1.03	2.86	21.55
1951–52	1.49	5.62	1.01	3.31	1.03	0.98	0.97	0.17	1.32	3.95	0.56	0.69	21.10
1952–53	0.13	0.05	0.60	0.98	1.84	1.14	0.98	2.07	2.00	3.31	T	1.62	14.72
1953–54	0.71	0.03	0.87	1.30	2.65	0.79	0.83	0.79	1.52	2.98	2.91	3.79	19.17
1954–55	1.09	0.54	1.00	0.43	1.00	1.31	0.44	0.82	1.18	1.86	3.08	0.00	12.75
1955–56	1.64	1.89	1.97	2.38	1.76	1.53	0.87	1.28	1.06	4.20	2.13	3.21	23.92
1956–57	1.16	1.10	0.53	0.96	1.47	1.14	0.75	1.22	1.75	2.51	0.52	0.78	13.89
1957–58	0.10	1.59	0.96	1.76	1.56	2.67	0.97	1.47	2.20	2.56	0.84	0.58	17.26
1958–59	1.99	1.16	2.90	2.77	1.95	1.33	0.75	1.62	4.10	1.75	T	0.91	21.23
1959–60	4.22	3.36	4.32	0.34	1.67	1.10	1.01	1.23	3.27	0.69	0.13	2.43	23.77
1960–61	0.55	1.44	1.72	1.24	0.65	1.46	1.96	2.26	4.02	1.45	0.76	0.64	18.15
1961–62	3.40	1.22	1.77	2.09	1.33	1.15	1.59	0.96	2.59	1.15	0.11	0.72	18.08
1962–63	0.58	1.85	1.31	0.91	1.69	1.21	0.85	1.07	0.57	5.00	1.44	2.10	18.58
1963–64	1.46	0.75	0.95	1.70	1.46	0.41	1.57	0.87	3.33	3.86	3.01	1.64	21.01
1964–65	2.27	0.85	1.62	3.62	2.25	0.64	0.24	2.55	0.81	2.30	1.15	4.74	23.04
1965–66	1.72	0.21	1.31	0.55	1.42	0.67	0.53	0.76	1.18	6.57	2,49	1.64	19.05
1966–67	0.79	1.34	3.33	1.68	1.50	0.62	1.27	0.99	1.30	2.53	0.02	0.01	15.38
1967–68	0.91	1.88	0.62	1.16	0.79	1.15	0.68	0.57	3.92	2.22	1.00	3.42	18.32
1968–69	4.51	2.39	1.59	3.12	3.05	0.75	0.69	1.39	1.19	5.21	0.70	0.09	24.68
1969–70	1.54	1.90	0.31	1.14	3.10	0.89	1.49	0.76	1.97	4.37	3.08	0.44	20.99
1970–71	1.79	1.38	1.75	0.99	1.84	0.77	0.69	0.58	2.45	4.42	1.31	1.11	19.08
1971–72	0.94	0.87	1.70	1.62	1.10	1.65	2.11	0.95	1.48	3.28	1.77	0.98	18.45
1972–73	1.38	1.84	0.80	2.19	0.52	0.56	0.70	0.45	1.13	2.14	0.01	0.63	12.35
1973–74	1.37	1.41	2.95	1.94	1.35	1.32	1.40	3.36	1.82	1.80	1.01	0.62	20.35
1974–75	0.80	0.12	1.10	1.31	1.56	1.08	1.50	1.27	1.50	1.40	1.08	4.26	16.98
1975–76	1.18	2.96	0.85	1.39	0.91	1.12	0.34	1.92	1.90	2.49	1.49	3.42	19.97
1976–77	0.96	0.62	0.73	0.86	0.83	0.71	1.40	0.41	2.90	0.52	3.60	1.50	15.04
1977–78	2.84	0.56	1.62	4.10	2.15	0.99	0.72	2.54	3.56	2.63	3.90	3.34	28.95
1978–79	1.90	0.15	0.96	0.91	1.70	1.45	0.82	2.33	2.67	1.23	0.40	1.79	16.31
1979–80	1.03	1.75	0.50	1.03	1.53	2.03	0.97	1.88	5.48	3.89	1.08	2.45	23.62
1980–81	1.20	0.83	0.78	2.58	1.81	1.85	2.17	1.75	3.86	4.70	1.17	0.96	23.66
1981–82	0.77	0.56	1.49	1.91	2.38	1.48	1.16	1.60	1.25	2.41	2.06	1.17	18.24
1982–83	2.37	0.75	1.39	1.60	0.93	0.85	1.71	2.41	1.20	2.96	3.66	1.16	20.99
1983–84	1.70	1.13	1.96	2.57	0.80	2.19	1.81	1.93	2.91	2.07	0.31	0.55	19.93
1984–85	2.15	2.25	1.40	1.29	0.31	1.28	0.90	1.31	2.81	1.89	0.35	1.62	17.56
1985–86	5.35	1.55	1.61	0.51	2.39	2.33	0.50	1.34	2.92	1.83	2.09	0.81	23.23
1986–87	3.63	0.80	1.78	0.63	0.38	0.46	3.47	1.15	1.89	1.95	4.85	0.98	21.97
1987–88	0.81	0.12	0.91	1.18	0.98	1.03	0.77	1.36	3.60	1.98	1.07	0.13	13.94
1988–89	2.30	0.62	1.39	1.69	1.39	1.48	2.29	1.09	2.70	2.05	2.70	3.69	23.39
1989–90	1.50	2.29	3.75	1.92	0.96	1.00	1.76	1.63	3.74	2.68	2.34	2.44	26.01
1990–91	T	2.32	1.37	2.60	1.41	0.41	0.72	1.21	2.72	5.36	0.77	1.15	20.04
1991–92	0.80	0.75	2.26	0.58	1.17	0.61	0.83	1.18	1.65	5.34	2.24	0.94	18.35
1992–93	1.21	1.07	2.37	1.53	1.68	0.60	0.73	3.77	2.22	4.00	7.00	1.19	27.37
MEAN	1.59	1.35	1.52	1.63	1.50	1.15	1.16	1.44	2.31	2.90	1.69	1.59	19.82

Mean precipitation for all crop years = 19.82

Table 6. Precipitation by day for crop year, September 1, 1992 through August 31, 1993.
Northwestern Agricultural Research Center, Kalispell, MT.

DATE	SEPT. 1992	OCT. 1992	NOV. 1992	DEC. 1992	JAN. 1993	FEB. 1993	MAR. 1993	APR. 1993	MAY 1993	JUNE 1993	JULY 1993	AUG. 1993	
1			0.03	0.02	0.15				0.05	0.78	0.03		
2			0.07		0.08		0.05	0.25	0.03	0.03	0.08		
3					0.02			0.05			0.58		
4			T		0.42			0.02			0.31		
5			0.22		0.16			0.70			1.08		
6		0.03	T					0.01			0.85		
7			0.19						0.42	0.15	0.23		
8	0.17		0.76	0.03					0.13	0.19	0.31	0.06	
9	0.08	0.01	0.25	0.01				0.21			0.70		
10			0.10					0.03			0.39		
11				0.11	0.02			0.20			0.02		
12	0.04		0.05	T	0.01			0.18		0.21	0.07		
13	0.02	0.34				T		0.02		0.53	0.10		
14	0.03	T	0.02			0.11	T	0.01			0.01		
15	0.13	0.02	0.03	0.08	0.01	0.20	0.03	0.02		0.07	0.33	0.03	
16	0.18		0.03				0.04			0.45		0.11	
17		0.10	0.02	0.12			0.02	T	0.10			0.41	
18			0.08	0.15				0.25			0.69	0.08	
19		0.05	0.07	0.04				1.08			0.27		
20		0.02	0.03	0.10	0.25	0.14	0.02	0.15	0.23				
21				0.02		0.05	0.11		0.16		0.17	0.07	
22			0.21	0.02		0.08				0.37	0.03	0.06	
23			0.03	0.03	0.08	0.02		0.34	0.35	0.10	0.07		
24	0.30								0.05	0.26	0.10		
25	0.01				0.22		0.10	0.09		0.05	0.23		
26	0.05			T	0.12	T	0.14	0.10	0.19		0.10		
27	0.19			0.01			0.15		0.31	0.03	0.21		
28	0.01		0.18	0.16	0.04		0.05	0.03			0.02		
29		0.12		0.16	0.10		0.01		0.20	0.22		0.37	
30		0.18		0.36				0.03		0.56	0.02		
31		0.20		0.11			0.01						
TOTAL	1.21	1.07	2.37	1.53	1.68	0.60	0.73	3.77	2.22	4.00	7.00	1.19	YTD 27.37

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 thru 1993.

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
Mean for years	May 25	31	Sept. 14	30	112

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, MT from 1950–93.

	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

Table 9. Summary of temperature records at the Northwestern Agricultural Research Center January 1950 through December 1993.

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	43.9
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
MEAN	22.1	27.7	33.8	43.3	51.7	58.3	63.8	63.0	53.4	43.4	32.4	25.3	43.2

Table 11. Summary of growing degree day (GDD) data at the Northwestern Agricultural Research Center, May 1, 1949 through October 31, 1993. 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
MEAN	236.4	336.7	467.8	456.8	279.4	107.4	1884.6

Montana State University

WILD OAT POPULATIION STUDY - R9 1993

Project Code:93-WOP-R9 Location :KALISPELL, MT

Cooperator :BRUCE MAXWELL By:Bob Stougaard

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	YIELD BARLEY BU/A*	TEST WT BARLEY	% PLUMP BARLEY	WILD OAT #/SQ FT 6-4-93	WILD OAT #/SQ FT 6-15-93	WILD OAT #/SQ FT 6-28-93	BARLEY #/SQ FT 6-4-93	BARLEY #/SQ FT 6-15-93	BARLEY #/SQ FT 6-28-93
1	0 BARLEY						0.0	0.0	0.0	1.3	0.7	0.0	0.0	0.0	0.0
1	0 DAP														
1	0 WILD OAT														
2	0 BARLEY						0.0	0.0	0.0	2.3	3.8	2.0	0.0	0.0	0.0
2	0 DAP														
2	10 WILD OAT														
3	0 BARLEY						0.0	0.0	0.0	6.2	7.8	7.0	0.0	0.0	0.0
3	0 DAP														
3	40 WILD OAT														
4	0 BARLEY						0.1	17.3	6.0	18.7	23.8	18.3	0.0	0.0	0.0
4	0 DAP														
4	160 WILD OAT														
5	0 BARLEY						0.0	0.0	0.0	37.8	50.3	38.2	0.0	0.0	0.0
5	0 DAP														
5	400 WILD OAT														
6	1/2X BARLEY						47.7	51.9	89.1	1.7	1.3	0.2	10.0	10.5	8.8
6	0 DAP														
6	0 WILD OAT														
7	1/2X BARLEY						42.7	51.4	79.4	2.8	5.7	3.0	10.5	10.5	9.7
7	0 DAP														
7	10 WILD OAT														
8	1/2X BARLEY						22.9	47.3	52.7	5.2	10.5	6.5	12.5	11.7	11.3
8	0 DAP														
8	40 WILD OAT														
9	1/2X BARLEY						9.5	48.3	51.7	12.8	21.5	15.5	10.0	9.7	9.8
9	0 DAP														
9	160 WILD OAT														
10	1/2X BARLEY						4.8	48.8	53.1	22.8	39.5	29.7	9.8	9.2	8.5
10	0 DAP														
10	400 WILD OAT														
11	1/2X BARLEY						61.0	49.9	64.7	0.0	0.3	0.0	9.0	9.7	8.2
11	7 DAP														
11	0 WILD OAT														
12	1/2X BARLEY						52.6	50.7	77.0	0.2	1.7	2.3	9.7	9.7	8.5
12	7 DAP														
12	10 WILD OAT														

Montana State University

WILD OAT POPULATIION STUDY - R9 1993

Project Code:93-WOP-R9 Location :KALISPELL, MT

Cooperator :BRUCE MAXWELL By:Bob Stougaard

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	YIELD BARLEY BU/A*	TEST WT BARLEY	% PLUMP BARLEY	WILD OAT #/SQ FT 6-4-93	WILD OAT #/SQ FT 6-15-93	WILD OAT #/SQ FT 6-28-93	BARLEY #/SQ FT 6-4-93	BARLEY #/SQ FT 6-15-93	BARLEY #/SQ FT 6-28-93
13	1/2X BARLEY 7 DAP 40 WILD OAT						39.7	49.9	66.8	0.3	7.7	9.3	10.8	10.7	9.5
14	1/2X BARLEY 7 DAP 160 WILD OAT						24.5	47.3	57.4	0.7	23.5	23.3	7.3	6.7	5.8
15	1/2XBARLEY 7 DAP 400 WILD OAT						27.4	50.4	66.6	0.5	44.7	47.8	11.5	12.2	9.8
16	1X BARLEY 0 DAP 0 WILD OAT						40.6	49.6	61.3	4.3	7.7	3.8	14.0	14.0	11.5
17	1X BARLEY 0 DAP 10 WILD OAT						32.2	49.6	56.6	0.7	1.7	1.5	15.2	14.5	13.2
18	1X BARLEY 0 DAP 40 WILD OAT						39.3	49.6	62.3	3.5	6.2	4.8	14.8	15.8	12.5
19	1X BARLEY 0 DAP 160 WILD OAT						25.0	51.2	59.5	8.8	15.5	13.0	15.7	14.8	12.0
20	1X BARLEY 0 DAP 400 WILD OAT						3.9	47.6	54.3	29.8	45.3	39.7	12.3	12.7	10.7
21	1X BARLEY 7 DAP 0 WILD OAT						43.6	51.7	80.0	0.5	1.5	0.5	14.5	15.0	11.2
22	1X BARLEY 7 DAP 10 WILD OAT						47.5	51.7	74.5	0.2	3.2	3.2	12.3	14.0	11.2
23	1X BARLEY 7 DAP 40 WILD OAT						48.4	50.1	65.9	0.5	6.5	7.2	14.3	15.0	12.7
24	1X BARLEY 7 DAP 160 WILD OAT						45.5	49.9	62.1	0.0	20.8	21.8	14.7	14.5	12.0

Montana State University

WILD OAT POPULATIION STUDY - R9 1993

Project Code:93-WOP-R9 Location :KALISPELL, MT

Cooperator :BRUCE MAXWELL By:Bob Stougaard

Weed/Crop Code Rating Data Type Rating Unit					YIELD BARLEY BU/A*	TEST WT BARLEY	% PLUMP BARLEY	WILD OAT #/SQ FT 6-4-93	WILD OAT #/SQ FT 6-15-93	WILD OAT #/SQ FT 6-28-93	BARLEY #/SQ FT 6-4-93	BARLEY #/SQ FT 6-15-93	BARLEY #/SQ FT 6-28-93
Trt No	Treatment Name	Form Amt	Fm Ds Rate	Grow Stg	Appl Code								
25	1X BARLEY 7 DAP 400 WILD OAT					33.3	50.1	63.8	0.5	51.3	51.5	15.2	15.7	11.8
26	2X BARLEY 0 DAP 0 WILD OAT					59.9	48.6	46.6	11.7	0.2	0.0	25.3	27.7	20.3
27	2X BARLEY 0 DAP 10 WILD OAT					50.0	48.6	46.1	5.8	3.3	3.2	28.7	32.7	24.7
28	2X BARLEY 0 DAP 40 WILD OAT					39.7	47.8	43.2	2.0	8.5	6.0	28.8	25.0	21.3
29	2X BARLEY 0 DAP 160 WILD OAT					16.0	46.0	31.7	13.0	24.3	17.7	30.0	29.7	21.3
30	2X BARLEY 0 DAP 400 WILD OAT					13.4	48.1	45.9	18.5	47.2	32.5	31.5	25.8	17.7
31	2X BARLEY 7 DAP 0 WILD OAT					46.6	48.3	51.3	0.3	1.7	1.0	32.3	31.8	23.0
32	2X BARLEY 7 DAP 10 WILD OAT					45.4	49.3	54.4	0.5	3.0	2.5	34.7	33.0	23.2
33	2X BARLEY 7 DAP 40 WILD OAT					46.0	48.8	51.4	0.5	7.7	7.5	33.0	34.0	22.5
34	2X BARLEY 7 DAP 160 WILD OAT					41.7	48.6	47.3	0.7	22.2	23.2	31.0	30.0	20.7
35	2X BARLEY 7 DAP 400 WILD OAT					38.8	49.4	50.1	0.8	41.8	46.0	31.3	29.5	21.5
LSD (.05) =						16.5	8.6	14.7	9.8	9.2	8.2	5.5	5.2	3.4
Standard Dev.=						10.1035	5.28618	9.02461	6.00964	5.64816	5.01944	3.37877	3.17025	2.09170
CV =						32.45	12.35	17.82	97.38	35.15	35.88	21.47	20.34	17.23

Montana State University

WILD OAT POPULATIION STUDY - R9 1993

Project Code:93-WOP-R9 Location :KALISPELL, MT

Cooperator :BRUCE MAXWELL By:Bob Stougaard

Weed/Crop Code	YIELD	TEST WT	% PLUMP	WILD OAT	WILD OAT	WILD OAT	BARLEY	BARLEY	BARLEY
Rating Data Type	BARLEY	BARLEY	BARLEY	#/SQ FT	#/SQ FT	#/SQ FT	#/SQ FT	#/SQ FT	#/SQ FT
Rating Unit	BU/A*			6-4-93	6-15-93	6-28-93	6-4-93	6-15-93	6-28-93
Block F	1.777	1.316	1.889	0.332	1.560	0.210	1.082	0.990	1.008
Block Prob(F)	0.1769	0.2748	0.1590	0.7189	0.2176	0.8110	0.3447	0.3769	0.3704
Treatment F	10.776	29.443	20.438	7.094	26.689	28.702	30.102	32.465	36.122
Treatment Prob(F)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

1-24-94 SITE DESC. Page 1

Montana State University

REDUCED HERBICIDE RATES FOR WILD OAT CONTROL - 1993

Project Code:93-WORR-R9 Location :KALISPELL, MT
Cooperator :DAVIS/MAXWELL By:Bob Stougaard

Site Description

Crop: SPRING BARLEY Variety: GALLATIN Planting Date: 5-27-93
Planting Method: PRESSDRILL Rate, Unit: 60 , LB Depth, Unit: 1.5 , "
Perennial Age, Unit: , Row Spacing, Unit: 7 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date: 6-4-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 20 , FT Reps: 4
Site Type: STRIP PLOTS Seed Bed Desc.: Ground Cover: NONE
Tillage Type: DISC,CULTIVATOR Study Design: RCB
Field Preparation/Plot Maintenance: AFTER FALL PLOW, SPRING DISC AND VIBRA-SHANK. PACKING OF FIELD PRIOR TO SEEDING

Soil Description

Texture: SILT LOAM % OM: 3 % Sand: 40 % Silt: 50 % Clay: 10
pH: 7.0 CEC: Soil Name: CRESTON SL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:						
Time of Day:						
Application Method:						
Application Timing:						
Air Temp., Unit:	,	,	,	,	,	,
% Relative Humidity:						
Wind Velocity, Unit:	,	,	,	,	,	,
Dew Presence (Y/N):						
Water Hardness:						
Soil Temp., Unit:	,	,	,	,	,	,
Soil Moisture:						
% Cloud Cover:						

Weed Species	Weed Stage, Density at Application					
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.										
B.										
C.										
D.										
E.										
F.										

Summary Comments:

Results from this season indicate that wild oat emerging with the crop causes substantially greater yield reductions as compared to the same densities planted 7 days later. Except for the 1/2X barley population, barley yields remained constant over the wild oat densities when wild oat was seeded 7 days after barley emergence. As an example, at the 1X barley seeding rate when wild oat was seeded with the barley crop, yield was 43 bu/A when no wild oat was present compared to 36 bu/A when 37 wild oat plants per square foot were seeded. These results suggest that controlling the first flush of weeds early is all that is necessary to insure optimum yields. Weeds which emerge later will not impact yield.

Montana State University

EFFECT OF WILD OAT DENSITY ON HERBICIDE PERFORMANCE

Project Code:DENSITY BY RATE Location :KALISPELL - R8

Cooperator :AM. CYAN & MONSANTO By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Form Ds	Rate	Grow Stg	Appl Code	YIELD BU/A*	TEST WT LB/BU	% PLUMP	BARLEY HEIGHT CM 7-26-93	BARLEY INJURY PERCENT 6-25-93	WILD OAT DENSITY #/SQ FT 5-28-93	WILD OAT CONTROL PERCENT 07-29-93	%WILDOAT INFEST. 8-13-93
1	0 WILD OATS						88.1	53.3	86.9	76	1	0.6	100	0.0
1	FARGO	4	EC	0	PPI	A								
2	0 WILD OATS						82.3	53.9	90.6	75	0	0.5	100	0.0
2	FARGO	4	EC	.31	PPI	A								
3	0 WILD OATS						86.1	53.5	87.3	80	3	0.4	100	0.0
3	FARGO	4	EC	.62	PPI	A								
4	0 WILD OATS						81.0	53.3	86.9	78	3	0.3	100	0.0
4	FARGO	4	EC	1.25	PPI	A								
5	0 WILD OATS						75.7	53.6	87.8	76	0	1.3	96	0.0
5	ASSERT	2.5	EC	0	POST	A								
6	0 WILD OATS						78.9	52.9	84.9	79	4	0.6	100	0.0
6	ASSERT	2.5	EC	.11	POST	A								
6	NIS	80	EC	.25	POST	A								
7	0 WILD OATS						86.8	52.6	85.3	81	1	0.3	100	0.0
7	ASSERT	2.5	EC	.23	POST	A								
7	NIS	80	EC	.25	POST	A								
8	0 WILD OATS						84.0	52.1	79.9	75	4	1.6	100	0.0
8	ASSERT	2.5	EC	.46	POST	A								
8	NIS	80	EC	.25	POST	A								
9	15 WILD OATS						54.8	52.5	81.9	71	1	3.4	32	45.3
9	FARGO	4	EC	0	PPI	A								
10	15 WILD OATS						74.8	53.1	84.6	76	1	2.1	74	12.3
10	FARGO	4	EC	.31	PPI	A								
11	15 WILD OATS						74.7	53.3	86.9	76	3	1.3	89	3.3
11	FARGO	4	EC	.62	PPI	A								
12	15 WILD OATS						85.4	53.9	86.7	84	4	0.9	90	3.0
12	FARGO	4	EC	1.25	PPI	A								
13	15 WILD OATS						53.4	51.8	80.1	76	0	6.8	7	44.0
13	ASSERT	2.5	EC	0	POST	A								
14	15 WILD OATS						60.1	52.1	83.6	74	1	6.9	33	41.0
14	ASSERT	2.5	EC	.11	POST	A								
14	NIS	80	EC	.25	POST	A								

Montana State University

EFFECT OF WILD OAT DENSITY ON HERBICIDE PERFORMANCE

Project Code:DENSITY BY RATE Location :KALISPELL - R8

Cooperator :AM. CYAN & MONSANTO By:Bob Stougaard

All rates are specified as lb ai/A

Weed/Crop Code Rating Data Type Rating Unit Rating Date						YIELD BU/A*	TEST WT LB/BU	% PLUMP	BARLEY HEIGHT CM 7-26-93	BARLEY INJURY PERCENT 6-25-93	WILD OAT DENSITY #/SQ FT 5-28-93	WILD OAT CONTROL PERCENT 07-29-93	%WILDOAT INFEST. 8-13-93
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code							
15	15 WILD OATS						75.2	52.7	86.4	76	3	6.3	67	16.3
15	ASSERT	2.5	EC	.23	POST	A								
15	NIS	80	EC	.25	POST	A								
16	15 WILD OATS						71.4	52.1	82.9	71	4	6.4	91	4.3
16	ASSERT	2.5	EC	.46	POST	A								
16	NIS	80	EC	.25	POST	A								
17	25 WILD OATS						49.7	52.3	81.1	74	0	11.3	0	59.5
17	FARGO	4	EC	0	PPI	A								
18	25 WILD OATS						71.9	53.1	85.4	79	1	4.1	64	16.5
18	FARGO	4	EC	.31	PPI	A								
19	25 WILD OATS						81.2	53.7	85.2	80	3	2.6	88	4.3
19	FARGO	4	EC	.62	PPI	A								
20	25 WILD OATS						83.4	53.9	87.1	76	6	1.1	71	2.3
20	FARGO	4	EC	1.25	PPI	A								
21	25 WILD OATS						50.0	51.9	82.9	81	0	10.9	26	33.8
21	ASSERT	2.5	EC	0	POST	A								
22	25 WILD OATS						54.1	52.7	83.4	74	3	10.5	38	39.5
22	ASSERT	2.5	EC	.11	POST	A								
22	NIS	80	EC	.25	POST	A								
23	25 WILD OATS						73.5	53.1	83.2	74	1	5.6	67	20.5
23	ASSERT	2.5	EC	.23	POST	A								
23	NIS	80	EC	.25	POST	A								
24	25 WILD OATS						80.3	52.7	81.3	73	5	10.1	86	9.3
24	ASSERT	2.5	EC	.46	POST	A								
24	NIS	80	EC	.25	POST	A								
25	45 WILD OATS						45.8	52.3	82.8	74	0	14.6	8	43.8
25	FARGO	4	EC	0	PPI	A								
26	45 WILD OATS						72.0	53.4	87.4	81	0	6.9	70	23.0
26	FARGO	4	EC	.31	PPI	A								
27	45 WILD OATS						77.8	53.5	86.3	83	0	8.5	67	13.5
27	FARGO	4	EC	.62	PPI	A								

Montana State University

EFFECT OF WILD OAT DENSITY ON HERBICIDE PERFORMANCE

Project Code:DENSITY BY RATE Location :KALISPELL - R8

Cooperator :AM. CYAN & MONSANTO By:Bob Stougaard

All rates are specified as lb ai/A

Weed/Crop Code Rating Data Type Rating Unit Rating Date						YIELD BU/A*	TEST WT LB/BU	% PLUMP	BARLEY HEIGHT CM 7-26-93	BARLEY INJURY PERCENT 6-25-93	WILD OAT DENSITY #/SQ FT 5-28-93	WILD OAT CONTROL PERCENT 07-29-93	%WILDOAT INFEST. 8-13-93
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code							
28	45 WILD OATS						76.1	53.1	85.1	79	1	1.5	91	4.3
28	FARGO	4	EC	1.25	PPI	A								
29	45 WILD OATS						51.4	51.3	80.4	73	0	21.1	17	46.3
29	ASSERT	2.5	EC	0	POST	A								
30	45 WILD OATS						53.3	51.3	80.5	74	4	28.6	25	47.0
30	ASSERT	2.5	EC	.11	POST	A								
30	NIS	80	EC	.25	POST	A								
31	45 WILD OATS						48.5	51.0	78.7	71	3	26.4	40	45.0
31	ASSERT	2.5	EC	.23	POST	A								
31	NIS	80	EC	.25	POST	A								
32	45 WILD OATS						76.9	52.2	81.2	73	5	19.0	79	15.8
32	ASSERT	2.5	EC	.46	POST	A								
32	NIS	80	EC	.25	POST	A								
LSD (.05) =							15.3	1.1	5.3	7	5	6.1	23	11.5
Standard Dev.=							10.8514	.776062	3.76715	4.91805	3.47200	4.32501	16.4834	8.21390
CV =							15.38	1.47	4.47	6.45	177.77	62.27	24.97	44.31
Block F							1.566	2.400	4.039	4.229	0.454	0.698	0.377	0.465
Block Prob(F)							0.2030	0.0728	0.0095	0.0075	0.7153	0.5558	0.7701	0.7071
Treatment F							6.224	4.133	2.358	2.009	1.001	12.597	15.711	21.847
Treatment Prob(F)							0.0001	0.0001	0.0008	0.0055	0.4786	0.0001	0.0001	0.0001

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Montana State University

EVALUATION OF WILD OAT HERBICIDES, RATES AND APPLICATION TIMINGS AT SEVERAL WILD OAT DENSITIES

Project Code:COMPLEX WILD OAT Location :KALISPELL - R8
Cooperator :AM. CYAN & MONSNATO By:Bob Stougaard

Site Description

Crop: SPRING BARLEY Variety: GALLATIN Planting Date: 4-22-93
Planting Method: RESEARCH Rate, Unit: 60 , LB/A Depth, Unit: 1.5 , "
Perennial Age, Unit: , Row Spacing, Unit: 6 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date: 5-4-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 15 , FT Reps: 4
Site Type: R8 Seed Bed Desc.: Ground Cover: ALF ROOTS
Tillage Type: Study Design:
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC AND CULTIVATE. PACKED PRIOR TO HAND SEEDING WILD OATS, THEN DISC IN OATS.

Soil Description

Texture: FINE SANDY LOAM % OM: 4.0 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.7 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:	4-21-93	5-25-93				
Time of Day:	2:00 PM	1:00 PM				
Application Method:	BACKPACK	BACKPACK				
Application Timing:	PPI	POST				
Air Temp., Unit:	59 ,F	72 ,F	,	,	,	,
% Relative Humidity:	32	5				
Wind Velocity, Unit:	2 ,MPH	2 ,MPH	,	,	,	,
Dew Presence (Y/N):	N	N				
Water Hardness:		N				
Soil Temp., Unit:	50 ,F	60 ,F	,	,	,	,
Soil Moisture:	FAIR	GOOD				
% Cloud Cover:	60	0				

Weed Species	Weed Stage, Density at Application					
BARLEY	NA ,NA	5 LF,~/FT	,	,	,	,
WILD OATS	NA ,NA	2 LF,~/FT	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2.5	FLAT FAN	11002VS	14"	20"	10'	20	H2O	20
B.	"									
C.										
D.										
E.										
F.										

Summary Comments: High temperatures during wild oat emergence thinned the the wild oat stand in half. For both herbicides, barley yield decreased as wild oat population increased regardless of the herebicide rate applied. However, the effect was most pronounced with Assert. When wild oat populations were low, there was little difference in barley yield between the full and half rates of either herbicide, suggesting that herbicide rates can be reduced when weed pressures are low.

Montana State University

REDUCED HERBICIDE RATES FOR WILD OAT CONTROL - 1993

Project Code:93-WORR-R9 Location :KALISPELL, MT

Cooperator :DAVIS/MAXWELL By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	YIELD BARLEY BU/A*	TEST WT BARLEY	PERCENT PLUMP	BARLEY INJURY PERCENT 6-16-93	WILD OAT CONTROL PERCENT 7-29-93	WILD OAT SEED/QD
	Weed/Crop Code											
	Rating Data Type											
	Rating Unit											
	Rating Date											
1	HOELON	3	EC	1	1WABE	A	65.8	54.5	89.7	19	72	269.0
2	HOELON	3	EC	.5	1WABE	A	42.8	52.9	83.1	11	21	1093.7
3	HOELON	3	EC	.25	1WABE	A	25.4	52.2	80.1	0	0	945.8
4	ASSERT	2.5	EC	.46	1WABE	A	77.4	54.5	89.3	21	90	409.0
4	Activator-90	80	EC	.25	1WABE	A						
5	ASSERT	2.5	EC	.23	1WABE	A	58.9	54.1	86.8	16	71	486.8
5	Activator-90	80	EC	.25	1WABE	A						
6	ASSERT	2.5	EC	.11	1WABE	A	48.3	53.5	83.5	15	51	1231.0
6	Activator-90	80	EC	.25	1WABE	A						
7	HOELON	3	EC	1	2WABE	A	53.3	54.3	89.3	24	61	569.9
8	HOELON	3	EC	.5	2WABE	A	28.5	51.9	77.9	9	0	1381.1
9	HOELON	3	EC	.25	2WABE	A	22.8	50.4	74.5	6	0	1024.3
10	ASSERT	2.5	EC	.46	2WABE	A	51.4	53.3	86.4	25	75	869.7
10	Activator-90	80	EC	.25	2WABE	A						
11	ASSERT	2.5	EC	.23	2WABE	A	43.9	53.1	85.3	19	68	945.4
11	Activator-90	80	EC	.25	2WABE	A						
12	ASSERT	2.5	EC	.11	2WABE	A	40.1	52.2	80.2	13	38	1238.3
12	Activator-90	80	EC	.25	2WABE	A						
13	HOELON	3	EC	1	3WABE	A	64.4	53.5	89.5	24	89	326.1
14	HOELON	3	EC	.5	3WABE	A	54.9	53.5	90.6	18	80	402.7
15	HOELON	3	EC	.25	3WABE	A	37.8	52.9	92.6	14	59	904.3
16	ASSERT	2.5	EC	.46	3WABE	A	56.0	52.5	89.3	26	93	502.1
16	Activator-90	80	EC	.25	3WABE	A						
17	ASSERT	2.5	EC	.23	3WABE	A	49.6	53.5	87.2	21	78	706.1
17	Activator-90	80	EC	.25	3WABE	A						
18	ASSERT	2.5	EC	.11	3WABE	A	49.8	54.1	88.2	16	47	1140.5
18	Activator-90	80	EC	.25	3WABE	A						

Montana State University

REDUCED HERBICIDE RATES FOR WILD OAT CONTROL - 1993

Project Code:93-WORR-R9 Location :KALISPELL, MT

Cooperator :DAVIS/MAXWELL By:Bob Stougaard

All rates are specified as lb ai/A

Weed/Crop Code									YIELD	TEST WT	PERCENT	BARLEY	WILD OAT	WILD OAT
Rating Data Type									BARLEY	BARLEY	PLUMP	INJURY	CONTROL	SEED/QD
Rating Unit									BU/A*			PERCENT	PERCENT	
Rating Date												6-16-93	7-29-93	
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code								
19	WEEDY CHECK								18.3	51.1	75.7	5	0	1595.7
LSD (.05) =									16.3	2.0	7.9	11	23	551.5
Standard Dev.=									11.5214	1.39394	5.61704	7.72253	16.1057	389.949
CV =									24.61	2.63	6.59	48.95	30.88	46.19
Block F									5.722	1.965	3.345	9.154	1.338	3.268
Block Prob(F)									0.0018	0.1301	0.0257	0.0001	0.2716	0.0281
Treatment F									7.239	2.565	3.560	3.518	16.733	3.928
Treatment Prob(F)									0.0001	0.0040	0.0002	0.0002	0.0001	0.0001

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Montana State University

REDUCED HERBICIDE RATES FOR WILD OAT CONTROL - 1993

Project Code:93-WORR-R9 Location :KALISPELL, MT
Cooperator :DAVIS/MAXWELL By:Bob Stougaard

Site Description

Crop: SPRING BARLEY Variety: GALLATIN Planting Date: 4-16-93
Planting Method: PRESSDRILL Rate, Unit: 60 , LB Depth, Unit: 1.5 , "
Perennial Age, Unit: , Row Spacing, Unit: 7 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date: 4-30-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 15 , FT Reps: 4
Site Type: STRIP PLOTS Seed Bed Desc.: Ground Cover: NONE
Tillage Type: DISC,CULTIVATOR Study Design: RCB
Field Preparation/Plot Maintenance: AFTER FALL PLOW, SPRING DISC AND VIBRA-SHANK. PACKING OF FIELD PRIOR TO SEEDING

Soil Description

Texture: SILT LOAM % OM: 3 % Sand: 40 % Silt: 50 % Clay: 10
pH: 7.0 CEC: Soil Name: CRESTON SL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:	5-18-93	5-25-93	6-1-93			
Time of Day:	9:30	11:00	10:30			
Application Method:						
Application Timing:	1 WABE	2 WABE	3 WABE			
Air Temp., Unit:	63 ,F	70 ,F	60 ,F	,	,	,
% Relative Humidity:	32	21	20			
Wind Velocity, Unit:	0 ,MPH	1.5 ,MPH	1.5 ,MPH	,	,	,
Dew Presence (Y/N):	N	N	N			
Water Hardness:	N	N	N			
Soil Temp., Unit:	60 ,F	65 ,F	58 ,F	,	,	,
Soil Moisture:	GOOD	GOOD	GOOD			
% Cloud Cover:	25	10	50			

Weed Species	Weed Stage, Density at Application					
WILD OAT	1 LF,10/F	1.5L,	3 LF,	,	,	,
BARLEY	2 LF,10.F	3.5L,	3.5L,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2	FLAT FAN	11002VS	14"	20"	10'	20	H2O	20
B.	"									
C.	"									
D.										
E.										
F.										

Summary Comments: s10H With both herbicides, wild oat control was poorest when applications were made at 2 weeks after barley emergence. Weed control was more complete when herbicides were applied at either 1 or 3 weeks after barley emergence. This fact suggests that wild oat control was more strongly affected by environmental conditions than growth stage during 1993. A cursory look at the weather data during the three application dates suggests daily minimum temperatures of 40 or below reduced herbicide activity.

Of the herbicides evaluated, Assert provided the most complete control. Wild oat control with Hoelon was less effective and reduced rates failed completely. Reduced Assert rates resulted in moderate reductions in wild oat control. Averaged over the 3 application dates, control was 85% at the 1X use rate, 72% at the 1/2X rate, and 45% at the 1/4X rate. However, even at the 1/4 X rate, barley yield was twice that of the nontreated control.

Montana State University

ASSERT CARRIER VOLUME, RATE AND DATE STUDY

Project Code:93-ASS-R9 Location :KALISPELL, MT

Cooperator : By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Form Ds	Rate	Grow Stg	Appl Code	YIELD BARLEY BU/A*	TEST WT	% PLUMP	BARLEY HEIGHT CM 7-27-93	BARLEY INJURY PERCENT 6-25-93	BARLEY INJURY PERCENT 7-20-93	WILD OAT CONTROL PERCENT 7-20-93	WILD OAT CONTROL PERCENT 7-29-93
1	1WABE						50.9	52.5	84.1	103	0	0	0	0
1	CHECK				1WABE	A								
2	ASSERT	2.5	EC	.11	1WABE	A	86.4	54.5	92.2	101	0	0	86	70
2	8GPA													
3	ASSERT	2.5	EC	.11	1WABE	A	89.5	54.8	92.2	103	0	0	91	75
3	16 GPA													
4	ASSERT	2.5	EC	.11	1WABE	A	88.5	54.1	92.5	101	0	0	90	72
4	24 GPA													
5	ASSERT	2.5	EC	.23	1WABE	A	90.5	54.5	92.2	103	0	0	92	80
5	8 GPA													
6	ASSERT	2.5	EC	.23	1WABE	A	92.9	54.8	92.3	99	0	0	97	86
6	16 GPA													
7	ASSERT	2.5	EC	.23	1WABE	A	92.0	54.7	92.2	99	0	0	99	93
7	24 GPA													
8	ASSERT	2.5	EC	.46	1WABE	A	98.0	54.6	94.0	100	0	0	99	92
8	8 GPA													
9	ASSERT	2.5	EC	.46	1WABE	A	95.2	54.5	91.4	105	0	0	100	94
9	16 GPA													
10	ASSERT	2.5	EC	.46	1WABE	A	91.5	55.0	92.6	99	0	0	100	95
10	24 GPA													
11	2WABE						38.5	51.6	80.1	106	0	0	0	0
11	CHECK				2WABE									
12	ASSERT	2.5	EC	.11	2WABE	A	70.1	53.7	91.0	98	0	0	64	45
12	8 GPA													
13	ASSERT	2.5	EC	.11	2WABE	A	68.3	53.9	89.2	101	0	0	63	39
13	16 GPA													
14	ASSERT	2.5	EC	.11	2WABE	A	68.6	54.3	90.4	96	0	0	51	36
14	24 GPA													
15	ASSERT	2.5	EC	.23	2WABE	A	73.6	54.1	89.3	98	0	0	77	60
15	8GPA													

Montana State University

ASSERT CARRIER VOLUME, RATE AND DATE STUDY

Project Code:93-ASS-R9 Location :KALISPELL, MT

Cooperator : By:Bob Stougaard

All rates are specified as lb ai/A

Weed/Crop Code Rating Data Type Rating Unit Rating Date						YIELD BARLEY BU/A*	TEST WT	% PLUMP	BARLEY HEIGHT CM 7-27-93	BARLEY INJURY PERCENT 6-25-93	BARLEY INJURY PERCENT 7-20-93	WILD OAT CONTROL PERCENT 7-20-93	WILD OAT CONTROL PERCENT 7-29-93
Trt No	Treatment Name	Form Amt	Fm Ds Rate	Grow Stg	Appl Code								
16	ASSERT 16 GPA	2.5	EC .23	2WABE	A	83.3	53.7	89.1	108	0	0	80	67
17	ASSERT 24 GPA	2.5	EC .23	2WABE	A	80.6	53.5	88.8	103	0	0	86	68
18	ASSERT 8 GPA	2.5	EC .46	2WABE	A	85.5	54.1	89.3	96	0	0	93	75
19	ASSERT 16 GPA	2.5	EC .46	2WABE	A	93.7	54.3	90.0	103	0	3	96	83
20	ASSERT 24 GPA	2.5	EC .46	2WABE	A	91.9	53.9	89.6	105	0	0	92	82
21	3WABE CHECK					42.3	52.1	80.7	108	0	0	0	0
22	ASSERT 8 GPA	2.5	EC .11	3WABE	A	72.0	53.3	88.4	99	0	0	77	58
23	ASSERT 16 GPA	2.5	EC .11	3WABE	A	83.8	53.9	91.4	100	0	0	91	79
24	ASSERT 24 GPA	2.5	EC .11	3WABE	A	79.7	53.1	89.1	101	0	0	81	64
25	ASSERT 8 GPA	2.5	EC .23	3WABE	A	90.4	53.9	89.6	103	0	5	100	89
26	ASSERT 16 GPA	2.5	EC .23	3WABE	A	86.2	53.9	91.4	94	0	3	95	89
27	ASSERT 24 GPA	2.5	EC .23	3WABE	A	86.4	53.9	92.1	99	0	1	97	84
28	ASSERT 8 GPA	2.5	EC .46	3WABE	A	86.8	53.9	90.3	98	0	8	100	98
29	ASSERT 16 GPA	2.5	EC .46	3WABE	A	78.6	53.7	91.4	94	0	13	100	95
30	ASSERT 24 GPA	2.5	EC .46	3WABE	A	88.7	53.9	90.7	100	0	3	100	98

Montana State University

ASSERT CARRIER VOLUME, RATE AND DATE STUDY

Project Code:93-ASS-R9 Location :KALISPELL, MT

Cooperator : By:Bob Stougaard

Weed/Crop Code	YIELD	TEST WT	% PLUMP	BARLEY	BARLEY	BARLEY	WILD OAT	WILD OAT
Rating Data Type	BARLEY			HEIGHT	INJURY	INJURY	CONTROL	CONTROL
Rating Unit	BU/A*			CM	PERCENT	PERCENT	PERCENT	PERCENT
Rating Date				7-27-93	6-25-93	7-20-93	7-20-93	7-29-93
LSD (.05) =	13.3	1.0	3.6	8	0	4	13	15
Standard Dev.=	9.40681	.709653	2.55770	5.53290	0	2.99065	9.41865	10.4273
CV =	11.64	1.32	2.84	5.50	0	265.84	11.81	15.16
Block F	12.321	12.730	10.134	12.241	0.000	2.446	4.249	4.387
Block Prob(F)	0.0001	0.0001	0.0001	0.0001	1.0000	0.0693	0.0075	0.0063
Treatment F	10.051	4.707	6.229	1.658	0.000	3.390	39.755	30.139
Treatment Prob(F)	0.0001	0.0001	0.0001	0.0380	1.0000	0.0001	0.0001	0.0001

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Montana State University

ASSERT CARRIER VOLUME, RATE AND DATE STUDY

Project Code:93-ASS-R9 Location :KALISPELL, MT

Cooperator : By:Bob Stougaard

Site Description

Crop: BARLEY Variety: GALLATIN Planting Date: 4-27-93

Planting Method: PRESSDRILL Rate, Unit: 60 , LB/A Depth, Unit: 1.5 , "

Perennial Age, Unit: , Row Spacing, Unit: 7 , "

Soil Temp., Unit: , Soil Moisture: Emergence Date: 5-11-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 20 , FT Reps: 4

Site Type: Seed Bed Desc.: Ground Cover: NONE

Tillage Type: Study Design: RCB

Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC AND CULTIVATE, PACKED PRIOR TO SEEDING, HARROWED AFTER WEED SEED SPREAD.

Soil Description

Texture: SILT LOAM % OM: 3 % Sand: 50 % Silt: 40 % Clay: 10

pH: 7.7 CEC: Soil Name: CRESTON S.L. Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:	5-18-93	5-25-93	6-1-93			
Time of Day:	1:00 PM	3:00	12:00			
Application Method:	BACKPACK	BACKPACK	BACKPACK			
Application Timing:	1WABE	2WABE	3WABE			
Air Temp., Unit:	72 ,F	70 ,F	63 ,F	,	,	,
% Relative Humidity:	22	25	35			
Wind Velocity, Unit:	1.5 ,MPH	1.5 ,MPH	2 ,MPH	,	,	,
Dew Presence (Y/N):	N	N	N			
Water Hardness:	N	N	N			
Soil Temp., Unit:	72 ,F	68 ,F	62 ,F	,	,	,
Soil Moisture:	GOOD	GOOD	GOOD			
% Cloud Cover:	0	0	0			

Weed Species	Weed Stage, Density at Application					
BARLEY	2.5",	4 LF,	2TLR,	,	,	,
WILD OAT	1.5",	2 LF,	4 LF,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2.5	FLATFAN	11002VS	14"	20"	10'	8 24	H20	20
B.	"									
C.	"									
D.										
E.										
F.										

Summary Comments: s10HCarrier volume had no effect on wild oat control or yield. Applying Assert in 8 GPA would the be preferred as one could treat 3 times as many acres per load compared to the 24 GPA rate.

Wild oat control was poorest when applications were made 2 weeks after barley emergence. However, the reduction was slight and yield was not adversely affected.

There was no difference in weed control between the first and third application timings. Because water-logged conditions did not exist at this study site, the barley was more competitive and the reduced rates performed very well, especially when applied at the easliest timing. Although slight differences in control were noted, there were no yield differences between the 1X and 1/2X use rates, regardless of the application timing.

Montana State University

Hoelon Surfactant Study on Spring Barley

Project Code:92-HSS-R13 Location :Kalispell, MT
Cooperator :Stougaard/Keener By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Form Ds	Rate	Grow Stg	Appl Code	BARLEY YIELD BU/A 9-22-93	BARLEY INJURY PERCENT 6-3-93	BARLEY INJURY PERCENT 6-9-93	BARLEY INJURY PERCENT 6-25-93	WILD OAT CONTROL PERCENT 7-29-93
1	HOELON	3	EC	1.0	EPOS	D	64.5	11	8	0	83
2	HOELON	3	EC	.50	EPOS	D	65.8	6	3	0	63
3	HOELON	3	EC	.25	EPOS	D	70.2	2	2	0	22
4	HOELON	3	EC	1.0	EPOS	D	84.3	7	7	0	79
4	Activator-90	1									
5	HOELON	3	EC	.5	EPOS	D	67.2	6	7	0	56
5	Activator-90	1									
6	HOELON	3	EC	.25	EPOS	D	67.8	5	5	0	47
6	Activator-90	1									
7	HOELON	3	EC	1.0	EPOS	D	81.9	10	15	0	86
7	SUN-IT	.25									
8	HOELON	3	EC	.50	EPOS	D	89.5	6	6	0	82
8	SUN-IT	.25									
9	HOELON	3	EC	.25	EPOS	D	74.8	5	3	0	38
9	SUN-IT	.25									
10	HOELON	3	EC	1.0	POST	D	77.5	4	6	0	59
11	HOELON	3	EC	.50	POST	D	58.4	3	5	0	30
12	HOELON	3	EC	.25	POST	D	46.5	3	7	0	0
13	HOELON	3	EC	1.0	POST	D	76.3	5	7	0	67
13	Activator-90	1									
14	HOELON	3	EC	.50	POST	D	53.7	5	6	0	52
14	Activator-90	1									
15	HOELON	3	EC	.25	POST	D	61.6	3	3	0	37
15	Activator-90	1									
16	HOELON	3	EC	1.0	POST	D	82.0	5	9	0	91
16	SUN-IT	.25									
17	HOELON	3	EC	.50	POST	D	79.1	6	8	0	71
17	SUN-IT	.25									

Montana State University

Hoelon Surfactant Study on Spring Barley

Project Code:92-HSS-R13 Location :Kalispell, MT
Cooperator :Stougaard/Keener By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	BARLEY YIELD BU/A	BARLEY INJURY PERCENT	BARLEY INJURY PERCENT	BARLEY INJURY PERCENT	WILD OAT CONTROL PERCENT
	Weed/Crop Code										
	Rating Data Type										
	Rating Unit										
	Rating Date						9-22-93	6-3-93	6-9-93	6-25-93	7-29-93
18	HOELON	3 EC		.25	POST	D	64.9	3	7	0	40
18	SUN-IT			.25							
19	UNTREATED						47.3	1	4	0	0
20	UNTREATED						38.4	4	5	0	0
	LSD (.05) =						22.7	5	8	0	31
	Standard Dev.=						13.7430	3.02374	4.71085	0	18.7847
	CV =						20.33	60.27	76.19	0	37.48
	Block F						7.271	0.396	4.417	0.000	4.106
	Block Prob(F)						0.0021	0.6760	0.0189	1.0000	0.0243
	Treatment F						2.993	1.832	1.062	0.000	7.201
	Treatment Prob(F)						0.0020	0.0553	0.4231	1.0000	0.0001

Summary Comments: Results were erratic with applications made 1 week after barley emergence. Surfactants did not provide any clear advantage compared to Hoelon alone with respect to the level of control obtained. Weed and crop responses were more obvious when the same treatments were made two weeks after barley emergence. Wild oat control and barley yield were improved when either Activator-90 or Sunit-II were applied with Hoelon. This indicates that surfactants are more helpful when weeds become larger. This reponse was again most apparent at the lower rates. Of the two surfactants, Sunit-II increased control and yield the most. The 1/2X rate of Hoelon plus Sunit-II provided control and yields comparable to the recommended 1X rate without surfactants.

Montana State University

AVENGE GRANULAR FORMULATION AND ADJUVANT STUDY ON BARLEY

Project Code: 93-AFAS-R9 Location : KALISPELL,MT R9
Cooperator : PAM HUTCHINSON By: Bob Stougaard

Weed/Crop Code						BARLEY	BARLEY	BARLEY	WILD OAT
Rating Data Type						YIELD	CROP INJ	CROP INJ	CONTROL
Rating Unit						BUSHEL/A	%	%	%
Rating Date						9-8-93	6-10-93	6-16-93	7-29-93
Trt-Eval Interval						100 DAT	10 DAT	16 DAT	60 DAT
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Appl Code				
12	AVENGE	64	WP	1	lb ai/A	3-5LF	A	64.4	4	2	25
12	HARMONY EXTRA	75	DF	.5	oz pr/A	3-5LF	A				
12	MCPA	3.7	EC	.25	lb ai/A	3-5LF	A				
12	Activator-90	100	EC	.5	gal pr/100gal	3-5LF	A				
13	UNTREATED							57.1	0	0	0
LSD (.05) =								12.6	1	3	32
Standard Dev.=								8.72344	.978945	1.82691	22.3715
CV =								12.40	38.27	182.69	48.67
Block F								18.716	8.261	0.384	4.221
Block Prob(F)								0.0001	0.0003	0.7651	0.0117
Treatment F								3.346	9.615	1.099	6.268
Treatment Prob(F)								0.0024	0.0001	0.3906	0.0001

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Montana State University

AVENGE GRANULAR FORMULATION AND ADJUVANT STUDY ON BARLEY

Project Code:93-AFAS-R9 Location :KALISPELL,MT R9
Cooperator :PAM HUTCHINSON By:Bob Stougaard

Site Description

Crop: SPRING BARLEY Variety: GALLATIN Planting Date: 4-30-93
Planting Method: PRESSDRILL Rate, Unit: 60 , LB Depth, Unit: 1.5 , "
Perennial Age, Unit: , Row Spacing, Unit: 7 , "
Soil Temp., Unit: 58 , F Soil Moisture: GOOD Emergence Date: 5-11-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: STRIP PLOT Seed Bed Desc.: Ground Cover: NONE
Tillage Type: CULTIVATOR Study Design: RCB
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC AND VIBRA-SHANK. BRILLION PACKER PRIOR TO SEEDING

Soil Description

Texture: FINE SANDY LOAM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.8 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions: High precipitation levels recieved in June and July

Application Information

	A	B	C	D	E	F
Application Date:	5-31-93					
Time of Day:	3:00 PM					
Application Method:	BACKPACK					
Application Timing:	POST					
Air Temp., Unit:	73 ,F	,	,	,	,	,
% Relative Humidity:	22					
Wind Velocity, Unit:	0 3 ,MPH	,	,	,	,	,
Dew Presence (Y/N):	N					
Water Hardness:	N					
Soil Temp., Unit:	68 ,F	,	,	,	,	,
Soil Moisture:	GOOD					
% Cloud Cover:	15					

Weed Species	Weed Stage, Density at Application					
WILD OAT	3L ,10/F	,	,	,	,	,
BARLEY	3 TL,25/F	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2	FLAT FAN	11002VS	14"	20"	10′	20	H2O	20
B.										
C.										
D.										
E.										
F.										

Summary Comments: Avenge plus Assert tank mix combinations provided the most complete control of wild oat. Avenge alone or in combination with broadleaf herbicides failed to provide acceptable wild oat control, regardless of formulation.

The SG formulation (designated as WP in the protocol) was very difficult to work with, particularly treatments 8 through 12. This formulation settled out and did not completely go into solution.

It may be worth while to evaluate this formulation with a commercial sprayer. Based on my experience, problems may arise in keeping the product in solution. This could lead to plugged nozzles at the very least. Problems may be even greater for those who use chemical injectors or induction systems.

The majority of treatments provided poor wild oat control. Avenge applied alone, or tank-mixed with broadleaf herbicides failed to provide acceptable wild oat control. The only treatments to provide acceptable wild oat control were the Avenge plus Assert combinations. The level of wild oat control achieved with the Avenge + Assert combinations was most likely due to the activity of Assert. This points to the capacity of Assert to provide acceptable wild oat control when applied at half the normal use rate. This study also reconfirms the fact that Avenge does not perform well in this region.

Montana State University

EARLY APPLICATION OF BANVEL SGF TO SMALL GRAIN

Project Code:93-Banvel Location :Kalispell, MT R9

Cooperator :Wayne Belles By:Bob Stougaard

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Appl Code	YIELD BU/ACRE 9-4-93	BARLEY INJURY PERCENT 6-3-93	BARLEY INJURY PERCENT 6-10-93	BARLEY INJURY PERCENT 6-16-93	LAMBSQTR CONTROL PERCENT 6-10-93	LAMBSQTR CONTROL PERCENT 6-16-93	BARLEY SCALD PERCENT 6-16-93
1	BANVEL	2	EC	.125	lb ai/A	1-3LF	A	84.9	3	3	3	100	100	9
1	HARM EXTRA	75	DF	.375	oz ai/gal	1-3LF	A							
1	NIS	80	EC	6.4	oz pr/A	1-3LF	A							
2	BANVEL	2	EC	.125	lb ai/A	3-4LF	A	84.2	20	14	6	100	100	8
2	HARM EXTRA	75	DF	.375	oz ai/gal	3-4LF	A							
2	NIS	80	EC	6.4	oz pr/A	3-4LF	A							
3	BANVEL	2	EC	.125	lb ai/A	1-3LF	A	83.4	0	8	4	100	100	8
3	2,4-D	3.8	EC	.38	lb ai/A	1-3LF	A							
4	BANVEL	2	EC	.125	lb ai/A	3-4LF	A	83.2	13	23	6	100	100	7
4	2,4-D	3.8	EC	.38	lb ai/A	3-4LF	A							
5	BANVEL	2	EC	.125	lb ai/A	1-3LF	A	83.2	0	3	0	100	100	10
6	BANVEL	2	EC	.125	lb ai/A	3-4LF	A	83.3	14	5	4	100	100	9
7	UNTREATED							82.4	0	3	0	0	0	10
LSD (.05) =								7.5	10	8	6	0	1	3
Standard Dev.=								5.03104	6.61438	5.06897	3.86580	0	.549170	1.86552
CV =								6.02	94.98	63.08	124.42	0	0.64	21.67
Block F								32.342	0.619	1.054	4.801	0.000	0.632	5.374
Block Prob(F)								0.0001	0.6117	0.3930	0.0125	1.0000	0.6041	0.0081
Treatment F								0.097	6.279	8.907	1.611	0.000	18885.000	1.625
Treatment Prob(F)								0.9958	0.0011	0.0001	0.2014	1.0000	0.0001	0.1976

11-9-93 SITE DESC. Page 1

Montana State University
Early Application of Banvel SGF to small grain

Project Code:93-Banvel Location :Kalispell, MT R9
Cooperator :Wayne Belles By:Bob Stougaard

Site Description

Crop: SPRING BARLEY Variety: GALLATIN Planting Date: 4-21-93
Planting Method: PRESSDRILL Rate, Unit: 60 , LBS/A Depth, Unit: 1.5 , "
Perennial Age, Unit: , Row Spacing, Unit: 7 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date: 5-11-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: SOLID SEEDING Seed Bed Desc.: PACKED Ground Cover: NONE
Tillage Type: VIBRA-SHANK Study Design: RCB
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC, VIBRA-SHANK, AND BRILLION PACKING. WEED SPECIES SEEDED PRIOR TO VIBRA-SHANKING.

Soil Description

Texture: FINE SANDY LOAM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.7 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:	5-16-93	5-24-93				
Time of Day:	12:30 PM	9:00 AM				
Application Method:	BACKPACK	BACKPACK				
Application Timing:	2 LF BAR.	4LF-1 TLR				
Air Temp., Unit:	72 ,F	57 ,F	,	,	,	,
% Relative Humidity:	25	35				
Wind Velocity, Unit:	2 ,MPH	0 ,MPH	,	,	,	,
Dew Presence (Y/N):	N	Y				
Water Hardness:	N	N				
Soil Temp., Unit:	68 ,F	58 ,F	,	,	,	,
Soil Moisture:	GOOD	GOOD				
% Cloud Cover:	25	0				

Weed Species	Weed Stage, Density at Application					
LAMBSQUARTER	COTY,FEW	2 LF,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	3	FLATFAN	11002VS	14"	20"	10'	20	H20	20
B.	"									
C.	"									
D.										
E.										
F.										

RESULTS: One benefit of early Banvel applications appears to be improved crop tolerance. Barley injury increased as application timing was delayed. All injury was transitory and symptoms were not detected by season's end. Although weed seed was sown at this site, adequate weed pressures did not materialize. There was no yield differences among any of the treatments including the nontreated.

Montana State University

BROADLEAF CONTROL WITH HARMONY EXTRA

Project Code:93-BUCK-R9 Location :KALISPELL R9
Cooperator :DUPONT, MIKE KING By:Bob Stougaard

Weed/Crop Code													
Rating Data Type							YIELD	BARLEY INJURY	BARLEY INJURY	LAMBSQTR CONTROL	LAMBSQTR CONTROL	BCKWHEAT CONTROL	BCKWHEAT CONTROL
Rating Unit							BU/ACRE	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT
Rating Date							9-24-93	6-3-93	6-16-93	6-3-93	6-16-93	6-3-93	6-16-93
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Appl Code						
1	HARMONY EXTRA	75	DF	.2	oz ai/A	1TRLF	A	77.4	0	1	99	99	86	99
1	NIS	80	EC	6.4	oz pr/A	1TRLF	A							
2	HARMONY EXTRA	75	DF	.3	oz ai/A	1TRLF	A	61.9	0	0	97	100	91	100
2	NIS	80	EC	6.4	oz pr/A	1TRLF	A							
3	HARMONY EXTRA	75	DF	.4	oz ai/A	1TRLF	A	80.8	0	0	94	100	90	100
3	NIS	80	EC	6.4	oz pr/A	1TRLF	A							
4	HARMONY EXTRA	75	DF	.2	oz ai/A	1TRLF	A	70.9	0	0	98	100	89	100
4	NIS	80	EC	6.4	oz pr/A	1TRLF	A							
4	28% UAN	8	EC	1	gal pr/A	1TRLF	A							
5	HARMONY EXTRA	75	DF	.3	oz ai/A	1TRLF	A	69.3	0	1	90	97	84	98
5	NIS	80	EC	6.4	oz pr/A	1TRLF	A							
5	28% UAN	8	EC	1	gal pr/A	1TRLF	A							
6	HARMONY EXTRA	75	DF	.4	oz ai/A	1TRLF	A	76.3	0	0	96	100	92	100
6	NIS	80	EC	6.4	oz pr/A	1TRLF	A							
6	28% UAN	8	EC	1	gal pr/A	1TRLF	A							
7	HARMONY EXTRA	75	DF	.2	oz ai/A	2TRLF	A	70.4	0	3	61	88	15	88
7	NIS	80	EC	6.4	oz pr/A	2TRLF	A							
8	HARMONY EXTRA	75	DF	.3	oz ai/A	2TRLF	A	69.1	0	3	66	91	19	91
8	NIS	80	EC	6.4	oz pr/A	2TRLF	A							
9	HARMONY EXTRA	75	DF	.4	oz ai/A	2TRLF	A	67.4	0	5	64	91	23	91
9	NIS	80	EC	6.4	oz pr/A	2TRLF	A							
10	HARMONY EXTRA	75	DF	.2	oz ai/A	2TRLF	A	72.7	0	5	66	91	33	91
10	NIS	80	EC	6.4	oz pr/A	2TRLF	A							
10	28% UAN	8	EC	1	gal pr/A	2TRLF	A							
11	HARMONY EXTRA	75	DF	.3	oz ai/A	2TRLF	A	63.9	0	6	60	91	30	91
11	NIS	80	EC	6.4	oz pr/A	2TRLF	A							
11	28% UAN	8	EC	1	gal pr/A	2TRLF	A							
12	HARMONY EXTRA	75	DF	.4	oz ai/A	2TRLF	A	73.9	0	5	63	91	18	91
12	NIS	80	EC	6.4	oz pr/A	2TRLF	A							
12	28% UAN	8	EC	1	gal pr/A	2TRLF	A							
13	HARMONY EXTRA	75	DF	.2	oz ai/A	3TRLF	A	64.3	0	11	0	71	0	73
13	NIS	80	EC	6.4	oz pr/A	3TRLF	A							

Montana State University

BROADLEAF CONTROL WITH HARMONY EXTRA

Project Code:93-BUCK-R9 Location :KALISPELL R9
Cooperator :DUPONT, MIKE KING By:Bob Stougaard

Trt No	Treatment Name	Form Amt	Form Ds	Form Rate	Rate Unit	Grow Stg	Appl Code	YIELD BU/ACRE 9-24-93	BARLEY INJURY PERCENT 6-3-93	BARLEY INJURY PERCENT 6-16-93	LAMBSQTR CONTROL PERCENT 6-3-93	LAMBSQTR CONTROL PERCENT 6-16-93	BCKWHEAT CONTROL PERCENT 6-3-93	BCKWHEAT CONTROL PERCENT 6-16-93
14	HARMONY EXTRA	75	DF	.3	oz ai/A	3TRLF	A	73.4	0	14	0	74	0	74
14	NIS	80	EC	6.4	oz pr/A	3TRLF	A							
15	HARMONY EXTRA	75	DF	.4	oz ai/A	3TRLF	A	68.6	0	11	0	76	0	76
15	NIS	80	EC	6.4	gal pr/A	3TRLF	A							
16	HARMONY EXTRA	75	DF	.2	oz ai/A	3TRLF	A	66.9	0	15	0	74	0	73
16	NIS	80	EC	6.4	oz pr/A	3TRLF	A							
16	28% UAN	8	EC	1	gal pr/A	3TRLF	A							
17	HARMONY EXTRA	75	DF	.3	oz ai/A	3TRLF	A	57.5	0	19	0	73	0	73
17	NIS	80	EC	6.4	oz pr/A	3TRLF	A							
17	28% UAN	8	EC	1	gal pr/A	3TRLF	A							
18	HARMONY EXTRA	75	DF	.4	oz ai/A	3TRLF	A	58.5	0	15	0	70	0	70
18	NIS	80	EC	6.4	oz pr/A	3TRLF	A							
18	28% UAN	8	EC	1	gal pr/A	3TRLF	A							
19	BRONATE	4	EC	1	pt pr/A	3TRLF	A	71.5	0	8	0	89	0	89
20	NONTREATED							58.8	0	0	0	0	0	0
LSD (.05) =								10.3	0	6	7	7	12	7
Standard Dev.=								7.29517	0	4.33956	4.97176	4.78494	8.42085	4.70116
CV =								10.62	0	71.88	10.43	5.75	25.20	5.65
Block F								52.921	0.000	3.909	1.626	5.903	4.817	5.584
Block Prob(F)								0.0001	1.0000	0.0131	0.1935	0.0014	0.0047	0.0020
Treatment F								3.101	0.000	7.766	285.391	87.540	83.835	90.642
Treatment Prob(F)								0.0005	1.0000	0.0001	0.0001	0.0001	0.0001	0.0001

1-24-94 SITE DESC. Page 1

Montana State University
BUCKWHEAT CONTROL WITH HARMONY EXTRA

Project Code:93-BUCK-R9 Location :KALISPELL R9
Cooperator :DUPONT, MIKE KING By:Bob Stougaard

Site Description

Crop: SPRING BARLEY Variety: GALLATIN Planting Date: 4-21-93
Planting Method: PRESSDRILL Rate, Unit: 60 , LB Depth, Unit: 1.5 , "
Perennial Age, Unit: , Row Spacing, Unit: 7 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date: 5-12-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: SOLID SEEDED Seed Bed Desc.: Ground Cover: NONE
Tillage Type: DISC AFTER PLOW Study Design: RCB
Field Preparation/Plot Maintenance: PLOWED IN FALL, SPRING DISC THEN VIBRA-SHANK. PRIOR TO VIBRA-SHANK W.BUCKWHEAT, PIGWEED AND LAMBSQUARTER SEEDED

Soil Description

Texture: FINE SANDY LAOM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.8 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions: FAVORABLE

Application Information

	A	B	C	D	E	F
Application Date:	5-24-93	5-30-93	6-4-93			
Time of Day:	9:00 AM	9:30 AM	9:00			
Application Method:	BACKPACK	BACKPACK	BACKPACK			
Application Timing:	EARLYPOST	M. POST	L. POST			
Air Temp., Unit:	56 ,F	70 ,F	70 ,F	,	,	,
% Relative Humidity:	58	33	25			
Wind Velocity, Unit:	0 ,MPH	0 ,MPH	2.5 ,MPH	,	,	,
Dew Presence (Y/N):	Y	N	N			
Water Hardness:	N	N	N			
Soil Temp., Unit:	55 ,F	65 ,F	58 ,F	,	,	,
Soil Moisture:	GOOD	GOOD	GOOD			
% Cloud Cover:	0	0	0			

Weed Species	Weed Stage, Density at Application					
WILD BUCKWHEAT	1TLF,	2-3L,	2.5L,	,	,	,
FANWEED	.5" ,	,	,	,	,	,
LAMBSQUARTER	2.5L,	4 LF,	3-7L,	,	,	,
CHICKWEED	,	,	,	,	,	,
HENBIT	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2	FLAT FAN	11002VS	14"	20"	10'	20	H20	20
B.	"									
C.	"									
D.										
E.										
F.										

Summary Comments: s10H

This study was established to determine if broadleaf weed control in small grains could be enhanced with the addition of surfactants to standard herbicide treatments. Neither surfactant or herbicide rate had any effect on weed control or barley yield. However, application timing did effect weed control. As application was delayed and weeds became larger, control declined with all herbicide rates regardless of the surfactant used. The results of this study point to the need of treating weeds when small. Allowing weeds to become larger results in reduced control, and allows the weeds to compete with the crop for longer periods of time. Although the surfactants screened in this study did not improve weed control, additional surfactants should be evaluated for the potential to reduce broadleaf herbicide rates.

Montana State University

EVALUATION OF PURSUIT FOR WEED CONTROL IN ALFALFA

Project Code:93-PIA-Y5 Location :KALSIPELL,MT Y-5

Cooperator :AM. CYAN By:Bob Stougaard

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Appl Code	ALFALFA YIELD TONS/A 7-28-93	ALFALFA HEIGHT INS 7-28-93	ALFALFA INJURY PERCENT 6-16-93	PENNYCRS CONTROL PERCENT 7-26-93	PIGWEED CONTROL PERCENT 7-26-93	LAMBSQTR CONTROL PERCENT 7-26-93	GRNFOXTL CONTROL PERCENT 7-26-93
1	PURSUIT	2	EC	.047	lb ai/A	3-5LF	A	1.3	22	17	100	100	88	100
1	NIS	80	EC	1	qt pr/A	3-5LF	A							
1	28% N	28	EC	1	qt pr/A	3-5LF	A							
2	PURSUIT	2	EC	.063	lb ai/A	3-5LF	A	1.5	22	18	100	100	93	100
2	NIS	80	EC	1	qt pr/A	3-5LF	A							
2	28% N	28	EC	1	qt pr/A	3-5LF	A							
3	PURSUIT	2	EC	.094	lb ai/A	3-5LF	A	1.6	21	16	100	100	99	100
3	NIS	80	EC	1	qt pr/A	3-5LF	A							
3	28% N	28	EC	1	qt pr/A	3-5LF	A							
4	PURSUIT	2	EC	.047	lb ai/A	3-5LF	A	1.6	22	15	100	100	99	100
4	SUNIT-II	100	EC	1	pt pr/A	3-5LF	A							
4	28% N	28	EC	1	qt pr/A	3-5LF	A							
5	PURSUIT	2	EC	.063	lb ai/A	3-5LF	A	1.5	23	18	100	100	99	100
5	SUNIT-II	100	EC	1	pt pr/A	3-5LF	A							
5	28% N	28	EC	1	qt pr/A	3-5LF	A							
6	PURSUIT	2	EC	.063	lb ai/A	3-5LF	A	1.5	22	18	100	100	100	100
6	BUCTRIL	2	EC	.125	lb ai/A	3-5LF	A							
6	NIS	80	EC	1	qt pr/A	3-5LF	A							
6	28% N	28	EC	1	qt pr/A	3-5LF	A							
7	PURSUIT	2	EC	.063	lb ai/A	3-5LF	A	1.4	21	21	100	100	98	100
7	BUCTRIL	2	EC	.125	lb ai/A	3-5LF	A							
7	SUNIT-II	100	EC	1	pt pr/A	3-5LF	A							
7	28% N	28	EC	1	qt pr/A	3-5LF	A							
8	UNTREATED							1.2	24	0	0	0	0	0
LSD (.05) =								0.5	3	8	0	0	7	0
Standard Dev.=								.342001	2.19747	5.34662	0	0	4.84591	0
CV =								23.29	9.89	34.95	0	0	5.75	0
Block F								1.607	0.680	3.073	0.000	0.000	0.398	0.000
Block Prob(F)								0.2178	0.5744	0.0512	1.0000	1.0000	0.7555	1.0000
Treatment F								0.719	0.539	5.784	0.000	0.000	200.364	0.000
Treatment Prob(F)								0.6572	0.7953	0.0009	1.0000	1.0000	0.0001	1.0000

NIS = Nonionic surfactant (Activator 90) added at .5% v/v
SUNIT II added at 1 qt/A 28% N added at 1 qt/A

1-25-94 SITE DESC. Page 1

Montana State University

EVALUATION OF PURSUIT FOR WEED CONTROL IN ALFALFA

Project Code:93-PIA-Y5 Location :KALSIPELL,MT Y-5
Cooperator :AM. CYAN By:Bob Stougaard

Site Description

Crop: ALFALFA Variety: ONEIDA VR Planting Date: 5-10-93
Planting Method: PRESSDRILL Rate, Unit: 7 , # PLS Depth, Unit: .5 , "
Perennial Age, Unit: 0 , YR Row Spacing, Unit: 7 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date:

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: SOLID SEEDED Seed Bed Desc.: Ground Cover: NONE
Tillage Type: Study Design: RCB
Field Preparation/Plot Maintenance: PLOW, DISC, VIBRASHANK, CULTI-PACK

Soil Description

Texture: SILT LOAM % OM: 5.4 % Sand: 40 % Silt: 50 % Clay: 10
pH: 7.7 CEC: Soil Name: CRESTON S. L. Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions: EXCESSIVE RAINFALL IN JUNE AND JULY

Application Information

	A	B	C	D	E	F
Application Date:	6-4-93					
Time of Day:	3:00 PM					
Application Method:	BACKPACK					
Application Timing:	4 TRIF					
Air Temp., Unit:	70 ,F	,	,	,	,	,
% Relative Humidity:	25					
Wind Velocity, Unit:	2 ,MPH	,	,	,	,	,
Dew Presence (Y/N):	N					
Water Hardness:	N					
Soil Temp., Unit:	68 ,F	,	,	,	,	,
Soil Moisture:	GOOD					
% Cloud Cover:	10					

Weed Species	Weed Stage, Density at Application					
PENNYCRESS	1-3",12/F	,	,	,	,	,
PIGWEED	1-3",12/F	,	,	,	,	,
GREEN FOXTAIL	3-4L,4/FT	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2.6	XR FLAT FN	11002VS	14"	20"	10'	20	H2O	20
B.										
C.										
D.										
E.										
F.										

Summary Comments: Pursuit appears to be an excellent herbicide for use in alfalfa. Pursuit demonstrated broad spectrum weed control and good crop tolerance. The addition of SUNIT-II enhanced lambsquarter control at the 0.047 lb/A rate. Crop injury was minor and not observed at the July 26 evaluation.

Montana State University
Weed Control with Roundup in Dormant Alfalfa

Project Code:92-RDA-X2 Location :Kalispell, MT
Cooperator :Doug Ryerson - Monsanto By:Bob Stougaard

Trt No	Treatment Name	Form Ant	Form Ds	Rate	Rate Unit	Grow Stg	Appl Code	CHKWEED CONTROL PERCENT 6-11-93 14DAT	CHICKWD PERCENT CONTROL 8-31-93	POAANNUA CONTROL PERCENT 6-11-93 14DAT	POAANNUA PERCENT CONTROL 8-31-93	BCKWHEAT CONTROL PERCENT 6-11-93 14DAT	SHPRPRS PERCENT CONTROL 8-31-93
1	ROUNDUP	3 EC	.19	lb ae/A	DORM	A		92	27.5	97	38.8	91	27.5
1	Amm. Sulfate	1 EC	2.5	gal pr/100gal	DORM	A							
2	ROUNDUP	3 EC	.19	lb ae/A	DORM	A		88	20.0	96	32.5	98	55.0
3	ROUNDUP	3 EC	.28	lb ae/A	DORM	A		80	31.3	70	16.3	88	55.0
4	ROUNDUP	3 EC	.38	lb ae/A	DORM	A		79	37.5	87	33.8	83	80.0
5	LEXONE	75 DF	.5	lb ai/A	DORM	A		100	55.0	99	67.5	100	76.3
6	ROUNDUP	3 EC	.19	lb ae/A	1-TRI	A		81	40.0	95	35.0	96	31.3
6	Amm. Sulfate	1 EC	2.5	gal pr/100gal	1-TRI	A							
7	ROUNDUP	3 EC	.19	lb ae/A	1-TRI	A		85	33.8	90	22.5	95	61.3
8	ROUNDUP	3 EC	.28	lb ae/A	1-TRI	A		58	12.5	86	12.5	91	43.8
9	ROUNDUP	3 EC	.38	lb ae/A	1-TRI	A		86	46.3	94	55.0	96	60.0
10	LEXONE	75 DF	.5	lb ai/A	1-TRI	A		100	47.5	99	78.8	100	81.3
11	ROUNDUP	3 EC	.19	lb ae/A	3-TRI	A		79	10.0	86	21.3	85	12.5
11	Amm. Sulfate	1 EC	2.5	gal pr/100gal	3-TRI	A							
12	ROUNDUP	3 EC	.19	lb ae/A	3-TRI	A		60	13.8	76	27.5	83	45.0
13	ROUNDUP	3 EC	.28	lb ae/A	3-TRI	A		20	10.0	66	10.0	77	31.3
14	ROUNDUP	3 EC	.38	lb ae/A	3-TRI	A		30	27.5	98	53.8	63	32.5
15	LEXONE	75 DF	.5	lb ai/A	3-TRI	A		100	35.0	96	67.5	100	48.8
16	UNTREATED CHEK							100	22.5	36	5.0	100	7.5
LSD (.05) =								30	45.2	31	39.6	21	43.8
Standard Dev.=								21.3052	31.6502	21.4591	27.6781	14.3896	30.6601
CV =								27.57	107.75	25.08	76.68	15.94	65.52
Block F								0.953	2.262	0.976	0.213	2.186	1.110
Block Prob(F)								0.4230	0.0942	0.4124	0.8870	0.1028	0.3551
Treatment F								5.133	0.779	2.410	2.633	2.094	2.120
Treatment Prob(F)								0.0001	0.6931	0.0117	0.0062	0.0286	0.0266

Nonionic surfactant (Ativator 90) added to each treatment at .5% v/v
Amonium sulfate added to selected treatments at 2% v/v(17 lb/100 gal)

Montana State University
Weed Control with Roundup in Dormant Alfalfa

Project Code:92-RDA-X2 Location :Kalispell, MT
Cooperator :Doug Ryerson - Monsanto By:Bob Stougaard

Weed/Crop Code											
Rating Data Type							ALFALFA INJURY	ALFALFA INJURY	ALFALFA INJURY	ALFALFA INJURY	ALFALFA YIELD	ALFALFA YIELD
Rating Unit							PERCENT	PERCENT	PERCENT	PERCENT	TONS/A	TON\A
Rating Date							4-12-93	4-23-93	4-28-93	8-31-93	6-10-93	8-10-93
Trt-Eval Interval							14DAT	14DAT	14DAT			
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Rate Unit	Grow Stg	Appl Code					
1	ROUNDUP	3	EC	.19	lb ae/A	DORM	A	68	71	63	7.5	2.46	1.23
1	Ann. Sulfate	1	EC	2.5	gal pr/100gal	DORM	A						
2	ROUNDUP	3	EC	.19	lb ae/A	DORM	A	70	75	71	5.0	2.47	1.22
3	ROUNDUP	3	EC	.28	lb ae/A	DORM	A	74	84	80	6.3	2.24	1.21
4	ROUNDUP	3	EC	.38	lb ae/A	DORM	A	74	85	85	3.8	2.13	1.23
5	LEXONE	75	DF	.5	lb ai/A	DORM	A	10	11	5	3.8	2.72	1.24
6	ROUNDUP	3	EC	.19	lb ae/A	1-TRI	A	0	44	38	5.0	2.26	1.27
6	Ann. Sulfate	1	EC	2.5	gal pr/100gal	1-TRI	A						
7	ROUNDUP	3	EC	.19	lb ae/A	1-TRI	A	0	45	34	3.8	2.50	1.22
8	ROUNDUP	3	EC	.28	lb ae/A	1-TRI	A	0	50	45	6.3	2.37	1.24
9	ROUNDUP	3	EC	.38	lb ae/A	1-TRI	A	0	46	36	5.0	2.47	1.26
10	LEXONE	75	DF	.5	lb ai/A	1-TRI	A	0	16	11	1.3	2.70	1.22
11	ROUNDUP	3	EC	.19	lb ae/A	3-TRI	A	0	48	68	3.8	1.85	1.20
11	Ann. Sulfate	1	EC	2.5	gal pr/100gal	3-TRI	A						
12	ROUNDUP	3	EC	.19	lb ae/A	3-TRI	A	0	48	73	3.8	1.83	1.22
13	ROUNDUP	3	EC	.28	lb ae/A	3-TRI	A	0	46	71	1.3	1.81	1.19
14	ROUNDUP	3	EC	.38	lb ae/A	3-TRI	A	0	54	85	1.3	1.33	1.22
15	LEXONE	75	DF	.5	lb ai/A	3-TRI	A	0	14	15	0.0	2.45	1.20
16	UNTREATED CHEK							0	0	0	0.0	2.78	1.26
LSD (.05) =								3	15	16	5.8	0.28	0.11
Standard Dev.=								2.40081	10.8129	11.0165	4.04403	.197407	.074283
CV =								13.02	23.50	22.63	112.53	8.68	6.06
Block F								0.181	0.164	0.501	2.580	0.981	3.441
Block Prob(F)								0.9089	0.9202	0.6835	0.0652	0.4101	0.0245
Treatment F								693.759	22.261	28.739	1.268	16.019	0.393
Treatment Prob(F)								0.0001	0.0001	0.0001	0.2617	0.0001	0.9742

Nonionic surfactant (Activator 90) added to each treatment at .5% v/v
Ammonium sulfate added to selected treatments at 2% v/v (17 lb/100 gal)

11-10-93 SITE DESC. Page 1

Montana State University
Weed Control with Roundup in Dormant Alfalfa

Project Code:92-RDA-X2 Location :Kalispell, MT
Cooperator :Doug Ryerson - Monsanto By:Bob Stougaard

Site Description

Crop: ALFALFA Variety: CENTURIAN Planting Date: 4-26-91
Planting Method: PRESSDRILL Rate, Unit: 7#PLS , LB/A Depth, Unit: .5 , "
Perennial Age, Unit: 3 , YR Row Spacing, Unit: 7 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date:

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 20 , FT Reps: 4
Site Type: FIELD SEEDING Seed Bed Desc.: Ground Cover: 80% ALF
Tillage Type: Study Design: RCB
Field Preparation/Plot Maintenance: PLOTS WERE STAKED OUT IN AN ESTABLISHED 3 YEAR OLD STAND OF ALFALFA

Soil Description

Texture: SILT LOAM % OM: 5.6 % Sand: 30 % Silt: 60 % Clay: 10
pH: 7.9 CEC: Soil Name: CRESTON SILT LM Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions: IRRIGATED, OPTIMUM

Application Information

	A	B	C	D	E	F
Application Date:	3-29-93	4-8-93	4-13-93			
Time of Day:	1:30 PM	9:00 AM	11:00AM			
Application Method:	BACKPACK	BACKPACK	BACKPACK			
Application Timing:	DORMANT	1ST TRIF	3RD TRIF			
Air Temp., Unit:	57 ,F	42 ,F	42 ,F	,	,	,
% Relative Humidity:	20	42	30			
Wind Velocity, Unit:	2 ,MPH	0 ,MPH	3.5 ,MPH	,	,	,
Dew Presence (Y/N):	N	Y	Y			
Water Hardness:	N	N	N			
Soil Temp., Unit:	54 ,F	41 ,F	43 ,F	,	,	,
Soil Moisture:	GOOD	V GOOD	V.GOOD			
% Cloud Cover:	99	0	95			

Weed Species	Weed Stage, Density at Application					
SHPRSE	1-10,2/FT	7 LF,2/FT	7 LF,2/FT	,	,	,
CHKWD	.5" ,3/FT	1" ,3/FT	1" ,3/FT	,	,	,
ANBLUE	.5-1,2-4	1.5",MANY	1.5",MANY	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2	TEEJETEVEN	11002VS	12"	20"	10'	20	H20	20
B.	"									
C.	"									
D.										
E.										
F.										

Summary Comments: NIS (Activator 90) added to Roundup treatments. Ammonium sulfate added to various treatments at 2% v/v (17 lb/100 gal).

RESULTS:

The alfalfa never went dormant due to extensive winter snow cover. As a result, even the earliest Roundup treatments caused substantial injury to alfalfa. The last application appeared to cause the greatest harm as reflected in the first cutting yield. However, injury was transitory and there were no yield differences by the second cutting.

Weed pressure consisted mostly of annual bluegrass. Where annual bluegrass pressure was heavy, no other weeds were present. Most Roundup treatments initially provided very good control of the weeds present. Weed control was poorest with the last application, possibly due to interception from the alfalfa canopy. Roundup failed to provide effective season long control.

Montana State University
POAST ON CANOLA

Project Code:93-POCANOLA Location :KALISPELL, MT
Cooperator :ED DAVIS\BASF CORP By:Bob Stougaard

Trt No	Treatment Name	Form Amt	Form Ds	Fm Rate	Rate Unit	Grow Stg	Appl Code	CANOLA INJURY PERCENT 6-3-93	CANOLA INJURY PERCENT 6-9-93	WILD OAT CONTROL PERCENT 6-3-93	WILD OAT CONTROL PERCENT 6-9-93	YIELD LB/ACRE 9-27-93
	Weed/Crop Code											
	Rating Data Type											
	Rating Unit											
	Rating Date											
1	POAST	1.53	EC	.1	lb ai/A	3-LF	A	0 a	8 a	78 c	79 b	1401 a
1	MSO	80	EC	1	qt pr/A	3-LF	A					
2	POAST	1.53	EC	.1	lb ai/A	3-LF	A	1 a	4 a	81 bc	84 ab	1351 a
2	DASH	80	EC	1	qt pr/A	3-LF	A					
3	POAST	1.53	EC	.2	lb ai/A	3-LF	A	0 a	4 a	84 abc	79 b	1342 a
3	MSO	80	EC	1	qt pr/A	3-LF	A					
4	POAST	1.53	EC	.2	lb ai/A	3-LF	A	1 a	5 a	89 ab	86 ab	1349 a
4	DASH	80	EC	1	qt pr/A	3-LF	A					
5	POAST	1.5	EC	.3	lb ai/A	3-LF	A	0 a	5 a	90 a	91 a	1408 a
5	MSO	80	EC	1	qt pr/A	3-LF	A					
6	POAST	1.5	EC	.3	lb ai/A	3-LF	A	0 a	3 a	91 a	92 a	1584 a
6	DASH	80	EC	1	qt pr/A	3-LF	A					
7	POAST	1.5	EC	.1	lb ai/A	5-LF	A	0 a	5 a	0 d	91 a	1245 a
7	MSO	80	EC	1	qt pr/A	5-LF	A					
8	POAST	1.5	EC	.1	lb ai/A	5-LF	A	0 a	3 a	0 d	89 ab	1315 a
8	DASH	80	EC	1	qt pr/A	5-LF	A					
9	POAST	1.5	EC	.2	lb ai/A	5-LF	A	0 a	5 a	0 d	91 a	1356 a
9	MSO	80	EC	1	qt pr/A	5-LF	A					
10	POAST	1.5	EC	.2	lb ai/A	5-LF	A	0 a	8 a	0 d	94 a	1272 a
10	DASH	80	EC	1	qt pr/A	5-LF	A					
11	POAST	1.5	EC	.3	lb ai/A	5-LF	A	0 a	5 a	0 d	91 a	1643 a
11	MSO	80	EC	1	qt pr/A	5-LF	A					
12	POAST	1.5	EC	.3	lb ai/A	5-LF	A	0 a	5 a	0 d	92 a	1457 a
12	DASH	80	EC	1	qt pr/A	5-LF	A					
13	UNTREATED							0 a	6 a	0 d	0 c	408 b
	LSD (.05) =							1	6	8	9	435
	Standard Dev.=							.994107	3.88414	5.21442	6.47604	301.569
	CV =							516.94	79.21	13.23	7.96	22.89
	Block F							0.649	18.982	5.776	4.051	4.467
	Block Prob(F)							0.5889	0.0001	0.0025	0.0140	0.0091
	Treatment F							0.892	0.720	290.800	59.405	3.850
	Treatment Prob(F)							0.5629	0.7229	0.0001	0.0001	0.0008

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Montana State University

POAST RATES AND ADDITIVES ON CANOLA

Project Code:93-POCANOLA Location :KALISPELL, MT
Cooperator :ED DAVIS\BASF CORP By:Bob Stougaard

Site Description

Crop: CANOLA Variety: IMC 01 Planting Date: 5-4-93
Planting Method: DISC DRILL Rate, Unit: 8 PLS , LBS/A Depth, Unit: .5 , "
Perennial Age, Unit: , Row Spacing, Unit: 6 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date:

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: SOLID SEEDED Seed Bed Desc.: FIRM Ground Cover: NONE
Tillage Type: VIBRA-SHANK,BRILLION Study Design: RCB
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC,VIBRA-SHANK, BRILLION.

Soil Description

Texture: FINE SANDY LOAM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.7 CEC: Soil Name: KALISPELL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:	5-19-93	5-28-93				
Time of Day:	10:00 AM	12:30 PM				
Application Method:	BACKPACK	BACKPACK				
Application Timing:	POST 1-3L	POST 3-5L				
Air Temp., Unit:	72 ,F	72 ,F	,	,	,	,
% Relative Humidity:	30	30				
Wind Velocity, Unit:	3 ,MPH	4 ,MPH	,	,	,	,
Dew Presence (Y/N):	N	N				
Water Hardness:	N	N				
Soil Temp., Unit:	68 ,F	67 ,F	,	,	,	,
Soil Moisture:	DRY-TOP	GOOD				
% Cloud Cover:	0	0				

Weed Species	Weed Stage, Density at Application					
WILD OAT	2 LF,25/F	3 LF,5/FT	,	,	,	,
CANOLA	COTY,10	1-3",	,	,	,	,
FANWEED	2-6L,20	,	,	,	,	,
BUCKWHEAT	1-2L,4/F	,	,	,	,	,
LAMBQTR	2 LF,20	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2.5	FLAT FAN	11002VS	14"	20"	10'	20	H20	20
B.	"		"	"	"	"	"	20	"	20
C.										
D.										
E.										
F.										

Summary Comments: Poast was applied with one of two surfactants; methylated sunflower oil (MSO) or Dash. Wild oat populations were heavy and reduced canola yields by 75% in the nontreated control. For the most part, all treatments provided effective control and differences among herbicide treatments were slight. Wild oat control tended to be more complete with Dash compared to MSO. There were no differences in canola yields among the herbicide treatments.

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SELECT CANOLA STUDY

Project Code:93-SCS-R9 Location :KALSIPELL, MT R9
Cooperator :VALENT, LEONARD WELCH By:Bob Stougaard
All rates are specified as lb ai/A

Trt No	Treatment Name	Form	Amt	Ds	Rate	Grow Stg	Appl Code	YIELD CANOLA LB/ACRE	CANOLA INJURY PERCENT	CANOLA INJURY PERCENT	CANOLA INJURY PERCENT	WILD OAT CONTROL PERCENT	WILD OAT CONTROL PERCENT	CANOLA 50%BLOOM JULIAN
	Rating Date							9-29-93	5-27-93	6-3-93	6-9-93	6-3-93	6-9-93	6-25-93
1	UNTREATED							1604	3	4	5	23	23	178
1	6# CANOLA													
2	SELECT	2	EC		.063	1-2LF	A	2159	13	13	14	95	100	178
2	COC		1			1-2LF	A							
2	6# CANOLA													
3	SELECT	2	EC		.094	1-2LF	A	1581	18	30	23	95	98	178
3	COC		1			1-2LF	A							
3	6# CANOLA													
4	SELECT	2	EC		.125	1-2LF	A	1793	23	23	20	95	100	178
4	COC		1			1-2LF	A							
4	6# CANOLA													
5	UNTREATED					3-4LF	A	1449	8	16	10	13	0	178
5	6# CANOLA													
6	SELECT	2	EC		.063	3-4LF	A	1841	3	0	4	21	87	176
6	COC		1											
6	6# CANOLA													
7	SELECT	2	EC		.094	3-4LF	A	1698	0	3	7	23	89	177
7	COC		1											
7	6# CANOLA													
8	SELECT	2	EC		.125	3-4LF	A	1639	3	6	10	35	94	178
8	COC		1											
8	6# CANOLA													
9	POAST	1.5	EC		.188	3-4LF	A	1788	3	4	5	23	91	178
9	COC		1											
9	6# CANOLA													
10	UNTREATED							1404	1	5	4	0	0	177
10	9# CANOLA													
11	SELECT	2	EC		.063	1-2LF	A	1793	6	13	6	94	98	177
11	COC		1											
11	9# CANOLA													
12	SELECT	2	EC		.094	1-2LF	A	1740	3	3	9	95	99	177
12	COC		1											
12	9# CANOLA													

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SELECT CANOLA STUDY

Project Code:93-SCS-R9 Location :KALSIPELL, MT R9
Cooperator :VALENT, LEONARD WELCH By:Bob Stougaard
All rates are specified as lb ai/A

Frt No	Treatment Name	Form Amt	Form Ds	Rate	Grow Stg	Appl Code	YIELD CANOLA LB/ACRE 9-29-93	CANOLA INJURY PERCENT 5-27-93	CANOLA INJURY PERCENT 6-3-93	CANOLA INJURY PERCENT 6-9-93	WILD OAT CONTROL PERCENT 6-3-93	WILD OAT CONTROL PERCENT 6-9-93	CANOLA 50%BLOOM JULIAN 6-25-93
13	SELECT	2	EC	.125	1-2LF	A	1787	8	14	10	93	98	177
13	COC	1											
13	9# CANOLA												
14	UNTREATED						1121	0	0	3	0	0	178
14	9# CANOLA												
15	SELECT	2	EC	.063	3-4LF	A	1933	0	5	4	0	92	178
15	COC	1											
15	9# CANOLA												
16	SELECT	2	EC	.094	3-4LF	A	1746	3	5	10	21	91	178
16	COC	1											
16	9# CANOLA												
17	SELECT	2	EC	.125	3-4LF	A	1994	0	4	0	20	91	178
17	COC	1											
17	9# CANOLA												
18	POAST	1.5	EC	.188	3-4LF	A	1620	0	4	3	20	86	176
18	COC	1											
18	9# CANOLA												
19	UNTREATED						1757	0	0	0	0	0	176
19	12# CANOLA												
20	SELECT	2	EC	.063	1-2LF	A	1524	3	8	6	90	98	178
20	COC	1											
20	12# CANOLA												
21	SELECT	2	EC	.094	1-2LF	A	1732	19	20	24	96	100	178
21	COC	1											
21	12# CANOLA												
22	SELECT	2	EC	.125	1-2LF	A	1632	6	13	5	93	100	177
22	COC	1											
22	12# CANOLA												
23	UNTREATED						1160	0	0	1	0	0	177
23	12# CANOLA												
24	SELECT	2	EC	.063	3-4LF	A	1534	3	15	13	44	89	177
24	COC	1											
24	12# CANOLA												

Montana State University

SELECT CANOLA STUDY

Project Code:93-SCS-R9 Location :KALSIPELL, MT R9
Cooperator :VALENT, LEONARD WELCH By:Bob Stougaard
All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	YIELD CANOLA LB/ACRE 9-29-93	CANOLA INJURY PERCENT 5-27-93	CANOLA INJURY PERCENT 6-3-93	CANOLA INJURY PERCENT 6-9-93	WILD OAT CONTROL PERCENT 6-3-93	WILD OAT CONTROL PERCENT 6-9-93	CANOLA 50%BLOOM JULIAN 6-25-93
25	SELECT	2	EC	.094	3-4LF	A	1771	0	3	5	0	85	177
25	COC	1											
25	12# CANOLA												
26	SELECT	2	EC	.125	3-4LF	A	1766	3	5	10	0	92	177
26	COC	1											
26	12# CANOLA												
27	POAST	1.5	EC	.188	3-4LF	A	1799	3	3	16	0	91	178
27	COC	1											
27	12# CANOLA												
LSD (.05) =							492	13	21	19	30	14	2
Standard Dev.=							348.190	9.35097	14.5158	13.1052	21.0496	10.2175	1.42100
CV =							20.73	201.98	183.36	157.79	52.35	13.88	0.80
Block F							15.766	1.257	2.210	5.586	15.358	5.936	4.457
Block Prob(F)							0.0001	0.2951	0.0935	0.0016	0.0001	0.0011	0.0061
Treatment F							1.642	1.753	1.121	0.962	14.627	56.938	0.886
Treatment Prob(F)							0.0492	0.0306	0.3402	0.5268	0.0001	0.0001	0.6253

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Montana State University

SELECT CANOLA STUDY

Project Code:93-SCS-R9 Location :KALSIPELL, MT R9
Cooperator :VALENT, LEONARD WELCH By:Bob Stougaard

Site Description

Crop: CANOLA Variety: IMC 01 Planting Date: 4-29-93
Planting Method: PRESSDRILL Rate, Unit: 6,9,12, #/A Depth, Unit: .5 , "
Perennial Age, Unit: , Row Spacing, Unit: 6 , "
Soil Temp., Unit: , Soil Moisture: GOOD Emergence Date:

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: STRIP PLOTS Seed Bed Desc.: Ground Cover: NONE
Tillage Type: VIBRA-SHANK Study Design: RCB
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC AND VIBRASHANK.
SEEDBED PREPARATION WITH BRILLION PACKER.

Soil Description

Texture: FINE SANDY LOAM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.8 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions: GOOD

Application Information

	A	B	C	D	E	F
Application Date:	5-19-93	5-28-93				
Time of Day:	10:00 AM	1:00 PM				
Application Method:	BACKPACK	BACKPACK				
Application Timing:	1-2 LF	POST				
Air Temp., Unit:	72 ,F	72 ,2	,	,	,	,
% Relative Humidity:	25	22				
Wind Velocity, Unit:	3 ,MPH	4 ,MPH	,	,	,	,
Dew Presence (Y/N):	N	N				
Water Hardness:	N	N				
Soil Temp., Unit:	68 ,F	66 ,F	,	,	,	,
Soil Moisture:	DRY TOP	GOOD				
% Cloud Cover:	0	0				

Weed Species	Weed Stage, Density at Application					
WILD OAT	1-2L,30	3-5L,25	,	,	,	,
WILD BUCKWHEAT	1-2L,1-5	3 LF,	,	,	,	,
FANWEED	6 LF,3-5	,	,	,	,	,
PIGWEED	4 LF,3-5	,	,	,	,	,
LAMBSQUARTER	4 LF,35	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKPACK	2	FLAT FAN	11002VS	14"	20"	10′	20	H20	20
B.	"									
C.										
D.										
E.										
F.										

Summary Comments:
Select provided excellent wild oat control at all rates and timings, however control tended to be more complete with the earlier applications. Canola tolerance appears to be very good, despite the injury ratings. The early season injury that was observed was a random event and due to herbicide contamination in the spray boom.

Although Select provided excellent control, yields did not vary much compared to the untreated controls. This may be due to the extremely high common lambsquarters pressure present. Although wild oat was successfully controlled, common lambsquarter was not and competition from it may have over shadowed any yield advantage afforded by controlling the wild oats.

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TREFLAN PLANTBACK STUDY

Project Code:TREFBACK Location :KALISPELL
Cooperator :FAY/DAVIS By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Form Ds	Rate	Grow Stg	Appl Code	W WHEAT PLOT YLD BU/A	SP WHEAT PLOT YLD BU/A	BARLEY PLOT YLD BU/A	OATS PLOT YLD BU/A
	Weed/Crop Code									
	Rating Data Type						PLOT	PLOT	PLOT	PLOT
	Rating Unit						BU/A	BU/A	BU/A	BU/A
	Rating Date						9-27-93	9-27-93	9-27-93	9-27-93
	Frt-Eval Interval						15MOPOST	15MOPOST	15MOPOST	15MOPOST
1	TREFLAN	4	EC	.75	PPI	A	75.4	28.2	25.3	49.6
2	TREFLAN	4	EC	1.0	PPI	A	86.0	45.1	40.7	75.3
3	TREFLAN	4	EC	1.5	PPI	A	58.1	23.7	24.9	44.7
4	CHECK						75.9	27.7	34.8	65.4
	LSD (.05) =						30.0	15.6	24.0	31.1
	Standard Dev.=						14.9964	7.80266	12.0154	15.5715
	CV =						20.31	25.03	38.25	26.51
	Block F						1.899	2.697	0.633	1.593
	Block Prob(F)						0.2296	0.1460	0.5632	0.2787
	Treatment F						1.789	4.447	1.228	2.463
	Treatment Prob(F)						0.2492	0.0572	0.3784	0.1601

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Montana State University
TREFLAN PLANTBACK STUDY

Project Code:TREFBACK Location :KALISPELL
Cooperator :FAY/DAVIS By:Bob Stougaard

Site Description

Crop: PLANTBACK CROPS Variety: VARIOUS Planting Date:
Planting Method: RESEARCH Rate, Unit: , Depth, Unit: ,
Perennial Age, Unit: , Row Spacing, Unit: 6 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date:

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 23.5 , FT Reps: 3
Site Type: Seed Bed Desc.: Ground Cover:
Tillage Type: Study Design: RCB
Field Preparation/Plot Maintenance: SITE TILLED ON 9/21 (KUBOTA ROTOTILLER)

Soil Description

Texture: FINE SANDY LOAM % OM: 4.2 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.7 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:						
Time of Day:						
Application Method:						
Application Timing:						
Air Temp., Unit:	,	,	,	,	,	,
% Relative Humidity:						
Wind Velocity, Unit:	,	,	,	,	,	,
Dew Presence (Y/N):						
Water Hardness:						
Soil Temp., Unit:	,	,	,	,	,	,
Soil Moisture:						
% Cloud Cover:						

Weed Species	Weed Stage, Density at Application					
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.										
B.										
C.										
D.										
E.										
F.										

Summary Comments: Test area was tilled on 9/21/92 using the Kubota rototiller. One pass per rep was then seeded with Winridge winter wheat. Area was left undisturbed until spring of 1993 when the following crops were seeded into the stale seedbed: Hi-Line spring wheat (60 lb/A), Gallatin spring barley (60 lb/A), Otana spring oats (60 lb/a), and Apollo alfalfa (10 pls/A).

In spring 1992 Treflan had been applied preplant incorporated at rates of 0.75, 1.00, and 1.50 lb/A. Canola was then seeded at 7 lb/A.

After crop removal and tillage winter wheat was seeded to the test area in the fall of 1992, and spring wheat, barley, and oats in the spring of 1993. Crop tolerance to Treflan residues was determined by measuring biomass production from 1 m length of row and by taking grain yields for each crop. No injury was observed at Kalispell. The extent to which rotational crops were injured appears to be a function of organic matter and clay content of the soil. At equivalent use rates, the potential for crop injury would be greatest on coarse textured, low organic matter soils.

Montana State University

ASSERT CARRYOVER POTENTIAL TO CANOLA

Project Code:93-WORR-R9 Location :KALISPELL, MT
Cooperator : By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	CANOLA YIELD LBS/A 9-22-93 424 DAT	CANOLA NO.PLTS PER 4' 6-10-93 412 DAT	CANOLA CROP INJ PERCENT 6-16-93 418 DAT
1	HOELON	3	EC	1	1WABE	A	1828	63.3	3.8
2	HOELON	3	EC	.5	1WABE	A	1689	54.3	2.5
3	HOELON	3	EC	.25	1WABE	A	1577	76.5	2.5
4	ASSERT	2.5	EC	.46	1WABE	A	1669	64.0	3.8
4	NIS	80	EC	.25	1WABE	A			
5	ASSERT	2.5	EC	.23	1WABE	A	1983	63.5	0.0
5	NIS	80	EC	.25	1WABE	A			
6	ASSERT	2.5	EC	.11	1WABE	A	1862	63.0	1.3
6	NIS	80	EC	.25	1WABE	A			
7	HOELON	3	EC	1	2WABE	A	1538	54.0	2.5
8	HOELON	3	EC	.5	2WABE	A	1982	56.0	3.8
9	HOELON	3	EC	.25	2WABE	A	1971	49.8	2.5
10	ASSERT	2.5	EC	.46	2WABE	A	2098	58.0	2.5
10	NIS	80	EC	.25	2WABE	A			
11	ASSERT	2.5	EC	.23	2WABE	A	2017	50.0	1.3
11	NIS	80	EC	.25	2WABE	A			
12	ASSERT	2.5	EC	.11	2WABE	A	1634	63.0	2.5
12	NIS	80	EC	.25	2WABE	A			
13	HOELON	3	EC	1	3WABE	A	2193	48.8	5.0
14	HOELON	3	EC	.5	3WABE	A	2000	48.3	0.0
15	HOELON	3	EC	.25	3WABE	A	1778	60.3	6.3
16	ASSERT	2.5	EC	.46	3WABE	A	2280	56.8	11.3
16	NIS	80	EC	.25	3WABE	A			
17	ASSERT	2.5	EC	.23	3WABE	A	1868	55.8	2.5
17	NIS	80	EC	.25	3WABE	A			
18	ASSERT	2.5	EC	.11	3WABE	A	1902	57.0	6.3
18	NIS	80	EC	.25	3WABE	A			

Montana State University

ASSERT CARRYOVER POTENTIAL TO CANOLA

Project Code:93-WORR-R9 Location :KALISPELL, MT
Cooperator : By:Bob Stougaard

All rates are specified as lb ai/A

Weed/Crop Code						CANOLA	CANOLA	CANOLA
Rating Data Type						YIELD	NO.PLTS	CROP INJ
Rating Unit						LBS/A	PER 4'	PERCENT
Rating Date						9-22-93	6-10-93	6-16-93
Trt-Eval Interval						424 DAT	412 DAT	418 DAT
Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code			
19	WEEDY CHECK						2111	62.0	3.8
20	NONTREATED						1815	59.0	3.8
LSD (.05)	=						532	20.1	8.2
Standard Dev.	=						375.844	14.2152	5.82832
CV	=						19.89	24.45	172.69
Block F							2.827	4.012	1.239
Block Prob(F)							0.0465	0.0117	0.3041
Treatment F							1.175	0.898	0.738
Treatment Prob(F)							0.3101	0.5868	0.7647

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Montana State University

REDUCED HERBICIDE RATES FOR WILD OAT CONTROL - 1993 CANOLA PLANTBACK

Project Code:93-WORR-R9 Location :KALISPELL, MT
Cooperator : By:Bob Stougaard

Site Description

Crop: CANOLA Variety: IMC 01 Planting Date: 5-4-93
Planting Method: DISC DRILL Rate, Unit: 6 , LB/A Depth, Unit: .5 , "
Perennial Age, Unit: , Row Spacing, Unit: 6 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date: 5-12-93

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: Seed Bed Desc.: Ground Cover: NONE
Tillage Type: Study Design: RCB
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC, VIBRA-SHANK AND PACKED PRIOR TO SEEDING

Soil Description

Texture: FINE SANDY LOAM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.7 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:						
Time of Day:						
Application Method:						
Application Timing:						
Air Temp., Unit:	,	,	,	,	,	,
% Relative Humidity:						
Wind Velocity, Unit:	,	,	,	,	,	,
Dew Presence (Y/N):						
Water Hardness:						
Soil Temp., Unit:	,	,	,	,	,	,
Soil Moisture:						
% Cloud Cover:						

Weed Species	Weed Stage, Density at Application					
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.										
B.										
C.										
D.										
E.										
F.										

Summary Comments: This study was established to determine the carryover potential of reduced rates of Assert to canola. Assert was applied at the 1X, 1/2X, and 1/4X use rates to wild oat infested spring barley during 1992. Similar Hoelon treatments were included as controls. Treatments were applied at either 1, 2, or 3 weeks after barley emergence. The following spring, a seedbed was prepared by discing and field cultivating. Canola was seeded at 6 lb/A on May 4, 1993. Percent crop injury ratings, canola plant population and yield were determined for each treatment. None of the herbicide treatments injured canola. Although this is only one year's worth of data, it appears that rotating to canola following an Assert application may be realistic in some situations.

Montana State University

PURSUIT CARRYOVER POTENTIAL TO CANOLA

Project Code:93-POL-R9 Location :KALISPELL, MT
Cooperator :AM CYANAMID By:Bob Stougaard

All rates are specified as lb ai/A

Trt No	Treatment Name	Form Amt	Fm Ds	Rate	Grow Stg	Appl Code	YIELD LBS/A	CANOLA # PLANTS 4FT ROW
	Weed/Crop Code							
	Rating Data Type							
	Rating Unit							
	Rating Date						9-22-93	6-10-93
1	PURSUIT	2	EC	.046	PRE	A	1992	47
2	PURSUIT	2	EC	.031	PRE	A	2121	50
3	PURSUIT	2	EC	.015	PRE	A	2161	44
4	PURSUIT	2	EC	.046	EPOST	A	1938	45
5	PURSUIT	2	EC	.031	EPOST	A	1951	44
6	PURSUIT	2	EC	.015	EPOST	A	1974	49
7	PURSUIT	2	EC	.046	LPOST	A	1797	38
8	PURSUIT	2	EC	.031	LPOST	A	2027	49
9	PURSUIT	2	EC	.015	LPOST	A	2045	45
10	SENCOR	75	DF	.38	PRE	A	2271	42
11	SENCOR	75	DF	.25	POST	A	2156	49
12	WEEDY CHECK						2045	50
13	NONTREATED						1748	47
	LSD (.05) =						411	15
	Standard Dev.=						284.321	10.5611
	CV =						14.09	23.00
	Block F						8.078	3.257
	Block Prob(F)						0.0003	0.0327
	Treatment F						1.034	0.432
	Treatment Prob(F)						0.4405	0.9394

1-27-94 SITE DESC. Page 1

Montana State University

PURSUIT CARRYOVER POTENTIAL ON LENTILS - 1993

Project Code:93-POL-R9 Location :KALISPELL, MT
Cooperator :AM CYANAMID By:Bob Stougaard

Site Description

Crop: LENTILS Variety: CHILEAN Planting Date:
Planting Method: PRESSDRILL Rate, Unit: 50 , LB/A Depth, Unit: .5 , "
Perennial Age, Unit: , Row Spacing, Unit: 6 , "
Soil Temp., Unit: , Soil Moisture: Emergence Date:

Plot Width/Area, Unit: 10 , FT Plot Length, Unit: 18.3 , FT Reps: 4
Site Type: STRIP PLOTS Seed Bed Desc.: Ground Cover: NONE
Tillage Type: VIBRA-SHANK Study Design: RCB
Field Preparation/Plot Maintenance: FALL PLOW, SPRING DISC AND VIBRA-SHANK CULTIVATION. BRILLION PACKER PRIOR TO SEEDING FOR SEEDBED PREPARATION

Soil Description

Texture: FINE SANDY LOAM % OM: 5.5 % Sand: 60 % Silt: 30 % Clay: 10
pH: 7.8 CEC: Soil Name: KALISPELL FSL Fertility Level:

Moisture Conditions

Moisture On:	Date	Amount	Unit	Type		Date	Amount	Unit	Type
1.					2.				
3.					4.				
5.					6.				
7.					8.				

Overall Moisture Conditions:

Application Information

	A	B	C	D	E	F
Application Date:						
Time of Day:						
Application Method:						
Application Timing:						
Air Temp., Unit:	,	,	,	,	,	,
% Relative Humidity:						
Wind Velocity, Unit:	,	,	,	,	,	,
Dew Presence (Y/N):						
Water Hardness:						
Soil Temp., Unit:	,	,	,	,	,	,
Soil Moisture:						
% Cloud Cover:						

Weed Species	Weed Stage, Density at Application					
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,
	,	,	,	,	,	,

Application Equipment

	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A.	BACKBACK	2	FLAT FAN	11002VS	14"	20"	10'	20	H20	20
B.										
C.										
D.										
E.										
F.										

Summary Comments: Pursuit had been applied at the 1X, 1/2X, and 1/4X use rates to lentils during 1992. The following spring, a seedbed was prepared by discing and field cultivating. Canola was seeded at 7 lb/A on May 4, 1993. Canola plant population and yield were determined for each treatment. None of the herbicides treatments injured canola. Although this is only one year's worth of data, it appears that rotating to canola following a Pursuit application may be realistic in some situations.

YEAR/PROJECT: 1993/755: INTRASTATE ALFALFA YIELD TRIALS - DRYLAND & IRRIGATED

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

From 1990 to 1993, alfalfa nurseries were established at Kalispell to compare forage production of varieties under both dryland and irrigated conditions. The varieties ranged from 1 (most dormant) to 6 in fall dormancy ratings and from susceptible to highly resistant to *Verticillium* wilt.

The trials were seeded at 10 lbs/acre in mid-April and fertilized with 176 lbs P_2O_5/acre in the establishment year. Sethoxydim was generally used for grass control and either bromoxynil or 2,4-DB was used for broadeaf control in the seeding year. If winter annuals (e.g. dandelions) became a problem, metribuzin was used for control. Experimental design was a randomized complete block with 4 replicates (3 in the 1990 irrigated trial).

The nurseries seeded in 1993 were harvested twice, the 1990-seeded irrigated trial was harvested three times and then plowed down, and the others were harvested 4 times (3 cuttings from June through August plus a fall cutting after growth had stopped in late September). We used an ALMACO plot harvester, set to leave a 3-inch stubble. The alfalfa was at the late vegetative through mid-bud stage when harvested.

Due to high crop year precipitation in 1993 (27.37 inches, compared to an average of 19.83 inches) no irrigation was used except during the establishment period for the 1993 seeding. The frost-free period in 1993 was 132 days (average - 112 days), with 1582 growing degree days (GDD) from May to October, 1993 (average - 1893 GDD). In this very wet growing season, forage yields on well drained dryland sites exceeded those for the irrigated sites.

1990 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – DRYLAND – 1993

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield Harv–1	Harv–2	Harv–3	Harv–4	Total
			t/a	*t/a*	*t/a*	*t/a*	*t/a*
5472	4	MR	2.68	1.14	1.38	0.94	6.13
Allegiance	3	R	2.73	1.09	1.35	0.92	6.09
DK 135	4	MR	2.77	1.00	1.27	0.82	5.87
DK 122	2	HR	2.75	0.93	1.26	0.87	5.81
Asset	4	R	2.67	0.98	1.27	0.89	5.81
Ultra	3	R	2.73	0.92	1.30	0.86	5.80
WL 317	3	R	2.66	0.99	1.26	0.84	5.75
5262	2	LR	2.78	1.00	1.20	0.70	5.69
Aggresor	4	R	2.61	0.96	1.23	0.86	5.65
Arrow	3	R	2.54	0.92	1.26	0.88	5.60
Mngrn–14	––	––	2.59	1.11	1.19	0.71	5.59
5364	4	MR	2.73	0.92	1.13	0.72	5.51
Multiplier	3	R	2.51	0.90	1.20	0.82	5.42
WL 225	2	R	2.53	0.88	1.19	0.74	5.34
Wilson	6	––	2.18	0.94	1.15	0.83	5.10
Ladak 65	1–2	S	2.58	0.75	1.02	0.53	4.88
Wrangler	2	LR	2.63	0.72	0.93	0.53	4.81
Husky	3	––	2.23	0.89	1.02	0.67	4.80
Runner	––	––	2.47	0.68	1.00	0.46	4.59
Spredor II	1	––	2.37	0.71	0.87	0.49	4.44
MEAN			2.59	0.92	1.17	0.75	5.44
LSD(0.05)			0.36	0.16	0.23	0.15	0.74
P–VALUE			0.04	0.00	0.00	0.00	0.00
CV(s/mean)			9.8	11.9	14.2	13.6	9.7

[1/] Fall dormancy rating
[2/] Vert wilt resistance

1st harvest – 6/1/93 – midbud
2nd harvest – 7/2/93 – vegetative
3rd harvest – 8/9/93 – late vegetative
4th harvest – 9/28/93 – mid bud

1990 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – DRYLAND

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield 1990 t/a	1991 t/a	1992 t/a	1993 t/a	Total t/a
DK 135	4	MR	3.08	6.99	5.98	5.87	21.92
5472	4	MR	3.07	6.68	5.95	6.13	21.83
Asset	4	R	3.27	6.52	5.74	5.81	21.34
Allegiance	3	R	3.06	6.24	5.80	6.09	21.19
Mngrn–14	––	––	2.88	6.59	6.11	5.59	21.17
Ultra	3	R	3.18	6.65	5.32	5.81	20.96
DK 122	2	HR	3.07	6.54	5.49	5.81	20.91
Arrow	3	R	3.10	6.35	5.84	5.60	20.89
5364	4	MR	3.00	6.75	5.58	5.51	20.84
WL 317	3	R	2.87	6.26	5.54	5.75	20.42
5262	2	LR	3.01	6.23	5.38	5.69	20.31
Multiplier	3	R	3.28	6.30	5.06	5.42	20.06
WL 225	2	R	3.10	6.16	5.45	5.34	20.05
Aggresor	4	R	2.97	5.74	5.17	5.65	19.53
Husky	3	––	3.31	6.00	4.99	4.80	19.10
Ladak 65	1–2	S	2.88	5.66	5.19	4.89	18.62
Spredor II	1	––	3.09	5.95	5.08	4.45	18.57
Wrangler	2	LR	2.52	5.92	5.09	4.82	18.35
Wilson	6	––	2.33	5.47	5.41	5.10	18.31
Runner	––	––	2.74	5.16	4.33	4.59	16.82
MEAN			2.99	6.21	5.43	5.44	20.06
LSD(0.05)			0.40	0.94	1.03	0.74	2.69
P–VALUE			0.00	0.03	0.26	0.00	0.01
CV(s/mean)			9.5	10.7	13.3	9.7	9.1

Seeding date: 4/18/90

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

1990 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED – 1993

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield Harv–1	Harv–2	Harv–3	Total
			t/a	*t/a*	*t/a*	t/a
5472	4	MR	3.32	1.13	0.97	5.43
WL 317	3	R	3.08	1.04	1.09	5.21
Ultra	3	R	3.25	0.92	1.02	5.19
DK 135	4	MR	3.24	0.97	0.95	5.16
Multiplier	3	R	3.30	0.91	0.92	5.14
Allegiance	3	R	3.17	0.99	0.93	5.09
DK 122	2	HR	3.17	0.88	0.92	4.97
Arrow	3	R	3.08	0.90	0.95	4.93
5364	4	MR	3.32	0.87	0.74	4.92
Aggresor	4	R	2.86	0.88	0.90	4.64
Asset	4	R	2.83	0.90	0.88	4.60
5262	2	LR	3.13	0.78	0.67	4.57
Mngrn–14	––	––	2.97	0.92	0.62	4.51
Ladak 65	1–2	S	3.19	0.70	0.62	4.51
Wrangler	2	LR	3.18	0.65	0.65	4.47
WL 225	2	R	2.71	0.76	0.86	4.33
Runner	––	––	2.98	0.64	0.57	4.19
Wilson	6	––	2.15	0.88	0.85	3.89
Husky	3	––	2.61	0.68	0.58	3.88
Spredor II	1	––	2.84	0.54	0.41	3.78
MEAN			3.02	0.85	0.80	4.67
LSD(0.05)			0.38	0.14	0.12	0.55
P–VALUE			0.00	0.00	0.00	0.00
CV(s/mean)			7.6	10.0	9.2	7.1

[1/]Fall dormancy rating
[2/]Vert wilt resistance

Harvest–1: 6/4/93 – midbud
Harvest–2: 7/6/93 – early bud
Harvest–3: 8/10/93 – early bud

1990 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield 1990 t/a	1991 t/a	1992 t/a	1993 t/a	TOTAL t/a
Ultra	3	R	4.88	8.12	5.83	5.19	24.01
Multiplier	3	R	4.68	8.20	5.83	5.14	23.84
5472	4	MR	4.22	8.09	6.03	5.43	23.76
DK 135	4	MR	4.42	8.11	6.02	5.16	23.71
DK 122	2	HR	4.41	7.98	5.74	4.97	23.09
Asset	4	R	4.45	7.99	6.02	4.60	23.06
Allegiance	3	R	3.85	7.89	6.04	5.09	22.88
5364	4	MR	4.21	7.89	5.81	4.92	22.84
WL 317	3	R	4.12	7.54	5.92	5.20	22.79
Arrow	3	R	4.16	7.54	5.69	4.93	22.32
5262	2	LR	3.98	7.67	5.79	4.57	22.01
Mngrn–14	--	--	3.54	7.92	5.80	4.51	21.77
Husky	3	--	4.30	7.73	5.57	3.87	21.47
Aggresor	4	R	3.91	7.31	5.52	4.64	21.38
WL 225	2	R	4.43	7.23	5.38	4.34	21.37
Wrangler	2	LR	3.54	6.80	5.52	4.47	20.33
Ladak 65	1–2	S	3.55	6.60	5.42	4.51	20.08
Runner	--	--	3.67	6.52	5.31	4.19	19.69
Spredor II	1	--	3.86	6.95	5.08	3.78	19.67
Wilson	6	--	3.21	7.05	5.34	3.88	19.49
MEAN			4.07	7.56	5.68	4.67	21.98
LSD(0.05)			0.32	0.40	0.55	0.55	1.35
P–VALUE			0.00	0.00	0.01	0.00	0.00
CV(s/mean)			4.8	3.2	5.8	7.1	3.4

Seeding date: 4/18/90

[1/]Fall dormancy rating
[2/]Vert wilt resistance

1991 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – DRYLAND – 1993

VARIETY	FD[1]	VD[2/]	Dry Matter Yield HARV–1	HARV–2	HARV–3	HARV–4	TOTAL
			t/a	*t/a*	*t/a*	*t/a*	*t/a*
More	––	––	3.04	1.28	1.36	1.32	7.00
Magnum III	4	MR	2.90	1.40	1.40	1.29	6.98
Ultra	3	R	3.06	1.18	1.30	1.23	6.77
Columbo	3	HR	2.79	1.27	1.34	1.35	6.74
W90–VSX	––	––	2.98	1.25	1.29	1.21	6.72
2841	3	R	2.88	1.19	1.26	1.20	6.53
5364	4	MR	2.69	1.25	1.25	1.23	6.42
Eclipse	3	R	2.94	1.14	1.17	1.13	6.38
Viking 1	2	HR	2.78	1.15	1.23	1.20	6.36
Multiking	3	R	2.61	1.29	1.26	1.18	6.34
Legacy	4	R	2.76	1.14	1.21	1.21	6.33
2833	3	R	2.64	1.17	1.24	1.26	6.30
Perry	3	––	2.82	1.11	1.19	1.13	6.25
5246	3	R	2.66	1.19	1.24	1.14	6.24
UN–72	––	––	2.75	1.11	1.17	1.20	6.24
Webfoot	3	––	2.55	1.19	1.24	1.15	6.13
Riley	4	LR	2.79	1.04	1.15	1.14	6.11
5262	2	LR	2.75	1.15	1.19	1.01	6.10
Alfagraze	2	––	2.69	1.07	1.19	1.09	6.03
Ladak–65	1–2	S	2.81	1.06	1.17	0.91	5.94
Barrier	––	––	2.63	1.03	1.22	1.02	5.90
Vernal	2	––	2.66	1.03	1.15	0.97	5.79
VSA 9096	––	––	2.59	1.04	1.12	0.99	5.74
MEAN			2.77	1.16	1.23	1.15	6.32
LSD(0.05)			0.33	0.14	0.16	0.15	0.67
P–VALUE			0.13	0.00	0.07	0.00	0.01
CV(s/mean)			8.5	8.7	9.1	9.5	7.5

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

Harvest–1: 6/2/93 – early bud
Harvest–2: 7/2/93 – vegetative
Harvest–3: 8/9/93 – early bud
Harvest–4: 9/27/93 – mid bud

1991 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – DRYLAND

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield 1991	1992	1993	TOTAL
			t/a	*t/a*	*t/a*	*t/a*
Magnum III	4	MR	2.90	5.76	6.98	15.64
Ultra	3	R	3.11	5.71	6.77	15.59
More	--	--	2.65	5.25	7.00	14.90
Columbo	3	HR	2.63	5.45	6.74	14.82
W90–VSX	--	--	2.56	5.25	6.72	14.53
5364	4	MR	2.53	5.51	6.42	14.46
Viking 1	2	HR	2.84	5.25	6.36	14.45
Multiking 1	3	R	2.87	5.18	6.34	14.39
2841	3	R	2.64	5.08	6.53	14.25
Eclipse	3	R	2.49	5.31	6.38	14.18
Legacy	4	R	2.62	5.04	6.33	13.99
UN–72	--	--	2.62	5.02	6.24	13.88
Ladak–65	1–2	S	2.36	5.51	5.94	13.81
2833	3	R	2.62	4.95	6.24	13.80
Perry	3	--	2.32	5.24	6.24	13.80
Webfoot	3	--	2.64	4.86	6.14	13.64
Riley	4	LR	2.19	5.18	6.11	13.48
5246	3	R	2.67	4.56	6.24	13.48
Vernal	2	--	2.33	4.83	5.80	12.96
5262	2	LR	2.34	4.51	6.11	12.96
Barrier	--	--	2.44	4.40	5.89	12.73
Alfagraze	2	--	2.40	4.21	6.03	12.64
VS 9096	--	--	2.55	4.34	5.74	12.63
MEAN			2.58	5.06	6.32	13.96
LSD(0.05)			0.30	0.98	0.67	1.87
P–VALUE			0.00	0.09	0.01	0.01
CV(s/mean)			8.2	13.7	7.5	8.3

Seeding date: 4/26/91

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

1991 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED – 1993

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield Harv–1	Harv–2	Harv–3	Harv–4	Total
			t/a	*t/a*	*t/a*	*t/a*	*t/a*
Magnum III	4	MR	2.75	1.44	1.35	0.66	6.19
5364	4	MR	2.78	1.32	1.23	0.69	6.01
Viking 1	2	HR	2.63	1.23	1.19	0.69	5.73
Columbo	3	HR	2.55	1.24	1.19	0.67	5.65
Ultra	3	R	2.43	1.25	1.18	0.69	5.54
5246	3	R	2.74	1.17	1.06	0.56	5.53
Legacy	4	R	2.57	1.14	1.13	0.68	5.52
Multiking	3	R	2.44	1.28	1.20	0.59	5.51
UN–72	––	––	2.68	1.10	1.09	0.63	5.50
5262	2	LR	2.70	1.18	1.05	0.50	5.42
More	––	––	2.69	1.13	1.00	0.59	5.41
W90–VSX	––	––	2.67	1.11	1.02	0.59	5.37
Eclipse	3	R	2.60	1.09	1.04	0.63	5.36
VS 9096	––	––	2.63	1.12	1.03	0.50	5.27
2841	3	R	2.55	1.11	0.98	0.60	5.24
Alfagraze	2	––	2.65	1.06	1.01	0.47	5.18
Webfoot	3	––	2.51	1.15	1.04	0.45	5.15
2833	3	R	2.31	1.06	1.02	0.57	4.95
Riley	4	LR	2.49	0.98	0.94	0.44	4.84
Perry	3	––	2.58	0.97	0.90	0.39	4.83
Barrier	––	––	2.47	0.95	0.92	0.45	4.78
Vernal	2	––	2.45	1.03	0.93	0.36	4.77
Ladak 65	1–2	S	2.56	0.85	0.82	0.27	4.50
MEAN			2.58	1.13	1.06	0.55	5.32
LSD(0.05)			0.22	0.13	0.15	0.12	0.47
P–VALUE			0.00	0.00	0.00	0.00	0.00
CV(s/mean)			6.0	8.3	10.3	14.9	6.3

[1/]Fall dormancy rating
[2/]Vert wilt resistance

Harvest–1: 6/3/93 – bud
Harvest–2: 7/8/93 – vegetative
Harvest–3: 8/10/93 – early bud
Harvest–4: 9/27/93 – mid bud

1991 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield 1991 t/a	1992 t/a	1993 t/a	TOTAL t/a
Magnum III	4	MR	3.37	7.38	6.19	16.94
5364	4	MR	3.47	7.32	6.01	16.80
Legacy	4	R	3.78	7.34	5.53	16.64
Viking 1	2	HR	3.69	6.90	5.73	16.32
Columbo	3	HR	3.61	6.96	5.65	16.22
More	--	--	3.89	6.83	5.40	16.12
W90–VSX	--	--	3.69	7.00	5.37	16.06
Ultra	3	R	3.87	6.77	5.55	16.19
UN–72	--	--	3.77	6.80	5.50	16.07
VS 9096	--	--	3.66	6.91	5.28	15.84
5246	3	R	3.44	6.78	5.53	15.75
2841	3	R	3.51	6.90	5.24	15.65
5262	2	LR	3.25	6.95	5.42	15.63
2833	3	R	3.80	6.69	4.95	15.44
Multiking	3	R	3.14	6.72	5.51	15.36
Alfagraze	2	--	3.43	6.68	5.19	15.30
Eclipse	3	R	3.43	6.53	5.35	15.31
Perry	3	--	3.35	6.75	4.83	14.92
Webfoot	3	--	3.33	6.49	5.15	14.97
Riley	4	LR	3.33	6.45	4.84	14.62
Barrier	--	--	3.32	6.35	4.78	14.47
Vernal	2	--	3.01	6.37	4.77	13.72
Ladak–65	1–2	S	2.81	5.94	4.50	13.24
MEAN			3.47	6.77	5.31	15.55
LSD(0.05)			0.36	0.43	0.47	1.07
P–VALUE			0.00	0.00	0.00	0.00
CV(s/mean)			7.4	4.5	6.3	4.3

Seeding date: 5/17/91

[1/]Fall dormancy rating
[2/]Vert wilt resistance

1992 INTRASTATE ALFALFA TRIAL
KALISPELL – DRYLAND – 1993

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield HARV–1	HARV–2	HARV–3	HARV–4	TOTAL
			t/a	*t/a*	*t/a*	*t/a*	*t/a*
4J19	––	––	3.17	1.19	1.35	1.06	6.77
Achieva	3	R	3.05	1.17	1.42	1.08	6.72
WL 323	4	R	3.08	1.15	1.38	1.08	6.69
Guardsman	––	––	3.07	1.23	1.33	1.02	6.64
Benchmark	3	R	3.17	1.01	1.18	1.15	6.52
PGI 3212	––	––	2.99	1.05	1.32	1.01	6.38
5454	4	MR	2.74	1.29	1.33	1.01	6.36
Webfoot MPR	3	––	3.03	1.01	1.27	0.98	6.29
Milkmaker II	2	––	2.91	1.14	1.31	0.92	6.27
5246	3	R	2.80	1.09	1.35	0.94	6.17
Arrow	3	R	2.87	1.06	1.30	0.92	6.15
MBS 2131	––	––	2.65	1.18	1.25	0.97	6.04
WL 322HQ	4	R	2.55	1.14	1.31	1.02	6.03
Crown II	3	R	2.94	0.86	1.23	0.98	6.01
Profit	2	R	2.82	1.02	1.18	0.98	6.00
DK 133	4	R	2.58	1.07	1.29	1.04	5.97
ABI 9143	––	––	2.62	1.15	1.22	0.93	5.92
Class	3	R	2.61	0.88	1.32	0.94	5.75
Riley	4	LR	2.71	0.77	1.34	0.83	5.65
AP 8950	––	––	2.36	1.06	1.26	0.93	5.62
5364	4	MR	2.42	0.96	1.31	0.93	5.61
Perry	3	––	2.31	0.77	1.17	0.75	5.00
WI 9125	––	––	2.32	0.52	1.37	0.68	4.89
Wisfall	––	––	2.86	0.22	1.26	0.52	4.87
Ladak 65	1	––	2.52	0.59	1.16	0.56	4.83
MEAN			2.77	0.98	1.29	0.93	5.97
LSD(0.05)			0.45	0.16	0.21	0.13	0.74
P–VALUE			0.00	0.00	0.74	0.00	0.00
CV(s/mean)			11.5	11.7	11.9	10.2	8.8

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

1st harvest – 6/2/93 – midbud
2nd harvest – 7/2/93 – vegetative
3rd harvest – 8/9/93 – early bud
4th harvest – 9/28/93 – mid bud

1992 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – DRYLAND – 1993

VARIETY	FD[1/]	VW[2/]	---Dry Matter Yield--- 1992 t/a	1993 t/a	TOTAL t/a
Benchmark	3	R	4.01	6.52	10.53
Achieva	3	R	3.48	6.72	10.20
4J19	–	–	3.13	6.77	9.89
WL 323	4	R	3.03	6.69	9.72
Guardsman	–	–	2.99	6.64	9.63
Webfoot MPR	3	–	3.29	6.29	9.58
PGI 3212	–	–	3.01	6.38	9.39
DK 133	4	R	3.41	5.97	9.38
ARROW	3	R	3.20	6.15	9.35
5454	4	MR	2.89	6.36	9.26
MILKMAKER II	2	– –	2.91	6.27	9.17
MBS 2131	–	–	3.02	6.04	9.06
WL 322HQ	4	R	2.94	6.03	8.97
5246	3	R	2.78	6.17	8.95
PROFIT	2	R	2.91	6.00	8.91
ABI 9143	–	–	2.91	5.92	8.82
CROWN II	3	R	2.74	6.01	8.75
AP 8950	–	–	2.90	5.62	8.52
CLASS	3	R	2.68	5.75	8.43
RILEY	4	LR	2.57	5.65	8.22
5364	4	MR	2.49	5.61	8.10
PERRY	3	– –	2.48	5.00	7.48
LADAK 65	1	– –	2.29	4.83	7.11
WI 9125	–	–	1.93	4.89	6.82
WISFALL	–	–	1.86	4.87	6.72
MEAN			2.87	5.97	8.84
LSD(0.05)			0.70	0.74	1.24
P–VALUE			0.00	0.00	0.00
CV (s/mean)			17.2	8.8	9.9

Seeding date: 4/23/92

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

1992 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED – 1993

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield Harv–1	Harv–2	Harv–3	Harv–4	Total
			t/a	*t/a*	*t/a*	*t/a*	*t/a*
5454	4	MR	2.39	1.04	0.87	0.73	5.03
DK 133	4	R	2.37	0.92	0.85	0.80	4.94
5364	4	MR	2.43	0.97	0.82	0.70	4.92
Achieva	3	R	2.40	0.90	0.83	0.74	4.87
Class	3	R	2.39	0.93	0.81	0.72	4.85
Benchmark	3	R	2.35	0.89	0.80	0.78	4.82
4J19	––	––	2.21	1.05	0.85	0.69	4.79
Guardsman	––	––	2.24	1.01	0.84	0.69	4.79
Webfoot MPR	3	––	2.38	0.91	0.82	0.65	4.76
WL 323	4	R	2.36	0.91	0.82	0.65	4.74
Crown II	3	R	2.37	0.82	0.81	0.72	4.71
PGI 3212	––	––	2.03	1.00	0.90	0.71	4.65
5246	3	R	2.20	0.96	0.84	0.63	4.63
Arrow	3	R	2.19	0.92	0.82	0.68	4.61
AP 8950	––	––	2.02	0.99	0.88	0.69	4.58
MBS 2131	––	––	1.87	1.09	0.92	0.70	4.58
ABI 9143	––	––	2.03	0.92	0.83	0.64	4.41
Milkmaker II	2	––	2.22	0.86	0.77	0.53	4.38
Profit	2	R	2.05	0.87	0.84	0.59	4.36
WL 322HQ	4	R	1.80	0.94	0.86	0.71	4.32
Perry	3	––	2.17	0.77	0.76	0.58	4.29
Riley	4	LR	2.20	0.67	0.69	0.47	4.03
WI 9125	––	––	2.18	0.58	0.65	0.55	3.95
Ladak 65	1	––	2.09	0.58	0.67	0.34	3.68
Wisfall	––	––	2.21	0.22	0.74	0.34	3.50
MEAN			2.21	0.87	0.81	0.64	4.53
LSD(0.05)			0.12	0.08	0.07	0.08	0.26
P–VALUE			0.00	0.00	0.00	0.00	0.00
CV(s/mean)			4.0	6.4	6.0	9.2	4.0

[1/]Fall dormancy rating
[2/]Vert wilt resistance

Harvest–1: 6/3/93 – early bud
Harvest–2: 7/6/93 – early bud
Harvest–3: 8/10/93 – early bud
Harvest–4: 9/29/93 – early bud

1992 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED

VARIETY	FD[1/]	VW[2/]	Dry Matter Yield 1992	Dry Matter Yield 1993	Dry Matter Yield TOTAL
			t/a	*t/a*	*t/a*
Achieva	3	R	4.99	4.87	9.85
DK 133	4	R	4.84	4.94	9.77
Class	3	R	4.87	4.85	9.72
Benchmark	3	R	4.81	4.82	9.63
Crown II	3	R	4.89	4.71	9.60
Webfoot MPR	3	– –	4.79	4.76	9.55
4J19	– –	– –	4.71	4.79	9.50
WL 323	4	R	4.66	4.74	9.39
5364	4	MR	4.45	4.92	9.37
PGI 3212	– –	– –	4.69	4.65	9.33
5454	4	MR	4.24	5.03	9.27
Guardsman	– –	– –	4.39	4.79	9.18
Arrow	3	R	4.46	4.61	9.08
MBS 2131	– –	– –	4.41	4.58	8.98
AP 8950	– –	– –	4.31	4.58	8.89
Perry	3	– –	4.59	4.29	8.88
5246	3	R	4.07	4.63	8.70
ABI 9143	– –	– –	4.21	4.41	8.62
WI 9125	– –	– –	4.67	3.95	8.62
Milkmaker II	2	– –	4.16	4.38	8.54
Profit	2	R	4.15	4.36	8.50
WL 322HQ	4	R	4.00	4.32	8.32
Riley	4	LR	4.17	4.02	8.19
Ladak 65	1	– –	4.01	3.68	7.69
Wisfall	– –	– –	4.04	3.50	7.54
MEAN			4.46	4.53	8.99
LSD(0.05)			0.28	0.26	0.43
P–VALUE			0.00	0.00	0.00
CV(s/mean)			4.4	4.0	3.4

Seeding date: 4/24/92

[1/]Fall dormancy rating
[2/]Vert wilt resistance

1993 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – DRYLAND

VARIETY	FD[1/]	VW[2/]	---Dry Matter Yield--- Harv–1	Harv–2	TOTAL
			t/a	*t/a*	*t/a*
W6040	--	--	1.14	1.56	2.69
ICI 631	--	--	1.09	1.54	2.63
AS–K94	--	--	1.06	1.57	2.63
Venture	--	--	1.07	1.56	2.63
WISYN–C	--	--	1.01	1.61	2.61
Dawn	--	--	1.08	1.50	2.58
Vernema	4	MR	1.06	1.51	2.56
AP 8950	--	--	1.01	1.52	2.53
Apollo Supreme	4	R	1.04	1.48	2.52
ABI 9143	--	--	1.01	1.48	2.49
5454	4	MR	0.94	1.54	2.47
Dominator	--	--	0.98	1.49	2.47
Profit	2	R	0.99	1.45	2.43
Dart	3	R	0.94	1.49	2.43
5364	4	MR	0.94	1.44	2.38
Perry	3	--	0.88	1.31	2.19
Wrangler	2	LR	0.82	1.26	2.08
Spredor 3	--	--	0.87	1.16	2.02
Ladak 65	1	--	0.82	1.13	1.94
MEAN			0.99	1.45	2.44
LSD(0.05)			0.17	0.16	0.31
P–VALUE			0.01	0.00	0.00
CV(s/mean)			12.2	7.8	8.9

Seeding date: 4/22/93

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

1st harvest – 7/29/93 – late bud
2nd harvest – 9/23/93 – mid bud

1993 INTRASTATE ALFALFA YIELD TRIAL
KALISPELL – IRRIGATED – 1993

VARIETY	FD[1/]	VW[2/]	----Dry Matter Yield---- Harv–1	Harv–2	Total
			t/a	*t/a*	t/a
AS–K94	--	--	1.83	1.92	3.74
Vernema	4	MR	1.65	1.83	3.48
ICI 631	--	--	1.66	1.73	3.39
W6040	--	--	1.66	1.72	3.38
AP 8950	--	--	1.57	1.80	3.38
Venture	--	--	1.59	1.77	3.36
Profit	2	R	1.60	1.70	3.30
WISYN–C	--	--	1.53	1.72	3.24
ABI 9143	--	--	1.54	1.70	3.24
Dart	3	R	1.49	1.72	3.21
Dawn	--	--	1.50	1.70	3.20
5364	4	MR	1.52	1.62	3.14
Apollo Supreme	4	R	1.48	1.59	3.07
Wrangler	2	LR	1.51	1.55	3.06
5454	4	MR	1.46	1.60	3.06
Dominator	--	--	1.42	1.63	3.05
Perry	3	--	1.46	1.57	3.03
Ladak 65	1	--	1.54	1.33	2.87
Spredor 3	--	--	1.47	1.40	2.87
MEAN			1.55	1.66	3.21
LSD(0.05)			0.15	0.15	0.28
P–VALUE			0.00	0.00	0.00
CV(s/mean)			6.9	6.3	6.1

Seeding date: 4/22/93

[1/]Fall dormancy rating
[2/]Vert wilt resistance

1st harvest – 7/29/93 – late bud
2nd harvest – 9/23/93 – mid bud

YEAR/PROJECT: 1993/755 ALFALFA POPULATION DENSITY STUDY

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

On 5/20/93, 'Arrow' and 'LegenDairy' alfalfas were seeded in a randomized 2 x 4 x 3 factorial design. Factors included the 2 varieties, 4 seeding rates (7-, 12-, 17-, and 22-lbs/acre), and 3 spacing arrangements (6-inch rows, 12-inch rows, and broadcast). The area was fertilized with 44 lbs N/a and 208 lbs P_2O_5/a the previous fall. Poast was applied at 1.5 lb product/a on 6/10/93 for grass control. Stand counts were taken on 6/14 by counting the number of seedlings within a 1-foot square randomly placed within the plot. Occupancy was measured on 6/17 by counting the squares containing seedlings in a 2- x 20-inch grid, randomly placed. Prior to the first harvest on 7/29, visual vigor ratings were made and 6-inch sections of each plot were sampled for NIRS quality analyses. Quality samples were taken again before the 9/24 harvest.

Many new plantings of alfalfa are being made with custom air seeders that broadcast the alfalfa seed. We wanted to determine if our current seeding rate recommendation (7 lbs PLS/a) would change when broadcasting as compared to seeding in rows.

Stands were similar for cultivar. Number of plants per square foot increased as seeding rate increased from 7 to 22 lbs/a. Broadcasting increased stands by 38% as compared to seeding in 6- and 12-inch rows. Total forage yields were greater for LegenDairy than for Arrow. Increasing the seeding rate did not increase first year total forage yields. Broadcasting alfalfa seed produced more forage (3.65 t/a) than 6-inch spacing (3.42 t/a), which in turn produced more alfalfa forage than 12-inch spacing (3.01 t/a).

ALFALFA POPULATION DENSITY STUDY

KALISPELL, 1993

6" = 6–inch spacing
12" = 12–inch spacing
B = broadcast

STAND (pl/ft^2)

Seeding Rate (PLS/a)	'LegenDairy' 6"	'LegenDairy' 12"	'LegenDairy' B	'Arrow' 6"	'Arrow' 12"	'Arrow' B
7	23	42	47	32	33	46
12	52	47	70	53	53	71
17	43	54	77	61	55	81
22	63	67	99	71	75	86

Cultivar means:

LegenDairy	Arrow
57	60

NS

Seeding Rate (lbs/a) means:

7	12	17	22
37	58	62	77

LSD(0.05) = 10 **

Spacing means:

6"	12"	Brcast
50	53	72

LSD(0.05) = 8 **

Interactions – NS

% OCCUPANCY

Seeding Rate (PLS/a)	'LegenDairy' 6"	'LegenDairy' 12"	'LegenDairy' B	'Arrow' 6"	'Arrow' 12"	'Arrow' B
7	71	89	65	80	81	58
12	83	92	75	89	91	81
17	88	97	88	91	95	86
22	85	96	87	94	94	87

Cultivar means:

LegenDairy	Arrow
85	85.5

NS

Seeding Rate (lbs/a) means:

7	12	17	22
74	85	91	90

LSD(0.05) = 4 **

Spacing means:

6"	12"	Brcast
85	92	78

LSD(0.05) = 3 **

Interactions:
Cultivar x spacing – LSD(0.05) = 8
Rate x spacing – LSD(0.05) = 7

VIGOR (0–5)

Seeding Rate (PLS/a)	'LegenDairy' 6"	'LegenDairy' 12"	'LegenDairy' B	'Arrow' 6"	'Arrow' 12"	'Arrow' B
7	2.8	3.0	3.5	3.3	2.8	2.5
12	2.8	3.8	4.3	3.8	3.8	4.0
17	3.8	3.5	4.8	3.5	3.3	4.5
22	3.8	4.0	4.5	4.0	3.0	4.5

Cultivar means:

LegenDairy	Arrow
3.7	3.6

NS

Seeding Rate (lbs/a) means:

7	12	17	22
3.0	3.7	3.9	4.0

LSD(0.05) = 0.5 **

Spacing means:

6"	12"	Brcast
3.4	3.4	4.1

LSD(0.05) = 0.4 **

Interactions: NS

ALFALFA POPULATION DENSITY STUDY

KALISPELL, 1993

FIRST HARVEST YIELD (tons/acre)

6" = 6–inch spacing
12" = 12–inch spacing
B = broadcast

Seeding Rate (PLS/a)	'LegenDairy' 6"	'LegenDairy' 12"	'LegenDairy' B	'Arrow' 6"	'Arrow' 12"	'Arrow' B
7	0.96	0.71	1.15	0.91	0.51	0.80
12	0.68	0.87	1.23	1.02	0.76	1.06
17	1.30	0.85	1.40	1.06	0.73	0.86
22	0.86	0.91	1.42	0.89	0.61	1.26

Cultivar means:

LegenDairy	Arrow
1.03	0.87

LSD(0.05) = 0.11 **

Seeding Rate (lbs/a) means:

7	12	17	22
0.84	0.93	1.03	0.99

LSD(0.05) = 0.16
P–VALUE = 0.09

Spacing means:

6"	12"	Brcast
0.96	0.74	1.15

LSD(0.05) = 0.14 **

Interaction:
Cultivar x spacing – LSD(0.05) = 0.61
(P=0.07)

SECOND HARVEST YIELD (tons/acre)

Seeding Rate (PLS/a)	'LegenDairy' 6"	'LegenDairy' 12"	'LegenDairy' B	'Arrow' 6"	'Arrow' 12"	'Arrow' B
7	2.57	2.42	2.57	2.58	2.33	2.47
12	2.34	2.23	2.47	2.46	2.25	2.50
17	2.52	2.24	2.57	2.48	2.31	2.62
22	2.39	2.20	2.33	2.33	2.19	2.53

Cultivar means:

LegenDairy	Arrow
2.40	2.42

NS

Seeding Rate (lbs/a) means:

7	12	17	22
2.49	2.38	2.46	2.33

LSD(0.05) = 0.08 **

Spacing means:

6"	12"	Brcast
2.46	2.27	2.51

LSD(0.05) = 0.07 **

Interactions: NS

TOTAL YIELD (tons/acre)

Seeding Rate (PLS/a)	'LegenDairy' 6"	'LegenDairy' 12"	'LegenDairy' B	'Arrow' 6"	'Arrow' 12"	'Arrow' B
7	3.53	3.13	3.72	3.48	2.83	3.27
12	3.02	3.10	3.70	3.48	3.01	3.56
17	3.82	3.09	3.97	3.54	3.04	3.48
22	3.24	3.11	3.75	3.21	2.80	3.78

Cultivar means:

LegenDairy	Arrow
3.43	3.29

LSD(0.05) = 0.14 *

Seeding Rate (lbs/a) means:

7	12	17	22
3.33	3.31	3.49	3.31

Main effect: NS

Spacing means:

6"	12"	Brcast
3.42	3.01	3.65

LSD(0.05) = 0.17 **

Interactions: NS

YEAR/PROJECT: 1993/755 Perennial Forage Grass Trial - Irrigated

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

Two new varieties of meadow bromegrass ('Paddock' and 'Fleet'), three varieties of perennial ryegrass ('Greenstone', 'Dairymaster', and 'Zero Nui'), and 'Matua' prairie grass were seeded on April 28, 1993 and harvested on July 29 and again on September 23. Phosphorus fertilizer (180 lbs P_2O_5/a) was incorporated in fall of 1992, and 80 lbs nitrogen/a was applied post emergence on June 14, 1993.

The cool, wet growing season was very favorable for grass growth in 1993. Forage yields of seeding-year perennial grasses ranged from 3.0 to 6.8 t/a. Matua prairie grass topped the nursery, followed closely by the perennial ryegrasses. These grasses as a group yielded over 2 t/a more the bromegrasses; however, we do not know if the ryegrasses or Matua will survive a Montana winter.

Paddock and Fleet meadow bromegrass yielded over 1 t/a more forage then 'Regar' bromegrass. The two new varieties were selected for improved seed production over Regar. It appears that the two new varieties are not only better seed producers, but also better forage producers.

Samples are currently being analyzed for quality (CP, ADF, NDF).

SPECIES	VARIETY	STAND ESTAB %	VIGOR 6/25 ---(0-5)---	VIGOR 7/27 ---(0-5)---	DRY MATTER YIELD 7/29 ----tons/acre----	DRY MATTER YIELD 9/23 ----tons/acre----	DRY MATTER YIELD Total ----tons/acre----	spring 94 vigor
Prairie grass	Matua	81	2.8	4.3	3.14	3.66	6.81	—
Perennial rye	Greenstone	100	5.0	3.8	3.52	3.27	6.78	Good
Perennial rye	Dairymaster	99	5.0	4.3	3.26	3.36	6.62	Fair-Mod
Perennial rye	Zero Nui	98	4.8	4.5	3.32	3.02	6.33	" "
Meadow brome	Paddock	94	3.3	4.0	2.50	2.49	4.99	
Meadow brome	Fleet	95	3.3	4.5	2.37	2.50	4.87	
Meadow brome	Regar	88	1.5	4.0	1.19	2.51	3.70	
Mountain brome	CO8005308	93	3.0	3.3	1.60	2.03	3.63	
Pub. wheatgr.	Greenleaf	89	2.0	2.5	0.87	2.21	3.08	
Int. wheatgr.	Oahe	86	1.5	2.3	0.72	2.32	3.04	
MEAN		92	3.2	3.7	2.25	2.74	4.98	
LSD(0.05)		5	0.6	1.6	0.41	0.44	0.64	
P-VALUE		0.00	0.00	0.05	0.00	0.00	0.00	
CV(s/mean)		3.7	12.3	29.2	12.6	11.1	8.9	

Irrigation: 1" on 5/14, 8/5 and 8/13

YEAR/PROJECT: 1993/755 Short Duration Perennial Grass Study - Irrigated

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
Cooperators: Dr. Ray Ditterline, MSU Bozeman, Dave Wichman, CARC

On April 18, 1989, Reed canarygrass (RCG), 'Garrison' creeping foxtail (GCF), 'Regar' meadow bromegrass (RMB), 'Potomac' orchardgrass (PO), and 'Linn' perennial ryegrass (LPR) were seeded in a silty clay loam soil at Kalispell. The following fertilizer applications were made over the life of the experiment:

Summer, 1989 - 68 lbs N/acre
10/24/89 - 132 lbs P_2O_5/acre
10/25/89 - 136 lbs N/acre
Summer, 1990 - 68 lbs N/acre
4/12/91 - 90 lbs N/a + 110 lbs P_2O_5/acre
3/24/92 - 90 lbs N/acre
4/9/93 - 80 lbs N/acre

For the past three years (1990, 1991, 1992), the five grass species have been subjected to very intensive grazing management to simulate pressures in a short duration grazing system. One-third (33%) and one half (50%) of available forage was removed every 7 and 14 days (7/33, 7/50, 14/33, 14/50) starting in early May and continuing until mid-September. A "graduated" treatment (Grad), which began with weekly cuttings and increased to 14-day and 28-day cuttings was included. These intensive practices were compared to a check treatment in which each species was cut to 3 inches every 28-30 days. The design was a split plot with species as whole plots and harvest treatments as subplots. Harvesting was done with an ALMACO plot harvester with adjustible cutting height.

In 1993, all treatments for all species were cut to a 3-inch height on the same date (June 17, 1993) to determine effects of the three previous years' management on plant vigor. Forage samples from each plot were separated by species to determine stand integrity. Percent original species was used to calculate species yield from total dry weight yield from each plot. Differences among species means, harvest treatment means, and the interaction between the two effects were highly significant. Plant vigor and forage yields of Reed canarygrass and Linn perennial ryegrass were substantially lower than other species in 1993, indicating that these two species are less adapted to intensive grazing than Regar, Potomac and Garrison. Removing 33 and 50% of topgrowth every 7 days for three years generally reduced spring growth in 1993 compared to the check (30-day clipping interval). However, removing 33% and 50% of topgrowth every 14 days or gradually decreasing the frequency as the season progressed (Grad) actually increased plant vigor and forage yields in 1993 compared to the check treatment.

Results from this research indicate that intensive management

of pastures (33-50% removal of forage every 14 days), may distribute forage more evenly throughout the grazing season as well as have less negative impact on plant vigor.

SHORT DURATION GRAZING STUDY - KALISPELL, MT - 1993

1993 SPECIES YIELDS (one cutting)

	Species					
Harvest Treatment	RCG	GCF	RMB	PO	LPR	means
	t/a					
7/33	0.42	2.75	2.88	2.09	0.37	1.70
7/50	0.71	2.25	2.07	1.89	0.28	1.44
14/33	0.43	3.32	3.91	4.02	0.28	2.39
14/50	0.31	3.21	2.96	3.24	1.02	2.15
Grad	0.61	3.27	3.56	3.42	0.38	2.24
Check	0.70	2.53	2.81	3.07	0.29	1.88
means	0.53	2.89	3.03	2.95	0.44	

LSD(0.05) - species means = 0.56**
- harvest management means = 0.28**
- interaction = 0.85**

YEAR/PROJECT: 1993/755 CEREAL FORAGE TRIAL - DRYLAND

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

Oat and barley varieties were planted on April 29 at 36 lbs/a for the oats and 51 lbs/a for the barley and emerged May 10. No fertilizer was applied to the nursery since alfalfa was plowed under in fall of 1992. The plots were harvested for forage at the early-milk growth stage in July. 'Stampede' oats produced 4.55 t/a, 0.89 t/a more then 'Monida' oats and 1.16 t/a more forage than 'Otana' oats. 'Westford' barley produced 4.04 t/a, 0.71 t/a more than 'Haybet' barley. 'Horsford' barley produced the least amount of forage (2.64 t/a) of all cereal forages.

VARIETY	STAND %	HEADING date	HEIGHT inches	HARVEST date	YIELD t/a
Stampede oats	93	>7/8	42	7/29	4.55
Westford barley	90	7/7	46	7/29	4.04
Magnum oats	94	6/29	51	7/23	3.74
Monida oats	94	7/2	47	7/23	3.66
Otana oats	91	7/3	50	7/23	3.39
Haybet barley	96	6/28	45	7/19	3.33
MT910208 barley	94	6/26	42	7/16	3.20
MT910207 barley	95	6/26	42	7/19	3.17
MT910103 barley	95	6/26	40	7/16	3.15
Horsford barley	93	6/27	45	7/16	2.64
LSD(0.05)	4		3		0.35
P-VALUE	0.08		0.00		0.00
CV(s/mean)	2.9		3.9		7.0

PROJECT TITLE: Intrastate Spring Barley Evaluation

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Tom Blake/Pat Hensleigh, Plant and Soil Science,
Bozeman, MT.

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

RESULTS: Yields were extremely high as a result of the excessive amounts of rain received during the season. Barley that resisted lodging and was not susceptible to diseases yielded well above the average for this location. Steptoe had the highest yield at 153.9 bu/A although the test weight was extremely low (40.4 lb/bu). The average yield for the nursery was 127.4 bu/A while the mean test weight was 46.1 lb/bu. Most varieties, although yielding well above average, were poor in test weight as well as other characteristics (plumpness and color) . Test weights ranged from 40.4 to 48.7 lb/bu. The cool, wet growing season was not only reflected in the late heading dates but also the delayed harvest date. Late tillering also complicated and delayed harvest in the majority of barley varieties. Lodging was severe in the majority of plots.

FUTURE PLANS: Variety evaluations will continue to be conducted at the Northwestern Agricultural Research Center in 1994.

Table 1. Agronomic data from the Interstate Spring Barley Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT.
Planted: May 3, 1993 Harvested: September 17, 1993

CI Number	VARIETY	YIELD BU/A	TEST WT LB/BU	PERCENT PLUMP	HEADING DATE	HEIGHT INCHES	LODGING INDEX 1/
CI 15229	Steptoe	153.88	40.43	89.00	181.33	39.37	29.07
MN 52	Excel	150.60	45.10	94.00	184.67	40.03	.00
20140523	MT140523 HR20	146.45	47.00	92.00	185.67	36.75	51.93
WPB92 1	Medallion	145.95	43.27	87.00	188.00	33.46	.00
DA587170	WPB DA 587-170	145.88	42.87	92.00	190.00	29.53	.00
MT900176	Steptoe/Robust	145.76	42.73	96.00	183.00	37.40	3.70
H5870120	Lindy/Martin (MT87	143.50	42.17	93.00	181.00	38.06	23.33
ND 9866	Stark	142.48	47.97	95.00	184.33	42.65	29.47
MT890128	Steptoe/Robust	141.15	42.40	94.00	183.00	36.09	16.67
H5860219	Lewis/Apex (MT8602	141.09	47.03	93.00	187.00	40.03	24.47
MT890008	Fleet/Bowman	137.96	44.37	85.00	190.33	39.37	22.60
CI 15478	Klages	137.50	45.20	87.00	189.33	43.31	47.87
H6860756	Gallatin/Bellona (	137.42	48.50	91.00	186.00	38.06	.00
C16	Coors C16	137.31	48.53	95.00	188.00	41.99	.00
MT910024	Bowman/MT 81143	136.76	47.37	97.00	183.67	42.65	55.00
12140523	MT140523 HR 12	136.37	47.13	92.00	185.33	37.40	56.90
MT900071	Hector/Bowman	136.28	47.03	93.00	186.67	43.96	26.10
MT910046	Bowman/MT 83592	136.18	47.03	91.00	180.67	40.03	22.23
MT140523	Hector/Klages	135.98	47.17	93.00	186.67	40.03	22.63
2B885133	BA 2B88-5133	135.85	47.60	97.00	182.33	40.68	1.87
NS 78054	Baronesse	135.53	47.37	96.00	186.33	36.09	.00
MT910160	MT 81619/Bowman	135.13	48.23	97.00	188.67	39.37	.00
CI 15856	Lewis	133.59	48.20	95.00	184.67	41.34	30.20
MT851195	MT41918/TR450	132.98	46.90	93.00	185.00	38.06	16.67
MT890070	MT47219/Bowman	132.90	46.43	87.00	182.00	39.37	23.13
BA 1202	BA 1202	132.53	46.97	94.00	187.67	39.37	.00
H3860224	Lewis/Apex (MT8602	131.40	47.63	92.00	187.00	34.78	.00
BU585-82	WPB BU 585-82	131.29	43.27	97.00	188.33	28.22	.00
H1851195	MT41918/TR450 (MT8	130.57	46.40	94.00	184.00	41.99	33.90
21140523	MT140523 HR21	129.51	46.17	94.00	185.00	38.71	69.77
H2860224	Lewis/Apex (MT8602	129.40	47.37	95.00	186.33	39.37	1.47
MT910187	MT140523/Menuet	129.25	48.00	93.00	184.67	37.40	20.73
MT910176	MT 83491/Bowman	128.94	46.87	93.00	184.67	38.71	9.27
MT910032	Bowman/MT 81619	127.94	46.23	84.00	183.67	33.46	16.67
MT851032	Harrington/Clark	127.55	46.67	93.00	187.33	39.37	53.97
H5851161	MT 41918/MT 41279(	127.40	47.10	88.00	186.33	40.68	38.60
MT886610	MT 81143/Lewis	126.73	46.80	90.00	186.67	40.03	20.73
MT900111	Menuet/Bowman	125.69	47.73	96.00	182.33	38.71	6.50
MT861596	Lewis/MT 41549	124.36	48.73	90.00	187.00	40.03	20.73
MT910167	MT 83424/Fleet	123.14	46.90	70.00	188.33	31.50	.00
BA 1215	2B82-8529 (BA 852	122.60	47.40	97.00	186.33	36.75	2.77
MT910150	MT 81143/MT 83444	122.60	48.47	94.00	184.00	38.71	.00
863829H7	Princesse/Regatta	122.19	44.23	86.00	190.33	26.90	.00
MT 81161	Lewis//Kgs/Smt	121.97	47.50	95.00	185.33	38.71	38.90
MT860756	Gallatin/Bellona	121.62	47.57	93.00	184.33	37.40	.00

Cont'd

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

CI Number	VARIETY	YIELD BU/A	TEST WT LB/BU	PERCENT PLUMP	HEADING DATE	HEIGHT INCHES	LODGING INDEX 1
MT910170	MT 83424/MT138575	120.06	44.47	86.00	188.00	36.09	86.80
SK 76333	Harrington	119.48	44.53	83.00	188.67	40.03	61.73
C14	Coors C14	118.72	47.83	93.00	181.00	32.15	.00
MT 83435	Clark/TR450	118.13	46.30	90.00	184.67	40.03	51.37
MT910173	MT 83424/MT81616	118.02	44.97	87.00	188.33	40.68	45.93
MT889106	Apex/Lewis	116.06	46.97	91.00	182.00	41.34	41.23
H6851032	Harrington/Clark(M	116.02	46.47	92.00	187.00	41.34	82.33
PI483127	Russell	115.52	41.77	81.00	180.33	36.75	.00
H881161	MT 81161 -HR8	115.15	46.37	90.00	183.33	36.09	17.60
H3851032	Harrington/Clark(M	115.15	46.13	92.00	188.00	41.99	44.17
H1281161	MT 81161-HR12	114.13	46.83	94.00	183.33	36.75	35.57
BZ588335	WPB BZ 588-335	114.11	40.47	90.00	187.00	24.93	.00
H1381161	MT 81161-HR13	112.42	46.17	90.00	183.33	37.40	5.03
C93 1	Galena	108.98	45.60	85.00	191.33	34.12	1.87
PI491534	Gallatin	106.29	46.97	91.00	187.00	39.37	13.33
C93 2	IdaGold	106.10	43.03	66.00	190.67	31.50	14.80
CI 15514	Hector	103.08	45.07	85.00	187.33	41.34	72.03
MT890018	Gallatin/Apex	102.49	47.13	90.00	186.67	34.12	39.27
BZ489-29	WPB BZ 489-29	81.71	46.77	80.00	192.00	26.90	.00
EXPERIMENTAL MEANS		127.39	46.09	.00	185.83	37.64	22.67
LSD (0.05)		17.25	7.75	.00	1.98	2.89	34.56

1/ Lodging Index = lodging prevalence X lodging severity divided by 9.

PROJECT TITLE: Early Yield Spring Barley Evaluation - Screening of early generation spring barley selections.

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Tom Blake/Pat Hensleigh, Plant and Soil Science,
Bozeman, MT.

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

RESULTS: Yields were extremely high as a result of the excessive amounts of rain received during the season. Barley that resisted lodging diseases yielded well above the average for this location. Steptoe had the highest yield at 168.4 bu/A, although the test weight was extremely low (40.5 lb/bu). The average yield for the nursery was 112.1 bu/A while the mean test weight was 44.4 lb/bu. Most varieties, although yielding well above average, were poor in test weight as well as other characteristics (plumpness and color) . Test weights ranged from 38.9 to 49.1 lb/bu. The cool, wet growing season was not only reflected in the late heading dates but also the delayed harvest date. Late tillering also complicated and delayed harvest in the majority of barley varieties. Lodging was severe in the majority of plots.

FUTURE PLANS: Disease resistant varieties will continue to be evaluated at Kalispell through cooperative regional variety trials.

Table 1. Agronomic data from the Early Yield Spring Barley Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT.
Planted: April 16, 1993 Harvested: September 9, 1993

CI Number	VARIETY	YIELD BU/A	TEST WT LB/BU	% PLUMP	HEADING DATE	HEIGHT INCHES	LODGING INDEX 1/
CI 15229	Steptoe	168.37	40.47	86.00	178.00	36.09	43.33
MT920041	MT 81143/MT 81161	145.67	49.00	96.00	171.33	36.75	.00
MT920161	MT 83424/MT 81161	144.90	48.20	89.00	172.33	37.40	3.33
MT920207	MT 83435/MT 81502	144.27	49.10	95.00	173.00	34.78	31.83
MT920073	MT 81161/MT 83518	141.83	46.97	88.00	171.67	36.09	50.37
MT920027	Heartland/ID910719	140.50	42.30	93.00	168.33	34.12	.00
MT920074	MT 81161/MT 83518	130.87	47.97	91.00	173.00	36.75	23.70
MT920163	MT 83424/MT 81161	129.37	48.07	93.00	174.00	39.37	27.03
MT920072	MT 81161/MT 83518	129.00	48.20	93.00	172.67	37.40	7.80
MT920021	Harrington/MT 83518	128.73	47.03	95.00	177.00	38.06	29.80
MT920071	MT 81161/MT 83518	127.90	47.03	88.00	172.33	36.75	27.60
MT920201	MT 83435/MT 81161	127.40	48.10	84.00	174.67	40.03	14.80
MT920174	MT 83424/MT140523	127.30	43.90	71.00	172.33	39.37	52.37
MT920129	MT 83422/MT 81143	127.03	47.43	85.00	175.67	35.43	30.37
MT920167	MT140523/MT 83435	126.27	44.57	76.00	173.00	37.40	52.77
MT920146	MT 83424/Elrose	125.03	47.23	96.00	176.33	34.12	35.53
MT920053	MT 81143/MT140523	124.03	46.20	92.00	173.33	37.40	42.97
MT920070	MT 81161/MT 83518	121.13	46.67	75.00	173.00	38.71	49.07
MT140523	Hector/Klages	121.00	46.10	95.00	173.00	36.75	42.57
MT920200	MT 83435/MT 81161	120.37	45.23	76.00	174.33	39.37	37.40
MT920234	MT 83491/MT 81161	119.57	44.70	79.00	175.00	39.37	49.27
MT920112	MT 81502/MT140523	119.40	46.97	93.00	174.67	36.75	43.87
MT920164	MT 83424/MT 81502	118.90	47.00	97.00	172.33	37.40	38.87
MT920178	MT 83424/ND 7691	118.77	43.43	67.00	175.67	36.09	51.87
MT920024	Harrington/MT 83592	118.77	43.40	69.00	175.33	37.40	45.93
MT920208	MT 83435/MT 81502	118.57	43.43	77.00	173.33	37.40	60.73
MT920057	MT 81143/VD403582	118.37	45.30	75.00	173.67	40.03	53.70
MT920064	MT 81161/MT 83422	118.37	47.20	88.00	175.33	37.40	39.27
MT920059	MT 81143/VD403582	118.03	46.80	77.00	175.00	40.03	42.60
MT920022	Harrington/MT 83592	115.47	46.33	79.00	177.00	38.06	33.33
MT920095	MT 81502/Gallatin	114.50	44.53	64.00	171.00	35.43	55.57
MT920068	MT 81161/MT 83422	112.60	43.87	82.00	172.33	41.34	57.03
MT920234	MT 83491/MT 81161	111.30	46.80	84.00	172.67	37.40	58.30
MT920069	MT 81161/MT 83422	109.83	44.50	74.00	173.00	36.09	56.63
MT920113	MT 81502/MT140523	108.93	44.73	76.00	173.67	38.06	57.03
MT920045	MT 81143/MT 81161	108.93	45.97	88.00	170.67	36.75	11.87
MT920162	MT 83424/MT 81161	108.77	43.33	79.00	172.33	37.40	49.27
MT920015	Elrose/MT 83518	107.50	44.13	73.00	175.33	36.75	59.23
MT920166	MT140523/MT 83435	107.27	42.10	59.00	176.00	37.40	62.57
MT920097	MT 81502/Gallatin	107.03	43.77	68.00	172.00	36.75	50.17
MT920223	MT 83444/MT 81502	105.37	44.77	81.00	172.00	36.09	69.63
MT920238	MT 83592/MT 83422	104.53	42.50	56.00	171.67	36.75	46.27
MT920211	MT 83435/MT 81502	104.27	43.80	69.00	175.33	37.40	68.13
MT920154	MT 83424/Harrington	103.70	43.83	70.00	175.33	37.40	49.67

Cont'd

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

CI Number	VARIETY	YIELD BU/A	TEST WT LB/BU	% PLUMP	HEADING DATE	HEIGHT INCHES	LODGING INDEX 1/
MT920096	MT 81502/Gallatin	103.27	42.57	56.00	172.33	37.40	60.73
SK 76333	Harrington	101.30	43.20	83.00	176.33	38.06	53.70
MT920062	MT 81161/MT 83422	100.67	43.30	70.00	174.00	36.75	59.80
MT920189	MT 83435/Clark	100.53	43.37	60.00	176.67	40.68	57.40
MT920047	MT 81143/MT 81161	100.27	46.03	91.00	171.33	36.09	27.40
MT920212	MT 83444/MT 81502	99.30	42.33	69.00	174.00	38.06	80.80
MT920099	MT 81502/Gallatin	97.17	43.70	85.00	171.67	38.06	36.70
MT920049	MT 81143/MT140523	96.50	43.87	81.00	170.67	37.40	63.33
CI 15514	Hector	95.83	43.40	65.00	173.33	40.03	66.10
MT920109	MT 81502/MT140523	94.53	44.73	73.00	174.00	37.40	69.27
MT910208	Gallatin/Awnless Betzes	91.57	39.53	52.00	170.67	41.99	22.80
MT920101	MT 81502/Gallatin	89.20	41.13	70.00	171.67	38.06	78.20
AZ90 123	Washonupana/MT 83424	88.87	44.60	42.00	170.33	34.12	84.33
MT920249	MT140523/MT 81161	86.27	40.17	73.00	173.00	36.75	75.20
MT920115	MT 83422/Lamont	85.53	41.57	71.00	174.33	38.71	65.17
CI 16569	Haybet	84.70	38.43	39.00	172.33	39.37	60.90
MTSU 247	Shonkin	81.63	40.07	38.00	177.00	38.06	75.53
MT910103	Gallatin/Awnless Betzes	79.90	39.73	53.00	168.33	39.37	10.00
MT910207	Gallatin/Awnless Betzes	76.53	38.90	41.00	170.00	39.37	53.33
MT920196	MT 83435/MT 81143	73.87	39.87	62.00	174.67	38.06	73.70
EXPERIMENTAL MEANS		112.14	44.43	.00	173.39	37.61	46.68
LSD (0.05)		21.97	2.55	.00	3.67	2.50	25.81

1/ Lodging Index = lodging prevalence X lodging severity divided by 9.

PROJECT TITLE: Uniform Northwestern Oat Nursery

YEAR/PROJECT: 1993/756

INVESTIGATORS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Tom Blake/Pat Hensleigh, Plant and Soil Science,
Bozeman, MT

OBJECTIVE: Evaluation of new and introduced oat varieties for yield and disease resistance in Montana.

RESULTS: Abundant rains during the summer insured heavy yields for oat varieties this year and was apparent in six varieties that yielded above 200 bushel per acre. All varieties yielded well with the nursery average being 188.8 bu/A. Test weights were good considering that the majority of the nursery had lodged as heads were beginning to fill. The highest test weight was recorded in the variety Hytest (37.23 lb/bu). Troy, Calibre and Otana had the highest test weight among the more familiar entries. Heading was delayed this year due to a cool, wet growing season. Lodging was moderate to severe in all varieties except Robert, Ajay, Ogle and Valley.

FUTURE PLANS: There are plans for continued evaluation of new and introduced lines of oat in Montana by growing the Uniform Oat Nursery.

Table 1. Agronomic data from the Statewide Uniform Oat Nursery grown on the Northwestern Agricultural Center, Kalispell, MT.
Planted: May 13, 1993 Harvested: September 30, 1993

CI or STATE #	Variety	YIELD BU/A	TEST WT LB/BU	HEADING DATE	HEIGHT INCHES	LODGING INDEX 1/
W 82056	Robert	236.91	35.70	190.67	51.18	.00
CI483126	Monida	228.63	35.73	188.67	49.87	45.97
CI467882	Border	222.57	33.47	189.00	48.56	45.57
82AB1142	Ajay	210.28	35.87	188.00	38.06	.00
CI 9401	Ogle	205.47	33.60	180.00	45.28	.00
ND820603	Valley	200.52	35.20	186.00	49.87	2.60
OT 308	Calibre	198.13	36.93	188.33	57.09	69.47
CI 8263	Cayuse	197.21	33.07	187.67	49.87	79.47
CI 9297	Appaloosa	192.38	33.80	190.33	48.56	74.47
CI 9252	Otana	191.74	36.37	187.00	53.81	74.90
W 80474	Riel	179.20	35.97	187.00	53.15	86.90
NEWDAK	Newdak	176.50	33.73	180.00	50.52	60.73
PI548769	Troy	173.97	37.50	184.67	55.12	33.00
CI 6611	Park	171.77	33.97	184.33	54.46	72.47
81AB5792	Rio Grande	171.22	33.50	185.33	45.28	78.13
DERBY	Derby	166.13	35.97	185.67	56.43	92.67
SD820045	Settler	163.88	35.17	181.00	52.49	86.90
HYTEST	Hytest	111.51	37.23	181.33	53.81	92.67
EXPERIMENTAL MEANS		188.78	35.15	185.83	50.74	55.33
LSD (0.05)		39.79	2.11	1.83	2.19	43.63

1/ Lodging Index = prevalence X lodging severity divided by 9.

PROJECT TITLE: Western Regional Spring Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Luther Talbert/Susan Lanning, Plant and Soil Science,
Bozeman, MT.

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

RESULTS: Spring wheat maturity was delayed until late summer by cool, wet environmental conditions that persisted through most of July. Both yields and test weights were reduced, and heading dates were much later than normal. The average yield was 62.06 bu/A, compared to 81 bu/A last year. Kauz "s" and Penawawa were the high yielding varieties with 92.6 and 92.1 bu/A respectively. The test weight average for the nursery was 48.86 lb/bu with the high test weight of 57.7 lb/bu from the variety Kauz "s". Heading was very late in comparison to previous years. The mean heading date was July 3rd. Slight incidences of scab and leaf rust were present at the end of the growing season.

FUTURE PLANS: There are plans for continued evaluation of new and introduced lines of spring wheat in Montana by growing the Western Regional Spring Wheat Nursery.

Table 1. Agronomic data from the Western Regional Spring Wheat nursery grown on the Northwestern Agricultural Research Center.
Planted: May 3, 1993 Harvested: September 28, 1993

VARIETY		YIELD BU/A	TEST WT LB/BU	HEADING DATE	HEIGHT INCHES
OR386306	KAUZ 'S'	92.59	57.50	183.67	34.78
PI495916	PENAWAWA	92.14	53.10	184.67	35.43
OR487255	TAN.S/PEW.S	89.42	55.67	180.33	35.43
UT 1708	UT77W1054-1777/MCKAY	84.49	49.40	186.67	38.71
OR488189	BJY.S/4/TZPP//IRN46/	83.84	52.80	184.67	31.50
ID 452	VANDAL/3/WA6291/PROD	80.48	49.93	190.67	34.78
UT 1723	UT77W1054-1777/MCKAY	79.19	49.60	188.33	38.71
ID 377S	GALLO-YR'S'/AU X KAL	76.68	49.30	180.33	35.43
UT 1117	UT78S116-2746/906R	74.71	51.17	186.33	34.12
WA 7715	K74182/POTAM 70,SEL.	73.26	51.03	183.33	36.75
SUNDER02	SUNSTAR 2	71.71	54.30	180.67	31.50
OR487374	CORVALLIS SEL.487037	70.66	51.27	180.33	25.59
WA 7183	WAKANZ	69.59	49.77	191.33	34.12
WA 7176	K78504/K74129-33//K7	69.46	49.10	187.00	34.78
WA 7677	K80184/K7905769	67.93	50.37	185.67	34.12
UT 1711	UT77W1054-1777/MCKAY	67.07	50.93	187.67	36.75
WA 7712	K82382/K82407	66.78	48.57	183.67	38.71
CI 17903	MCKAY	66.61	48.57	186.67	34.78
ID 429	ID182/FIELDWIN	62.37	52.20	178.67	34.12
FM 5702	NW CONSORTIUM,FM0057	60.56	50.53	177.67	24.28
FM 8631	NW CONSORTIUM,FM0086	59.97	50.33	177.67	24.93
ID 439	ID203/ID166//906R	59.24	48.53	183.33	32.15
ML 42	SEL. ML 42	58.42	49.13	187.67	34.12
ID 440	ID130/MAYA74-PVN'S'/	57.26	46.87	181.00	34.12
OR487410	CORVALLIS SEL.487041	51.84	50.03	185.00	32.81
SDM 405	CENTENIAL 2*/FIELDWI	50.78	46.77	182.67	33.46
UC 638	SERRA	48.53	48.13	181.00	31.50
NKF 8022	KLASIC	48.46	49.63	177.00	25.59
ID 441	OWENS/4/FDR/MENG//81	48.04	45.33	180.33	32.15
UT850646	UT77W1054-1777/906R	46.92	47.60	184.00	43.31
SDM 406	CENTENIAL 2*/FIELDWI	46.72	46.10	182.00	32.81
UT 1597	WYNNE/UT78S166-2746	45.55	47.43	189.33	36.09
ID 392	OWENS/ID159	42.52	44.07	188.67	36.09
ID 448	A771084S-B/ID246	40.55	43.50	188.67	34.12
OR895224	CORVALLIS SEL.489522	38.82	45.10	188.00	32.15
ID 408	ID232/A75120S-2214-1	29.19	38.37	185.67	31.50
CI 4734	FEDERATION	23.95	35.90	190.00	45.28
EXPERIMENTAL MEANS		62.06	48.86	184.33	33.96
LSD (0.05)		15.27	1.36	1.48	6.20

PROJECT TITLE: Advanced Yield Spring Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Luther Talbert/Susan Lanning, Plant and Soil Science,
Bozeman, MT.

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

RESULTS: Spring wheat maturity was delayed until late summer by cool, wet environmental conditions that persisted through most of July. Both yields and test weights were reduced, and heading dates were much later than normal. The average yield was 67.6 bu/A, compared to 90 bu/A last year. Two Montana entries (MT 9265 and MT 9266) were the high yielding varieties with 99.7 and 94.7 bu/A respectively. The test weight average for the nursery was 52.47 lb/bu with the high test weight of 56.5 lb/bu from the variety MT 9221. As noted, heading dates were very late in comparison to previous years. The mean heading date was July 3rd. Slight incidences of scab and leaf rust were present at the end of the growing season.

FUTURE PLANS: There are plans for continued evaluation of new and introduced lines of spring wheat in Montana by growing the Advanced Yield Spring Wheat Nursery.

Table 1. Agronomic data from the Advanced Yield Spring Wheat Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT.
Planted: May 3, 1993 Harvested: September 28, 1993

CI Number	VARIETY	YIELD BU/A	TEST WT LB/BU	HEADING DATE	HEIGHT INCHES
MT 9265	MT8452/MN73167	99.70	54.13	185.00	38.06
MT 9266	MT8452/MN73167	94.69	55.27	182.67	34.12
WA 6920	PENAWAWA	89.88	53.77	183.33	34.78
ND 606	AMIDON	87.71	50.40	184.33	40.68
ND 582	STOA	81.49	52.73	184.33	42.65
MT 8849	RS6880/MT7819	80.14	52.87	186.33	38.06
MT 9234	MN70181/OLAF//MAYA/MT7634	79.43	54.23	184.33	34.12
MT 9257	MT7810/MT8402	79.26	55.53	181.67	34.78
MT 9260	MT7810/MT8180/3/NK715//BW	78.48	55.57	185.33	34.12
CI 17429	LEW	76.38	55.93	188.67	43.31
MT 9254	MT7819/MT8354	75.02	51.60	185.67	38.71
MT 9222	SHASHI/PONDERA/NEWANA//MA	74.13	54.10	180.00	37.40
CI 15930	OLAF	73.48	54.43	185.33	35.43
MT 9242	CI15838/MT7418//PONDERA/M	72.85	55.03	184.33	36.09
WBEXPRES	WESTBRED EXPRESS	72.47	53.27	185.67	29.53
CI 13596	FORTUNA	72.22	54.37	184.33	42.65
MT 9154	BW574//NEWANA/FORTUNA	71.90	54.50	185.00	42.65
MT 9203	CROW'S'/61502	71.40	54.10	180.33	42.65
CI 17904	OWENS	70.33	48.17	182.33	33.46
BZ684-23	BZ684-23	70.17	49.07	186.00	34.78
WB 926	WESTBRED 926	69.73	53.00	178.33	32.81
C982-324	RAMBO	68.74	53.23	185.67	34.78
MT 9262	MT8177/3/MT808//LEW/81TAU	68.39	54.93	183.67	32.81
MT 9153	BW574//NEWANA/FORTUNA	68.33	51.27	182.33	34.78
MT 9158	MEXSEL2315/LEADER	66.70	49.53	183.33	32.81
FA982220	FA 982-220	65.41	51.07	186.67	32.81
MT 9232	MT8421/MT8450	64.93	52.50	180.00	34.78
MT 9217	RS7055/MT7736//CI15838/MT	64.91	54.23	184.33	34.12
CI 17430	NEWANA	64.36	52.30	187.67	33.46
CI 17828	PONDERA	63.95	53.83	183.00	35.43
MT 9233	MT8421/MT8438	63.29	49.77	185.33	38.06
MT 9221	MT8411//SU73/LEW	62.41	56.50	185.67	40.03
MT 9253	RS6508/LEW/4/BUTTE//MT781	61.57	53.83	178.33	31.50
PI483235	GLENMAN	60.63	51.73	186.67	37.40
MT 9157	BW574//NEWANA/FORTUNA	59.62	51.67	187.33	45.28
CI 17790	LEN	59.40	51.30	184.67	35.43
MT 9248	LEW/OLAF//MT8336	59.09	52.37	188.67	38.06
PI486139	KLASIC	57.63	50.73	177.00	25.59
MT 9212	MT8402/ALEX	57.54	53.03	177.33	36.09
MT 9229	MT8416/MT8456	57.48	51.63	180.67	32.15
MT 9206	MT7926//LEW/81TAU1328	57.32	49.13	186.00	40.68
MT 9215	MT8406/MT8302	57.29	47.90	181.33	40.68
ND CUT	CUTLESS	56.67	52.53	182.00	36.09
CI 10003	THATCHER	55.91	53.03	187.67	47.90
MT 8402	HI-LINE	55.87	51.40	182.00	34.12
TR983239	TR 983-239	55.22	51.67	180.67	31.50
MT 9209	MEXSEL2315/MT7736//MT747/	54.41	50.77	183.67	39.37
BZ984326	WPB BZ 984-326	49.46	50.20	180.33	32.81
PH986-61	WESTBRED 936	35.14	47.00	177.33	29.53
EXPERIMENTAL MEANS		67.60	52.47	183.52	36.30
LSD (0.05)		9.65	1.58	2.18	2.33

PROJECT TITLE: Western Regional Hard Red Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Phil Bruckner/Rhoda Burrows, Plant and Soil Science,
Bozeman, MT.

OBJECTIVE: To evaluate hard red winter wheats for adaptability, yield, quality, and disease resistance.

RESULTS: Winter kill was less severe in the hard red winter wheats although was evidenced in all varieties to some degree. Yields were reduced from long term averages due to environmental conditions in both winter and summer as well as foliar diseases. The average yield was 65.2 bu/A with the low yield being 37.2 bu/A (UT 303) and the highest 118.6 bu/A (OR 870834). Test weights also suffered from the poor growing environment during the 1993 season. The mean test weight was 51.08 lb/bu and the high was 56.15 lb/bu (OR850153). Lodging was moderate to heavy and obviously contributed to poor yields and test weights. Four varieties had no lodging (OR 870834, OR 850153, OR 860247, and MT 8713). TCK smut (dwarf bunt) was observed in the nursery at low to moderate levels however, only five varieties were free of disease infection. Twenty-three entries had TCK infection at, or greater than 1 %. Leaf rust and powdery mildew were also prevalent in the nursery.

FUTURE PLANS: There are plans for continued evaluation of new and introduced lines of spring wheat in Montana by growing the Western Regional Spring Wheat Nursery.

Table 1. Agronomic data from the Western Regional Hard Red Winter Wheat Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT.
Planted: September 21, 1992 Harvested: August 27, 1993

CI Number	VARIETY	YIELD BU/A	TEST WT LB/BU	HT (IN)	HEADING DATE	WINTER %KILL 1/	LODGING INDEX 2/
OR870834	VS74-709/NAC	118.57	53.05	35.93	160.75	14.00	.00
OR861555	VS 74-709/BUC	102.80	51.53	40.35	162.00	10.00	.83
OR 2619	NZT/BEZ1//ALD,F1/4/F	100.89	53.35	34.94	158.75	14.00	.10
OR850513	RBS/ANZA/3/KVZ/HYS//	98.09	56.15	31.99	156.50	5.00	.00
OR860247	GNS/LP/3/5*ATR/AGA//	90.41	53.38	33.96	155.50	18.75	.00
WA 7758	CI9432/4/908/FN*W//4	83.66	53.90	46.26	162.00	4.00	51.13
OR851911	BNS/LP/3/5*ATR/AGA//	81.99	50.65	30.02	154.25	14.25	.55
WA 7759	PI173467/CI13438//MG	76.74	51.37	41.34	160.25	5.25	8.75
WA 7760	KVZ/3/BEZ//MNT/BURT/	76.28	52.30	45.28	162.25	6.25	76.60
WA 7757	PI173467/GNS//WSR/3/	73.48	51.63	47.24	160.25	4.50	74.13
UT 150	ID51022/MANNING	72.80	49.98	42.81	159.50	2.75	.27
UT 190	AG POD/WHEAT	68.91	52.23	43.31	159.00	8.75	2.50
CI 13844	WANSER	68.91	51.60	47.24	158.75	9.00	66.38
ID 447	RGR/3/II-60-156/CI14	68.05	50.02	34.94	161.50	2.75	2.50
XNH 1401	HYBRITECH	67.75	53.42	47.24	157.50	3.50	82.47
WA 7679	N823105/N8106201	67.69	53.97	47.74	160.25	3.50	55.68
IDHW0355	2*MC/NP824/3/LMH66/5	67.11	52.48	48.23	160.25	4.25	79.73
MT 8713	RRI/MT 6928	63.81	51.37	37.40	157.75	2.75	.00
UT182016	CI12385/UK//CLM/3/CI	63.01	47.95	44.29	159.00	2.75	15.28
ID 433	II-60-156/CI 14106//	62.58	50.92	46.75	159.50	5.00	96.25
ID 426	ID 77281 Hard Red	60.45	48.78	36.42	158.75	4.50	.05
ID 445	ID 77294 Hard White	60.20	52.05	51.18	159.75	2.75	77.23
OR387020	NA160/SDY//BJY.S (38	59.11	51.28	32.48	159.00	28.00	.27
XNH 1486	HYBRITECH	58.53	49.63	41.34	156.25	9.00	37.13
DS 00001	BLIZZARD sib (Sunder	56.81	49.85	46.26	160.25	3.50	96.03
WA 7761	WTN/HTN//WTN, N84091	56.46	52.28	48.23	159.75	6.00	76.68
WA 7762	WA7270/HYAK HWW, D86	53.14	51.95	49.21	163.00	4.00	70.75
WA 7678	CI 14484//BNK/GNS/3/	51.41	51.90	47.74	160.00	1.75	79.80
MT 8719	RRI/MT 6928	49.89	49.70	43.80	158.75	4.25	82.00
ID 444	ID 77190 Hard Red	49.59	49.98	47.74	167.00	2.50	95.28
SDM206W	SUNDERMAN BLIZZARD R	49.19	53.13	48.72	160.75	1.75	79.15
ID 453	BEZ-1//CI13438/BURT/	48.54	50.63	48.72	158.75	7.25	92.80
UT187416	FENG KNG15/MANNING	47.80	47.48	40.35	157.50	3.25	68.35
ID 454	A742332-9-4/A75284W	45.80	50.52	49.21	158.50	7.75	84.58
CI 1442	KHARKOF	42.00	50.25	46.75	159.00	4.25	88.00
ID 423	ID0076/3 11-60-157/W	41.24	46.73	36.42	159.25	5.25	1.93
ID 443	ID 77089 Hard Red	38.20	48.18	42.81	163.75	1.25	85.53
UT 303	1257-6/MNG	37.23	45.58	42.81	158.25	3.50	41.10
EXPERIMENTAL MEANS		65.24	51.08	42.83	159.57	6.36	46.57
LSD (0.05)		17.22	1.98	2.47	3.60	7.43	17.67

1/ Winter Kill = % plot reduction due to winter injury and snow mold
2/ Lodging Index = lodging prevalence X lodging severity divided by 9

Table 2. Agronomic data from the Western Regional Hard Red Winter Wheat Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT.
Planted: September 21, 1992 Harvested: August27, 1993

CI Number	VARIETY	% TCK 1/ 7-19-93	POWDERY MILDEW 2/	LEAF RUST 3/
XNH 1486	HYBRITECH	12.75	17.50	12.50
MT 8713	RRI/MT 6928	6.50	17.50	7.50
OR851911	BNS/LP/3/5*ATR/AGA//	5.75	20.00	7.50
CI 1442	KHARKOF	5.50	7.50	5.00
OR861555	VS 74-709/BUC	5.38	7.50	2.50
OR 2619	NZT/BEZ1//ALD,F1/4/F	5.25	.00	.00
CI 13844	WANSER	4.88	15.00	20.00
XNH 1401	HYBRITECH	4.38	.00	.00
WA 7761	WTN/HTN//WTN, N84091	3.50	5.00	7.50
ID 426	ID 77281 Hard Red	3.50	2.50	15.00
OR870834	VS74-709/NAC	3.38	.00	.00
MT 8719	RRI/MT 6928	3.25	15.00	2.50
WA 7678	CI 14484//BNK/GNS/3/	3.25	5.00	2.50
OR387020	NA160/SDY//BJY.S (38	2.50	5.00	.00
OR850513	RBS/ANZA/3/KVZ/HYS//	2.50	.00	.00
WA 7757	PI173467/GNS//WSR/3/	2.50	40.00	20.00
WA 7762	WA7270/HYAK HWW, D86	2.37	12.50	7.50
WA 7758	CI9432/4/908/FN*W//4	2.37	7.50	12.50
WA 7679	N823105/N8106201	1.88	32.50	2.50
OR860247	GNS/LP/3/5*ATR/AGA//	1.62	5.00	5.25
UT187416	FENG KNG15/MANNING	1.50	10.00	7.50
UT 303	1257-6/MNG	1.50	15.00	7.50
ID 453	BEZ-1//CI13438/BURT/	1.00	5.00	32.50
ID 423	ID0076/3 11-60-157/W	.63	20.00	15.00
WA 7759	PI173467/CI13438//MG	.37	3.50	15.00
ID 443	ID 77089 Hard Red	.37	17.50	55.00
IDHW0355	2*MC/NP824/3/LMH66/5	.25	2.50	15.00
WA 7760	KVZ/3/BEZ//MNT/BURT/	.25	10.00	.00
ID 433	II-60-156/CI 14106//	.12	2.50	10.00
SDM206W	SUNDERMAN BLIZZARD R	.12	15.00	10.00
ID 445	ID 77294 Hard White	.12	5.00	5.00
DS 00001	BLIZZARD sib (Sunder	.12	5.00	.00
UT 150	ID51022/MANNING	.12	5.00	20.00
ID 444	ID 77190 Hard Red	.00	5.00	12.50
UT182016	CI12385/UK//CLM/3/CI	.00	.00	22.50
ID 447	RGR/3/II-60-156/CI14	.00	2.50	5.00
UT 190	AG POD/WHEAT	.00	22.50	20.00
ID 454	A742332-9-4/A75284W	.00	7.50	22.50
EXPERIMENTAL MEANS		2.36	9.70	10.66
LSD (0.05)		3.16	19.17	17.93

1/ % TCK smut = ocular observation of % TCK per plot
2/ Powdery Mildew = percent of flag leaf infected with powdery mildew
3/ Leaf Rust = percent of flag leaf infected with leaf rust

PROJECT TITLE: Western Regional Soft White Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Phil Bruckner/Rhoda Burrows, Plant and Soil Science,
Bozeman, MT.

OBJECTIVE: To evaluate soft white winter wheats for adaptability, yield, quality, and disease resistance.

RESULTS: Yields were drastically reduced in many varieties of the Soft White Winter Wheat nursery due to a combination of winter injury and snow mold. Most severe in the Oregon entries, the winter kill complex in some cases thinned stands by 90%. Apparently however, regrowth combined with spring and summer tillering enabled some varieties to produce a fair yield in spite of considerable stand reduction. Besides the Oregon entries suffering from the winter kill, there were also large plot losses in the varieties of Nugaines, Moro, Elgin and Kharkof. The high yield was 138.9 bu/A (WA 7756) while the mean for the nursery was 92 bu/A. Eighteen varieties had yields in excess of 100 bu/A. Test weights were less than normal due mainly to environmental conditions throughout the growing season. The mean test weight was 49.07 lb/bu and the high was 54.55 lb/bu (OR 851139). TCK smut (dwarf bunt) was observed in the nursery at low levels with only seven varieties having greater than 1% infection. There were twelve varieties that had no TCK infection.

FUTURE PLANS: Continued evaluation of new and introduced lines is planned in the future through cooperative state-wide testing.

Table 1. Agronomic data from the Western Regional Soft White Winter Wheat Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT in 1993.
Planted: September 21, 1992 Harvested: August 30, 1993

CI NUMBER	VARIETY	YIELD BU/A	TESTWT LB/BU	HEADING DATE	HEIGHT INCHES	WINTER KILL % 1/	% TCK 2/	LODGE INDEX 3/
CI 1442	Kharkof	55.85	51.50	158.5	49.21	94.75	.25	67.7
CI 11755	Elgin	62.79	49.00	164.0	44.78	82.50	.12	5.0
CI 13740	Moro	64.96	47.30	162.3	41.83	93.25	.00	.0
CI 13968	Nugaines	39.79	47.85	161.0	31.00	97.25	.12	.0
CI 17596	Stephens	93.45	48.88	159.0	34.45	57.50	.62	.0
CI 17917	Tres	78.52	47.80	164.3	37.89	83.75	.12	.0
OR 855	Paha//Sel.72-330/D	73.04	47.77	162.8	32.97	91.50	.00	.0
WA 7662	Luke/Daws//Hill 81	74.71	44.80	162.8	30.51	93.25	.25	.0
WA 7686	VH02254/ORCW8313,	109.3	50.15	160.5	34.94	52.50	.25	.0
WA 7753	Tyree/Roazon/Tres,	74.04	45.78	165.3	34.94	71.75	.00	.0
WA 7690	VPM/MS951/YMH/Hill	98.00	49.90	160.5	36.91	64.75	.25	.0
OR850933	YMH/HYS/4/MRS/3/YM	63.49	48.40	157.5	31.99	85.75	.12	.0
OR851048	Stephens/Quilamapu	102.2	48.97	159.5	35.43	66.00	.12	.0
OR860303	AFG2/BUC, F1/KVF	36.83	51.53	154.8	31.99	98.00	5.50	.0
ID085153	Sprague/Stephens	122.4	50.00	159.3	38.39	43.75	.12	.0
WA 7729	WA6814/Tres, VA087	64.59	45.70	163.8	33.46	94.75	.00	.0
WA 7730	VH090077	64.05	45.03	164.8	32.97	88.75	.00	.0
WA 7717	WA7690 Sib	110.2	50.17	162.8	41.34	23.75	.12	.0
WA 7695	Daws//SU92/3*Omar-	59.15	44.13	163.0	31.00	75.50	.00	.0
WA 7697	SPN//SU92/3*Omar-2	61.90	48.38	162.8	31.50	90.50	.00	.0
XWH 1004	X WH1004 Hybritech	135.7	53.20	159.5	37.89	4.500	.37	.0
XWH 1005	X WH1005 Hybritech	125.8	52.70	160.0	39.37	3.250	.37	.0
PB185WW1	Daws/ CIMMYT/PNW B	113.9	51.92	159.0	36.42	40.00	.25	.0
OR851139	YMH/HYS/3/EG/17838	129.9	54.55	161.0	41.34	32.50	.12	.0
OR856537	HYS/YAHA//WA4095/3	23.14	41.30	163.3	35.43	99.50	.00	.0
OR855350	Pendleton Sel. OR8	74.76	47.22	161.3	34.94	86.25	.00	.0
ORFW0333	Pendleton Sel.	84.93	45.28	165.3	33.46	55.25	.12	.0
WA 7622	Tyee/Roason/Tres,	97.74	47.22	164.5	37.40	4.250	.00	.0
WA 7752	Tres//Madsen/Tres,	113.2	51.50	162.8	38.88	2.500	.12	.2
WA 7754	Pullman Sel. VD090	82.70	45.92	163.5	38.88	3.500	.00	.0
WA 7755	Pullman Sel. VH091	131.8	51.10	159.5	39.37	2.000	.87	.0
WA 7756	Pullman Sel. VH091	138.9	53.50	160.8	40.85	3.250	1.00	.0
XWH 1008	XWH1008 Hybritech	113.0	48.77	158.8	35.43	7.500	1.25	.0
OR870012	HYS703/3/55-1744/7	92.57	48.00	162.0	34.45	38.50	.12	.0
OR870337	KVZ/3/HD/ON//BB/4/	111.3	50.45	159.0	32.48	6.500	1.25	.0
OR870831	AFG2/BUC,F1/KVZ	105.1	53.28	154.3	34.94	5.000	6.00	.0
OR880525	OR946/HILL/HILL	118.8	52.78	162.5	41.34	1.500	.75	.0
ORFWHS02	T. TIMOPHEEVI/2*P1	82.21	46.15	163.0	43.80	4.000	.00	42.7
ORFWB004	STEPHENS*2/SM-4	101.2	49.48	164.0	36.42	10.50	4.75	.0
ORFWHS04	FW84106/GREER	110.7	51.80	158.8	34.94	7.750	.37	.0
PB83WW56	Plant Breeders 1 S	135.4	50.58	158.8	38.39	2.750	.62	.0
PB83WW59	Plant Breeders 1 S	130.5	51.25	162.0	40.85	4.750	.00	.8
	OVERALL MEAN =	91.96	49.07	161.2	36.78	47.02	.628	2.777
	LSD (05 by t)=	17.57	1.742	1.984	1.976	20.07	2.533	7.268

1/ Winter Kill % = that percent of plot reduced by snow mold and winter injury
2/ % TCK = percent of plot (ocular observation) infected with Dwarf Bunt
3/ Lodging Index determined by lodging prevalence X severity divided by 9.

PROJECT TITLE: Intrastate Winter Wheat Evaluation

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Phil Bruckner/Rhoda Burrows, Plant and Soil Science, Bozeman, MT.

OBJECTIVE: Evaluation of early generation winter wheat lines for yield, quality, and disease resistance to dwarf bunt and stripe rust.

RESULTS: Yields were drastically reduced in most varieties of the Intrastate Winter Wheat nursery due to a severe infestation of Septoria. Winter kill was not as harsh yet was observed in all plots to some degree. The high yield was 85 bu/A (Ram) while the mean for the nursery was 47 bu/A. Test weights were also less than normal due mainly to environmental conditions throughout the growing season as well as reaction to heavy disease pressures. The mean test weight was 47.2 lb/bu and the high was 53.6 lb/bu (Lamar). TCK smut (dwarf bunt) was observed in the nursery at very low levels.

FUTURE PLANS: Disease resistant varieties will continue to be evaluated at Kalispell through cooperative variety testing.

Table 1. Agronomic data from the Intrastate Winter Wheat Nursery grown on the Northwestern Agricultural Research Center Center, Kalispell, MT
Planted: September 18, 1992 Harvested: August 26, 1993

	VARIETY	YIELD BU/A	TESTWT LB/BU	HEADING DATE	HEIGHT INCHES	WINTER KILL% 1/	LODGING INDEX 2/
PI477287	RAM	85.00	50.53	158.33	40.35	3.10	.00
CO850061	YUMA	69.58	51.10	154.00	37.40	4.33	.00
CO820009	LAMAR	69.10	53.60	156.00	45.93	3.33	23.70
MT 88046	PMN5/MT77003//HP344	67.13	52.17	156.33	40.68	4.00	.00
CI 17860	NEELEY	67.12	50.23	161.67	45.28	3.33	1.47
MT 8918	MT7673/MT7115	66.03	48.70	161.00	43.31	1.00	26.30
QT542-F2	HYBRITECH 542 F2	65.50	50.47	156.67	44.62	2.00	2.77
MT 8039	JUDITH	63.87	50.47	158.00	43.96	9.00	.00
IDHW0355	2*MC/NP824/3/LMH66/	63.48	50.47	162.33	47.90	3.33	4.67
ND 8002	SEWARD	61.38	52.63	162.67	50.52	2.33	32.13
PI555458	PROMONTORY	59.75	45.20	158.33	38.71	1.33	.00
PI512302	BLIZZARD	59.73	52.00	163.33	47.90	3.33	6.30
ID 355	MC*2/NP824/3/LMH66/	58.53	48.27	161.33	48.56	1.67	20.37
CI 15075	CENTURK	58.03	48.47	159.00	46.59	4.00	41.13
MT 7811	FRD/WNK//MT6928/TDR	57.77	46.27	160.67	44.62	2.67	2.60
RDW(SEL)	AC READYMADE	57.38	50.67	160.67	46.59	5.33	.00
CI 17441	VONA	56.62	49.77	154.67	36.75	1.67	3.33
PI499375	KS73164/PI94424	56.45	48.53	160.67	49.21	2.67	.57
CI 17879	ROCKY	55.03	47.77	159.67	47.24	.67	59.03
CI 17902	WINRIDGE	54.10	48.27	164.00	46.59	2.33	.57
QT 542	HYBRITECH 542	52.97	48.97	157.00	43.96	5.33	8.43
MT 88030	HP340/NRS//MT7216(1R	52.28	50.20	160.00	40.42	11.00	10.90
S86-15	KESTREL	51.10	46.47	162.67	46.59	8.00	1.10
MT 8719	RRI/MT 6928	50.18	49.57	160.00	42.65	3.33	16.13
MTSF2238	LEW/TBR//RDW	49.33	48.97	161.00	44.62	2.00	17.57
MT 8909	MT8001/MT7673	45.83	49.23	160.67	40.03	1.33	.00
CI 17846	MANNING	45.03	43.03	158.00	40.03	5.67	16.47
PI517194	TIBER	43.78	47.13	162.33	47.24	3.33	4.63
S86-736	S86-736	43.68	45.07	160.33	46.59	2.00	5.57
CI 17844	REDWIN	43.00	48.70	162.33	46.59	1.67	.00
PI495594	TAM 107	42.77	47.77	153.00	36.09	3.33	5.93
W235	WINALTA/BEZOSTAYA	42.23	49.77	161.00	52.49	3.33	67.47
CI 17727	WESTON	41.17	45.90	159.33	49.87	4.67	19.43
MT 8713	RRI/MT 6928	40.95	46.57	159.00	36.75	6.67	.00
PI499376	LENORE/KS73164	40.93	43.40	159.67	37.40	2.00	.00
CI 13670	WINALTA	39.40	50.23	160.33	53.81	3.33	80.10
PI499377	MANNING/MT7579	37.97	44.00	160.33	43.31	4.33	10.37
XNH 1609	HYBRITECH 1486	37.60	43.90	154.67	40.68	2.00	.00
PI518591	ARAPAHO	34.23	40.87	158.00	40.03	5.67	.00
PI557013	MERIDIAN	33.68	45.50	165.00	37.40	3.33	.00
PI491532	CREE	30.75	46.53	161.33	51.18	3.00	56.43
PI491533	NORWIN	29.22	46.00	160.33	31.50	6.67	.00
MT 8949	RDW/FRD//RRI/(TT/BU	25.60	37.30	161.67	47.90	5.00	.00
CI 17735	NORSTAR	23.02	43.60	162.00	53.81	3.33	56.77
CI 17439	ROUGHRIDER	20.87	44.20	161.33	50.52	5.33	69.20
PI478771	AGASSIZ	19.08	43.90	161.00	52.23	5.00	65.73
MTSF1142	LEW/TBR//RDW	14.10	39.90	161.33	43.31	2.67	7.60
MT 88005	WSC/YOGO//RSC/3/TD2	10.60	38.00	160.67	48.29	7.00	11.50
MT 8957	RDW/FRD//RRI/(TT/BU	7.57	41.67	162.33	44.62	5.67	.00
EXPERIMENTAL MEANS		46.95	47.18	159.92	44.54	3.83	15.43
LSD (0.05)		16.56	2.49	2.35	3.06	5.15	21.43

1/ Winter Kill = winter injury+snow mold 2/ Lodging Index = Prev X Sever / 9

PROJECT TITLE: Advanced Winter Wheat Nursery

PROJECT LEADERS: Bob Stougaard and Todd Keener, NWARC, Kalispell, MT
Phil Bruckner/Rhoda Burrows, Plant and Soil Science, Bozeman, MT

OBJECTIVE: Evaluation of winter wheat varieties for yield, quality, and disease resistance.

RESULTS: Yields were dramatically reduced this year due to a severe infestation of Septoria. Less severe, yet frequent throughout this nursery were; leaf rust, scab, and powdery mildew. The highest yield from the Advanced Yield nursery was 81.5 bu/A from the variety, MT 91366. Yields averaged 54.7 bu/A with the lowest yield being 18.9 bu/A from the variety, MT 88005. Test weights were also lowered by the high incidence of diseases. The average test weight for the nursery was 49.58 lb/bu with the highest test weight being 55.33 lb/bu (MT91366). Heading dates were 7 to 10 days later than normal. Lodging was severe in eight varieties and light to moderate in more than half of the entries. Winter kill, snow mold and winter injury combined, was light in the trial but was observed in the majority of plots.

FUTURE PLANS: Continued evaluation of new and introduced lines is planned in the future through cooperative state-wide testing.

Table 4. Agronomic data from the Advance Yield Winter Wheat Nursery grown on the Northwestern Agricultural Research Center.
Planted: September 18, 1992 Harvested: August 26,1993

CI NUMBER	VARIETY	YIELD BU/A	TESTWT LB/BU	HEIGHT INCHES	HEADING DATE	LODGING INDEX 1/	WINTER % KILL
CI 17860	NEELEY	57.53	48.23	45.28	164.0	1.6	4.7
MT 91125	TAMW/RRI/MT 7115	23.45	47.40	45.93	162.0	79.5	7.0
MT 91192	WWP 4394/MT7811/	61.05	49.50	40.68	162.0	.0	2.3
MT 91225	KS79H69/MT 79121	63.40	52.37	47.90	159.0	18.9	6.7
MT 91233	HMK/MT79121//MT7	38.70	43.40	41.99	159.0	2.7	2.0
MT 91304	MT 7963/BBY//ODK	62.67	49.33	45.28	158.3	16.6	2.7
MT 91324	MT7823/LOV24//MT	58.17	49.03	41.99	158.3	13.3	7.7
MT 91366	MT7811/LOV24//MT	81.85	55.33	49.21	163.7	.7	2.7
MT 91429	NWN/LOV24//MT770	75.90	53.27	43.96	161.0	.0	9.7
MT 91432	MT 7951/WWP 4394	67.70	50.00	41.99	162.0	.0	4.0
MTSF1142	LEW/TBR//RDW	25.60	44.43	43.31	162.7	1.3	5.0
CI 17844	REDWIN	64.28	52.13	47.90	162.0	.0	8.3
MTSF2238	LEW/TBR//RDW	52.00	49.87	45.28	160.3	16.3	7.7
MTSF1258	LEW/TBR//RDW	56.88	51.70	48.56	159.0	29.2	1.7
MTSF1260	LEW/TBR//RDW	51.63	49.63	47.90	159.3	41.3	0
MTSF1570	LEW/TBR//RDW	39.07	47.90	45.28	162.0	66.8	1.3
MT 88005	WSC/YOGO//RSC/3/	18.98	41.40	45.93	162.0	64.8	2.7
MTS92127	LEW/TBR//RDW	60.88	53.97	46.59	160.7	7.0	8.3
MTS92137	LEW/TBR//RDW	60.15	51.00	45.28	161.3	.0	1.7
MTS92094	LEW/TBR//RDW	54.68	49.03	47.24	161.3	18.8	4.3
MTS92012	LEW/TBR//RDW	48.80	50.03	47.24	161.7	37.5	6.7
MTS92015	LEW/TBR//RDW	50.92	50.03	43.96	162.0	5.7	2.0
CI 17735	NORSTAR	28.98	47.80	55.77	166.7	65.8	10.0
MTS92019	LEW/TBR//RDW	68.57	52.03	46.59	159.7	22.2	2.3
MTS92021	LEW/TBR//RDW	65.97	51.67	45.93	161.7	.0	4.0
MTS92042	LEW/TBR//RDW	64.77	51.60	44.62	162.0	20.0	7.3
MTS92045	LEW/TBR//RDW	67.35	51.80	43.31	162.0	14.8	7.3
MTS92053	LEW/TBR//RDW	62.83	52.30	45.28	163.3	.0	5.7
MTS92055	LEW/TBR//RDW	67.58	54.47	45.93	161.7	1.8	5.7
MTS92057	LEW/TBR//RDW	51.27	49.30	45.93	160.0	.7	7.0
MT 8039	JUDITH	63.78	48.80	41.99	160.3	.0	10.0
CI 17879	ROCKY	65.18	50.47	47.24	159.0	57.0	6.3
MT 90003	ORS-W 30-166/WRG	49.90	49.87	46.59	164.7	.0	8.3
MT 90026	ID 103/WRG//MT 7	73.20	54.77	47.90	162.7	.0	7.7
MT 90027	ID103/WRG//MT784	34.48	39.30	47.90	160.0	.0	5.7
MT 91051	ORSFWT/FRD//MT78	31.38	41.57	49.21	161.7	3.7	2.0
	OVERALL MEAN =	54.71	49.58	45.91	161.4	16.91	5.2
	LSD(0.05 by t)=	14.41	2.966	2.392	1.404	23.06	6.1

1/ Lodging Index = lodging prevalance X severity divided by 9.

PROJECT TITLE: Seed Treatment Dwarf Bunt Control in Winter Wheat

INVESTIGATORS: Todd Keener and Bob Stougaard, NWARC, Kalispell, MT.

OBJECTIVE: Evaluate Dividend seed treatment for control of Dwarf Bunt in eight winter wheat varieties.

RESULTS: Four soft white and four hard red winter wheat varieties of varying susceptibility to TCK dwarf bunt were selected for the 1992-93 trial. These eight varieties were seeded non-treated as well as treated with 1 oz Dividend per hundred weight. A research plot seeder was used to seed varieties on 9/22/92 in four-row plots, ten feet in length at a rate of 60 lb / acre. Seeding depth was 3/4 - 1 inch and row spacing was 12 inches. On October 1, 1992 an inoculum solution was applied to the test area using a research plot sprayer when winter wheat was in the three leaf stage. The TCK inoculum was prepared using screenings and smut balls from infected wheat samples. One bushel of screenings was soaked in 10 gallons of water for 15 minutes and then filtered twice through fine mesh cheese cloth to make the inoculum solution. The final application rate of the inoculum solution was approximately 100 gallons per acre. TCK ocular estimations were taken June 12 and July 1, 1993.

There were 105 days continuous snow cover from Dec 4, 1992 until Mar 18, 1993. Total snow cover days were 120 for the 1992-93 winter. Previous total days of snow cover for 1990, 1991, and 1992 were 65, 69, and 55 respectively. The environmental conditions were favorable for TCK infection and combined with successful inoculation techniques, assured high infection levels on susceptible cultivars of winter wheat.

SUMMARY: 1993

As in the 1992 Seed Treatment Study control of TCK, dwarf bunt was complete in all varieties treated with 1 oz Dividend per hundred weight. Hard red winter wheat varieties showed a higher degree of susceptibility to the disease with Judith having the highest disease infection (49.5 % occular, 25.3% count). The check varieties Lewjain and Winridge demonstrated a high degree of resistance to TCK.

Yields did vary significantly when comparing similar varieties of treated versus nontreated winter wheat. The higher yields taken from Dividend treated plots of Nugaines, Judith, Tiber, and Rocky could be related to less winter kill in those plots but most likely is a reflection of the seed treatment protection of additional diseases by Dividend. Dividend has offered partial protection against other smuts (loose and flag), Septoria, common bunt, leaf stripe, scab, foot rot, Rhizoctonia root rot, speckled snow mold, strawbreaker foot rot, and mildews. Septoria, scab, and snow mold infection were yield limiting factors in winter wheat nurseries this year.

FUTURE PLANS: TCK Dwarf Bunt evaluations will be continued in cooperative efforts with regional personnel.

Table 1. 1993 Agronomic Data from the Seed Treatment Dwarf Bunt Study. Northwestern Agricultural Research Center, Kalispell, MT.

Variety	Trtmt 1/	Yield Bu/A	Test Wt Lb/Bu	Height Inches	Winter Kill %	% TCK 7/1 * Ocular	Count
Luke	Treated	86.1	49.3	37.9	28.8	0	0
Nugaines	Treated	59.7	46.9	33.1	78.8	0	0
Stephens	Treated	96.3	50.0	39.9	13.5	0	0
Lewjain	Treated	80.6	47.5	35.9	13.5	0	0
Judith	Treated	111.7	55.4	45.0	33.8	0	0
Tiber	Treated	101.4	58.1	50.4	24.8	0	0
Rocky	Treated	116.1	58.3	48.2	58.7	0	0
Winridge	Treated	98.9	54.3	51.5	30.0	0	0
Luke	Untreated	75.3	49.4	35.9	42.5	2.5	7.8
Nugaines	Untreated	40.2	44.6	34.8	85.0	5.8	11.2
Stephens	Untreated	83.0	50.6	39.2	30.0	.1	.3
Lewjain	Untreated	75.3	46.9	36.6	25.0	0	0
Judith	Untreated	78.5	52.8	45.1	46.3	49.5	25.3
Tiber	Untreated	79.9	56.2	50.4	55.0	15.5	17.3
Rocky	Untreated	88.7	56.5	46.0	80.0	16.0	17.7
Winridge	Untreated	99.3	53.3	51.3	28.0	.1	0
OVERALL MEAN =		85.7	51.9	42.6	42.1	5.58	4.97
P-VALUE TRTS =		.000	.000	.000	.000	.000	.000
LSD(0.05 by t)=		13.7	3.13	2.06	20.37	9.73	9.50

1/ Seed treatment for treated varieties was Dividend at 1 oz/cwt

* Percent TCK = % TCK Dwarf bunt per plot. COUNT is determined by average number of infected heads per foot of row. OCULAR rating is visual estimate of percent TCK.

Table 2. 1992 Data from the Seed Treatment Dwarf Bunt Study

Variety	Trtmt 1/	Yield Bu/A	Test Wt Lb/Bu	Height Inches	Heading Date	% TCK Count	7/9 * Ocular
Luke	Treated	121.3	58.9	34.5	160	0	.1
Nugaines	Treated	112.2	57.4	34.5	158	0	0
Stephens	Treated	114.1	57.4	37.4	159	0	0
Lewjain	Treated	119.7	57.3	33.0	161	0	0
Judith	Treated	123.3	59.2	42.8	155	0	.1
Tiber	Treated	102.4	60.8	46.8	157	0	.1
Rocky	Treated	96.3	57.8	46.3	154	0	.0
Winridge	Treated	98.4	59.2	47.3	159	0	.0
Luke	Untreated	109.9	58.7	30.0	159	1.0	.3
Nugaines	Untreated	115.6	57.9	34.5	158	.7	1.0
Stephens	Untreated	119.0	58.8	36.0	158	.9	.4
Lewjain	Untreated	120.9	57.0	33.0	161	0	0
Judith	Untreated	118.7	58.7	40.4	156	20.0	15.0
Tiber	Untreated	111.6	61.2	45.8	158	6.9	5.8
Rocky	Untreated	91.8	58.3	45.3	154	18.4	19.8
Winridge	Untreated	109.6	60.2	46.3	160	0	0
OVERALL MEAN =		111.5	58.66	39.8	158	.039	2.76
P-VALUE TRTS =		.0012	.0000	.000	.00	.000	.000
LSD(0.05 by t)=		15.52	1.541	2.58	1.1	.059	5.07

YEAR/PROJECT: 1993/758 Statewide Legume Adaptation
non-irrigated

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
In cooperation with Dr. Jim Sims, MSU, Bozeman

Nine small-seeded and nine large-seeded annual legumes were planted April 29. The seed of each species was inoculated with the appropriate Rhizobium strain. Although this is usually an irrigated experiment, it was not irrigated in 1993 due to excessive summer precipitation. First forage harvest for all legumes occurred on July 16. Second and third harvests for species having sufficient regrowth occurred on August 23 and September 23. 'Tinga' tangier flatpea and Hairy vetch produced over 4 tons herbage per acre as compared to 3.12 t/a for Austrian winter pea. For the small-seeded legumes, 'Multicut' berseem clover yielded 4.6 t/a (total of 3 harvests), almost 2 t/a more than other small-seeded legumes, including 'Nitro' alfalfa. The cool, wet weather evidently favored the berseem clover and retarded the growth of Nitro.

LARGE-SEEDED

VARIETY	EMERG. day[1]	STAND %[2]	VIGOR (0-5)[3]	---DRY MATTER YIELD-- 7/16	8/23	TOTAL
				-----tons/acre------		
Tinga tangier flatpea	13	86	4.3	2.64	2.03	4.67
Hairy vetch	13	86	4.3	1.23	3.16	4.39
Procon field pea	13	96	5.0	3.47		3.47
Miranda yellow pea	13	96	5.0	3.37		3.37
Austrian winter pea	12	90	4.5	3.12		3.12
Chickling vetch	12	94	4.8	3.08		3.08
Kabuli chickpea	14	89	4.5	1.70	0.78	2.48
Trapper pea	13	86	4.8	2.45		2.45
Desi chickpea	14	88	4.0	1.46	0.50	1.96
MEAN	13	90	4.6	2.50	1.61	3.22
LSD(0.05)	1	5	0.7	0.54	0.77	0.47
P-VALUE	0.00	0.00	0.09	0.00	0.00	0.00
CV(s/mean)	2.1	1.7	5.4	7.4	29.9	10.1

[1]Day 13 = May 11
[2]Visual estimates - 6/8/93
[3]Visual: 5 = high vigor; 0 = dead

Statewide Legume Adaptation - 1993

SMALL-SEEDED

VARIETY	EMERG day[1]	STAND %[2]	VIGOR (0-5)[3]	---DRY MATTER YIELD--- 7/16	8/23	9/23	TOTAL
				-------tons/acre-------			
Multicut berseem	11	96	3.3	1.57	1.99	1.06	4.63
Berseem clover sel-1	11	93	3.3	1.57	2.05	0.51	4.12
Nitro alfalfa	11	94	2.8	1.00	1.23	0.54	2.77
Paraggio barrel medic	10	94	3.3	1.76	0.99		2.75
Indianhead lentil	11	96	4.0	1.85	0.53		2.38
MTBM-5 black medic	12	88	3.0	0.55	1.66		2.21
Ascot barrel medic	11	89	2.8	1.19	0.81		2.00
George black medic	12	88	2.8	0.73	1.15		1.88
Sava snail medic	9	95	4.5	1.63	0.24		1.88
MEAN	11	92	3.3	1.32	1.18	0.70	2.73
LSD(0.05)	1	3	0.7	0.20	0.22	0.17	0.36
P-VALUE	0.00	0.00	0.09	0.00	0.00	0.00	0.00
CV(*s/mean*)	3.3	2.4	13.9	10.5	12.8	13.7	9.0

[1]Day 11 = May 9
[2]Visual estimates - 6/8/93
[3]Visual: 5=high vigor; 0=dead

YEAR/PROJECT: 1993/758

1993 WESTERN REGIONAL DRY PEA YIELD TRIAL

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

Twelve varieties of dry pea were seeded on April 16 in a randomized complete block design with 4 replicates. Phosphorus fertilizer was applied preplant at 42 lbs P_2O_5/a, and nitrogen fertilizer at 9 lbs N/a. Weeds were controlled by hand. At maturity (109 - 116 days after seeding) plants were pulled and then thrashed when dry.

Yields ranged from 1799 lbs/a ('Columbian') to 2721 lbs/a (PS-experimental cultivar). Mean yield was 19% less than that of 1992. The cool, wet weather seemed to enhance vegetative growth, with the average maturity time being 16 days longer than in 1992, and the average length of the stems being 18 inches longer.

VARIETY	EMERG day[1/]	STAND %	FIRST BLOOM day[2/]	NODES FIRST BLOOM	HT in	MATUR day[3/]	SEED SIZE no/lb	YIELD lbs/a
Trapper	18	96	66	13.0	62	116	3599	1824
Alaska 81	18	85	53	7.5	62	114	2410	1907
PS710202	17	96	56	8.8	56	112	2395	2513
Latah	17	95	55	8.8	61	111	2252	2225
PS010598	17	100	60	12.5	59	112	2164	2320
PS810098	17	99	51	8.3	65	111	2164	2488
Columbian	17	94	51	7.3	60	114	2147	1799
IMPCS	17	91	50	7.3	57	111	2124	2116
PS810102	17	95	52	8.3	58	110	2035	2485
PS810106	18	93	51	7.8	53	111	1967	2347
Umatilla	17	98	57	11.3	46	109	1958	2516
PS010603	17	94	58	11.8	49	109	1829	2721
mean	17	95	55	9	57	112	2254	2272
LSD(0.05)	1	7	1	1.0	9	2	182	477
P-VALUE	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00
CV(s/mean)	2.7	5.4	1.4	7.8	11.4	1.4	5.6	14.6

[1/] Day 17 = 5/3/93
[2/] Day 58 = 6/13/93
[3/] Day 109 = 8/3/93

YEAR/PROJECT: 1993/758

1993 WESTERN REGIONAL LENTIL YIELD TRIAL

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

Twelve varieties of lentils were seeded April 16 in a randomized complete block design with 4 replicates. Phosphorus was applied preplant at 42 lbs P_2O_5/a, and nitrogen at 9 lbs N/a. Weeds were controlled by hand. At maturity (116 - 129 days after seeding) plants were pulled and then thrashed when dry.

Seed yields in 1993 were less than 50% those of a normal year. They ranged from 885 lbs/a ('Crimson') to 261 lbs/a ('Chilean 78'). Mean yield (605 lbs/a) was 1/3 that of 1992. Cool, wet weather stimulated vegetative growth and reduced pod and seed set. All cultivars were infected with sclerotinia white mold; however, percent white mold infection was not related to seed yield. The upright growth habit of Crimson may have allowed more air movement within the canopy, resulting in fewer foliar diseases and higher yields.

VARIETY	EMERG day[1]	STAND %	FIRST BLOOM day[2]	SCLERO-TINIA % plot	HT in	MATUR day[3]	SEED SIZE no/lb	YIELD lbs/a
Crimson	17	95	61	55	23	119	13790	885
Emerald	16	95	61	15	28	129	9585	771
LC960027	17	96	55	59	23	116	6751	757
LC900001	16	95	60	34	28	126	9372	704
Palouse	17	94	56	56	22	117	6449	693
Brewer	16	99	56	41	24	121	7833	669
LC960102	17	95	56	53	23	116	6754	668
LC960090	16	94	57	36	26	128	8884	600
Laird	17	95	64	15	25	127	8816	460
Redchief	16	99	56	58	26	119	9093	446
LC960092	16	99	57	46	24	121	8912	349
Chilean 78	16	95	58	38	28	118	8554	261
mean	16	96	58	42	25	121	8733	605
LSD(0.05)	1	5	1	24	4	4	808	351
P-VALUE	0.10	0.30	0.00	0.00	0.00	0.00	0.00	0.03
CV(s/mean)	2.9	3.5	1.4	40.3	10.3	2.4	6.4	40.3

[1]day 17 = 5/3/93
[2]day 61 = 6/16/93
[3]day 119 = 8/13/93

YEAR/PROJECT: 1993/758 WINTER CANOLA NATIONAL VARIETY TEST

PERSONNEL: Leon Welty, NWARC
Louise Prestbye, NWARC
In cooperation with Dr. Paul Raymer, Univ. of Georgia

Twelve cultivars of winter canola were seeded on fallow on August 26, 1992 at 7 lbs/a. The experimental design was a randomized complete block with 4 replicates. Plots consisted of four 12-ft rows spaced 12 inches apart.

Treflan was preplant incorporated at 1 lb AI/a. No fertilizer was applied to the nursery. With the exception of 'Ceres' and 'Cobra', acceptable stands were obtained for all cultivars and, with adequate snow cover, at least 60% survived the winter. First bloom occurred in mid-May and continued for approximately six weeks. All cultivars matured in the first week of August. The plants in each plot were hand cut when most of the pods were brown. The plants were bound together and laid on the plot stubble to dry. The seed was thrashed out by feeding the plants into a Hege plot combine. Shatter was estimated to be only 10%. Seed yields varied from 2456 lbs/a ('Cascade') to 3766 lbs/a ('Apache'). Small samples of the open pollinated seed were submitted to determine oil content.

VARIETY	STAND[1/] (1-5)	WINTER SURV[2/] %	FIRST BLOOM May	MATUR Aug	HT in	YIELD lbs/a
Apache	1.4	83	17	4	45	3766
Pendleton	1.5	64	18	4	47	3640
DP91-3	1.7	85	18	4	46	3550
Capricorn	1.8	78	17	5	47	3513
Cobra	2.5	90	17	4	47	3098
Liborius	1.4	60	19	4	46	3050
CPB 90607	1.6	71	18	5	44	3029
Inca	1.3	68	17	5	44	3018
Ceres	2.1	84	18	4	45	3010
Doublol	2.2	60	19	4	45	2891
Bridger	2.4	80	16	4	44	2704
Cascade	1.9	85	16	4	44	2456
MEAN	1.8	76	17	4	45	3144
LSD(0.05)	0.9	21	1	1	6	647
P-VALUE	0.11	0.05	0.00	0.03	0.96	0.01
CV(s/mean	34.0	19.5	4.7	16.6	9.0	14.3

[1/]10/2/92: Visual estimates (1=excellent; 5=no stand)
[2/]4/20/93: % established plants surviving winter (visual estimates)

YEAR/PROJECT: 1993/758

TITLE: Determine Feasibility of Using Rotational Crops to Reduce Pest Problems in Peppermint

PERSONNEL: Principal Investigator:
Leon E. Welty, Agronomist, MSU, Kalispell, MT
Louise Prestbye, Research Technician, MSU, Kalispell, MT
Cooperators:
Dr. Don Mathre, Plant Pathologist, MSU, Bozeman, MT
Dr. Bill Grey, Plant Pathologist, MSU, Bozeman, MT

PROCEDURES - 1992:

Cultures of Verticillium dahliae were isolated from peppermint root samples collected from several fields in the Flathead Valley in February, 1992. Sterile oat kernels were inoculated with spore suspensions from these cultures and incubated until numerous microsclerotia of the fungus were visible on the husks. Greenhouse tests on the pathogenicity of the infested kernels were positive for V. dahliae.

Oat kernels were ground with a coffee grinder and mixed with ground wheat in a 50:50 ratio. On 21 May, 1992, the oat kernel-wheat mixture containing the fungus was seeded at a 2-inch depth at 50 lbs/acre into two fields, one with a fine sandy loam (light) soil and one with a silty clay loam (heavy) soil. Plots were arranged in an RCB design with four replicates for the following treatments:

1. Barley - grain harvested, residue plowed
2. Fallow - hand weeded
3. Vapam fumigant - 50 GPA
4. Sorghum (high HCN), cut once, returned to plot & plowed as green manure
5. Sorghum, cut twice, returned & plowed
6. Marigold, cut once, returned & plowed
7. Winter rapeseed (high glucosinolate), cut once, returned & plowed
8. Winter rapeseed, cut twice, returned & plowed

On 5 September, 1992, the green manure crops were rototilled by treatment so soil and plant debris were not moved from plot to plot.

RESULTS - 1992:

Table 1. Dry matter production of rotational crops.

Treatment	Heavy Soil t/a	Light Soil t/a
Sorghum - 1 cut	5.08	4.77
Sorghum - 2 cut	3.18	2.10
Rapeseed - 1 cut	5.63	2.26
Rapeseed - 2 cut	4.80	----
Marigold - 1 cut	4.19	3.05
Barley grain	56.1 bu/a	12.4 bu/a

PROCEDURES - 1993:

On 17 and 18 May, 1993, Black Mitcham meristem foundation roots were hand planted (in one-half of each plot) in four 17 ft. rows per plot at each site. Planting rate was one 5 gallon bucket of roots per plot.

On 25 Aug., 1993, approximately 30 peppermint stems were randomly picked from each plot. In the lab, the lower leaves were stripped from the stem and a center section cut out. This stem section was surface sterilized with 10% NaOCl for 3 minutes, the ends removed and a 5-mm piece placed on 2% water agar + 100 ppm chloramphenicol. Presence of V. dahliae was determined after 4 to 5 days incubation.

On 10, 20, and 30 Sept., 1993, visual estimates of V. dahliae symptoms were made by one observer. On 14 Oct., 1993, three scientists independently scored the plots for the percentage of dead plants in each plot.

RESULTS - 1993 - HEAVY SOIL:

Table 2. V. dahliae infestation on peppermint planted on heavy soil.

	----------VISUAL ESTIMATES----------				
	Sept., 1993		Oct., 1993		
1992 CROP	symptoms	Obs.1	Obs.2	Obs.3	means
	% of plot[1/]		----% dead plants/plot----		
Barley	24	24	20	23	22
Fallow	26	26	26	19	24
Vapam	14	18	18	16	17
Sorghum 1-cut	24	33	35	25	31
Rapeseed 2-cut	13	15	16	13	15
Marigold	18	19	19	13	17
Sorghum 2-cut	27	28	28	18	25
Rapeseed 1-cut	15	18	19	14	17
LSD(0.05)	9	10	11	9	8
P-VALUE	0.01	0.01	0.02	0.08	0.01
CV(s/mean)	30.3	29.8	33.2	36.6	26.4

[1/] mean of three separate observations

Because of the cool, wet year, V. dahliae symptoms did not appear until early August. With warm temperatures in August symptoms appeared very rapidly.

No significant treatment differences were obtained from the lab analyses. Visual estimates showed differences at the 0.01 - 0.08 significance level. The estimates on the percentage of each plot showing Verticillium wilt symptoms during September (mean of 3 observations during Sept.) indicated rapeseed, Vapam, and marigold showed some degree of control. In October, all three observers ranked the rapeseed 2-cut treatment as having the lowest mortality followed by marigold, Vapam, and rapeseed 1-cut (not in the same order). The means of the 3 observers showed rapeseed 2-cut to have the lowest mortality (15%), followed by marigold, Vapam, and rapeseed 1-cut (all at 17%).

Originally, a deep plowing treatment was to be included in this experiment, but it was eliminated do to logistics problems. A strip of land adjacent to this nursery was seeded with the inoculum at the same rate and plowed one foot deep. Interestingly, peppermint planted in this strip showed the fewest Verticillium wilt symptoms of any treatment at either site.

RESULTS - 1993 - LIGHT SOIL:

Table 3. V. dahliae infestation on peppermint planted on light soil.

1992 CROP	LAB infected stems %	----------VISUAL ESTIMATES---------- Sept., 1993 symptoms % of plot[1/]	Oct., 1993 Obs.1	Obs.2	Obs.3	means
			---% dead plants/plot----			
Barley	11.8	66	49	41	44	45
Fallow	17.3	67	45	38	43	42
Vapam	5.5	77	49	49	48	49
Sorghum 1-cut	20.5	62	55	53	56	55
Rapeseed 2-cut	7.8	74	48	45	50	48
Marigold	3.3	46	34	23	25	27
Sorghum 2-cut	8.3	75	48	43	49	47
Rapeseed 1-cut	15.3	55	49	51	40	47
LSD(0.05)	12.7	17	10	22	26	16
P-VALUE	0.10	0.01	0.02	0.16	0.39	0.09
CV(s/mean)	76.9	18.0	15.1	34.6	39.5	25.1

[1/] mean of three separate observations

Verticillium wilt symptoms appeared sooner and were much more severe in peppermint planted in the light soil as compared to heavy soil.

The lab analysis on the percent of Verticillium wilt infected stems indicated that marigold had the lowest percentage of infected stems, followed by Vapam, rapeseed 2-cut and sorghum 2-cut. Visual estimates of the percentage of plants showing Verticillium wilt symptoms in September showed marigold had significantly fewer diseased plants than any other treatment except rapeseed 1-cut. When 3 independent observers scored the percentage of dead plants in each plot on 14 October, all ranked marigold as the treatment with the lowest mortality and sorghum 1-cut with the highest. When the mortality scores of the 3 observers were averaged, marigold had significantly lower mortality than any other treatment.

It must be noted that all plots contained numerous dead plants. No treatment effectively controlled the disease. The inoculum was extremely virulent and levels may have been higher than those expected in production fields. The fact that some treatments showed moderate degrees of control is somewhat encouraging.

YEAR/PROJECT: 1993/758

TITLE: Effect of 1992 harvest date on subsequent year's peppermint oil production and quality at Kalispell and Corvallis, MT in 1993.

PERSONNEL: L.E.Welty and L.S.Prestbye, NWARC
M.P.Westcott and M.L.Knox, WARC

PROCEDURES:

In 1992, harvest date (fall management) studies were initiated at the Northwestern Agricultural Research Center at Kalispell and the Western Agricultural Research Center at Corvallis in meristem 'Black Mitcham' peppermint. The experimental design was a randomized complete block with 10 harvest treatments and 4 replications. Plots were harvested weekly from early August to late September. One uncut control was included to determine the effect of no topgrowth removal on root vigor in 1993.

On May 11, 1993 the entire field at Kalispell was flamed for control of peppermint rust. Plots were irrigated from May 12 to September 9 with a total of 14.7 inches of water. On October 7, 1992, 22 lbs N/a, 104 lbs P_2O_5/a, and 150 lbs K_2O/a were applied with an air seeder. From June 3 to August 6, 1993, 260 lbs N/a and 58 lbs S/a were applied by fertigation. Sinbar, Basagran, and Assure II were used for weed control.

Herbage from all plots was harvested August 10, 1993, stored in onion bags, allowed to dry, and distilled on August 20, 1993. Oil chemical analyses were performed by A.M.Todd Company.

RESULTS:

On August 10, 1993 the plots at Kalispell were in the mid-bud to early-bloom stage. Dry matter yields ranged from 4.22 to 4.79 tons/acre (Table 1a). Oil content ranged from 1.0 ml/lb (uncut) to 1.8 ml/lb (August 26, mid-bloom). Oil yield averaged 24.9 lbs/acre.
Menthofuran was the only chemical quality component where significant differences were detected among treatments (Table 2a).

Fall harvest in 1992 significantly affected dry matter production in 1993. Unfortunately, there was really no trend (as influenced by 1992 harvest date) for dry matter and oil yields in 1993. Treatments that produced the most dry matter (August 5 and uncut) produced the least amount of oil/acre.

Significant differences in dry matter, oil content, and oil yield were observed at Corvallis (Table 1b). However, as at Kalispell, no trends were apparent with 1992 harvest date. None of the 5 quality components showed significant differences at Corvallis (Table 2b).

We thought that any treatment in 1992 that stressed the peppermint would result in lower dry matter and oil yields in 1993. This was not apparent. Possibly, meristem derived peppermint needs to be stressed to produce high oil yields, particularly in a wet, cool year like 1993.

The average oil yield from the production field in 1993 was 59 lbs/acre. In this production field, it took twice as much dry matter to produce a pound of oil in 1993 as it did in 1992 (baby mint).

Table 1a. Effect of fall harvest date on subsequent year's dry matter yield, oil content, and oil yield at Kalispell, MT (NWARC) in 1993.

		8/10/93 HARVEST		
1992 Harvest Date	1992 Stage at Harvest	Dry Matter *tons/acre*	Oil Content *ml/lb*	Oil Yield *lbs/acre*
8/5	bud	4.79	1.2	21.4
8/12	10% flower	4.53	1.5	26.0
8/19	30% flower	4.48	1.7	29.2
8/26	70% flower	4.77	1.8	31.4
9/2	late flower	4.43	1.5	24.4
9/10	petal drop	4.71	1.4	25.0
9/16	mature	4.36	1.3	21.5
9/23	mature	4.43	1.7	28.5
9/29	mature	4.22	1.5	23.9
Uncut		4.79	1.0	17.9
	mean	4.55	1.5	24.9
	LSD(0.05)	0.38	0.5	9.3
	P–VALUE	0.04	0.11	0.16

Table 1b. Effect of fall harvest date on subsequent year's dry matter yield, oil content, and oil yield at Corvallis, MT (WARC) in 1993.

1992 Harvest Date	Dry Matter *tons/acre*	Oil Content *ml/lb*	Oil Yield *lbs/acre*
8/7	2.77	2.6	27.1
8/13	2.83	2.5	26.8
8/20	3.32	2.1	26.3
8/27	3.32	2.8	35.8
9/3	2.58	3.0	29.2
9/10	1.96	3.1	23.0
9/17	2.76	2.1	22.2
9/25	2.43	3.0	28.0
9/29	2.61	2.5	24.0
Uncut	3.62	2.5	34.5
mean	2.82	2.6	27.7
LSD(0.05)	0.67	0.7	9.3
P–VALUE	0.00	0.04	0.08

Table 2a. Effect of fall harvest date on subsequent year's peppermint quality at Kalispell, MT (NWARC) in 1993.

1992 Harvest Date	Total Heads	Mentho–furan	Menthone	Menthol	Menthyl Acetate Ester
			%		
8/5	7.82	1.62	19.57	42.35	5.35
8/12	7.95	1.62	19.15	42.73	5.10
8/19	8.83	1.71	19.27	42.04	5.33
8/26	8.28	1.80	20.43	42.85	4.87
9/2	8.05	1.74	17.75	43.37	5.78
9/10	7.68	1.77	19.79	43.21	5.78
9/16	8.07	1.85	17.69	42.73	6.19
9/23	8.12	1.78	18.53	42.50	5.64
9/29	7.47	1.85	19.38	42.57	5.38
uncut	7.73	1.61	19.61	41.47	5.73
means	8.00	1.73	19.12	42.58	5.51
LSD(0.05)	1.20	0.16	2.18	1.91	1.14
P–VALUE	0.61	0.01	0.25	0.72	0.50
A.M.Todd [1/]	9.5–11.5	1.0–4.0	20.0–28.0	48.0–55.0	5.5–7.5
MT means [2/]	10.0	1.7	23.8	43.9	3.8

Table 2b. Effect of fall harvest date on subsequent year's peppermint quality at Corvallis, MT (WARC) in 1993.

1992 Harvest Date	Total Heads	Mentho–furan	Menthone	Menthol	Menthyl Acetate Ester
			%		
8/7	6.9	1.7	12.9	45.6	7.2
8/13	6.8	1.6	12.9	45.5	7.6
8/20	7.3	1.6	11.8	45.7	7.8
8/27	7.3	1.8	13.2	45.0	6.9
9/3	6.2	1.5	13.2	45.6	7.2
9/10	6.7	1.5	13.1	45.2	7.5
9/17	6.7	1.6	13.1	43.5	7.3
9/25	6.8	1.7	12.2	46.5	7.2
9/29	6.6	1.6	12.8	45.8	7.3
uncut	7.4	1.6	14.3	44.6	6.6
means	6.9	1.6	12.9	45.3	7.2
LSD(0.05)	0.9	0.3	2.4	2.5	1.0
P–VALUE	0.31	0.62	0.76	0.51	0.53
A.M.Todd [1/]	9.5–11.5	1.0–4.0	20.0–28.0	48.0–55.0	5.5–7.5
MT means [2/]	10.0	1.7	23.8	43.9	3.8

[1/] A.M.Todd typical assay ranges for the individual components in prime peppermint oil.
[2/] 1991 mean values for 14 commercial quality Montana peppermint oils.

YEAR/PROJECT: 1993/758

TITLE: Effect of harvest date on peppermint oil production at Kalispell, MT in 1993.

PERSONNEL: L.E.Welty and L.S.Prestbye, NWARC

PROCEDURES:

In 1992, harvest date (fall management) studies were initiated at the Northwestern Agricultural Research Center in meristem 'Black Mitcham' peppermint. In 1993, an area adjacent to the 1992 study was established with the same design. Hay and oil yields were determined starting July 22 and continued at 10-day intervals until September 29. Two uncut controls were included to determine effect of no topgrowth removal on 1994 hay and oil production. Harvest dates and growth stages are shown in Table 1.

The entire field was flamed on May 11 for rust. Plots were irrigated from May 12 to September 9 with a total of 14.7 inches of water. On October 7, 1992, 22 lbs N/a, 104 lbs P_2O_5/a, and 150 lbs K_2O/a were applied with an air seeder. From June 3 to August 6, 1993, 260 lbs N/a and 58 lbs S/a were applied by fertigation. Sinbar, Basagran, and Assure II were used for weed control.

Hay from each plot was stored in onion bags, allowed to dry, and later distilled. Oil chemical analyses were performed by A.M.Todd Company.

RESULTS:

Dry matter yield ranged from 3.82 to 4.84 tons/acre (Table 1). Differences among harvest dates were significant, with the highest yields occurring on August 12 and September 10, and the lowest on July 22, August 23, and September 29. The dip in production at mid-season (August 23) was similar in the 1992 trial (September 2, 1992), although it occurred at a different growth stage (late bud vs late bloom in 1992).

Oil content was highest (3.0 to 3.4 ml/lb) between August 2 and 23, and lowest on September 29 (2.5 ml/lb) when the mint had stopped blooming .

Oil yield averaged 47 lbs/acre. The lowest yields came from the first and last harvest dates. There were no significant differences from August 2 to September 20, although there was a reduction trend from August 12 to September 20. High oil content compensated for the dip in dry matter yield on August 23, resulting in a higher oil yield. Oil yield from the production field, which was swathed August 10 and distilled August 20, was 59 lbs/acre.

A.M.Todd Company lists the "typical" assay ranges for the individual components in prime peppermint oil as follows: Total heads - 9.5% to 11.5%, menthofuran - 1.0% to 4.0%, menthol - 48.0% to 55.0%, menthone - 20.0% to 28.0%, and menthyl acetate ester - 5.5% to 7.5%. No significant differences in total heads were detected at NWARC in 1993 (Table 2). There were significant differences among all harvest dates for menthone, ranging from 12.32% on September 29 to 32.93% on August 2. Levels on the last 2 harvest dates were below the "typical" level. Menthofuran ranged from 1.84% (August 2) to 3.47% (August 23). The first 3 harvest dates were lower than the later dates, but all were within the "typical" zone. The levels seemed to increase during bud growth and then level off through flowering. Ester levels remained steady from early bud through mid-bloom, then rapidly increased through the end of

flowering. Oil from the last 2 harvests contained the highest menthol levels; however, only the final harvest was within the "typical" zone. Menthol decreased from the vegetative stage through early bud, then increased throughout the flowering stage.

These plots will be harvested in 1994 to determine 1993 fall harvest date effects on dry matter and oil yields per acre.

Table 1. Effect of harvest date on peppermint dry matter yield, oil content and oil yield at Kalispell, MT (NWARC) in 1993.

1993 Harvest Date	Stage	Dry Matter *tons/acre*	Oil Content *ml/lb*	Oil Yield *lbs/acre*
7/22	vegetative	4.07	2.9	43.2
8/2	early bud	4.46	3.1	52.9
8/12	mid bud	4.76	3.0	53.6
8/23	late bud	4.07	3.4	52.1
9/2	10% flower	4.60	2.7	46.9
9/10	mid bloom	4.84	2.6	47.0
9/20	mid bloom	4.45	2.7	44.7
9/29	past bloom	3.82	2.5	35.8
mean		4.38	2.9	47.0
	LSD(0.05)	0.59	0.5	9.4
	P–VALUE	0.01	0.01	0.01

Table 2. Effect of harvest date on peppermint oil quality at Kalispell, MT (NWARC) in 1993.

1993 Harvest Date	Total Heads	Mentho–furan	Menthone	Menthol	Menthyl Acetate Ester
	----------%----------				
7/22	8.42	2.62	22.35	42.14	4.14
8/2	7.70	1.84	32.93	34.91	2.03
8/12	7.54	2.67	27.14	38.28	2.92
8/23	7.45	3.47	24.76	40.43	2.80
9/2	7.37	3.32	21.02	44.21	3.26
9/10	7.66	2.74	25.09	40.83	3.21
9/20	7.71	3.34	17.86	46.58	4.62
9/29	7.73	3.43	12.32	50.61	6.79
means	7.70	2.93	22.93	42.25	3.72
(MT means)[1/]	10.00	1.70	23.80	43.90	3.80
LSD(0.05)	0.91	1.08	8.37	6.24	2.13
P–VALUE	0.43	0.05	0.00	0.00	0.00

[1/] means of 14 lots of commercial quality Montana oil in 1991.