THIRTIETH ANNUAL REPORT
1978

Research Report No. 151

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

1570 Montana 35
Kalispell, Montana

Prepared By

Vern R. Stewart
Associate Professor of Agronomy and Superintendent

Leon E. Welty
Assistant Professor

ADMINISTRATION 750

The Administration Project concerns itself with personnel and the direction of all other research projects.

Purchases made and which were charged to this project include a new 60" x 30" desk with a typing return. This was purchased for the secretary. The purchase price of the desk was $281. For the research technician's office a four-drawer letter file was purchased at a cost of $104.

Following is a listing of personnel which include full time staff, parttime and seasonal employees during 1978.

The full-time staff in 1978 included:

Vern R. Stewart, Superintendent & Assoc. Agronomist (April 1, 1952)
Leon E. Welty, Assist. Agronomist (January 15, 1973)
Jeanette Calbick, Secretary (September 1, 1963)
Robert Sharp, Farm/Ranch Hand III (March 1 thru December 1, 1978)
Todd Keener, Ag Res. Technician II (March 27, 1978)
Patrick Hensleigh, Res. Assist. in Agronomy (April 15, 1977)

Parttime and seasonal employees:

Jim Aichlmayr (June 5 until September 15)
John Gordon (March 1 thru July 21)
Gregg Johnson (July 25 thru October 26)
Kevin Kephart (June 12 until September 15)
Karen LaBrant (June 12 until September 15)
Romana Maughan (June 26 until September 15)
Lori McPherson (July 12 until September 15)
Karen Seney (June 13 thru July 13)
Herbert Young (yard maintenance, 2 days/week throughout summer)

The Youth Employment Program (YEP) provided the following:

Charlie Crow
Karen Lentz
Doug Summers

Kevin Kephart has worked for us the last three summers and this year did his senior project on the station. Kevin is going to Montana State University majoring in Soil Science.

PHYSICAL PLANT 751

This project covers all aspects of the Physical Plant which includes all buildings (residences, crops research, garage and machine shed and barn). Also, maintenance of lawns and roadways.

In 1978 the Crops Research Building was remodeled. By insulating, putting an electric furnace ($580) and an overhead door in the south room it was converted into the shop. This made it possible to make a dry lab out of the portion of the middle room. Also, by partioning off part of the room a conference room and a chemical room were created. The chemical room was equiped with a sink and cupboards. This enhanced the measuring and mixing of chemicals and also provided a safe storage area. The conference room was paneled and new lights installed. New lights were also installed in the dry lab to provide more light for those weighting samples.

GENERAL FARM 752

The general farm project supports all research projects.

The Ford F350 flatbed truck which was purchased in 1977 was traded in on a 1978 F600 Ford truck. After using the 1977 Ford truck it was determined it did not have the power to pull the trailer and also haul the tractor.

Other pieces of equipment purchased in 1978, the cost and project to which each was charged follows:

Model 4075 B&D Grinder	$129 (755)
Gasoline Weed & Grass trimmer	$289 (752)
Lawn Boy Model #6279 Lawn mower	$265 (752)
Rod Weeder-Morris Model B2-12	$1584 (752)
Norwest Trials, Model 16EPE	$1550 (G&C 494)

DATE	VISITOR	REPRESENTING	ADDRESS
January			
5	Jim Rehbein	Dept. Natural Resources	Kalispell
	Jerry Tucker	Dept. Natural Resources	Kalispell
10	Gerard Peters	Job Applicant	Kalispell
16	Norman Baldwin	Job Applicant	Kalispell
17	Carroll Rost	Farmer	Columbia Falls
18	Gordon Kelly	Physical Plant - MSU	Bozeman
18	Rose & Wayne Cassidy	Job Applicant	Kalispell
19	Bob Pleton	Job Applicant	Kalispell
	Thad Wojciechowski	Ext. Program Coordinator	Missoula
25	Roy Nordwall	Thermal Tech	Kalispell
26	Don Parsons	Job Applicant	Kalispell
February			
1	Todd Keener	Job Applicant	Vancouver, WA
8	Stephen Ohlde	Job Applicant	Kalispell
16	Beryl Mahlum	Farmer	Somers
17	Jim Aichlemeyer	Job Applicant	Portland, OR
21	Karl & Maynard Thompson	Farmers	Kalispell
	John Sheldon	Farmer	Kalispell
22	Carl Shrade	Farmer	Columbia Falls
24	Tom Seymore	Farmer	Charlo
25	Bradly Thompson	Job Applicant	Crawfordsville,IN
March			
8	Ron Brenchley	Monsanto	Ashton, ID
10	Henry Robinson	Retired Vo-Ag Teacher	Kalispell
14	Jeff Donat	Job Applicant	Kalispell
	Jean McIntire	Housewife	Polson
16	Paul D. Rank	National Weather Ser.	Kalispell
21	Jeff Donat	Job Applicant	Kalispell
	Clyde Pederson	Farmer	Kalispell
23	John Gordon	Job Applicant	Columbia Falls
29	Luke Lalum	Vo-Ag Teacher	Kalispell
30	Sigrid Brekkeflat	Farmer	Bigfork
30	Thomas Odegard	Farmer	Bigfork
31	Gene Heim	Farmer	Bigfork
April			
4	Lowell Darrington	Monsanto	
10	Mark Lalum	Vo-Ag Teacher	Kalispell
11	Charles Lemry	Farmer	St. Ignatius
14	Karen Seney	Student	Kalispell
17	Don Curtis	Sod-Farmer	Kalispell
	Homer Metcalf	Plant & Soil Science-MSU	Bozeman
21	Ray & LaDean Thompson	Industrial Engineer	LosAngles, CA
24	George & Mrs. Darrow	Farmers	Bigfork
26	Mary Klies	American Hoechst	Billings
27	Art, Karen & Barb Lentz	Job Applicant	Kalispell
	Mr. Smith	Farmer	Kalispell
May			
4	Chuck White	Kalispell Feed & Grain	Kalispell
	Roger Smith	Wilber-Ellis Co.	Spokane, WA
	Rich Pocock	Mobay Corp.	Sugar City, ID
	Forrest Peters	Mobay Corp.	Spokane, WA
	Neal McAlpin	Farmer	Plosn

Visitors (con't)

DATE	VISITOR	REPRESENTING	ADDRESS
May			
10	Will Richards	Richards Sheet Metal	Kalispell
	Byron Hoylman	General Sheet Metal	Kalispell
11	Melanie Williams	Job Applicant	Bozeman
17	Gordon Anderson	CPA	Bozeman
	Billy Holly	CPA - MSU	Bozeman
	Tom Gibson	Property Control-MSU	Bozeman
	Paul Tutvedt	Farmer	Kalispell
19	George Alguard	Dept. Agriculture	Helena
	Oakfield Bain	Dept. Agriculture	Helena
23-25	Billy Holly	CPA-MSU	Bozeman
	Tom Gibson	Property Control-MSU	Bozeman
26	Mr.&Mrs. Doug Warren	Montana State University	Bozeman
	Willis Gorton	Farmer	Kalispell
30	John W. Cory	Investor (retired)	Bigfork
31	Don Lemon	Bitney's	Kalispell
June			
6	Doug Hammel	Vet and farmer	Kalispell
7	Dave Knadler	Daily InterLake	Kalispell
	Phil Bratten	Teacher	Stevensville
	FFA Chapter Members		Stevensville
8	Roger Lloyd	Dept. of Agriculture	Missoula
14	Les Mahugh	Neighbor	Kalispell
	George Evans	Plant & Soil Science-MSU	Bozeman
15	Ron Brenchley	Monsanto	Ashton, ID
16	Eric Rozell	Burlington Northern	Kalispell
	Ray Groski	Burlington Northern	Miles City
22	Bruce Hewitt	Gustafson Mfg.	Moses Lake, WA
	Dennis Latham	Highland Rim Exp. Station	Springfield,TN
23	Tom Blincoe	Farmer	Kalispell
	Tom Johnston	Farmer	Kalispell
30	Mary Klies	American Hoechst	Billings
	Harry McNeal	Plant & Soil Science-MSU	Bozeman
July			
6	Joan Speelman	Missoulian	Kalispell
	Ruth Steel	Bigfork Eagle	Bigfork
7	Clint Bourne	Retired Soil Scientist	Bigfork
	Takayaki Yoshizawa	Asian Veg. Res. & Devel. Cnt.	Taiwan
8	Boyd Johnson	Farmer	Carlston, Canada
10	Jaye Johnson & family	Farmer	Ronan
11	David Little	Kalispell Livestock News	Kalispell
12	Ray Woodward	Livestock & Range Res. Cnt.	Miles City
	Jim Rodebush	Stauffer Chemical	Swan Lake, ID
	Harry Jessup	Farmer	Kalispell
13	Jay Therkilsen	Gulf Chemical	Fargo, ND
	Dave Knadler	The Dailey InterLake	Kalispell
24	J. Martin	Farmer	Kalispell
August			
8	Al Jarvi	Cargill Sunflower Res. Cnt.	Fargo, ND
	Frank Ramley	Cargill	Minneapolis,MN

Visitors (con't)

DATE	VISITOR	REPRESENTING	ADDRESS
August			
9	Dr. Tom Ramage	Arizona State University	Tuscon, AZ
21	Dr. W.H. Wright & son	Physician	Kalispell
22	Robert Eslick	Plant & Soil Science-MSU	Bozeman
23	Ed Swift	American Crystal Sugar Co.	Moorhead, MN
	Erick Tybick	American Crystal Sugar Co.	Denmark
28	Cy Corlett	Rancher	Drummond
	Nick Isaacs	County Agent	Drummond
	Bob McMaham	Rancher	Drummong
	Allen Morrison	Rancher	Hall
	Bill Wright	Rancher	Hall
	Bill Gearheart	Rancher	Hall
30	Jim McKinley	Amchem	Albany, OR
September			
1	Nathen Byrd	Flathead County Agent	Kalispell
2	Clyde Pederson	Farmer	Kalispell
	Bill Ambrose	Farmer	Kalispell
	Allen Zimmerman	Farmer	Kalispell
4	Clarke Brothers	Farmers	Columbia Falls
7	Karl Welzenbach & family	Farmers	Wolf Point
11	J. Martin	Neighbor	Kalispell
14	David Vanek	Farmer	Lewistown
15	Mike Smith	University of California	Davis, CA
18	John Woodcock	Real Estate	Great Falls
19-20	Jay Therkilsen	Gulf Chemcial	Fargo, ND
21	Allen Taylor	Plant & Soil Science-MSU	Bozeman
25	Anna Courtney	Youth Incentive Program	Kalispell
26	Jim Hoffman	Utah State University	Logan, UT
	Blair Goates	Utah State University	Logan, UT
	Jack Walhden	Utah State University	Logan, UT
October			
4	Steve Lehmen	Photographer	Kalispell
26	N. D. Hobbs	John Deere Representative	Spokane, WA
	John Mann	John Deere Representative	Cheney, WA
27	Victor Anderson	Job Applicant	Kalispell
31	Dick Swartzback	Gulf Chemical	Merriam, KS
	Don Hopper	Gulf Chemical	Cascade
November			
2	Ken Paul	Gearmore Inc.	Lake Oswego, OR
14	Dallas Dix	Job Applicant	Bigfork
21	Harold Clarke	Farmer	Columbia Falls
22	Susan Hartman	Job Applicant	Whitefish
27	Glee Bratt	Job Applicant	Somers
28	Bill Peebler	Job Applicant	Kalispell
	Ken Jones	Job Applicant	Somers
	Glen Ames	Job Applicant	Kalispell
	John Frerich	Job Applicant	Whitefish
	Glenn Fulbright	Job Applicant	Dayton
	Jerry Hubbard	Job Applicant	Kalispell
	Larry Ivie	Job Applicant	Kalispell

Visitors (con't)

DATE	VISITOR	REPRESENTING	ADDRESS
November			
28	Dan Landon	Job Applicant	Kalispell
	Gary Haaven	Job Applicant	Kalispell
	Svend Larsen	Job Applicant	Dagmar
	Mike Wilson	Job Applicant	Kalispell
	Marvin Bates	Job Applicant	Eureka
	Michael McKnight	Job Applicant	Libby
December			
1	Phil Grawunder	Job Applicant	Whitefish
13	Svend Larsen	Job Applicant	Dagmar
	Dan Landon	Job Applicant	Kalispell
15	Glee Bratt	Job Applicant	Somers
	Larry Ivie	Job Applicant	Kalispell
18	Terry Novack	The Dailey InterLake	Kalispell

DATE	ACTITITY	STAFF	LOCATION
January			
10	Ag Council	Stewart	Kalispell
12	CRD Meeting	Stewart	Kalispell
13	Montana Pork Producers Meeting	Stewart	Kalispell
23	Mind Growers Meeting	Stewart	Kalispell
24	MT Agricultural Business Meeting	Stewart	Great Falls
February			
1	Sod-Seeding Meeting	Stewart	Bozeman
		Welty	Bozeman
9	CRD Meeting	Stewart	Kalispell
14	Ag Council	Stewart	Kalispell
		Welty	Kalispell
22	County Agents Up-Dating Meeting	Stewart	Ronan
		Welty	Ronan
22	Herbicide & Fertilizer Meeting	Stewart	Polson
23	Advisory Committee Meeting	Stewart	Allentown
		Welty	Allentown
27-	Planning Conference	Stewart	Bozeman
		Welty	Bozeman
March 3			
9	Montana Seed Growers Meeting	Stewart	Bozeman
10	Chamber Agricultural Meeting	Stewart	Kalispell
14-15	Weed Science Meeting	Stewart	Reno, NV
April			
14	Chamber Agricultural Meeting	Stewart	Kalispell
May			
2-3-4	Conservation Days	Stewart	Kalispell Area
12	Chamber Agricultural Meeting	Stewart	Kalispell
18	Vo-Ag Open Vhouse	Stewart	Kalispell
26	Flathead Chapter FFA Tour	Stewart	Creston
		Welty	Creston
June			
1	Ag Council Meeting	Stewart	Bozeman
7	Stevensville FFA Tour	Stewart	Stevensville
18-21	Tour of Oat Nurseries	Stewart	MT Agric. Res. Cnts.
23	Farm Tour with Chamber of Commerce	Stewart	Flathead County
July			
17-20	Western Society Crop Science	Stewart	Bozeman
20-21	Wheat Workers Conference	Stewart	Bozeman
28	NWARC Field Day	Stewart	Creston
		Welty	Creston
August			
3	4-H Tour	Welty	Creston
September			
13	Human Resources Award Meeting	Stewart	Kalispell
15	Chamber Agricultural Meeting	Stewart	Kalispell

DATE	ACTIVITY	STAFF	LOCATION
October			
12	Faculty Meeting	Stewart	Bozeman
17	Chamber Agricultural Meeting	Stewart	Kalispell
November			
1	Ag Council Meeting	Stewart	Bozeman
9	Fertilizer Meeting	Stewart	Kalispell
14-15	MT Potato Growers Meeting	Stewart	Missoula
21	Smut Meeting	Stewart	Logan, UT
December			
6- 7	Research Center Assoc. Meeting	Welty	Bozeman
11	Seed Production Seminar	Stewart	Kalispell

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DISTRIBUTION OF THE
1978 NORTHWESTERN AGRICULTURAL RESEARCH CENTER REPORT

Copies	
2	Office of Director, Montana Agricultural Experiment Station
1	Plant and Soil Science Department - Dr. A. Hayden Ferguson
4	Research Staff at Northwestern Agricultural Research Center
	C. W. Roath Vern R. Stewart Leon E. Welty Library
11	County Extension Agents in Northwestern Montana
	Program Coordinator - James DeBree Deer Lodge - Powell - David Streufert Flathead - Darrell E. Fenner Granite - Lake - G. Edward Bratton Lincoln - Robert E. Wilson Mineral - Willie Huot Missoula - Gerald W. Marks Ravalli - G. Robert Johnson Sanders - Barry Bowles Silver Bow - Tom Groce
3	Northwest Montana Banks
	Conrad National Bank - Kalispell The First Northwestern National Bank of Kalispell Western Montana National Bank - Missoula
1	Agricultural Stabilization and Conservation - Don Hughes
1	Farmers Home Administration - Marvin Jones
1	Soil Conservation Service - Tim Wiersum
1	Federal Land Bank Association - Bernie Herman
3	Feed Mills
	Equity Supply Company - Kalispell Kalispell Feed & Grain Supply Inc. - Kalispell Western Seed and Supply Company - Charlo

CLIMATOLOGICAL DATA

Northwestern Agricultural Research Center
Kalispell, MT 59901

Since 1949 the Northwestern Agricultural Research Center has cooperated with the United States Weather Service in securing weather information. Maximun and minimum temperatures are recorded daily at 8:00 a.m. Soil temperatures are recorded at depths of four and eight inches.

Summary of the 1977-78 Crop Year

There were 117 frost free days in 1978. The last killing frost occurred May 23, 1978 and the first killing frost was September 17, 1978. The mean for the period 1950-77 is 109 days.

Total precipitation for the crop year was 28.96 inches which is 9.73 inches more than the 29 year average. The mean temperature for the year was 41.9°F. This is 1.4°F lower than the long term average.

Following is a brief summary for each month of the crop year.

September 1977 - Precipitation was 1.35 inches above average. This above average rainfall interfered with harvest, but did provide excellent moisture for seeding of small grains.

October 1977 - Precipitation was considerably below normal. Good stands of winter wheat were noted during this month. Early seedings had heavy vegetative growth by the end of the month.

November 1977 - Precipitation was slightly above normal. First measureable snow was recorded November 20, but was all gone by November 30. Temperatures were slightly above normal. Winter wheat looked good.

December 1977 - Snow began to accumulate December 1 and we had 10 inches on the ground on December 10. We continued to have snow cover for the remainder of the month and by December 31 we had a total of 17 inches. Precipitation was 2.40 inches above normal. A total of 48 inches of snow fell during the month.

January 1978 - Snow continued to accumulate during this month with 22.5 inches on the ground on January 31. Precipitation was .56 inches above normal. Temperatures were very near normal.

February 1978 - There was continuous snow cover during this month with accumulation up to 30 inches on February 2 and ending the month with 8 inches of snow on the ground. Temperatures were just 2°F below normal with no severe low temperatures durthe month.

March 1978 - There was snow cover until March 25. Precipitation was below normal and temperatures slightly above.

April 1978 - Precipitation and temperatures were above normal for the month. Considerable loss of winter wheat was noted from snow mold, particularly those seeded in early September 1977.

May 1978 - Precipitation was 1.49 inches above normal. Temperatures were slightly below normal. Heavy rain plus heavy snow made it impossible to work many of our fields until very late in the season. Planting was also delayed because of wet fields and continuing rain.

June 1978 - June precipitation was slightly below the long time average. Crops were in good "shape" this month because there was no lack of moisture. Temperatures were near normal.

July 1978 - One of the wettest July's on record with the precipitation 2.44 inches above normal. The continuing rain hampered hay harvest. Temperatures were about normal.

August 1978 - The rain continued with 3.34 inches being recorded making hay harvest again very difficult. Considerable hay was ruined by the rain. Grain harvest was delayed and many fields of the semi-dwarf wheat sprouted causing severe economic loss. It should be noted the rain continued into September of 1978 making these grain losses very high.

The precipitation for the crop year was the highest ever recorded at 28.96 inches. That was 4.28 inches above the all time high of 24.68 inches observed during the crop year of 1968-69. The mean for all crop years since 1949-50 is 19.23 inches which is 9.73 inches less than the precipitation received during the 1977-78 crop year.

The winter of 1977-78 was quite mild with the lowest temperature being 16° below zero on January 3, 1978. The heavy snow caused high levels of TCK smut (dwarf smut) in 1978. Some susceptible varieties had infection levels of greater than 30% throughout the field.

Table 1. Summary of climatic data by months for the 1977-78 crop year (September to August) and average for the period 1949-78 at the Northwestern Agricultural Research Center, Kalispell, Montana.

Item	Sept. 1977	Oct. 1977	Nov. 1977	Dec. 1977	Jan. 1978	Feb. 1978	Mar. 1978	Apr. 1978	May 1978	June 1978	July 1978	Aug. 1978	Total or Average Growing Season
Precipitation (inches)													
Current Year	2.84	.56	1.62	4.10	2.15	.99	.73	2.54	3.56	2.63	3.90	3.34	28.96
Ave. 1949 to 1977-78	1.49	1.46	1.48	1.70	1.59	1.09	1.04	1.29	2.07	2.87	1.46	1.69	19.23
Mean Temperature (F)													
Current Year	51.6	42.5	30.4	22.0	21.6	26.1	34.3	43.7	48.1	59.1	63.4	60.3	41.9
Ave. 1949 to 1977-78	53.7	43.4	32.9	26.3	21.9	28.1	32.9	42.9	51.5	58.4	64.3	62.9	43.3
Last killing frost in spring*													
1978					May 23 (31 degrees)								
Ave. 1949-78					May 26								
First killing frost in fall*													
1978					September 17 (28 degrees)								
Ave. 1949-78					September 13								
Frost free period													
1978					117 days								
Ave. 1949-78					109 days								
Maximum summer temperature					91°F on July 16, 1978								
Minimum winter temperature					16° below zero on January 3, 1978								

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

Table 2. Summary of temperature data at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1978.

	Average temperature by month and year Degrees Fahrenheit												$\bar{x}$ for
Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Year
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	43.8	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	49.9*
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	25.1	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	29.8	33.2	43.6	52.5	54.8	61.9	68.2	42.8
1971-72	49.5	40.4	34.1	22.2	17.4	27.3	38.5	40.4	52.0	59.4	61.4	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	44.2	29.3	30.9	21.2	32.4	33.6	42.8	48.0	61.6	64.8	61.6	43.6*
1974-75	52.8	43.5	35.2	30.2	22.0	21.5	29.8	37.6	48.7	55.9	69.1	59.8	42.2
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	51.6	42.5	30.4	22.0	21.6	26.1	34.3	43.7	48.1	59.1	63.4	60.3	41.9
$\bar{x}$	53.7	43.4	32.9	26.3	21.9	28.1	32.9	42.9	51.5	58.4	64.3	62.9	

Mean temperature for all years = 43.3

* Denotes years above average temperature.

Table 3. Summary of temperature data obtained at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1978.

	Average maximum temperature by month and year Degrees Fahrenheit												$\bar{x}$ for
Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Year
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	32.2	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	56.2*
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	56.6*
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	28.7	39.6	43.5	53.1	59.2	76.2	80.0	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
$\bar{x}$	68.8	55.1	40.4	32.9	29.5	36.5	42.7	54.7	65.0	72.0	81.0	79.2	

Mean temperature for all years = 54.8

* Denotes years above average.

Table 4. Summary of temperature data obtained at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1978.

	Average minimum temperature by month and year Degrees Fahrenheit												$\bar{x}$ for
Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Year
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
1950-51	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	13.6	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	46.2	31.6
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
$\bar{x}$	38.4	31.8	25.4	19.7	14.4	19.7	23.0	31.0	37.9	44.8	47.7	46.4	

Mean temperature for all years = 31.7

* Denotes years above average temperature.

Table 5. Summary of precipitation records obtained at the Northwestern Agricultural Research Center on a crop year basis, September 1, 1949 thru August 31, 1978.

Year	Total precipitation in inches by month and year												Total for Year
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	
1949-50	1.03	1.05	1.67	.92	2.62	1.13	2.31	.84	.15	3.90	3.12	.75	19.49*
1950-51	.52	2.30	1.16	2.48	.94	1.29	.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	.98	.97	.17	1.32	3.95	.56	.69	21.10*
1952-53	.13	.05	.60	.98	1.84	1.14	.98	2.07	2.00	3.31	T	1.62	14.72
1953-54	.71	.03	.87	1.30	2.65	.79	.83	.79	1.52	2.98	2.91	3.79	19.17
1954-55	1.09	.54	1.00	.43	1.00	1.31	.44	.82	1.18	1.86	3.08	.00	12.75
1955-56	1.64	1.89	1.97	2.38	1.76	1.53	.87	1.28	1.06	4.20	2.13	3.21	23.92*
1956-57	1.16	1.10	.53	.96	1.47	1.14	.75	1.22	1.75	2.51	.52	.78	13.89
1957-58	.10	1.59	.96	1.76	1.56	2.67	.97	1.47	2.20	2.56	.84	.58	17.26
1958-59	1.99	1.16	2.90	2.77	1.95	1.33	.75	1.62	4.10	1.75	T	.91	21.23*
1959-60	4.22	3.36	4.32	.34	1.67	1.10	1.01	1.23	3.27	.69	.13	2.43	23.77*
1960-61	.55	1.44	1.72	1.24	.65	1.46	1.96	2.26	4.02	1.45	.76	.64	18.15
1961-62	3.40	1.22	1.77	2.09	1.33	1.15	1.59	.96	2.59	1.15	.11	.72	18.08
1962-63	.58	1.85	1.31	.91	1.69	1.21	.85	1.07	.57	5.00	1.44	2.10	18.58
1963-64	1.46	.75	.95	1.70	1.46	.41	1.57	.87	3.33	3.86	3.01	1.64	21.01*
1964-65	2.27	.85	1.62	3.62	2.25	.64	.24	2.55	.81	2.30	1.15	4.74	23.04*
1965-66	1.72	.21	1.31	.55	1.42	.67	.53	.76	1.18	6.57	2.49	1.64	19.05
1966-67	.79	1.34	3.33	1.68	1.50	.62	1.27	.99	1.30	2.53	.02	.01	15.38
1967-68	.91	1.88	.62	1.16	.79	1.15	.68	.57	3.92	2.22	1.00	3.42	18.32
1968-69	4.51	2.39	1.59	3.12	3.05	.75	.69	1.39	1.19	5.21	.70	.09	24.68*
1969-70	1.54	1.90	.31	1.14	3.10	.89	1.49	.76	1.97	4.37	3.08	.44	20.99*
1970-71	1.79	1.38	1.75	.99	1.84	.77	.69	.58	2.45	4.42	1.31	1.11	19.08
1971-72	.94	.87	1.70	1.62	1.10	1.65	2.11	.95	1.48	3.28	1.77	.98	18.45
1972-73	1.38	1.84	.80	2.19	.52	.56	.70	.45	1.13	2.14	.01	.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	.62	20.35*
1974-75	.80	.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	.85	1.39	.91	1.12	.34	1.92	1.90	2.49	1.49	3.42	19.97*
1976-77	.96	.62	.73	.86	.83	.71	1.40	.41	2.90	.52	3.60	1.50	15.04
1977-78	2.84	.56	1.62	4.10	2.15	.99	.73	2.54	3.56	2.63	3.90	3.34	28.96*
$\bar{x}$	1.49	1.46	1.48	1.70	1.59	1.09	1.04	1.29	2.07	2.87	1.46	1.69	

Mean precipitation for all crop years = 19.23

* Denotes years above average precipitation.

Table 6. Precipitation by day for crop year, September 1, 1977 thru August 31, 1978. Northwestern Agricultural Research Center, Kalispell, Montana.

Date	Sept. 1977	Oct. 1977	Nov. 1977	Dec. 1977	Jan. 1978	Feb. 1978	Mar. 1978	Apr. 1978	May 1978	June 1978	July 1978	Aug. 1978
1		.12	T			.26	.08	.11	.19		.64	
2			T	.43		.23		.07	.01		.01	
3	.11			.07	.12	.05		.04	.01		.32	
4	.10		T	.02	.36				.08		.40	
5	.24			.01			.03	.03	.02		1.08	
6	.03		.05	.29	.04	.10	.02	.01			T	
7		.14	T	.29								
8	.15	.15			.29	.14						
9		.02	T	.02	.39	T	.02			T	.75	
10		T	T	.39		.07			.51	.01	.06	
11			T	T					.05	.34	.12	
12				.01	.02				.02	.04	T	
13		.02		.08			.14		.02	.02		.13
14			.07	.72	.28		.07		.45	.35		
15			.10	.04	.07	T		.04	T	.03		T
16	.05		.18	.21	.07			T	.10	.02		.82
17	.63		T	.04	.10	T		.81	.19	.03	.25	.38
18	.02		.27	.14	.07	T		T			.03	.49
19	T			.03	.07	.01				.01	.12	.02
20	.10							.03		T		.11
21	T				T			.74				.26
22	.03		T	.17	T			.16	.26			
23	.09		.04	.35	.01			.47	.09	.21	1.01	
24	.14		.28	.03		.01	.30		.52	.27		
25	.18				T		T		.22	.44		
26	.07		.43	.01	.09	.02			.10	.86		
27			.08		.02		T	.01	.01		.12	
28	.20		.05	T	T	.10	T	.02	.11			
29	.50	.03	.05	.05	.12		.02	T	.28			
30	.20	.06	.02	.59	.07		T		.25			
31		.02		.11	.03		.05		.07			.12
Total	2.84	.56	1.62	4.10	2.15	.99	.73	2.54	3.56	2.63	3.90	3.34

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 thru 1978.

Year	Date Last Freeze	Temperature Degrees 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
$\bar{x}$ for all years	May 26	30	Sept. 13	30	109

Table 8. Temperature extremes at the Northwestern Agricultural Research Center Kalispell, MT, from 1950 thru 1978.

	Minimum		Maximum	
Year	Date	Temperature Degree F	Date	Temperature Degree 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	91
1978	Dec. 31	-31	July 16	91

Table 9. Summary of temperature records obtained at the Northwestern Agricultural Research Center, January 1950 thru December 1978.

Date	Average Temperature by Month and Year Degrees Fahrenheit												$\bar{x}$ for Year
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
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	42.9
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	38.3	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	43.2	51.4	59.4	63.0	64.9	58.7	47.4	35.8	24.0	44.3*
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	17.4	27.3	38.5	40.6	51.9	59.3	61.4	65.9	52.0	40.0	33.7	19.9	42.3
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	21.2	32.3	33.6	42.7	48.0	61.5	64.8	61.6	52.8	43.5	34.8	30.1	43.9*
1975	22.0	21.5	29.8	37.6	48.7	55.9	69.1	59.8	52.1	42.9	35.4	27.5	41.9
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
$\bar{x}$	21.9	28.1	32.9	42.9	51.5	58.4	64.3	62.9	53.7	43.5	32.5	26.1	

Mean temperature for all years = 43.2

* Denotes years above average mean.

Table 10. Summary of precipitation records obtained at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 thru December 1978.

Date	Total Precipitation (inches) by Months and Years												Total for Year
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1950	2.62	1.13	2.31	.84	.15	3.90	3.12	.75	.52	2.30	1.16	2.48	21.28*
1951	.94	1.29	.62	2.32	3.77	2.26	1.03	2.86	1.49	5.62	1.01	3.31	26.52*
1952	1.03	.98	.97	.17	1.32	3.95	.56	.69	.13	.05	.60	.98	11.43
1953	1.84	1.14	.98	2.07	2.00	3.31	T	1.62	.71	.03	.87	1.30	15.87
1954	2.65	.79	.83	.79	1.52	2.98	2.91	3.79	1.09	.54	1.00	.43	19.32*
1955	1.00	1.31	.44	.82	1.18	1.86	3.08	-	1.64	1.89	1.97	2.38	17.57
1956	1.76	1.53	.87	1.28	1.06	4.20	2.13	3.21	1.16	1.10	.53	.96	19.79*
1957	1.47	1.14	.75	1.22	1.75	2.51	.52	.78	.10	1.59	.96	1.76	14.55
1958	1.56	2.67	.97	1.47	2.20	2.56	.84	.58	1.99	1.16	2.90	2.77	21.67*
1959	1.95	1.33	.75	1.62	4.10	1.75	T	.91	4.22	3.36	4.32	.34	24.65*
1960	1.67	1.10	1.01	1.23	3.27	.69	.13	2.43	.55	1.44	1.72	1.24	16.48
1961	.65	1.46	1.96	2.26	4.02	1.45	.76	.64	3.40	1.22	1.77	2.09	21.68*
1962	1.33	1.15	1.59	.96	2.59	1.15	.11	.72	.58	1.85	1.31	.91	14.25
1963	1.69	1.21	.85	1.07	.57	5.00	1.44	2.10	1.46	.75	.95	1.70	18.79
1964	1.46	.41	1.57	.87	3.33	3.86	3.01	1.64	2.27	.85	1.62	3.62	24.51*
1965	2.25	.64	.24	2.55	.81	2.30	1.15	4.74	1.72	.21	1.31	.55	18.47
1966	1.42	.67	.53	.76	1.18	6.57	2.49	1.64	.79	1.34	3.33	1.68	22.40*
1967	1.50	.62	1.27	.99	1.30	2.53	.02	.01	.91	1.88	.62	1.16	12.81
1968	.79	1.15	.68	.57	3.92	2.22	1.00	3.42	4.51	2.39	1.59	3.12	25.36*
1969	3.05	.75	.69	1.39	1.19	5.21	.70	.09	1.54	1.90	.31	1.14	17.96
1970	3.10	.89	1.49	.76	1.97	4.37	3.08	.44	1.79	1.38	1.75	.99	22.01*
1971	1.84	.77	.69	.58	2.45	4.42	1.31	1.11	.94	.87	1.70	1.62	18.30
1972	1.10	1.65	2.11	.95	1.48	3.28	1.77	.98	1.38	1.84	.80	2.19	19.53*
1973	.52	.56	.70	.45	1.13	2.14	.01	.63	1.37	1.41	2.95	1.94	13.81
1974	1.35	1.32	1.40	3.36	1.82	1.80	1.01	.62	.80	.12	1.10	1.31	16.01
1975	1.56	1.08	1.50	1.27	1.50	1.40	1.08	4.26	1.18	2.96	.85	1.39	20.03*
1976	.91	1.12	.34	1.92	1.90	2.49	1.49	3.42	.96	.62	.73	.86	16.76
1977	.83	.71	1.40	.41	2.90	.52	3.60	1.50	2.84	.56	1.62	4.10	20.99*
1978	2.15	.99	.73	2.54	3.56	2.63	3.90	3.34	1.90	.15	.96	.91	23.76*
$\bar{x}$	1.59	1.09	1.04	1.29	2.07	2.87	1.46	1.69	1.50	1.43	1.46	1.70	

Mean annual precipitation for 29 years = 19.19

* Denotes years above average.

TITLE: Chemical control of wild oats (Avena fatua) in spring wheat and spring barley.

YEAR: 1978

LOCATION: Northwestern Agricultural Research Center

PERSONNEL: Vern R. Stewart
Cooperators - Weed Research Committee
Montana Agricultural Experiment Station, MSU
Montana Wheat Research and Marketing Committee
Agricultural Chemical Companies

OBJECTIVES:
1. To find a herbicide or herbicides that will effectively control wild oats in spring wheat and spring barley.
2. To determine the effect of herbicides on crops as it relates to yield and quality.

MATERIALS AND METHODS:

Three studies were conducted in 1978 on wild oats. These studies were planted in Creston silt loam soil. Newana spring wheat and Ingrid spring barley were seeded with a 12' press drill which had 7" spacings. The seeding rate for the barley was 80 lbs/a, for wheat 70 lbs/a. The grain was seeded in strips 280' long with 3' between each of the 12' wide strips. During the growing seasons the area between the strips were kept weed free. Herbicides were applied at right angles to the grain planting. Each study contained four replications. The herbicide plots were 10' wide and 12' long. Herbicides were applied with a tractor mounted research type sprayer with nozzles spaced 20" apart. Rates and volumes applied are found in the tabulated data. Forty-eight square feet were harvested with a Hege combine.

Experiment I - Effect of wild oat herbicides alone and various combinations on spring wheat and spring barley.

This experiment was designed to measure the effect of wild oat herbicides when used in combinations. Wild oats in the study were from a natural infestation. The entire experiment was sprayed with .375 lbs/a rate of bromoxynil and MCPA in combination.

Triallate, trifluralin and profluralin were incorporated following seeding, pre-emergence to the small grains. These herbicides were incorporated with a spike tooth harrow. The other herbicides were applied post-emergence depending upon the stage of growth of the grain. Stages of growth when applied are found in the tabulated data.

Experiment II - The combination of wild oat and broadleaf herbicides for weed control in spring wheat and barley.

This experiment was designed primarily to study the effect of combining wild oat herbicides with broadleaf herbicides as tank mixes or as combinations applied separately. Ten products were evaluated.

Triallate was incorporated following seeding, pre-emergence to the small grain with a spike tooth harrow. The remaining products were applied post-emergence depending upon the stage of growth of the small grains. The stages of growth and dates of application are found in the tabulated data.

Materials and Methods (con't)

Experiment III - Varietal reaction of wheat and barley varieties to wild oat herbicides.

In this experiment we studied four herbicides, three varieties of wheat and three varieties of barley. The wheat and barley tests were conducted independently. Triallate was incorporated following seeding with a spiked tooth harrow, harrowing two ways. Post-emergence applications were made according to label recommendations. Varieties used are shown in the tabulated data.

RESULTS AND DISCUSSIONS:

Experiment I - Barley

Yield differences between treatments were found to be statistically significant. The combination of triallate and metribuzin caused significant reduction in yield. The higher rates of trifluralin with triallate resulted in yield reductions. However, the profluralin + triallate combination did not reduce the yields. Yield differences were noted between the types of formulation of diclofop. The 2.36 EC formulation had an adverse effect on yield compared to the 3 EC formulation.

The combination of triallate and diclofop gave the best wild oat control. Diclofop alone gave effective control of wild oats. Barban at .375 lb/a gave excellent control, however the sequential treatment caused some yield reduction. Difenzoquat was fairly satisfactory in control of wild oats. The combination of triallate + trifluralin and profluralin + triallate were less effective in the control of wild oats than the diclofop treatments. Stand reductions were caused by the triallate + metribuzin combinations. There was little or not stand reduction in other treatments. Table 2.

Experiment I - Spring Wheat

The combination of triallate + metribuzin reduced wheat yields significantly as did the sequential treatment of barban. The 2.36 EC formulation of diclofop reduced yield some when compared to the 3 EC formulation of diclofop. Check yields were considerably lower than herbicide treatments. The triallate + metribuzin combination caused significant reduction in test weight.

Stands were reduced significantly with the combination of triallate + metribuzin.

The diclofop treatments gave the best overall wild oat control. The combinations of triallate + difenzoquat and triallate + diclofop gave excellent wild oat control. Barban treatments did not give the control that we saw in the other treatments. Difenzoquat alone gave fair control. Table 3.

Experiment II - Barley

Stands were not reduced significantly by any of the treatments. We obtained the most effective control of henbit and chickweed with the combinations of R40244 + triallate, R40244 + diclofop, and metribuzin + bromoxynil. Fanweed and shepherdspurse were effectively controlled by all herbicide combinations used in the test. The Silene species was effectively controlled by metribuzin + bromoxynil, triallate + R40244 and R40244 + diclofop.

Results and Discussions (con't)

The combination of difenzoquat + 2,4DLV ester gave the most effective wild oat control followed closely by difenzoquat + MCPA ester and the sequential treatment of (barban) + barban + bromoxynil.

Yields and test weights were found to be non-significant. Plumpness was reduced by bromoxynil + metribuzin treatment. Table 4.

Experiment II - Spring Wheat

Stand reductions were noted with the treatment of bromoxynil + metribuzin and it is interesting to note that the lower rate of metribuzin caused more stand reduction than the higher rate. R40244 + triallate caused 10 percent stand reduction whereas the combination of R40244 + diclofop caused a 7 percent stand reduction.

Metribuzin + bromoxynil and R40244 + triallate gave the most effective control of henbit. Chickweed was controlled with bromoxynil when applied early in the growing season, however when we waited for the right stage of growth of the wheat to apply the combination of difenzoquat + bromoxynil and MCPA or the phenoxy's the control of chickweed was diminished. This no doubt is due to the size of the weed. Fanweed was fairly effectively controlled by all treatments except where barban was used as a sequential treatment and MCP was added with the second application of barban.

The Silene specie was controlled effectively by any of the herbicide combinations that included bromoxynil except when applications were delayed to have the right stage of growth for the wild oat herbicide. Wild buckwheat control was similar to that of the Silene specie. The best overall broadleaf weed control was obtained with bromoxynil + metribuzin. Highest level of wild oat control was the combination of difenzoquat + 2,4DLV ester. The best overall rating for broadleaf and wild oat control was the combination of bromoxynil + diclofop.

Yields were reduced significantly when the combination of bromoxynil + metribuzin was used. This treatment also caused a significant reduction in test weights.

Experiment III - Varietal reaction of wheat and barley varieties to wild oat herbicides.

Barley - Barley yields because of varieties were found to be non-significant as were treatment yields. The interaction between varieties and treatments was non-significant, however we did note that the highest yield was obtained with the variety Unitan. The highest yield for treatment was the barban treatment, however these differences were non-significant. Most of the herbicides gave excellent control of wild oats except the sequential treatment of barban. Test weights were found to be statistically significant due to varieties. This would be anticipated because of the varieties used.

Spring Wheat - Yields of all varieties were very close. Treatments were found to be non-significant. The highest yield of wheat was from the diclofop .75 lbs/a treatment. This treatment also resulted in the best wild oat control followed by the sequential treatment of barban at .25+.25 lbs/a. Test weights were found to be statistically significant which we would have anticipated in these varieties with Fielder having the lowest test weight. Test weights are generally low for all varieties because of the continued rain during the harvest season.

Table 1. Products used in these experiments

Common Name	Trade Name or Other	Chemical Name	Company
barban	Carbyne	4-chloro-2-butynyl m-chlorocarbanilate	Gulf Chemical
bromoxynil	Bronimal Buctril	3,5-dibromo-4-hydroxybenzonitrile	Amchem Rhodia
difenzoquat	Avenge	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium	American Cyanamid
diclofop	Hoelon	[2-4-(2,4-dichorophenoxy)phenoxy]propanoic acid	American Hoechst
metribuzin	Sencor	4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H)one	Chemagro
MCPA		[(4-chloro-o-tolyl)oxy]acetic acid	Amchem
	R40244	1-(m-trifluoremethylphenyl)-3-chlor-4-chloromethyl-2-pyrlidone	Stauffer
triallate	Fargo	S-(2,3,3-trichloroally)diisopropylthio carbamate	Monsanto
2,4-D	2,4-D	(2,4-dichlorophenoxy)acetic acid	
trifluralin	Treflan	α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine	Elanco
profluralin	Tolban	N-(cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine	CIBA Geigy

Table 2. Effect of wild oat herbicides alone and in various combinations on Ingrid spring barley yield and wild oat control. Northwestern Agricultural Research Center, Kalispell, MT, 1978. Field No. R-13

Date seeded: May 18, 1978 Date harvested: September 19, 1978
Size of plot: 48 sq. ft.

Treatment		Yield	Test Wt	%	Wild Oat[10]	%	Height
Herbicide	Rate #/A	Bu/A	Lbs/Bu.	Plump	Control 1-10	Stand	Inches
Triallate[1]	1.25	98.8a[11]	50.2	96.0	7.6	100.0	18.8
Triallate[1] + metribuzin[2]	1.25 .25	78.9de	48.2	95.0	6.7	87.5	16.5
Triallate[1] + metribuzin[2][6]	1.25 .25+.25	70.0e	48.2	95.0	8.9	82.5	15.8
Triallate[1] + barban[3][5]	1.25 .375	84.9abcde	50.0	97.5	9.6	97.0	16.8
Triallate[1] + difenzoquat[9]	1.25 1.00	84.7abcde	49.8	97.3	9.7	97.5	18.0
Triallate[1] + diclofop[7]	1.25 .75	84.8abcde	48.9	97.0	10.0	97.5	17.0
Diclofop(2.36EC)[7]	.63	73.0e	49.3	95.5	9.9	95.0	16.5
Diclofop(2.36EC)[7]	.75	82.5bcde	49.5	97.0	9.9	98.8	17.0
Diclofop(3.0EC)[7]	.63	96.5abc	50.3	96.8	9.4	98.8	16.8
Diclofop(3.0EC)[7]	1.00	89.3abcd	49.6	96.8	9.6	98.8	16.3
Barban[3]	.375	91.6abcd	50.1	97.3	9.2	99.0	18.5
Barban[4][5]	.25+.25	79.5de	49.7	96.5	9.1	97.5	17.5
Difenzoquat[9]	.75	77.6de	49.5	96.8	9.1	100.0	19.0
Difenzoquat[9]	1.00	95.5abc	50.3	97.3	8.7	100.0	18.5
Triallate + trifluralin[1]	1.25 .50	89.6abcd	49.8	96.8	8.0	97.0	18.3
Triallate + trifluralin[1]	1.25 .625	81.1cde	49.4	96.5	7.7	98.0	17.8
Triallate + profluralin[1]	1.25 .50	91.3abcd	50.6	97.0	8.5	99.0	18.3
Triallate + profluralin[1]	1.25 .625	97.3ab	49.9	96.5	7.7	100.0	18.0
Check	0.0	77.0de	49.0	95.3	3.7	100.0	18.8
Check	0.0	76.2de	48.1	93.5	2.7	100.0	19.3
Check	0.0	90.0abcd	48.0	93.8	2.0	100.0	19.8
$\bar{x}$		83.8	49.4	96.38			
F[8]		4.77**	3.00**	2.94**			
S.E.$\bar{x}$		4.628	.432	.664			
L.S.D. (.05)		13.02	1.217	1.869			
C.V.%		7.81	1.23	.974			

1/ Post plant pre emergence incorporate
2/ Barley in 3-5 leaf stage
3/ Two leaf stage of wild oats
4/ Split applications: 1-2 leaf stage; 2nd 10 days later for second flush of wild oats.
5/ Apply 1-2 leaf stage, 5 gpa, 45PSI
6/ Split application of metribuzin: 1st - 6/17/78; 2nd - 7/1/78
7/ 1-3 leaf stage
8/ F-value for treatment differences

Table 2 . (con't)

9/ Difenzoquat applications and combinations.
10/ Weed control scale: 1 = no control, many weeds present; 10 = excellent control, no weeds present.
11/ Items having common letters are not significantly different from one another (Duncan's Multiple Range Test)
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

APPLICATION DATA:

	1/	3/4/5/	2/6/7/4/	9/	6/
Date	5/27/78	6/7/78	6/17/78	6/21/78	7/1/78
Temperature	69°F	68°F	68°F	69°F	65°F
Humidity	30%	43%	20%	34%	60%
Wind Velocity	0-6 mph	0-4 mph	0-4 mph	4-6 mph	0-4 mph
Soil Temperature	72°F	70°F	60°F	72°F	74°F
Soil Type	silt loam	silt loam	silt loam	slit loam	silt loam
Volume (GPA)	33	8.65	20	20	20
PSI	40	45	40	40	40
Nozzle	8003	65073	73154	73154	73154

Table 3. Effect of wild oat herbicides alone and in various combinations on Newana spring wheat yields and wild oat control. Northwestern Agricultural Research Center, Kalispell, MT 1978. Field No. R-13.

Date seeded: May 18, 1978 Date harvested: September 27, 1978
Size of plot: 48 sq. ft.

Treatment		Yield	Test Wt	Height	%	Wild Oat[10]
Herbicide	Rate #/A	Bu/A	Lbs/Bu.	Inches	Stand	Control 1-10
Triallate[1]	1.0	70.2abc[11]	58.0	20.5	96.3	7.0
Triallate[1]+metribuzin[2]	1.0+.25	46.4d	51.6	18.3	63.8	6.0
Triallate[1]+metribuzin[2/6]	1.0+.25+.25	50.4cd	51.6	17.5	55.0	8.9
Triallate[1]+barban[3/5]	1.0+.375	60.9bcd	57.9	19.0	93.8	9.6
Triallate[1]+difenzoquat[9]	1.0+1.0	77.4ab	56.9	20.0	92.0	9.9
Triallate[1]+diclofop[7]	1.0+.75	66.5bc	55.8	19.3	92.5	9.4
Diclofop(2.36EC)[7]	.63	68.7abc	56.6	19.0	96.3	9.7
Diclofop(2.36EC)[7]	.75	67.9bc	56.8	19.5	68.8	9.7
Diclofop(3.0EC)[7]	.63	80.9ab	58.7	21.0	100.0	9.0
Diclofop(3.0EC)[7]	1.0	88.9a	57.6	20.8	100.0	9.9
Barban[5]	.375	73.2ab	56.0	19.3	97.0	6.2
Barban[4/5]	.25+.25	67.0bc	56.0	19.0	93.8	7.2
Difenzoquat[9]	.75	65.8bc	56.1	19.5	95.0	7.6
Difenzoquat[9]	1.0	77.0ab	55.9	20.0	96.3	7.7
Triallate+trifluralin[1]	1.0+.5	79.9ab	55.9	19.8	95.8	8.1
Triallate+trifluralin[1]	1.0+.625	72.5ab	56.8	19.5	91.3	8.9
Triallate+profluralin[1]	1.0+.5	72.0ab	57.3	20.0	91.5	7.4
Triallate+profluralin[1]	1.0+.625	71.8ab	56.1	19.5	92.8	5.5
Check	0	44.5d	54.0	20.3	98.3	2.5
Check	0	68.0bc	57.2	19.8	94.5	6.0
Check	0	67.6bc	56.7	20.0	99.5	2.7
$\bar{x}$		67.7	56.3	19.5		
F[8]		2.87**	3.55**	2.67**		
S.E.$\bar{x}$		6.16	.915	.47416		
L.S.D. (.05)		17.34	2.57	1.33		
C.V. %		12.87	2.30	3.44		

1/ Post plant pre emergence incorporated
2/ Barley in 3-5 leaf stage, secondary roots have developed
3/ Two-leaf stage of wild oats
4/ Split application: 1-2 leaf stage and 10 days later for second flush of wild oats
5/ Apply when wild oats in 1-2 leaf stage, 5gpa, 45psi
6/ Split application of metribuzin: 1st = 6/17/78; 2nd = 7/1/78
7/ 1-3 leaf stage of wild oats
8/ F-value for treatment differences
9/ Difenzoquat and combination applications
10/ Weed control scale = 1 - many weeds present, no control; 10 - no weeds present excellent control
11/ Items having common letters are not significantly different from one another (Duncan's Multiple Range Test)
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 3. (con't)

APPLICATION DATA:

	1/	3/4/5/	2/4/6/7/	9/	6/
Date:	5/27/78	6/7/78	6/17/78	6/21/78	7/1/78
Temperature:	69°F	68°F	68°F	69°F	65°F
Humidity:	30%	43%	20%	34%	60%
Wind Velocity:	0-6mph	0-4mph	0-4mph	4-6mph	0-4mph
Soil Temperature:	72°F	70°F	60°F	72°F	74°F
Soil Type:	silt loam	silt loam	silt loam	silt loam	silt loam
Volume:	33gpa	8.65gpa	20gpa	20gpa	20gpa
PSI:	40	45	40	40	40
Nozzle Size:	8003	65073	73154	73154	73154

Table 4. Effect of the combination of wild oat herbicides and broadleaf herbicides on the yield and control of weeds in spring barley. Northwestern Agricultural Research Center, Kalispell, MT, 1978. Field No. R-13.

Date seeded: May 18, 1978 Date harvested: September 19, 1978
Size of plot: 48 sq. ft.

Treatment		Yield	Test Wt	Height	%	%
Herbicide	Rate #/A	Bu/A	Lbs/Bu	Inches	Stand	Plump
Bromoxynil + MCP (74-A-348[1]) + barban[3]	.5 + .5 + .5	75.9	48.6	19.8	100.0	96.3
Bromoxynil (74-A-344[2]) + barban[3]	.5 + .5	81.9	49.1	20.8	100.0	96.5
Bromoxynil (74-A-344[2]) + barban[3]	.375 + .375	83.5	49.6	19.3	98.8	96.5
Bromoxynil (74-A-344[2]) + metribuzin[4]	.375 + .0625	79.8	49.1	21.0	98.8	94.3
Bromoxynil (74-A-344[2]) + metribuzin[4]	.375 + .125	79.5	48.0	19.5	99.0	95.0
Bromoxynil (74-A-344[2]) + diclofop[5]	.375 + .75	76.0	49.5	19.8	98.8	97.5
R40244[6] + triallate[6]	.5 + 1.25	85.5	49.0	20.0	96.3	96.3
R40244[6] + diclofop[5]	.5 + .75	89.0	49.8	19.5	100.0	96.0
Difenzoquat+MCPA ester[9]	1.0 + .375	78.4	50.5	21.3	100.0	97.5
Difenzoquat + bromoxynil + MCP[9]	1.0 + .375+.375	91.2	50.0	19.5	98.8	97.8
Difenzoquat+2,4D-LVester[9]	1.0 + .25	79.1	50.0	20.8	98.8	98.0
Difenzoquat+2,4D amine[9]	1.0 + .50	81.8	50.1	20.3	98.8	97.3
Barban (barban+bromoxynil[7])	.25(.25+.375)	87.3	50.0	21.0	100.0	97.3
Barban (barban+MCP)[7]	.25(.25+.5)	83.6	49.3	20.5	100.0	98.3
Barban (barban + MCP + bromoxynil)[7]	.25(.25+.5 +.25	86.4	49.7	20.0	98.8	97.0
Check	0.0	78.5	49.0	21.0	100.0	95.0
Check	0.0	78.3	49.8	21.3	100.0	95.0
$\bar{x}$		82.1	49.5			96.54
F[8]		.921NS	1.52NS			2.18*
S.E.$\bar{x}$		4.735	.504			.801
L.S.D. (.05)		13.46	1.43			2.28
C.V. %		8.159	1.018			.829

APPLICATION DATA:

	6/	3/7/	4/5/7/	9/
Date:	5/27/78	6/7/78	6/17/78	6/21/78
Temperature:	69°F	68°F	68°F	69°F
Humidity:	30%	43%	20%	34%
Wind Velocity:	0-6 mph	0-4 mph	0-4 mph	4-6 mph
Soil Temperature:	72°F	70°F	60°F	72°F
Soil Type:	silt loam	silt loam	silt loam	silt loam
Volume:	33 gpa	8.65 gpa	20 gpa	20 gpa
PSI:	40	45	40	40
Nozzles:	8003	65073	73154	73154

Table 4. (con't)

Treatment		Weed Score 1-10[10]							
Herbicide	Rate #/A	Hen-bit	Chick-weed	Fan-weed	Shep-herds-purse	Silene	Wild Buck-wheat	x Broad-leaves	Wild Oats
Bromoxynil+MCP (74-A-348[1]+barban[3]	.5+.5+.5	6.2	8.5	10.0	10.0	8.7	9.5	8.8	4.2
Bromoxynil (74-A-344[2] + barban[3]	.5+.5	5.5	7.0	9.2	9.2	9.5	10.0	8.4	4.5
Bromoxynil (74-A-344[2])+ barban[3]	.375+.375	6.0	7.5	9.7	9.7	9.5	8.5	8.5	6.1
Bromoxynil (74-A-344[2])+metribuzin[4]	.375+.0625	9.5	10.0	9.9	9.9	10.0	10.0	9.9	2.7
Bromoxynil (74-A-344[2])+metribuzin[4]	.375+.125	10.0	10.0	10.0	10.0	10.0	10.0	10.0	3.7
Bromoxynil (74-A-344[2])+diclofop[5]	.375+.75	7.9	6.2	10.0	10.0	9.9	9.7	9.0	7.6
R40244[6] + triallate[6]	.5 +1.25	9.2	7.2	10.0	10.0	9.0	7.5	8.8	5.7
R40244[6] + diclofop[5]	.5 + .75	8.2	6.7	9.5	9.5	6.7	8.5	8.2	7.4
Difenzoquat + MCPA ester[9]	1.0 + .375	4.0	4.5	8.5	8.5	5.2	6.7	6.2	8.4
Difenzoquat+bromoxynil+MCP[9]	1.0+.375+.375	5.0	4.7	8.7	8.7	8.7	10.0	7.6	7.7
Difenzoquat+2,4D-LV ester[9]	1.0 + .25	3.5	4.7	8.5	8.5	5.7	7.7	6.4	8.5
Difenzoquat + 2,4D amine[9]	1.0 + .5	2.2	2.5	7.0	7.0	3.0	5.7	5.7	6.7
Barban (barban+bromoxynil)[7]	.25(.25+.375)	3.5	3.2	10.0	10.0	9.7	10.0	7.7	8.4
Barban (barban+MCP)[7]	.25(.25+.5)	5.2	5.5	9.5	9.5	4.5	8.2	7.1	7.5
Barban (barban+MCP+bromoxynil)[7]	.25(.25+.5+.25)	6.0	5.7	9.5	9.5	7.7	9.7	8.0	6.4
Check	0.0	3.0	4.5	6.0	6.0	3.5	3.2	4.4	3.5
Check	0.0	3.2	3.7	5.2	5.2	2.7	3.5	3.9	2.0

1/ 74-A-348 = combination of bromoxynil + MCP 1 + 1.
2/ New formulation of bromoxynil
3/ Applied when wild oats are in 2 leaf stage.
4/ Applied in 3-5 leaf stage (barley)
5/ Applied when wild oats 1-3 leaf stage
6/ Post plant pre emergence incorporated
7/ Sequential treatments, Barban 2 leaf, combination 10 days later
8/ F- value for treatment differences
9/ Difenzoquat and combination applications
10/ Weed control scale: 1 = many weeds present, no control; 10 = no weeds present, excellent control.
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

Table 5. Effect of the combination of wild oat herbicides and broadleaf herbicides on yields and the control of weeds in spring wheat, Northwestern Agricultural Research Center, Kalispell, MT, 1978. Field No. R-13.

Date seeded: May 18, 1978 Date harvested: October 5, 1978 Size of plot: 48 sq. ft.

Treatment		Yield	Test Wt	Height	%	Weed Score 1-10[10]						
Herbicide	Rate #/A	Bu/A	Lbs/Bu.	Inches	Stand	Hen-bit	Chick-weed	Fan-weed	Silene	Buck-wheat	x Broad-leaves	Wild Oats
Bromoxynil + MCP (74-A-348[1] + barban[3]	.5+.5 .5	78.8ab[11]	57.8	19.8	97.5	6.5	8.2	10.0	9.2	9.2	8.6	6.6
Bromoxynil(74-A-344[2]) + barban[3]	.5 .5	88.5a	58.0	19.8	98.8	5.2	8.0	9.5	9.0	9.7	8.3	8.1
Bromoxynil(74-A-344[2]) + barban[3]	.375 .375	80.3ab	58.6	19.5	98.8	4.7	8.0	9.7	7.7	9.2	7.9	8.5
Bromoxynil(74-A-344[2]) + metribuzin[4]	.375 .0625	67.2bc	56.2	18.8	91.8	8.4	9.6	10.0	10.0	9.6	9.5	5.2
Bromoxynil(74-A-344[2]) + metribuzin[4]	.375 .125	59.3c	49.6	19.3	96.5	9.7	9.9	10.0	10.0	9.7	9.9	3.7
Bromoxynil(74-A-344[2]) + diclofop[5]	.375 .75	73.0abc	57.9	19.8	96.3	7.7	8.2	9.7	10.0	10.0	9.1	9.6
R40244 + triallate[6]	.5+1.0	68.9bc	56.4	19.8	90.6	8.2	5.2	9.7	7.2	7.5	7.6	7.4
R40244[6] + diclofop[5]	.5+ .75	77.7ab	56.4	18.8	93.1	8.5	5.5	9.0	7.0	5.5	7.1	9.4
Difenzoquat+MCPA ester[9]	1.0+ .375	75.8abc	57.2	19.8	93.8	3.2	3.5	9.2	8.5	6.0	6.1	8.1
Difenzoquat+bromoxynil+ MCP[9]	1.0+ .375 .375	73.8abc	58.3	19.5	94.0	3.2	6.5	10.0	5.7	10.0	7.1	9.6
Difenzoquat+2,4D-LVester[9]	1.0+ .25	72.7abc	58.1	20.3	96.3	2.2	4.2	10.0	5.7	7.0	5.8	10.0
Difenzoquat+2,4D amine[9]	1.0+ .5	76.3abc	55.9	19.5	96.3	2.5	4.2	8.7	6.2	8.5	6.0	7.7
Barban + (barban+bromoxynil)[7]	.25 (.25+.375)	85.6ab	57.8	19.5	100.0	5.2	5.5	9.2	10.0	10.0	8.0	8.2
Barban+(barban+MCP)[7]	.25(.25+.5)	81.0ab	56.5	19.3	98.8	3.2	5.7	6.7	5.7	8.0	5.9	8.7
Barban + (barban + MCP + bromoxynil)[7]	.25(.25 .5+.25)	90.1a	56.5	20.0	98.8	4.7	7.7	10.0	6.5	10.0	7.8	8.1
Check	0.0	72.4abc	57.4	20.3	100.0	2.7	3.2	2.2	2.5	3.5	2.8	3.7
Check	0.0	74.5abc	57.1	20.5	99.5	2.7	2.7	2.0	2.5	3.7	2.7	4.0
$\bar{x}$		76.2	56.8	19.63								
F[8]		1.98*	3.27**	1.66								
S.E.$\bar{x}$		5.47	1.13	.37014								
L.S.D. (.05)		15.56	3.20	NS								
C.V.%		10.16	2.81	2.666								

Table 5. (con't)

1/ 74-A-348 = combination of Bromxoynil + MCP 1 + 1
2/ New formulation of bromoxynil
3/ Applied when wild oats are in 2 leaf stage
4/ Applied in 3-5 leaf stage (barley)
5/ Applied when wild oats are 1-3 leaf stage
6/ Post plant pre emergence incorporated
7/ Sequential treatments, Barban 2 leaf, combination 10 days later
8/ F-value for treatment differences
9/ Difenzoquat and combination applications
10/ Weed control scale = 1 - many weeds present, no control; 10 - no weeds present, excellent control
11/ Items having common numbers are not significantly different from one another (Duncan's Multiple Range Test)
* Indicates statistical significance at the .05 leve.
** Indicates statistical significance at the .01 level.

APPLICATION DATA:

	6/	3/7/	4/5/7/	9/
Date:	5/27/78	6/7/78	6/17/78	6/21/78
Temperature:	69°F	68°F	68°F	69°F
Humidity:	30%	43%	20%	34%
Wind Velocity:	0-6 mph	0-4 mph	0-4 mph	4-6 mph
Soil Temperature:	72°F	70°F	60°F	72°F
Soil Type:	silt loam	silt loam	silt loam	silt loam
Voume gpa:	33	8.65	20	20
PSI:	40	45	40	40
Nozzle Size:	8003	65073	73154	73154

Table 6. Effect of wild oat herbicides on the yield and test weight of three spring barley varieties, Kalispell, MT, 1978. Field No. R-13.

Date seeded: May 18, 1978 Date harvested: September 20, 1978
Size of plot: 48 sq. ft.

Treatment		Varieties				Wild Oat Score[6]
Herbicide	Rate #/A	Ingrid	Unitan	Purcell	$\bar{x}$	1-10
		YIELD BUSHEL/ACRE				
Triallate[1]	1.25	100.7	104.1	118.6	107.8	9.8
Difenzoquat[2]	.75	111.3	105.8	115.3	110.8	9.9
Difenzoquat[2]	1.00	102.8	116.8	105.2	108.2	9.9
Diclofop[3]	.50	93.4	114.7	114.3	107.4	9.6
Diclofop[3]	.75	97.9	112.3	90.7	100.3	10.0
Barban[4]	.375	102.7	100.7	112.7	105.4	8.9
Barban[5]	.25+.25	104.7	120.8	117.3	114.3	6.0
Check	0.0	109.4	121.1	109.2	113.2	0.0[7]
	$\bar{x}$	102.9	112.0	110.4	108.4	

ANALYSIS -YIELD

Source	D.F.	MS	F[8]
Total	95		
Rep	3	1094.64455	3.64NS
Varieties	2	764.99448	2.54NS
Error A	6	300.94351	
Trt	7	239.07439	1.24NS
Error B	21	193.49352	
VxTrt	14	232.29341	1.74NS
Error C	42	133.41904	

		TEST WEIGHT (Lbs/Bu)			
Triallate[1]	1.25	**50.1**	47.3	49.3	48.8
Difenzoquat[2]	.75	50.8	46.9	49.1	48.9
Difenzoquat[2]	1.00	50.4	47.7	49.8	49.3
Diclofop[3]	.50	49.7	47.1	49.3	48.7
Diclofop[3]	.75	49.9	47.1	49.0	48.7
Barban[4]	.375	50.9	46.4	49.4	48.9
Barban[5]	.25+.25	50.2	47.8	48.7	48.9
Check	0.0	50.8	47.4	49.3	49.2
	$\bar{x}$	50.3	47.2	49.2	

ANALYSIS - TEST WEIGHT

Source	D.F.	MS	F[8]
Total	95		
Rep	3	.09236	
Varieties	2	82.60948	348.18**
Error A	6	.23726	
Trt	7	.55327	.59
Error B	21	.9295	
VxTrt	14	.70948	1.63NS
Error C	42	.43345	

Table 6 . (con't)

1/ Post plant pre emergence incorporated
2/ Wild oats 3-5 leaf stage
3/ Wild oats 1-3 leaf stage
4/ Wild oats 2 leaf stage
5/ Sequential treatment: 2 leaf stage = 6/7/78; next applicaion 10 days later = 6/17/78
6/ Visual estimate of wild oat control
7/ The population in the check was somewhat less than the barban .25+.25
8/ F-value for treatment differences
* Indicates statistical difference at the .05 level
** Indicates statistical difference at the .01 level

APPLICATION DATA:

	1/	4/5/	3/5/	2/
Date:	5/27/78	6/7/78	6/17/78	6/21/78
Temperature:	69°F	68°F	68°F	69°F
Humidity:	30%	43%	20%	34%
Wild Velocity:	0-6 mph	0-4 mph	0-4 mph	4-6 mph
Soil Temperature:	72°F	70°F	60°F	72°F
Soil Type:	silt loam	silt loam	silt loam	silt loam
Volume:	33 gpa	8 gpa	20 gpa	20 gpa
P.S.I.:	40	45	40	40
Nozzle Size:	8003	65073	73154	73154

Table 7. Effect of several wild oat herbicides on three spring wheat varieties as related to several agronomic measurements. Northwestern Agricultural Research Center, Kalispell, MT 1978. Field No. R-13.

Date seeded: May 18, 1978 Date harvested: October 4, 1978
Size of Plot: 48 sq. ft.

Treatment		Varieties				Eilf Oat Score
Herbicide	Rate #/A	Olaf	Fielder	Newana	$\bar{x}$	0-10
		YIELD BUSHEL/ACRE				
Triallate[1]	1.00	69.2	77.9	78.0	75.0	5.7
Difenzoquat[2]	.75	80.0	84.3	85.7	83.4	6.5
Difenzoquat[2]	1.00	73.5	81.9	78.8	78.0	5.8
Diclofop[3]	.50	71.5	78.3	76.3	75.4	7.6
Diclofop[3]	.75	82.3	81.4	89.4	84.4	9.0
Barban[4]	.375	79.6	74.0	74.5	76.0	5.8
Barban[5]	.25+.25	82.4	75.1	78.7	78.7	8.5
Check	0.0	69.9	69.6	69.5	69.7	4.1
	$\bar{x}$	76.0	77.8	78.9		

ANALYSIS - YIELD

Source	D.F.	MS	F[7]
Total	71		
Rep	2	1011.55	3.20NS
Varieties	2	48.54	.15NS
Error A	4	316.27	
Treatment	7	202.34	.77NS
Error B	14	263.12	
V x T	14	38.66	1.13NS
Error B	28	34.32	

		TEST WEIGHT (Lbs/Bu)			
Triallate[1]	1.00	57.4	56.0	58.3	57.2
Difenzoquat[2]	.75	57.0	55.4	57.1	56.5
Difenzoquat[2]	1.00	55.6	55.0	55.8	55.5
Diclofop[3]	.50	57.0	54.9	57.6	56.5
Diclofop[3]	.75	57.2	53.9	56.5	55.9
Barban[4]	.375	56.4	53.9	56.2	55.5
Barban[5]	.25+.25	57.5	53.8	57.9	56.4
Check	0.0	56.3	53.7	56.5	55.5
	$\bar{x}$	56.8	54.6	57.0	

ANALYSIS - TEST WEIGHT

Source	D.F.	MS	F[7]
Total	71		
Rep	2	1.68	.36NS
Varieties	2	43.26	9.36*
Error A	4	4.62	
Treatment	7	3.76	1.93NS
Error B	14	1.95	
V x T	14	1.06	.98NS
Error B	28	1.08	

Table 7 . (con't)

1/ Post plant pre emergence incorporated
2/ Wild oats 3-5 leaf stage
3/ Wild oats 1-3 leaf stage
4/ Wild oats 2 leaf stage
5/ Sequential treatments, 2 leaf stage, next application 10 days later.
6/ Weed Control Scale: 1 = many weeds present, no control
10 = no weeds present, excellent control
7/ F - test for treatment and variety comparison
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

APPLICATION DATA:

	1/	4/5/	3/5/	2/
Date:	5/27/78	6/7/78	6/17/78	6/21/78
Temperature:	69°F	68°F	68°F	69°F
Humidity:	30%	43%	20%	34%
Wind Velocity:	0-6 mph	0-4 mph	0-4 mph	4-6 mph
Soil Temperature:	72°F	70°F	60°F	72°F
Soil Type:	silt loam	silt loam	silt loam	silt loam
Volume:	33 gpa	8.65 gpa	20 gpa	20 gpa
PSI:	40	45	40	40
Nozzle Size:	8003	65073	73154	73154

TITLE: Chemical control of broadleaf weeds in small grains

YEAR: 1978

LOCATION: Northwestern Agriculutral Research Center, Field No's R-14 and R-13

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Research Committee MAES, Montana Research and Marketing Committee, Chemical Company Research and Development Representatives

OBJECTIVES: To find a herbicide or herbicides that will effectively and economically control annual weeds in winter and spring grains with little or no deleterious effect on small grain yields.

MATERIALS AND METHODS:

Three separate experiments were conducted in 1978. They were: (1) Effect of broadleaf herbicides on winter wheat yields and weed control in winter wheat; (2) The effect of broadleaf herbicides on Ingrid spring barley yields and the control of broadleaf weeds; (3) The effect of broadleaf herbicides on Newana spring wheat yields and the control of broadleaf weeds. The herbicides used in these experiments are listed in Table 1.

Most of the herbicides used were post emergence of the crop however, one was applied post plant pre emergence and was incorporated with a spiked tooth harrow. This is indicated in the tabulated data. In the winter wheat studies the herbicides were applied at right angles to the established crop of winter wheat. The plots were 10' x 24'. In studies two and three Newana spring wheat and Ingrid spring barley were seeded with a 12' press drill which had 7" spacing. The seeding rate for the barley was 80 lbs/a, the wheat 70 lbs/a. The grain was seeded in strips 280' long with 3' between each of the 12' wide strips. During the growing season the area between the strips was kept weed free. Herbicides were applied at right angles to the grain planting. Each of these studies contained four replications. The herbicide plots were 10' x 12' long. Studies two and three were sprayed with triallate as a uniform treatment to control wild oats.

All the herbidies in the three studies were applied with a tractor mounted research type sprayer with the nozzles spaced 20 inches apart. Rates and volumns applied are found in the tabulated data. Forty-eight square feet were harvested with a Hegi combine.

Weed species found in a natural state in these experiments were: field gromwell (Lithospernium arvense L.); false flax (Camelina microcarpa L.); tumble mustard (Sisymbrium altissimum L.); field pennycress (Thlaspi arvense (L.)); tansy mustard (Descurainia pinnata (Walt)); henbit (Lamium amplexicaule L.); lambsquarter (Chenopodium album (L.)); wild buckwheat (Polygonum convolvulus (L.)); shepherds-purse (Capella bursa-pastoris L.); catchfly group (Silene conidea); quackgrass (Agropyron repens).

Where applicable, data were analyzed statistically using the analysis of variance method.

RESULTS AND DISCUSSION:

Experiment 1 - Effect of broadleaf herbicides on winter wheat yields and weed control

One week after herbicide application some phytotoxicity was noted in the Vel 5026 plus diclofop combinations. There was a slight chlorosis of the wheat plant. R40244 caused a slight chlorosis at the ½ lb/a and 1 lb/a and a severe chlorosis at 2 lbs/a. Most of these phytotoxic symptoms disappeared during the subsequent growing season.

There was a high population of broadleaf weeds in this test. The combination of bromoxynil and MCP gave excellent control of all the weeds present except for chickweed and grassy species. Vel 5026 was effective in suppressing broadleaf weeds at .125 lbs/a and .25 lbs/a and gave excellent control of the broadleaf weeds at .5 and 1.0 lb/a. R40244 at .25 lbs/a and .5 lb/a gave good weed control and at the 1 lb/a and 2 lbs/a level gave excellent weed control. The combination of diclofop and R40244 gave excellent control of weeds, however the diclofop alone did not give a high level of weed control. The combination of Vel 5026 and diclofop appear to have caused some antagonism and we had a reduction in the amount of weed control. Table 2.

Experiment 2 - The effect of broadleaf herbicides on Ingrid spring barley yields and the control of broadleaf weeds

Many of the herbicide treatments provided excellent weed control. All of the metribuzin treatments were weed free. This included the split application and in combination with bromoxynil. R40244 gave excellent weed control at all post emergence applications and very good control when applied at .75 lb/a post plant pre emergence. The bromoxynil-phenoxy combinations did not give effective control of henbit and chickweed.

Crop injury was severe in plots where the high rate of R40244 was used with all rates of metribuzin. The split application of metribuzin reduced stands significantly and caused considerable reduction in height.

Yield differences were found to be significantly different. It is interesting to note that the highest yield was the unweeded check. This is probably due in part to the fact that we did not have excessively high weed populations in the study, however these differences were not significantly different from most treatments. The metribuzin treatments, including the split application, were significantly lower in yield than the check. R40244 at .25 lbs/a applied post emergence, at the three to five leaf stage, resulted in the highest yield in the study at 106.1 bu/a. It also resulted in the highest percent of weed control of the species listed. We did note some reduction in height with R40244 and quite a reduction in height at higher rates when applied post emergence. Metribuzin caused considerable reduction in height, but gave excellent weed control. The combination of metribuzin and bromoxynil caused a decrease in yield below the check, a reduction in test weight and height, but excellent weed control. Table 3.

Experiment 3 - Effect of broadleaf herbicides on Newana spring wheat yield and the control of broadleaf weeds

Metribuzin gave excellent weed control of all species present. The combination of bromoxynil and metribuzin also gave excellent weed control This series of treatments did cause stand reductions with greatest loss occurring with the split application of metribuzin. The metribuzin treatment also resulted in significant stand reductions.

Results and Discussion (con't) :

The combination of bromoxynil with 2,4-D and with MCP did not give us effective weed control of henbit and chickweed, however it did give good control of wild buckwheat and fair control of Silene. Yields were not affected materially by these products nor were test weights or stand percentages.

R40244 provided fair to good weed control of most species. At the higher rates applied post emergence this product gave excellent weed control Yields were not significantly different from the check, however we did note some stand reduction at all rates except at .25 lb/a where there was a 100 percent stand. Table 4.

Table 1. Products used in these experiments.

Common Name	Trade Name or Other	Chemical Name	Company
bromoxynil	Brominal Buctril	3,5-dibromo-4-hydroxybenzonitrile	Amchem Rhodia
	2,4-D	(2,4-dichlorophenoxy) acetic acid	Rhodia
	MCPA	[(4-chloro-o-tolyl)oxy] acetic acid	Amchem
	R40244	1-(m-triflvoromenthylphenyl)-3-chlor-4-chloromethyl-2-pyrolidone	Stauffer
metribuzin		4-amino-6-tert-butyl-3-(methylthio)-05-triazin-5(4H)-one	Mobay
buthidazole	Vel 5026	3-[5-(1,1-dimethethyl)-1,3,4-thiadiazol-4-yl]-4-hydroxy-1-methyl-2-imidazolidinone	Velsicol
diclofop	Hoelon (HOE23408)	2-[4-(2,4-dichlorophenoxy)phenoxy] propanoic acid	American Hoechst

Table 2. Effect of broadleaf herbicides on winter wheat yields and weed control at Kalispell, MT in 1978. Field No. R-14.

Date seeded: September 20, 1977 Date harvested: September 20, 1978 Plot size: 240 sq. ft.
Harvested: 64 sq. ft.

Herbicide	Rate #/A	Yield Bu/A	Test Wt Lbs/Bu.	Silene	Chickweed	Fanweed + Shepherdspurse	Mustard	Wild Buckwheat	Grasses
Check	.0	77.7	50.0	5.7	3.0	2.7	5.3	9.0	7.0
Bromoxynil[1/]	.375	75.5	50.1	6.3	5.0	8.7	9.7	10.0	4.3
Bromoxynil[1/] + MCP	.375+.375	80.8	50.4	8.0	6.7	10.0	10.0	9.7	5.3
Vel 5026 (50WP)[2/]	.125	81.1	50.3	6.3	6.3	7.0	7.7	9.3	6.7
Vel 5026 (50WP)[2/]	.25	78.7	50.4	7.3	9.3	8.7	10.0	10.0	8.0
Vel 5026 (50WP)[2/]	.50	74.8	49.8	10.0	10 0	9.7	10.0	10.0	9.0
Vel 5026 (50WP)[2/]	1.00	71.5	49.7	9.3	9.3	10.0	10.0	10.0	9.0
Vel5026+HOE23408[3/]	.125+.75	65.7	50.2	5.7	6.0	5.3	5.3	7.4	9.0
Vel5026+HOE23408[3/]	.25 +.75	77.7	49.8	5.7	8.3	6.3	8.0	9.0	8.7
R 40244	.25	85.0	50.7	4.3	5.0	8.7	10.0	10.0	6.0
R 40244	.50	83.8	50.1	7.7	8.0	10.0	10.0	10.0	7.0
R 40244	1.00	83.3	50.2	8.0	10.0	10.0	10.0	10.0	8.7
R 40244	2.00	81.4	50.1	7.5	10.0	10.0	10.0	10.0	9.7
R40244+HOE23408	.50+1.0	83.9	50.2	8.0	7.7	10.0	10.0	10.0	8.7
HOE 23408	1.00	82.4	50.4	5.3	3.4	4.7	6.0	9.0	4.7
$\bar{x}$[4/]		78.9	50.2						
F		1.81	.496						
S.E.$\bar{x}$		3.94	.380						
L.S.D.(.05)		N.S.	N.S.						
C.V. %		7.06	1.07						

1/ Bronate formulation
2/ Post emergence 1-3, 3-5 leaf stage
3/ Joint (early) post emergence
4/ F value for variety comparison
5/ Weed Score = 1 = many weeds present, no control; 10 = no weeds present, excellent control.

APPLICATION DATA:

Date:	4/13/78	Soil Type:	silt loam
Humidity:	55%	Volume:	12 gpa
Temperature:	44°F	P.S.I:	40
Cloud Cover:	Clear	Nozzles:	8001
Soil Temperature:	42°F	Wind Velocity:	0-4 mph

Table 3. Effect of broadleaf herbicides on Ingrid spring barley yields and control of broadleaf weeds. Northwestern Agricultural Research Center, Kalispell, MT, 1978. Field No. R-13.

Date seeded: May 18, 1978 Date harvested: September 20, 1978
Size of plot: 48 sq. ft.

Treatment								
	Rate	Yield	Test Wt	%	%	Height	Weed Control 1-10[7]	
Herbicide	#/A	Bu/A	Lbs/Bu.	Plump	Stand	Inches	Henbit	Chickweed
Bromoxynil + 2,4-D[1/4]	.25 .375	92.7abc[8]	49.5	97.0	97.5	20.8	6.5	4.0
Bromoxynil + MCP[2/4]	.25 .375	87.1abcd	48.9	95.5	96.3	19.8	6.0	4.7
R40244[3]	.25	99.0ab	48.9	95.5	93.8	21.8	9.2	4.0
R40244[3]	.50	87.5abcd	48.3	95.3	88.8	18.8	9.5	7.6
R40244[3]	.75	81.5bcd	47.9	96.0	73.8	19.3	10.0	7.6
R40244[4]	.25	106.1a	47.9	95.5	93.8	20.8	10.0	9.5
R40244[4]	.50	81.6bcd	45.3	93.3	73.8	16.5	10.0	10.0
Metribuzin[4]	.25	71.9cd	45.3	95.5	72.5	16.5	10.0	10.0
Metribuzin[5]	.25+.25	67.3d	46.0	95.3	67.5	16.0	10.0	10.0
Metribuzin[4]	.50	70.5cd	46.9	96.3	78.8	18.0	10.0	10.0
Metribuzin + bromoxynil[4]	.0625 .25	80.0bcd	47.7	96.3	86.3	18.8	10.0	9.9
Metribuzin bromoxynil[4]	.125 .25	81.0bcd	47.4	95.8	97.5	16.3	10.0	10.0
Bromoxynil + 2,4D[1/4]	.125 .125	90.6abcd	48.0	96.0	97.5	18.8	8.5	6.5
Bromoxynil + MCP[2/4]	.25 .25	90.8abcd	49.5	97.0	96.2	21.0	7.5	5.5
Check	.0	98.0ab	50.9	98.0	98.8	21.8	4.0	3.2
Check	.0	108.8a	51.0	96.0	98.8	23.0	4.2	3.0
$\bar{x}$		87.1	48.1	95.9				
F[6]		2.66**	4.66**	1.98*				
S.E.$\bar{x}$		7.355	.79291	.71686				
L.S.D.(.05)		21.012	2.254	2.03772				
C.V. %		11.94	2.33	1.057				

1/ 77-A-579 Combination of bromoxynil + 2,4-D 1:1
2/ 77-A-348 Combination of bromoxynil + MCP 1:1
3/ Post plant pre emergence incorporated
4/ Post emergence 3-5 leaf stage
5/ Split application of metribuzin: 1st = 6/17/78; 2nd = 7/1/78
6/ F value for treatment differences
7/ Weed Score = 1 = many weeds, no control; 10 = no weeds, excellant control
8/ Items having common letters are not significantly different from one another.
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

NOTE: Triallate at 1.25 #/a post plant pre emergence incorporated throughout test.

Table 3. (con't)

APPLICATION DATA:

	3/	4/5/	5/
Date:	5/27/78	6/17/78	7/1/78
Temperature:	69°F	68°F	65°F
Humidity:	30%	20%	60%
Wind Velocity:	0-6 mph	0-4 mph	0-4 mph
Soil Temperature:	72°F	60°F	74°F
Soil Type:	silt loam	silt loam	silt loam
Volume, gpa:	33	20	20
P.S.I.:	40	40	40
Nozzle:	8003	73154	73154

Table 4. Effect of broadleaf herbicides on Newana spring wheat yields and control of broadleaf weeds. Northwestern Agricultural Research Center, Kalispell, MT 1978. Field No. R-13

Date seeded: May 18, 1978 Date harvested: October 5, 1978 Size of plot: 48 sq. ft.

Treatment		Yield	Test Wt	Height	%	Weed Control 1-10[7]			
Herbicide	Rate #/A	Bu/A	Lbs/Bu.	Inches	Stand	Henbit	Chickweed	Silene	Wild Buckwheat
Bromoxynil + 2,4-D[1/4]	.25+.25	80.3abc[8]	58.1	20.0	95.8	6.0	6.3	7.5	10.0
Bromoxynil + MCP[2/4]	.25+.25	81.8ab	57.7	21.0	95.5	5.8	8.5	7.5	9.5
R40244[3]	.25	87.5a	57.4	20.8	100.0	8.3	6.8	6.5	5.0
R40244[3]	.50	74.3abcd	56.9	19.8	85.0	9.5	8.0	7.5	7.0
R40244[3]	.75	69.0abcd	55.5	20.0	82.3	10.0	9.0	7.5	7.0
R40244[4]	.25	77.8abcd	54.8	20.0	91.3	10.0	9.5	9.3	9.5
R40244[4]	.50	70.0abcd	55.9	19.5	83.8	9.9	10.0	9.9	10.0
Metribuzin[4]	.25	66.5bcde	56.3	19.5	81.3	10.0	10.0	10.0	9.9
Metribuzin[5]	.25+.25	28.1f	55.5	16.3	40.0	10.0	10.0	10.0	10.0
Metribuzin[4]	.50	61.3de	49.7	18.5	73.8	10.0	10.0	10.0	9.9
Metribuzin+bromoxynil[4]	.0625+.25	60.4de	55.4	18.8	76.3	10.0	10.0	9.9	9.6
Metribuzin+bromoxynil[4]	.125+.25	49.6e	51.0	17.5	66.3	10.0	10.0	10.0	9.5
Bromoxynil+2,4D[1/4]	.375+.375	62.5cde	53.9	19.8	82.0	4.0	6.8	4.3	9.3
Bromoxynil+MCPA[2/4]	.375+.375	78.7abcd	55.7	20.5	96.3	6.8	5.5	8.1	9.9
Check	0	71.4abcd	56.4	20.3	96.3	3.0	3.8	4.8	3.5
Check	0	78.9abcd	57.2	21.0	97.5	3.0	3.8	3.0	4.3
$\bar{x}$		68.6	55.46	19.71					
F[6]		6.90**	2.44*	6.24**					
S.E.$\bar{x}$		5.530	1.464	.5105					
L.S.D.(.05)		15.80	4.18	1.451					
CV %		11.40	3.73	3.66					

APPLICATION DATA:

	3/	4/5/	5/
Date:	5/27/78	6/17/78	7/1/78
Temperature:	69°F	68°F	65°F
Humidity:	30%	20%	60%
Wind Velocity:	0-6 mph	0-4 mph	0-4 mph
Soil Temperature:	72°F	60°F	74°F
Soil Type:	silt loam	silt loam	silt loam
Volume:	33 gpa	20 gpa	20 gpa
P.S.I.:	40	40	40
Nozzle Size:	8003	73154	73154

1/ 77-A-579 Combination of bromoxynil + 2,4-D 1:1
2/ 77-A-348 Combination of bromoxynil + MCP 1:1
3/ Post plant pre emergence incorporated
4/ Post emergence 3-5 leaf stage
5/ Split application of metribuzin: 1st = 6/17/78; 2nd = 7/1/78
6/ F-value for treatment differences
7/ Weed control scale = 1 - many weeds present, no control; 10 - no weeds present, excellent control
8/ Items having common numbers are not significantly different from one another (Duncan's Multiple Range Test)
* Indicates statistical difference at the .05 level
** Indicates statistical difference at the .01 level

NOTE: Triallate at 1.00 #/A Postplant pre emergence incorporated throughout test.

TITLE: Chemical Weed Control in Legumes

PROJECT: Weed Investigations MS 754

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Weed Research Committee NAES, Chemical Company Research and Development Representatives

LOCATION: Northwestern Agricultural Research Center, Field No. X-4

OBJECTIVE: Evaluation of herbicides on yields and weed control in a new legume seeding.

MATERIALS AND METHODS:

The herbicide treatments were applied prior seeding and incorporated 3 to 6 inches deep with a tandem disk. All materials were applied with a research type plot sprayer in an aqueous solution. Herbicides used in this test are listed in Table 1. Each treatment plot was .82 acres (60' x 594'). Plant counts were obtained to study efficiency in weed control and also used as a guide in determining crop injury (plants per square foot, germination etc.). Harvest samples were taken at random from each plot and analyzed for percent alfalfa versus weed populations. Yield samples were also noted from randomly selected plots. Table 2. The test area was irrigated once during the season.

RESULTS AND DISCUSSION:

There was no significant difference in the plot yields when analyzed statistically. Table 2. There was an incidence of crop injury seen in the vernolate plots where there were fewer alfalfa plants per square foot. This may indicate a reduction of germination due to the nature of the chemical. This was counter acted by the fact that there were less weeds per square foot considering the three species observed. Table 2. The vernolate plot had no wild oats or grasses and had the highest percentage of alfalfa of the treatments.

Table 1. Products used in this test.

Common Name	Trade Name or Other	Chemical Name	Company
vernolate	Vernam	S-propyl dipropylthiocarbamate	Stauffer
EPTC	Eptam	S-ethyl dipropylthiocarbamate	Stauffer

Table 2. Effect of herbicides on weed control and yields in a new seeding of alfalfa. Northwestern Agricultural Research Center, Kalispell, MT 1978. Field X-4

Treatment			Percent Composition[1]				Plant Counts (per sq. ft.)			
Herbicide	Rate #/A	Yield T/A	Alfalfa	Broad-leaves	Grass	Wild Oats	Alfalfa	Pigeon-grass	Fan-weed	Shep-herds-purse
Vernam 7E	4	2.55	99.91	.09	.0	.0	21.5	.3	4.1	.7
Eptam 7E	4	2.57	97.94	.16	.98	.92	38.7	.4	5.8	1.0
Check	0	2.72	93.95	.08	3.12	2.85	30.9	2.1	9.2	2.6
$\bar{x}$		2.61								
F[2]		.134								
S.E.$\bar{x}$		.074								
L.S.D.(.05)		N.S.								
C.V. %		4.03								

1/ Percent composition of each species determined by weight
2/ F-value for treatment comparison
All treatments were applied preplant incorporated.

APPLICATION DATA:

Date -	6/15/78
Temperature -	65°F
Humidity -	30%
Wind Velocity -	calm
Soil Temperature -	67°F
Soil Type -	Creston silt loam
Volume -	20 gpa
P.S.I. -	40

TITLE: Chemical Weed Control in Legumes

PROJECT: Weed Investigations MS 754

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Weed Research Committee MAES, Chemical Company Research and Development Representatives

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT; Field No. Y-3

OBJECTIVE: To find a herbicide or herbicides that will provide effective control of weeds in established stands of alfalfa.

MATERIALS AND METHODS:

Herbicides were applied to an established stand of alfalfa at two stages of growth. The first application was made November 9, 1977 after grazing off the alfalfa. The second application was made in early spring as soon as the snow went off the field, March 30, 1978. Herbicides were applied in an aqueous solution with a research type sprayer. Plots were 10' x 20'. Herbicides used in this test are found in Table 1.

Weed species in this test were quackgrass (Agropyron repens (L.)); night flowering catchfly (Silene noctiflora (L.)); Kentucky bluegrass (Poa pratensis L.) and dandelion (Taraxacum officinale Weber).

Weeds observed in this study were grouped as grassy or broadleaf weeds. Harvested samples were separated to determine the percentage of legume, grassy weeds and broadleaved weeds. These determinations were made twice during the growing season at harvest time. First harvest was when the crop was in ten percent bloom, July 6, 1978, the second harvest was in late summer, August 24, 1978. The entire area was irrigated once during the growing season, however moisture was optimum throughout the growing season because of the heavy rainfall.

RESULTS AND DISCUSSION:

No specific phytotoxcity ratings were taken however some phytotoxcity was noted with the high rate of R40244 and Velsicol 5026 when used as dormant sprays. A slight dwarfing of newly emerged leaflets and mild chlorosis was also noted with the application of metribuzin at 1 lb/a. Most of the phytotoxic symptoms disappeared during the growing season and were not discernable at harvest time. A statistical analysis of the yield data indicated no significance difference between treatments, however many of the treatments exceeded the check in yield. A slight reduction in yield was noted with the higher rate of metribuzin. There were no differences in yield between the post-harvest applications and the dormant application of herbicides. Two lbs/a rate of Velsicol 5026 applied either as a post harvest treatment or as a dormant treatment resulted in excellent weed control giving us 100 percent alfalfa composition. Metribuzin at 1 lb/a also gave 100 percent alfalfa composition. All of the Velsicol 5026 treatments resulted in 90 percent alfalfa or better. R40244 did not give the same level of weed control as the other products, except at the two pound rate, which caused some discoloration of the alfalfa following application.

Table 1. Products used in the experiment.

Common Name	Trade Name or Other	Chemical Name	Company
metribuzin	Sencor	4-amino-6-(1,1-dimethylethyl-3-(methylthio)-1,2,4-trizzin-5(4H)-one	Mobay
	R 40244	1-(m-trifluoremethyl phenyl)-3-chlor-4-chloromethyl-2-pyrolidone	Stauffer
buthidazole	Vel 5026	1-(5-butyl-1,3,4-thiadiazol-2yl)-3-methyl-S-hydroxy-2-imidazolidinone	Velsicol

Table 2. Effects of several herbicides on the yields of an established stand of alfalfa. Northwestern Agriculutral Research Center, Kalispell, MT in 1978. Field No. Y-3.

1st Harvest: July 6, 1978 2nd Harvest: August 24, 1978

Treatment			Yield Tons/Acre				Percent Composition[3]		
			Replications						
Herbicide	Rate #/A	Cutting	I	II	III	$\bar{x}$	Alfalfa	Broadleaves	Grass
Vel 5026[1]	.50	1st	3.05	3.34	3.01		93.2	.8	6.0
		2nd	.99	1.53	1.05				
		Total	4.04	4.87	4.06	4.32			
Vel 5026[1]	.75	1st	3.42	2.73	1.58		98.1	1.1	.8
		2nd	1.04	1.70	1.05				
		Total	4.46	4.43	3.63	4.17			
Vel 5026[1]	1.00	1st	3.52	3.45	2.25		98.7	.7	.6
		2nd	1.08	1.37	1.11				
		Total	4.60	4.82	3.36	4.26			
Vel 5026[1]	1.50	1st	4.00	2.97	2.37		97.5	2.5	.0
		2nd	1.18	1.38	1.11				
		Total	5.18	4.35	3.48	4.34			
Vel 5026[1]	2.00	1st	3.70	3.56	2.39		100.0	.0	.0
		2nd	1.18	1.65	1.00				
		Total	4.88	5.21	3.39	4.49			
Vel 5026(50)[2]	.50	1st	4.26	3.01	2.92		97.5	1.4	1.1
		2nd	1.31	1.41	1.04				
		Total	5.57	4.42	3.96	4.65			
Vel 5026(50)[2]	.75	1st	3.56	3.20	2.28		99.4	.0	.6
		2nd	1.18	1.57	.98				
		Total	4.74	4.77	3.26	4.26			
Vel 5026(50)[2]	1.00	1st	3.22	3.66	2.24		99.9	.0	.1
		2nd	1.19	1.69	1.09				
		Total	4.41	5.35	3.33	4.36			

Table 2. (con't)

Treatment			Yield Tons/Acre				Percent Composition[3]		
			Replications						
Herbicide	Rate #/A	Cutting	I	II	III	$\bar{x}$	Alfalfa	Broadleaves	Grass
Vel 5026(50)[2]	1.50	1st	2.59	2.76	2.48		99.9	.0	.1
		2nd	1.09	1.32	1.32				
		Total	3.68	4.08	3.80	3.85			
Vel 5026(50)[2]	2.00	1st	3.54	3.10	2.01		100.0	.0	.0
		2nd	1.22	1.67	1.27				
		Total	4.76	4.77	3.28	4.27			
Metribuzin[2]	.25	1st	4.61	3.53	2.24		94.0	1.4	4.6
		2nd	1.34	1.49	1.15				
		Total	5.95	5.02	3.39	4.79			
Metribuzin[2]	.50	1st	3.64	3.41	2.32		98.2	1.3	.5
		2nd	1.29	1.50	1.17				
		Total	4.93	4.91	3.49	4.44			
Metribuzin[2]	1.00	1st	3.29	2.27	2.40		100.0	.0	.0
		2nd	1.02	1.34	1.25				
		Total	4.31	3.61	3.65	3.86			
Vel 5026(EC)[2]	.50	1st	2.79	3.33	2.77		99.1	.6	.3
		2nd	1.05	1.37	1.14				
		Total	3.84	4.70	3.91	4.15			
Vel 5026(EC)[2]	.75	1st	2.85	3.36	2.87		99.0	.0	1.0
		2nd	1.13	2.17	1.26				
		Total	3.98	5.53	4.13	4.55			
Vel 5026(EC)[2]	1.00	1st	3.86	2.90	1.84		99.9	.1	.0
		2nd	1.16	1.56	1.18				
		Total	5.02	4.46	3.02	4.17			
Vel 5026(EC)[2]	1.50	1st	4.31	2.50	3.15		99.4	.0	.6
		2nd	1.05	1.29	1.14				
		Total	5.36	3.79	4.29	4.48			
Vel 5026(EC)[2]	2.00	1st	3.44	2.59	2.16		100.0	.0	.0
		2nd	1.10	1.06	1.36				
		Total	4.54	3.65	3.52	3.90			
Check	0.00	1st	3.37	1.96	2.83		79.6	5.6	14.8
		2nd	1.14	1.33	1.33				
		Total	4.51	3.29	4.16	3.99			
R 40244(2E)[2]	.50	1st	2.68	2.73	2.26		85.8	1.0	13.2
		2nd	1.16	1.17	1.09				
		Total	3.84	3.90	3.35	3.70			
R 40244(2E)[2]	1.00	1st	3.35	2.98	2.34		85.0	.4	14.6
		2nd	1.21	1.14	1.08				
		Total	4.56	4.22	3.42	4.07			

Table 2. (con't)

Treatment			Yield Tons/Acre				Percent Composition[3]		
			Replications						
Herbicide	Rate #/A	Cutting	I	II	III	$\bar{x}$	Alfalfa	Broadleaves	Grass
R 40244(2E)[2]	2.00	1st	3.29	2.58	2.25		97.7	.1	2.2
		2nd	1.07	1.14	1.15				
		Total	4.36	3.72	3.40	3.83			

$\bar{x}$	4.22
F[4]	.86NS
S.E.$\bar{x}$	.310
L.S.D.(.05)	N.S.
C.V. %	10.38

1/ Post harvest application
2/ Dormant application
3/ Plot samples were separated into species on first cutting only and percent composition was determined by weight.
4/ F value for variety comparison

APPLICATION DATA:	1st	2nd
Date:	11/9/77	3/29/78
Temperature:	38°F	47°F
Humidity:	31%	67%
Wind Velocity:	calm	0-3 mph
Soil Temperature:	42°F	48°F
Soil Type:	Creston silt loam	Creston silt loam
Volume	16.0 gpa	25.6 gpa
P.S.I.	40	40

TITLE: Chemical Control of Weeds in Potatoes.

PROJECT: Weed Investigations MS 754

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Weed Research Committee MAES, Chemical Company Research and Development Representatives

LOCATION: James Treweek Farm, north of Kalispell, MT

OBJECTIVES:
1. To measure the effectiveness of certain herbicides for the control of weeds in potatoes.
2. To determine the effect of herbicides on potato yields.

MATERIAL AND METHODS:

Three herbicides were used in these investigations. The experiment was conducted on a field basis, the rows were 1000 feet long and two rows per plot. Area harvested was 6000 square feet.

Weed species found in these studies were; wild oats (Avena fatua); green foxtail (Setaria viridis (L.)); pigweed (Amaranthus retroflexus L.); field penny cress (fanweed) (Thlaspi arvense (L.)).

Herbicides were applied in a aqueous solution post plant, pre-emergence of the potatoes. They were applied with a tractor mounted boom sprayer and incorporated 3-6 inches with a two row Lilliston rolling cultivator in one operation. Field conditions at application time were excellent for incorporations and moisture levels were high. Periodic observations were made during the growing season by the grower and the research staff.

RESULTS AND DISCUSSION:

Growers Observations -

Prior to cultivation Mr. Treweek noted that wild oats was a predominate weed species present in this study. Effective control was obtained by all the herbicides used. He observed no injury at any time during the growing season.

Researchers Observations -

Visual weed estimates were made two weeks following cultivation of the potatoes and these scores are found in Table 2. Vernolate had the highest weed score of 9.5. On July 15, 1978 the vines were more vigorous in the cycloate treatment than in the check or the adjacant treatments. The cycloate treatment was the highest yielding in the test (431.25 cwt per acre). This is about 21 percent above the check treatment which contained a high population of wild oats. The vernolate yields are less than the cycloate yields, however they are higher than the EPTC yields. The herbicide treatments as a group ran from 6 to 21 percent higher yield than the check plot.

Table 1. Products used in the experiment.

Common Name	Trade Name or other	Chemical Name	Company
EPTC	Eptam	S-ethyl dipropylthiocarbamate	Stauffer
cycloate	Ro-Neet	S-ethyl cyclohexylethylthiocarbamate	Stauffer
vernolate	Vernam	S-propyl dipropylthiocarbamate	Stauffer

Table 2. Effects of certain herbicides on potato yields and weed control in Russet Burbank potatoes grown at the Jim Treweek farm, Kalispell, MT in 1978.

Date seeded: June 9, 1978 Date harvested: October 6, 1978
Plot size: 6000 sq. ft.

Treatment		Yield		Weed Control 1-10[1/]	
Herbicide	Rate #/A	(lbs)	Cwt/A	Wild Oats	Pidgeon Grass
Cycloate	4.0	5940	431.25	9.0	7.0
Vernolate	6.0	5440	394.95	8.0	8.0
Vernolate	4.0	5260	381.89	9.5	9.0
EPTC	4.0	5220	378.97	9.0	8.0
Check	0.0	4900	355.74	3.0	7.0

1/ Weed control score = 1 = no control, many weeds present; 10 = excellent control, no weed present.

Application Data: All treatments applied post plant pre emergence

Date:	6/12/78
Temperature:	64°F
Humidity:	43%
Wind Velocity:	2-5 mph
Cloud Cover:	P/C
Soil Temp:	62°F
Soil Type:	silt loam
Nozzle Size:	8006
GPA:	44 gpa
PSI:	30

TITLE: Weed Control in "Sod-Seeded" Legumes

PROJECT: Weed Investigations MS 754

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Weed Research Committee, MAES
Chemical Company Research & Development Representatives

LOCATION: Northwestern Agricultural Research Center - Field No. P-2

OBJECTIVES:

1. To determine what herbicide alone and in combination will effectively control exsisting vegetation and subsequent germinating weeds in sod-seeding of small legumes and grasses.
2. To find a rate of glyphosate that will control exsisting vegetation and a reduced rate, thereby reducing the cost.

MATERIALS AND METHODS:

Herbicides were applied to an established stand of alfalfa-orchard-bluegrass pasture. Plots were 10' x 30' in the combination experiment and 10' x 16' in the glyphosate rate study. All herbicides we applied with a research type tractor mounted sprayer. Weed species in the study were predominately shepherdspurse (Capella bursa-pastoris); dandelion (Taraxacum officinale). Rates, water volume, and application data are found in tabular form for each of the appropriate experiments.

RESULTS AND DISCUSSION:

Combination Experiment: Buthidazole reduced the alfalfa stand when used in combination with glyphosate and in the three way combination including napropamide. None of the other treatments had any effect on plant counts 48 days after seeding. R40244 gave the most effective broadleaf weed control. Table 1.

In Table 2 is given species composition data. The highest alfalfa percentages were obtained in the three way combination of glyphosate + R40244 + napropamide.

Yield of alfalfa from the glyphosate + R40244 + napropamide were the highest at 2.80 T/A, but not significantly higher than glyphosate + R40244 combination. Table 3.

Glyphosate Rate and Growth Stage Experiment: Glyphosate rates with and without a surfactant did not affect plant stands. Application at the third stage of growth did reduce plant stands significantly. Table 4.

Table 5 shows the percent of alfalfa for treatments and stage of growth. Higher alfalfa percentages were obtained when applications were made in the 7-8 inch stage (2nd).

Greater grass control was obtained when applications were made at 7-8 inch growth stage, rates and surfactant were not significantly different as relates to grass control. Table 6.

Weed percentages were higher when applications were made at the 10-14 inch stage of growth. Table 7.

Yields were not significantly different between glyphosate treatments except .75 lb/a of glyphosate which was significantly lower, exclusive of the check. There were not any significant yield differences between the first and second stages of growth, however the third stage was significantly lower in yield.

Table 1. Effect of glyphosate in combination with various herbicides on alfalfa stand establishment and number of broadleaves.

Treatment		Plants/ft^2		Number[4/5] Broadleaves/ft^2
Herbicide	Rate Lbs AE/acre	5/25/78[3/5]	6/13/78[3/5]	6/29/78
Glyphosate	1.5	28ab	21a	15.5ab
Glyphosate + EPTC[1]	1.5+3.75	23b	19ab	17.0a
Glyphosate + R40244[2]	1.5+0.50	23b	20a	0.9c
Glyphosate + napropamide[2]	1.5+2.00	28ab	22a	11.8b
Glyphosate + buthidazole[2]	1.5+0.50	23b	10c	1.2c
Glyphosate + R40244 + napropamide[2]	1.5+0.50 2.0	27ab	19ab	3.0c
Glyphosate + buthidazole + napropamide[2]	1.5+0.50 2.0	27ab	13bc	3.7c
Check	0.0	32a	17ab	-
Mean		26	17	7.6

1/ Granular, mixed with seed
2/ Tank mix
3/ Six, 3' counts/plot; mean of four replications
4/ Number of broadleaves occupying a 1' square - 3 counts/plot; mean of four replications
5/ Treatment means in the same column followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

APPLICATION DATA

Date:	5/1/78
Temperature:	60°F
Humidity	50%
Wind Velocity:	4-6 mph
Soil Temperautre:	68°F
Soil Type	Silt Loam
Volume G.P.A.:	29.2
P.S.I.:	40
Nozzle:	8003
Stage of Growth:	Orchardgrass - 4-8"
	Bluegrass - 3"
	Dandelion - 7" diameter

Table 2. Effect of glyphosate in combination with various herbicides on first year species composition.

Treatment		Species Composition[3]					
		1st Harvest 8/24/78			2nd Harvest 10/10/78		
Herbicide	Rate lbs AE/Acre	% Alfalfa[4]	% Grass[4]	% Broad-leaves[4]	% Alfalfa[4]	% Grass[4]	% Broad-leaves[4]
Glyphosate	1.5	83.5bc	0.5c	16.0ab	94.5a	4.5c	1.0b
Glyphosate + EPTC[1]	1.5+3.75	74.0c	1.5c	24.5a	92.5a	4.5c	3.0b
Glyphosate + R40244[2]	1.5+0.5	96.5ab	2.0c	1.0bc	96.0a	2.0c	1.5b
Glyphosate+napropamide[2]	1.5+2.0	86.5abc	0.0c	13.5abc	97.0a	1.0c	2.0b
Glyphosate+buthidazole[2]	1.5+0.5	93.0ab	2.0c	5.0bc	84.0b	13.0b	3.0b
Glyphosate+R40244[2] + napropamide	1.5+0.5 2.0	99.5a	0.0c	0.0c	97.0a	1.0c	2.0b
Glyphosate+buthidazole[2] + napropamide	2.0	89.0abc	5.5b	5.5bc	82.5b	14.5b	3.5b
Check	0.0	1.0d	95.5a	3.5bc	4.0c	88.0a	7.5a
Mean		77.9	13.4	8.6	80.9	16.1	2.9

1/ Granular, mixed with seed

2/ Tank mix

3/ Dry weight basis: hand separation of 1000 gram sample first harvest; 500 gram sample second harvest.

4/ Treatment means in the same column followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Table 3. Effect of glyphosate in combination with various herbicides on first year sod-seeded alfalfa yields.

Treatment		Alfalfa Yield[3] (T/A at 12% Moisture)		
Herbicide	Rate Pounds AE/Acre	1st[4] Harvest	2nd[4] Harvest	Total[4] Yield
Glyphosate	1.5	1.85bc	0.60a	2.45abc
Glyphosate + EPTC[1]	1.5+3.75	1.60c	0.54a	2.14c
Glyphosate + R40244[2]	1.5+0.5	2.23a	0.55a	2.78a
Glyphosate + napropamide[2]	1.5+2.0	1.68c	0.61a	2.29bc
Glyphosate + buthidazole[2]	1.5+0.5	2.28a	0.49a	2.76a
Glyphosate + R40244 + napropamide[2]	1.5+0.5+2	2.21a	0.60a	2.80a
Glyphosate + buthidazole + napropamide[2]	1.5+0.5+2	2.17ab	0.51a	2.68ab
Check	0.0	0.02d	0.02b	0.04d
Mean		1.76	0.49	2.24

1/ Granular, mixed with seed
2/ Tank mix
3/ Percent alfalfa X total plot yield; mean of four replications.
4/ Means in the same column followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multple Range Test.

Table 4. Effect of glyphosate rates and growth stages on stand establishment of sod-seeded alfalfa.

Treatment		Plants/ft^2 1/2/							
		First Count Stage of Growth				Second Count Stage of Growth			
Herbicide	Rate Lbs AE/A	2-3"	7-8"	10-14"	Mean 3/	2-3"	7-8"	10-14"	Mean 3/
Glyphosate	0.75	40a	39a	33a	37a	35ab	29a	23a	29a
Glyphosate + surfactant	0.75	41a	41a	33a	38a	37ab	29a	23a	30a
Glyphosate	1.00	45a	40a	31a	39a	39a	29a	17b	28a
Glyphosate + surfactant	1.00	40a	38a	30a	36a	36ab	28a	20ab	28a
Glyphosate	2.00	40a	41a	31a	37a	36ab	29a	18ab	28a
Glyphosate + surfactant	2.00	41a	42a	30a	38a	33b	30a	18ab	27a
Check	0.0	38a	41a	29a	36a	28c	29a	4c	20b
Mean 3/		41a	40a	31b		35a	29a	18b	

1/ Twelve 3 ft counts/plot; mean of four replications

2/ Treatment means within each growth stage (for each plant count) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

3/ Treatment means averaged across growth stage and growth stage means averaged across treatments followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Plant Count Dates:	Stage of Growth	First Count	Second Count
	2-3"	5/4/78	6/5/78
	7-8"	5/25/78	6/15/78
	10-14"	6/12/78	7/6/78

Application Data:	Stage of Growth		
	2-3"	7-8"	10-14"
Date:	4/12/78	5/1/78	5/18/78
Temperature:	52°F	66°F	57°F
Humidity:	22%	44%	55%
Wind Velocity:	2-5 mph	3-5 mph	0 mph
Soil Temperature:	54°F	68°F	56°F
Soil Type	Silt Loam	Silt Loam	Silt Loam
Volume G.P.A.	29.2	29.2	29.2
PSI:	40	40	40
Nozzle:	8003	8003	8003

Table 5. Effect of glyphosate rate, surfactant and sod growth stage on first year percent alfalfa.

Treatment		Percent Alfalfa[1/2/]							
	Rate Lbs	First Harvest 8/23/78 Stage of Growth				Second Harvest 10/11/78 Stage of Growth			
Herbicide	AE/A	2-3"	7-8"	10-14"	Mean[3/]	2-3"	7-8"	10-14"	Mean[3/]
Glyphosate	0.75	19.0c	82.5a	74.5a	58.7c	10.0d	87.5a	83.5a	60.3c
Glyphosate + surf	0.75	70.0b	97.0a	72.0a	79.7b	59.0bc	95.0a	69.5a	74.5b
Glyphosate	1.00	70.5b	96.0a	74.0a	80.2ab	43.5c	96.5a	81.0a	75.3b
Glyphosate + surf	1.00	84.0ab	95.5a	65.5a	81.7ab	78.5ab	82.5a	70.5a	77.2b
Glyphosate	2.00	93.0a	94.0a	80.5a	89.2ab	87.5a	95.5a	88.0a	90.3a
Glyphosate + surf	2.00	94.5a	96.5a	86.0a	92.3a	92.0a	93.0a	92.0a	92.3a
Check	0.0	15.0c	5.0b	6.5b	8.8d	19.0d	7.0b	15.0b	13.7d
Mean[3/]		63.7a	80.9a	65.6a		56.4b	79.6a	71.4ab	

1/ Dry weight basis: hand separation of 1000 gram sample first harvest; 500 gram sample second harvest; mean of two replications.

2/ Treatment means within each growth stage (for each harvest) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

3/ Treatment means averaged across growth stage and growth stage means averaged across treatments (for the same harvest) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Table 6. Effect of glyphosate rate, surfactant and growth stage on first year percent grass.

Treatment		Percent Grass[1/2/]							
	Rate	First Harvest 8/23/78				Second Harvest 10/11/78			
	Lbs	Stage of Growth				Stage of Growth			
Herbicide	AE/A	2-3"	7-8"	10-14"	Mean[3/]	2-3"	7-8"	10-14"	Mean[3/]
Glyphosate	0.75	77.0a	9.5b	9.0bc	31.8b	88.5a	5.0b	10.5b	34.7b
Glyphosate + surf	0.75	22.5bc	1.0b	21.5b	15.0c	33.0bc	3.0b	25.0b	20.3c
Glyphosate	1.00	28.5b	0.0b	4.0bc	10.8cd	41.5b	0.5b	8.5b	16.8cd
Glyphosate + surf	1.00	9.0cd	2.0b	10.0bc	7.0cd	18.0cd	15.5b	21.5b	18.3cd
Glyphosate	2.00	0.5d	1.5b	2.5bc	1.5d	8.5d	1.5b	7.0b	5.7de
Glyphosate + surf	2.00	1.5d	0.5b	0.5c	0.8d	4.0d	1.0b	1.5b	2.2e
Check	0.0	85.0a	93.5a	93.5a	90.7a	80.5a	91.0a	82.0a	84.5a
Mean[3/]		32.0a	15.4a	20.1a		39.1a	16.8a	22.3a	

1/ Dry weight basis: Hand separation of 1000 gram sample first harvest; 500 gram sample second harvest; mean of two replications.

2/ Treatment means within each growth stage (for each harvest) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

3/ Treatment means averaged across growth stage and growth stage means averaged across treatments (for the same harvest) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Table 7. Effect of glyphosate rate, surfactant and growth stage on first year percent weeds.

Herbicide	Rate Lbs AE/A	Percent Weeds[1/2/] First Harvest 8/23/78 Stage of Growth 2-3"	7-8"	10-14"	Mean[3/]	Second Harvest 10/11/78 Stage of Growth 2-3"	7-8"	10-14"	Mean[3/]
Glyphosate	0.75	4.0a	8.0a	16.0ab	9.3ab	2.0bc	7.0a	6.5ab	5.2abc
Glyphosate + surf	0.75	7.0a	3.0a	6.0cd	5.3bc	7.5ab	2.0a	5.5ab	5.0abc
Glyphosate	1.00	1.0a	4.0a	21.5ab	8.8ab	10.0a	3.0a	10.0a	7.7a
Glyphosate + surf	1.00	6.5a	3.0a	25.0a	11.5a	4.0bc	2.5a	8.5a	5.0abc
Glyphosate	2.00	6.5a	4.5a	17.0ab	9.3ab	4.0bc	3.5a	4.5ab	4.0bc
Glyphsoate + surf	2.00	4.0a	3.0a	13.5bc	6.8ab	4.0bc	6.0a	6.5ab	5.5ab
Check	0.0	0.0a	2.0a	0.0d	0.7c	1.0c	2.5a	2.5b	2.0c
Mean[3/]		4.1b	3.9b	14.1a		4.6a	3.6a	6.3a	

1/ Dry weight basis: hand separation of 1000 gram sample first harvest; 500 gram sample second harvest; mean of two replications.

2/ Treatment means within each growth stage (for each harvest) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

3/ Treatment means averaged across growth stage and growth stage means averaged across treatments (for the same harvest) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Table 8. Effect of glyphosate rates and growth stage on first year sod-seeded alfalfa yields.

Treatment			Alfalfa Yield[1] (T/A at 12% moisture)			
			Stage of Growth			
Herbicide	Rate Lbs AE/A		2-3"[2]	7-8"[2]	10-14"[2]	Mean[3]
Glyphosate	0.75	First harvest	0.57c	1.62b	1.64a	1.28c
		Second harvest	0.08c	0.53b	0.52a	0.38b
		Total	0.65c	2.15b	2.16a	1.65c
Glyphsoate + surf	0.75	First harvest	1.68b	2.31a	1.23b	1.74b
		Second harvest	0.40b	0.70a	0.43a	0.51a
		Total	2.08b	3.01a	1.66b	2.25b
Glyphsoate	1.00	First harvest	1.89b	2.23a	1.25b	1.79ab
		Second harvest	0.38b	0.67a	0.49a	0.51a
		Total	2.26b	2.90a	1.74b	2.30ab
Glyphosate + surf	1.00	First harvest	2.47a	2.09a	1.10b	1.89ab
		Second harvest	0.58a	0.61ab	0.39a	0.53a
		Total	3.05a	2.70a	1.49b	2.41ab
Glyphosate	2.00	First harvest	2.46a	2.15a	1.31ab	1.97a
		Second harvest	0.65a	0.63ab	0.41a	0.56a
		Total	3.11a	2.78a	1.72b	2.54a
Glyphodate + surf	2.00	First harvest	2.55a	2.15a	1.19b	1.96a
		Second harvest	0.64a	0.59ab	0.45a	0.56a
		Total	3.19a	2.74a	1.65b	2.53a
Check	0.0	First harvest	0.37c	0.11c	0.18c	0.22d
		Second harvest	0.09c	0.04c	0.09b	0.07c
		Total	0.46c	0.15c	0.27c	0.29c
Mean[3]		First harvest	1.71a	1.81a	1.13b	
		Second harvest	0.40a	0.54a	0.40a	
		Total	2.11a	2.35a	1.53b	

1/ Percent alfalfa X total plot yield; mean of four replications.

2/ Treatment means within each stage of growth (for the same harvest or for total yield) followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

3/ Treatment means averaged across growth stages and growth stage means averaged across treatments for the same harvest or for total harvest followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

TITLE: Irrigated Commercial Alfalfa Yield Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Ray Ditterline
Research Assistant - Patrick Hensleigh

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT.

DURATION: Through 1979

OBJECTIVE: Evaluate alfalfa varieties and experimental lines for forage production in northwestern Montana.

PROCEDURES:

The nursery was seeded in field Y-4 on May 10, 1976 utilizing a randomized complete block design with four replications. Plots consisted of four rows, 20 feet in length, spaced one foot apart. Thirty-two square feet was harvested from each plot on a common harvest date for all cuttings. One hundred and eighty pounds per acre of P_2O_5 was broadcast prior to seeding in 1976. The nursery was irrigated two times in 1978 with two inches being applied per irrigation.

RESULTS AND DISCUSSION:

In 1976 (year of seeding) four varieties (Apollo, Vanguard, Olympia and MS4) produced essentially the same amount of forage per acre as did the check variety, Thor. Washoe, Syn XX and Ladak 65 all produced substantially less forage than Thor.

In 1977 the highest producing variety in the nursery was Thor followed by MS4, Apollo, Vanguard and Olympia with no significant differences occurring among the five varieties.

In 1978 there were no significant yield differences among varieties (Table 1). Mean yields for the three year period were greatest for Thor followed by MS4. Washoe was the lowest yielding variety for the three year period (Table 2).

Table 1. Yield, plant height and vigor obtained from an irrigated commercial alfalfa yield trial, Kalispell, MT in 1978.

Variety	Yield (Tons/Acre at 12% Moisture) 1st Harvest 6/30/78	2nd Harvest 8/25/78	Total	Plant Height (Inches) 6/30/78	9/28/78	Vigor[1/] 9/28/78
Syn XX	2.53	1.91	4.44	30	12	2.6
Washoe	2.31	1.67	3.97	30	12	2.9
Ladak 65	2.81	1.55	4.36	20	8	4.4
Thor	2.78	2.01	4.79	32	13	2.4
Apollo	2.68	1.94	4.63	32	13	2.6
Vangard	2.86	1.82	4.68	29	12	2.9
Olympia	2.74	1.95	4.69	31	12	2.8
MS4	2.88	1.97	4.85	30	12	2.4
Mean	2.70	1.85	4.55	29	12	2.9
F-value for variety yield comparison	1.29NS	4.53**	1.69NS	15.19**	16.12**	23.48**
S.E.$\bar{x}$	.17	.08	.22	1.05	.40	.13
S.E.$\bar{d}$	.24	.11	.31	1.48	.56	.18
C.V. $\frac{100s}{\bar{x}}$ %	12.6	8.3	9.6	7.2	6.9	9.3
L.S.D. at 0.05	.49	.22	.63	3.02	1.17	.38
L.S.D. at 0.01	.68	.31	.88	4.19	1.59	.51

1/ Vigor = 1 - good; 5 - poor

NOTE: Thor and Ladak 65 are considered to be the check varieties for this nursery.

Table 2. Summary of yields obtained from an irrigated commercial alfalfa nursery at Kalispell, MT in 1976, 1977 and 1978.

Variety	Tons per acre at 12 percent moisture						Mean	1979	4-year Total	4-year Mean
	1976	DM	1977		1978					
Syn XX	2.81	2.47	4.74	4.17	4.44	3.91	4.00	4.08	14.63	3.66
Washoe	1.95	1.72	4.35	3.83	3.97	3.49	3.42	4.10	13.14	3.29
Ladak 65	2.48	2.18	5.44	4.79	4.36	3.84	4.09	4.07	14.88	3.72
Thor	3.08	2.71	6.19	5.45	4.79	4.22	4.69	4.02	16.40	4.10
Apollo	2.89	2.54	5.97	5.25	4.63	4.07	4.50	4.58	16.44	4.11
Vangard	3.18	2.80	5.90	5.19	4.68	4.12	4.59	4.34	16.45	4.11
Olympia	3.14	2.76	5.82	5.12	4.69	4.13	4.55	4.24	16.25	4.06
MS4	2.99	2.63	6.16	5.42	4.85	4.27	4.67	4.22	16.54	4.14
Mean yields (T/A)	2.81	2.47	5.57	4.90	4.55	4.00		4.21	15.59	3.9
F-value for variety yield comparison	23.0**		8.1**		1.69NS					
S.E.$\bar{x}$ (T/A)	0.087		0.241		0.22					
S.E.$\bar{d}$ (T/A)	0.122		0.340		0.31					
C.V. $\frac{100s}{\bar{x}}$ %	6.2		8.6		9.62					
L.S.D. at 0.05(T/A)	0.254	.224	0.708	.623	0.63	.554		0.90	1.74	—
L.S.D. at 0.01(T/A)	0.345		0.963		0.88					

NOTE: Thor and Ladak 65 are considered to be the check varieties for this nursery.

TITLE: Irrigated Commercial Alfalfa Yield Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Ray Ditterline
Research Assistant - Patrick Hensleigh

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT.

DURATION: Through 1982

OBJECTIVE: Evaluate alfalfa varieties and experimental lines for forage production in northwestern Montana.

PROCEDURE:

The nursery was seeded in field Y-6 on June 7, 1978 utilizing a randomized complete block design with four replications. Plots consisted of eight rows, 20 feet in length, spaced six inches apart. One hundred and eighty pounds per acre of P_2O_5 was broadcast prior to seeding. Thirty-two square feet was harvested from each plot on a common harvest date for all cuttings. The nursery was irrigated two times in 1978 with two inches being applied per irrigation.

RESULTS AND DISCUSSION:

Yield, plant height and vigor information are presented in Table 1. Adequate stands were obtained but strong competition from broadleaves reduced yields. No variety produced significantly more or less forage than Thor the check variety, however, SC400, Iroquois, and Honeoye all produced significantly more forage than the other check variety Ladak 65. The mean yield for the entire nursery was 1.78 T/A.

Table 1. Yield, plant height, and vigor for an irrigated commercial alfalfa yield trial at Kalispell, MT in 1978.

Variety	Total Yield (Tons/Acre)	Plant Height Inches	Vigor 8/3/78[1]	Vigor 9/27/78[1]
SC 400	2.17	28	2.4	2.1
Iroquois	2.17	28	2.5	2.1
Honeoye	2.11	29	2.8	1.9
Riley	1.82	28	3.3	2.3
520	1.80	27	2.6	2.5
Thor	1.78	28	2.3	2.4
Baker	1.77	27	2.9	2.6
Vernal	1.74	27	2.8	2.5
SC400A	1.72	28	1.9	2.4
Ladak 65	1.63	26	3.3	2.8
Ranger	1.52	27	3.3	3.1
Anchor	1.49	29	2.8	2.1
NK MW77-7	1.45	25	3.5	3.6
Mean Yield	1.78	27	2.8	2.5
F-value for variety yield comparison	2.87**	2.01NS	3.52**	3.88**
S.E.$\bar{x}$	.14	.8001	.25	.24
S.E.$\bar{d}$	.20	1.13	.35	.34
C.V. $\frac{100s}{\bar{x}}$ %	16.0	5.9	17.8	19.1
L.S.D. at 0.05	.41	2.30	.70	.68
L.S.D. at 0.01	.54	3.07	.95	.93

1/ Vigor = 1 -good; 5 - poor

Seeding Date: June 7, 1978
Harvest Date: September 27, 1978

NOTE: Thor and Ladak 65 are considered to be the check varieties for the nursery.

TITLE: Determination of optimum seeding rates for maximum forage yields of Regar bromegrass under irrigation and dryland.

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Scott Cooper
Research Assistant - Patrick Hensleigh

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT.

DURATION: Through 1978

OBJECTIVE: Determine the optimum seeding rates of Regar bromegrass needed to produce maximum stands and yields the seeding year and thereafter.

PROCEDURES:

An irrigated and a dryland nursery was seeded in field Y-5 on May 9, 1977. Regar bromegrass seeding rates were 4, 6, 8, 10, 12, 14, 16, and 18 lbs/a. Manchar smooth bromegrass and Chinook orchardgrass were seeded for yield comparison. The experimental design was a randomized complete block with four replications. Plots consisted of four rows 20 feet in length, spaced one foot apart. Harvest area was 32 square feet. The irrigated nursery was irrigated twice in 1978 with two inches being applied per irrigation.

RESULTS AND DISCUSSION:

This nursery was part of an Interstate Trial that was planted throughout Montana and the results have been incorporated into Bulletin No. 702, "Evaluation of Regar Meadow Bromegrass in Montana".

Mean yields for 1978 were 6.32 T/A for the dryland nursery and 5.36 T/A for the irrigated nursery (Tables 1 & 2). The lower mean yields for the irrigated nursery was due to cattle grazing the nursery shortly after the first harvest. The cattle showed a definite preference for Chinook orchardgrass and Manchar smooth bromegrass over Regar bromegrass. In 1977 and 1978 under dryland conditions, Regar bromegrass at the recommended seeding rate (8 lbs/a) produced the same amount of forage as Manchar smooth bromegrass (Table 3). Under irrigated conditions, Regar bromegrass at the recommended seeding rate (10 lbs/a) produced less forage than Manchar in 1977, but in 1978 Regar produced significantly more forage than Manchar. Chinook orchardgrass, under both irrigated and dryland conditions, produced the same amount of forage in 1977 as Regar, however in 1978 Regar produced significnatly more forage than Chinook.

Table 1 . Effect of seeding rate on forage yields of dryland Regar bromegrass.

Treatment	Tons per acre at 12 percent moisture		
	First Harvest	Second Harvest	Total
Regar 4 lbs/a	3.77	2.46	6.23
Regar 6 lbs/a	4.07	2.49	6.56
Regar 8 lbs/a	3.77	2.47	6.24
Regar 10 lbs/a	4.01	2.59	6.60
Regar 12 lbs/a	4.07	2.66	6.73
Regar 14 lbs/a	3.93	2.65	6.58
Regar 16 lbs/a	3.84	2.49	6.33
Regar 18 lbs/a	3.95	2.54	6.49
Manchar smooth bromegrass	4.06	2.49	6.55
Chinook orchardgrass	3.13	1.78	4.96
Harvest dates	6/21	8/30	
Mean yields (T/A)	3.86	2.46	6.32
F-value for variety yield comparison	3.23**	2.09NS	3.20**
S.E.$\bar{x}$ (T/A)	0.148	0.172	0.282
S.E.$\bar{d}$ (T/A)	0.209	0.244	0.399
C.V. $\frac{100s}{\bar{x}}$ %	7.7	14.0	8.9
L.S.D. 0.05 (T/A)	0.43	0.50	0.82
L.S.D. 0.01 (T/A)	0.58	0.68	1.11

Table 2. Effect of seeding rate on forage yields of irrigated Regar bromegrass.

Treatment	Tons per acre at 12 percent moisture		
	First Harvest	Second Harvest	Total
Regar 4 lbs/a	3.79	2.07	5.86
Regar 6 lbs/a	3.58	1.97	5.55
Regar 8 lbs/a	3.64	1.89	5.53
Regar 10 lbs/a	3.63	2.11	5.74
Regar 12 lbs/a	3.55	2.06	5.61
Regar 14 lbs/a	3.50	2.00	5.50
Regar 16 lbs/a	3.39	2.19	5.58
Regar 18 lbs/a	3.37	2.26	5.63
Manchar smooth bromegrass	2.99	1.25	4.24
Chinook orchardgrass	3.06	1.31	4.37
Harvest dates	6/20/78	8/30/78	
Mean Yields (T/A)	3.45	1.91	5.36
F-value for variety yield comparison	3.68**	4.49**	4.55**
S.E.$\bar{x}$ (T/A)	0.133	0.164	0.266
S.E.$\bar{d}$ (T/A)	0.188	0.232	0.376
C.V. $\frac{100s}{\bar{x}}$ %	7.7	17.2	9.9
L.S.D. at 0.05 (T/A)	0.39	0.48	0.77
L.S.D. at 0.01 (T/A)	0.52	0.64	1.04

Table 3. Summary of yields for an irrigated and a dryland Regar bromegrass seeding rate nursery grown at Kalispell, MT in 1977 and 1978.

Treatment	Tons per acre at 12 percent moisture					
	Dryland			Irrigated		
	1977	1978	Mean	1977	1978	Mean
Regar 4 lbs/a	2.67	6.23	4.45	3.41	5.86	4.64
Regar 6 lbs/a	2.75	6.56	4.66	3.67	5.55	4.61
Regar 8 lbs/a	3.01	6.24	4.63	3.87	5.53	4.70
Regar 10 lbs/a	3.19	6.60	4.90	3.86	5.74	4.80
Regar 12 lbs/a	3.18	6.73	4.96	4.06	5.61	4.84
Regar 14 lbs/a	3.21	6.58	4.90	4.07	5.50	4.79
Regar 16 lbs/a	3.42	6.33	4.88	4.00	5.58	4.79
Regar 18 lbs/a	3.46	6.49	4.98	4.25	5.63	4.94
Manchar smooth bromegrass	3.57	6.55	5.06	4.97	4.24	4.61
Chinook orchardgrass	3.07	4.96	4.02	3.65	4.37	4.01
Mean yield (T/A)	3.15	6.32		3.98	5.36	
F-value for variety yield comparison	2.35*	3.20**		4.8**	4.55**	
S.E.$\bar{x}$ (T/A)	0.190	0.282		0.194	0.266	
S.E.$\bar{d}$ (T/A)	0.268	0.399		0.274	0.376	
C.V. $\frac{100s}{\bar{x}}$ %	12.0	8.9		9.8	9.9	
L.S.D. at 0.05 (T/A)	0.55	0.82		0.56	0.77	
L.S.D. at 0.01 (T/A)	0.74	1.11		0.76	1.04	

TITLE: Evaluation of experimental birdsfoot trefoil lines when grown in mixtures with orchardgrass.

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperators - Scott Cooper and Ray Ditterline
Research Assistant - Patrick Hensleigh

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: Through 1979

OBJECTIVES: Evaluate the compatibility of several experimental trefoil lines with orchardgrass for forage production in western Montana.

PROCEDURES:

Seven experimental trefoil lines that were selected for seed size and seedling vigor, and three commercial trefoil varieties (Leo, Tretana and Empire) were seeded with orchardgrass in a randomized complete block design with four replications. The nursery was seeded in field Y-5 on May 9, 1977. Plots consisted of 8 rows spaced 6 inches apart (alternate trefoil and orchardgrass) and were 20 feet in length. One hundred and eighty pounds of P_2O_5 was broadcast prior to seeding. No nitrogen fertilizer was applied to the nursery. The nursery was irrigated two times in 1978 with two inches being applied per irrigation. Vigor and two harvests were obtained in 1978.

RESULTS AND DISCUSSION:

In 1978, as in 1977 there were no significant differences in yield among trefoil lines and varieties (Tables 1 & 2). This was due to the excellent orchardgrass vigor which was very competitive with all trefoil varieties. The mean yield for the entire nursery was 3.73 T/A in 1977 and 3.45 T/A in 1978. All lines and varieties produced more over the two year period than the check variety, Empire. S_2 was the highest yielding line over the two year period.

Table 1. Vigor and yields for an irrigated trefoil-orchardgrass nursery at Kalispell, MT in 1978.

Trefoil Line	Yield(Tons/Acre) 12% Moisture 1st Harvest	2nd Harvest	Total Yield (Tons/Acre)	Vigor 4/25/78[1/]	8/3/78[1/]	9/28/78[1/]
	6/19/78	8/25/78				
L_1	2.54	1.12	3.65	2.8	3.5	4.0
L_2	2.47	1.18	3.65	3.3	2.9	3.9
L_3	2.41	1.17	3.58	3.8	2.8	3.6
S_1	2.11	1.19	3.30	3.0	3.3	4.4
S_2	2.48	1.33	3.81	3.6	2.9	3.6
S_3	2.25	1.08	3.33	3.8	3.4	4.0
L_3-10 clone	1.98	1.28	3.26	4.3	2.5	3.8
Leo	2.04	1.12	3.17	3.1	3.1	3.8
Tretana	2.30	1.02	3.32	3.1	4.0	4.3
Empire	2.18	1.21	3.38	3.6	2.8	3.5
Mean	2.28	1.17	3.45	3.4	3.1	3.9
F-value for treatment yield comparison	1.03NS	.94NS	.79NS	2.92*	1.44NS	4.86**
S.E.$\bar{x}$	.19	.09	.24	.26	.37	.13
S.E.$\bar{d}$	.27	.13	.33	.37	.52	.18
C.V. = $\frac{100s}{\bar{x}}$	16.9	16.1	13.7	15.4	23.8	6.6
L.S.D. (0.05)	.55	.27	.68	.76	1.06	.37
L.S.D. (0.01)	.75	.36	.91	1.03	1.44	.50

1/ Vigor = 1 - good; 5 - poor
NOTE: Empire is considered to be the check variety for this nursery.

Table 2. Summary of yields for an irrigated trefoil-orchardgrass nursery at Kalispell, MT, in 1977 and 1978.

Trefoil Line	Tons per acre at 12 percent moisture 1977	1978	Mean
L_1	3.84	3.65	3.75
L_2	3.86	3.65	3.76
L_3	3.80	3.58	3.69
S_1	3.69	3.30	3.50
S_2	3.86	3.81	3.84
S_3	3.65	3.33	3.49
L_3-10 clone	3.99	3.26	3.63
Leo	3.65	3.17	3.41
Tretana	3.69	3.32	3.51
Empire	3.31	3.38	3.35
Mean:	3.73	3.45	
F-value for variety yield comparison	1.9 NS	0.79 NS	
S.E.$\bar{x}$	0.133	0.24	
S.E.$\bar{d}$	0.189	0.33	
C.V. = $\frac{100s}{\bar{x}}$	7.1	13.7	
L.S.D. (0.05)	0.39	0.68	
L.S.D. (0.01)	0.52	0.91	

NOTE: Empire is considered to be the check variety for this nursery

TITLE: Irrigated and dryland sainfoin yield trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Ray Ditterline
Research Assistant - Patrick Hensleigh

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: 1982

OBJECTIVE: Evaluate sainfoin varieties and experimental lines for forage production in Montana.

PROCEDURES:

The dryland nursery was seeded in field F-3, on May 8, 1978 and the irrigated nursery was seeded in field Y-6 on June 7, 1978. The experimental design was a randomized complete block with four replications. Plots consisted of eight rows, 20 feet long spaced 6 inches apart. Two hundred and twenty-five pounds of P_2O_5 was broadcast prior to seeding. Harvest area was 32 square feet. The irrigated nursery was irrigated twice in 1978 with two inches being applied per irrigation.

RESULTS AND DISCUSSIONS:

Occupancy, plant/ft^2, vigor and yield for the dryland nursery are presented in Table 1; and plant height, vigor, plants/ft^2, and yield for the irrigated nursery are presented in Table 2. Adequate stands were obtained at both the irrigated and the dryland nurseries. There were no significant differences in yield among varieties at the dryland site. The mean yield for the entire dryland nursery was 1.25 T/A. At the irrigated site Melrose produced significantly more forage than both checks (Remont and Eski) and World Collection Bulk produced significantly more forage than Eski. Yields of Remont and Eski were similar. The mean yield for the entire irrigated nursery was 2.43 T/A.

Table 2. Yield, plant height and vigor for an irrigated sainfoin yield trial at Kalispell, MT in 1978.

Entry	Yield 12% Moisture Ton/Acre 1/2/	Vigor 1/4/	Plant Height 3/ (inches)	Plants/ft^2 1/
Melrose	2.83	2.9	42	8
World Collection Bulk	2.62	3.0	44	7
Russian Bulk	2.36	2.9	37	8
Remont	2.34	1.9	42	9
Creston Composite	2.30	2.8	33	8
Eski	2.10	3.5	28	8
Date:	10/2	8/3	10/2	11/2
Mean:	2.43	2.81	37.3	8.0
F-value for variety yield comparison	5.04**	3.03*	5.18**	0.94N.S.
S.E.$\bar{x}$	.11	.30	2.79	0.62
S.E.$\bar{d}$	.16	.42	3.95	0.87
C.V. $\frac{100s}{x}$	9.44	21.43	10.58	15.48
L.S.D. at (0.05)	.33	.88	10.15	1.86
L.S.D. at (0.01)	.46	1.21	11.37	2.51

1/ Mean of four replications
2/ Percent bloom (10/2/78): Melrose, World Collection Bulk, Remont, 55%; Russian Bulk, 25%; Creston Composite, 10%; Eski, 5%.
3/ Mean of two replications
4/ Vigor: 1 = good; 5 = poor
NOTE: Remont and Eski are considered to be the check varieties for this nursery.

Table 1. Occupancy, plants/ft^2, vigor and yield for a dryland sainfoin variety trial at Kalispell, MT in 1978.

Entry	Yield 12% Moisture Ton/Acre [1/2/]	Percent Occupancy [1/]	Plants/ft^2 [1/] First Count	Plants/ft^2 [1/] Second Count	Vigor [1/3/]
Russian Bulk	1.41	50	8	8	3.0
Eski	1.37	54	9	9	3.3
Melrose	1.34	46	8	8	3.4
World Collection Bulk	1.16	42	7	8	3.8
Creston Composite	1.12	53	9	10	2.5
Remont	1.11	48	8	9	2.1
Dates:	8/2,8/7,8/21	7/10	7/10	11/1	7/5
Mean:	1.25	49	8	9	3.0
F-value for variety yield comparison	1.11N.S.	1.61N.S.	1.87N.S.	3.14*	3.53*
S.E.$\bar{x}$ (T/A)	.13	3.57	.63	.48	.32
S.E.d (T/A)	.18	5.05	.89	.68	.45
C.V. $\frac{100s}{\bar{x}}$	20.9	14.7	15.7	10.9	21.6
L.S.D. at (0.05)	.38	10.44	1.83	1.40	.94
L.S.D. at (0.01)	.52	14.5	2.56	1.96	1.30

1/ Mean of four replications.
2/ Harvest Dates: Remont - 8/2, World Collection Bulk and Melrose - 8/7, Creston Composite, Russian Bulk and Eski - 8/21. All varieties harvested at approximately 50% maturity.
3/ Vigor: 1 = good; 5 = poor
NOTE: Remont and Eski are considered to be the check varieties for this nursery.

TITLE: Annual Forages-Another Alternative for Stockmen

PERSONNEL: Leon E. Welty

LOCATION: Northwestern Agricultural Research Center Field Nos. R-4 and R-13

Many Montana farmers and ranchers utilize small grains for annual forages to supplement their perennial hay crop. Recently, public and private plant breeders have emphasized forage yield and palatibility of small grain varieties in their breeding programs. Several new varieties from these breeding programs were tested statewide by the Montana Agricultural Experiment Station (MAES).

We evaluated three barley and two oat varieties at Kalispell, Bozeman, Huntley and Havre, Montana in 1976 and at Kalispell, Huntley and Bozeman, Montana in 1977. The two oat varieties were Otana and Cayuse. Otana, a new MAES variety, was released for grain production but also shows much promise for forage production. The three barley varieties were Ridawn, Horsford and Stepford. Ridawn, an awnless variety selected from Ingrid, was released for forage production by the MAES. Foundation seed of Ridawn will be available in spring of 1980. Stepford, an awnless variety from a Horsford x Steptoe cross, was released by Montana Seeds Inc., Conrad, Montana. We seeded barley varieties under dryland and irrigation at 67 and 100 pounds per acre, respectively; and oat varieties at 50 and 100 pounds per acre, respectively at all locations. We harvested forage at the soft to medium dough stage at all locations.

Varieties responded differently to location in 1976 (Table 1). Under irrigation at Kalispell both oat varieties produced more forage than all barley varieties; and Ridawn and Stepford produced more forage than Horsford. Forage protein content at Kalispell was negatively correlated to forage yield. As forage yield increased protein content decreased. Ridawn produced the most forage and Stepford produced the least forage at Huntley under irrigation. At the Huntley dryland location oats produced more forage than barley. Forage yields were greater on Huntley dryland than on Huntley irrigated because the irrigated nursery was seeded one month later than the dryland nursery. Varietal differences at Bozeman irrigated and Havre dryland were insignificant.

Annual forage yields were very high under irrigation at Kalispell as compared to other locations in 1977 (Table 2). Forage yields were 2.8 times greater for Kalispell irrigated than for Kalispell dryland because of an unusually dry spring. Otana produced more forage than Cayuse under irrigation. Both irrigated oat varieties yielded more forage than all irrigated barley varieties. However, under dryland conditions at Kalispell, Ridawn and Stepford barley produced more forage than either oat variety. Forage yields on Huntley dryland were very low although Otana oats produced more forage than all other varieties. Varietal differences at Huntley irrigated were insignificant. Horsford produced less forage than all other varieties under dryland at Bozeman.

Small grains grown for annual forages can produce very high yields when grown in pure stands. Unfortunately, forage protein levels are low. The addition of an annual legume to the small grain will increase total forage protein. An excellent summary of dryland annual forage production throughout Montana was prepared by Krall and Dubbs (Montana Agricultural Experiment Station Capsule Information Series No. 6). In their studies forage protein levels were increased when adding peas to either barley or oats; however, total forage yields were reduced. Because of renewed interest in annual forage production in western Montana, we evaluated small grain-annual legume mixtures under irrigation and dryland at the Northwestern Agricultural Research Center.

We planted two small grain and two annual legume varieties in pure stands and in mixtures with each other in 1978. Small grains were Ridawn barley and Otana oats; and annual legumes were Fenn Austrian winter peas and Terra Verde Alfalfa. We seeded the dryland location on May 3 and the irrigated location on May 18. Two planting methods were investigated; (1) planting both legume and small grain in the same row (12 inch spacing) and (2) planting legume and small grain in alternate rows (6 inch spacing). We subjected the annual forages to two harvest management regimes; (1) a one harvest system where all forages were cut at hay stage and (2) a two harvest system where the first harvest was obtained pre-hay stage, and the second harvest was taken just prior to frost. Seeding rates for Otana, Ridawn, Fenn and Terra Verde planted in pure stands were 56, 76, 117 and 11 pounds per acre, respectively. Seeding rates for Otana, Ridawn, Fenn and Terra Verde planted in mixtures were 34, 46, 82 and 7 pounds per acre, respectively. We fertilized the irrigated nursery with 60 pounds N and 17 pounds P per acre, and the dryland nursery with 53 pounds N and 12 pounds P per acre. We broadcast the fertilizer post emergence on all treatments within each nursery.

Planting method (alternate vs same row) did not affect forage yield or protein content of the mixtures.

Harvesting monocultures (pure stands) and mixtures once during the growing season resulted in more forage production per acre and lower protein levels compared to harvesting twice during the growing season (Tables 3, 4, 5 and 6).

Total seasonal production for the irrigated nursery was about one ton per acre greater than for the dryland nursery (Tables 3, 4, 5 and 6). This difference was due primarily to better regrowth resulting from irrigation applications after the first harvest. In a normal crop year (19 inches precipitation) the yield difference between irrigated and dryland would be greater. During the 1977-78 crop year (September 1 through August 31), we received 29 inches of precipitation.

Generally, Otana monocultures produced more forage than Ridawn monocultures. However, Ridawn protein levels were greater than those of Otana (Tables 3, 4, 5 and 6). Fenn monocultures yielded more forage under dryland than Terra Verde monocultures, but protein levels were similar (Tables 3 and 4). Terra Verde emergence on the irrigated site was poor so no comparisons were made with Fenn at this location. Establishment failure of Terra Verde was due to seeding too deeply.

The addition of Fenn to Ridawn and Otana increased forage yields and protein levels of the mixtures, but the addition of Terra Verde did not increase either forage yields or protein contents when harvesting at hay stage on dryland (Table 3). When harvesting twice on dryland, neither Fenn nor Terra Verde increased yields of the Ridawn-legume mixtures. However, they did increase protein contents of the mixtures when harvested just prior to frost. The addition of Fenn to Otana increased forage yields, but Terra Verde did not. Both Fenn and Terra Verde increased protein levels of the mixtures, particularly in the second harvest (Table 4).

Under irrigation, when harvesting at hay stage, the addition of Fenn to Ridawn and Otana increased forage yields of mixtures by about 0.5 tons per acre and protein levels by 4-5 percent (Table 5). When harvesting twice under irrigation, Fenn-small grain mixtures produced more forage and protein than pure stands of Otana and Ridawn (Table 6).

Nitrate levels were low in monocultures and mixtures harvested at both the irrigated and dryland sites.

Maximizing annual forage yields takes careful planning and management. Results from the intrastate trials show a definite advantage of one small grain variety over another, depending upon location. Under irrigated conditions in northwestern Montana I would recommend planting Otana oats because they produce significantly more forage than other small grain varieties. Annual legume selection is also important. In our 1978 study Fenn additions increased yields and protein levels of mixtures more than did Terra Verde additions. Seeding rates for annual forages, whether in pure stands or in mixtures, should be based upon number of seed per square foot because number of seeds per pound for different species varies considerably. When planting under irrigation or high moisture conditions in pure stands, small grains should be seeded at 20-24 seeds per square foot and peas at 10-12 seeds per square foot. In mixtures small grains should be seeded at 10-12 and peas at 6-8 seeds per square foot. It appears that legume and small grain seed can be mixed and seeded in the same row without yield or protein reductions. This is based upon one year's data so you should be cautious about accepting this without some question. Fertilizer applications on small grains seeded in pure stands should include up to 80 pounds of actual nitrogen per acre and up to 17 pounds P per acre. If an annual legume comprises from 30-50 percent of an annual legume-small grain mixture, little or no nitrogen should be added because inoculated peas will provide themselves and adjacent grass plants with nitrogen. Phosphorous levels for mixtures should be quite high (17-22 pounds P per acre). All fertilizer applications should be based upon a reliable soils test. Weed control options for annual forage mixtures are limited. If possible, plant annual forage mixtures in clean, weed-free fields. For chemical control of weeds consult your county agent or local research center. Annual forages can be cut for hay or silage, or can be pastured. If annual forages are pastured or harvested twice during the season, protein levels will be high; but dry matter yields will be reduced. Harvesting once for hay will result in high dry matter production with lower protein levels. Before grazing or haying any annual forage mixture, analyze the forage for nitrates to make sure it is safe for animal consumption. This is very important if you plant a small grain in pure stand and use high rates of nitrogen fertilizer.

Table 1. Statewide summary of small grains grown for forage production in 1976.

Variety	Tons per acre at 12% moisture					
	Kalispell Irrigated	Bozeman Irrigated	Huntley Irrigated	Huntley Dryland	Havre Dryland	Mean
Otana oats	6.63 (5.0)[1]	3.14	3.09	4.65	2.71	4.04
Cayuse Oats	6.45 (5.2)	3.08	3.08	4.34	2.81	3.95
Ridawn barley	4.61 (6.7)	3.23	3.89	3.89	3.12	3.75
Horsford barley	3.78 (8.4)	3.29	-	3.19	2.63	3.22
Stepford barley	4.83 (6.8)	3.38	2.53	2.98	2.81	3.31
Mean	5.26	3.22	3.15	3.81	2.82	

1 Values in parenthesis are precent proteins.

Table 2. Statewide summary of small grains grown for forage production in 1977.

Variety	Tons per acre at 12% moisture					
	Kalispell Irrigated	Kalispell Dryland	Huntley Irrigated	Huntley Dryland	Bozeman Dryland	Mean
Otana oats	7.88	1.58	2.55	1.66	2.52	3.24
Cayuse oats	5.95	1.85	2.57	0.97	2.48	2.76
Ridawn barley	3.83	2.05	2.76	1.17	2.16	2.39
Horsford barley	3.05	1.20	2.50	0.84	1.27	1.77
Stepford barley	4.00	2.00	2.98	1.03	2.41	2.48
Mean	4.94	1.74	2.67	1.13	2.17	

Table 3. Forage yields and protein levels of dryland annual forages grown at Kalispell, MT in 1978 under simulated haying (one harvest).

Treatment	Harvest Date	Maturity at Harvest 1/	Tons/Acre (12% Moisture)	% Protein	Total Crude Protein/A (lbs)
Ridawn barley	7/26	SD	2.03	5.5	223
Fenn Aust Wint. peas	7/26	M-SD	1.74	19.0	662
Terra Verde alfalfa	7/26	5% bloom	1.04	17.1	356
Ridawn + Fenn	7/26	SD + M-SD	2.71	7.8	424
Ridawn + Terra Verde	7/26	SD+5% bloom	2.19	5.7	250
Otana oats	8/ 3	SD	3.03	3.8	231
Fenn Aust Wint. peas	8/ 3	SD	1.70	16.0	543
Terra Verde alfalfa	8/ 3	25% bloom	1.03	15.5	320
Otana + Fenn	8/ 3	SD + SD	3.49	6.2	433
Otana + Terra Verde	8/ 3	SD+25% bloom	3.03	4.3	261

1/ M = milk stage; SD = soft dough stage

Table 4. Forage yields and protein levels of dryland annual forages grown at Kalispell, MT in 1978 under simulated pasture management (two harvests).

Treatment	1st Harvest(7/11) Tons/A	1st Harvest(7/11) % Protein	2nd Harvest(9/8) Tons/A	2nd Harvest(9/8) % Protein	Total T/A	Total Crude Protein/A (lbs)
Ridawn barley	1.49	9.4	0.38	10.4	1.87	359
Ridawn + Fenn	1.63	10.6	0.47	12.8	2.10	466
Ridawn + Terra Verde	1.42	10.5	0.75	15.8	2.17	535
Otana oats	1.42	8.6	0.63	5.7	2.05	316
Otana + Fenn	1.74	11.6	0.79	8.6	2.53	540
Otana + Terra Verde	1.20	9.9	0.95	11.0	2.15	446
Fenn Aust Wint. peas	0.72	21.6	1.16	16.2	1.88	683
Terra Verde alfalfa	0.36	20.9	0.75	15.8	1.11	386

Maturity at Harvest

7/11 - Ridawn = 10% headed; Otana = 60% headed; Fenn = 40% bloom and Terra Verde = pre bud stage

9/8 - Ridawn = soft dough; Otana = milk to soft dough; Fenn = ripe in pod and alfalfa = 5% bloom

Table 5. Forage yields and protein levels of irrigated annual forages grown at Kalispell, MT in 1978 under simulated haying (one harvest).

Treatment	Harvest Date	Maturity at Harvest[1/]	Tons/Acre (12% Moisture)	% Protein	Total Crude Protein/A (lbs)
Ridawn barley	8/ 9	SD	3.06	6.1	373
Fenn Aust Wint. peas	8/ 9	HD	1.68	20.1	675
Ridawn + Fenn	8/ 9	SD + HD	3.53	11.2	790
Otana oats	8/21	MD	3.97	4.6	365
Fenn Aust Wint. peas	8/21	HD	2.81	17.6	988
Otana + Fenn	8/21	MD + HD	4.58	8.9	816

1/ SD = soft dough; MD = medium dough; and HD = hard dough

Table 6. Forage yields and protein levels of irrigated annual forages grown at Kalispell, MT in 1978 under simulated pasture management (two harvests).

Treatment	1st Harvest (7/13) Tons/A	1st Harvest (7/13) % Protein	2nd Harvest (9/14) Tons/A	2nd Harvest (9/14) % Protein	Total T/A	Total Crude Protein/A (lbs)
Ridawn barley	1.14	16.0	0.66	11.2	1.80	513
Ridawn + Fenn	0.99	21.4	2.50	17.8	3.49	1313
Otana oats	1.18	14.3	1.42	7.3	2.60	544
Otana + Fenn	1.03	17.9	2.68	14.4	3.71	1139
Fenn Aust Wint. peas	0.49	27.9	1.33	19.6	1.82	794

Maturity at Harvest

7/13 - Ridawn = boot stage; Otana = boot stage and Fenn = pre bloom

9/14 - Ridawn = soft dough; Otana = milk stage and Fenn = ripe in pod

TITLE: Alternatives for Set-Aside Acres

PERSONNEL: Leon E. Welty
Kevin Kephart

LOCATION: Northwestern Agricultural Research Center Field No. Y-9

The summers of 1976 and 1977 were very productive for small grain producers in the United States. Unfortunately, a wheat and barley surplus was created which lowered the price of these commodities. In response to this surplus the set-aside program was initiated to reduce wheat and barley production and to maintain or increase price levels.

According to set-aside regulations small grains may be seeded on set-aside acres if they are not allowed to mature. These small grains can, however, be grazed after September 1 or October 1 depending upon county regulations. Since small grains can be planted on set-aside, we need to know what varieties will be adapted to this culture and when they should be planted.

To answer these questions we seeded three small grain species (Otana oats, Ingrid barley and Crest winter wheat) on four dates (6/28, 7/14, 7/28 and 8/10) on a wetland site at the Northwestern Agricultural Research Center, Kalispell, MT. The three varieties were seeded at a rate of 100 pounds per acre. The soil was a silty, clay loam with a blocky structure. The water table was about four feet below the soil surface in mid-summer. Wetland areas will most likely be used for set-aside acreage in western Montana because they are the least accessible for spring planting.

Fertility requirements of small grains planted in mid-summer could be expected to vary from those of spring-planted small grains. We broadcasted 50 and 100 pounds of actual nitrogen per acre after the crop emerged for each planting date. No phosphorous fertilizer was applied because soil P levels were high.

One-half of the nursery was harvested on September 7 to coincide with the September 1 grazing date. The other half was harvested on September 29 to coincide with the October 1 grazing date.

Only Otana produced enough forage to make this practice economical. Crest and Ingrid produced very low yields for all planting dates and both harvest dates. Evidently Crest was not adapted to mid-summer plantings because growth was stunted during the entire growing season. Ingrid planted on June 30 and July 14 was yellow and stunted. This was apparently due to a nitrogen tie-up caused by the saturated soil condition.

The influence of planting date, harvest date and nitrogen treatment on Otana forage yields is presented in Table 2. Early planting produced more forage per acre than late planting. Harvesting Otana on September 29 produced more forage than when harvesting on September 7. The addition of nitrogen increased Otana forage yields for both harvest dates when planted on June 30 and July 14. However, yield response to nitrogen was not apparent when Otana was planted on July 28 and August 10 for the September 7 harvest date. The later seeding dates did not allow the crop sufficient time to respond to the nitrogen applications. When considering forage yield only, maximum production was obtained when planting on June 30 and harvesting on September 29.

Protein response to nitrogen application was opposite of yield response (Table 3). Protein levels of Otana increased as planting date was delayed. This could be expected because protein levels are negatively correlated with forage yields. Generally, protein concentrations of Otana forage were greater when harvested on September 7 than on September 29.

Livestock producers should be concerned with both forage yield and protein content of the forage crop. Total crude protein as affected by nitrogen rate, planting date and harvest date is presented in Table 4. For the September 7 harvest total crude protein was greatest when Otana was planted on June 30. When harvest was delayed until September 29, Otana crude protein levels were greatest with the July 28 planting date.

When utilizing small grain varieties for forage production, one has to be aware and concerned of high nitrate levels. A nitrate level of 0.68 percent (6760 ppm) was measured when 100 pounds nitrogen per acre was applied to Otana seeded on July 28 and harvested on September 7. At this nitrate level we would suggest a controlled feeding or grazing program. The nitrate level for the same treatment, when harvested on September 29, was reduced to 0.26 percent (2600 ppm). Forage with this nitrate level can be grazed without toxicity problems.

Agricultural Stabilization and Conservation Service regulations state, "Set-aside must be land that has been tilled in at least one of the last three years for a small grain or row crop, is in a rotation that includes a small grain or row crop, or was accepted set-aside on voluntary diversion in 1978". Planting annual forages on set-aside acreages is desireable because they will not interfere with planting of small grains the following spring.

If you plan to seed a small grain variety on set-aside for fall grazing, plant an oat variety, preferably Otana, if seed can be obtained. Date of planting will depend upon the allowable grazing date for your county. If this date is September 1, seed Otana in the latter part of June or early part of July. If the allowable grazing date is October 1, Otana should be seeded in the latter part of July. We recommend broadcasting 50 pounds per acre of actual nitrogen after the crop emerges. If phosphorous levels are low an appropriate application should be drilled with the seed. Regardless of variety selected, planting date or harvest date; the forage should be analyzed for nitrate content before grazing. Your local county extension agent can make a spot check for nitrates at no charge.

Table 1. Effect of planting date, harvest date and nitrogen rate on growth stage[1] of Otana oats prior to harvest.

Nitrogen	6/30		7/14		7/28		8/10	
Lbs/A	9/7	9/29	9/7	9/29	9/7	9/29	9/7	9/29
0	SD (37")[2]	SD (39")	IB (23")	SD (28")	VS (21")	VS (35")	VS (9")	VS (15")
50	SD (37")	SD (43")	IB (27")	SD (32")	VS (25")	VS (33")	VS (11")	VS (21")
100	SD (41")	SD (41")	IB (33")	SD (36")	VS (28")	VS (40")	VS (11")	VS (22")

1 SD = soft dough stage, IB = in the boot and VS = vegetative stage
2 Height of forage in inches just prior to harvest

Table 2. Effect of planting date, harvest date and nitrogen rate on Otana forage production.

	Tons per acre at 12% moisture							
Nitrogen	6/30		7/14		7/28		8/10	
Lbs/A	9/7	9/29	9/7	9/29	9/7	9/29	9/7	9/29
0	1.30	2.04	0.71	0.83	0.61	1.40	0/96	0.36
50	1.94	2.69	1.04	2.04	0.76	1.89	0.08	0.59
100	2.52	2.91	1.30	2.67	0.81	2.15	0.08	0.67

Table 3. Effect of planting date, harvest date and nitrogen rate on percent protein of Otana oats.

Nitrogen	6/30		7/14		7/28		8/10	
Lbs/A	9/7	9/29	9/7	9/29	9/7	9/29	9/7	9/29
0	12.7	9.2	17.5	8.2	19.3	9.7	22.0	14.1
50	12.2	10.3	15.2	9.2	24.4	13.8	33.3	23.2
100	12.9	10.4	18.0	11.6	28.9	16.9	36.1	28.3

Table 4. Effect of planting date, harvest date and nitrogen rate on crude protein[1] of Otana oats.

	Total pounds crude protein/acre							
Nitrogen	6/30		7/14		7/28		8/10	
Lbs/a	9/7	9/29	9/7	9/29	9/7	9/29	9/7	9/29
0	331.0	375.8	248.6	135.8	235.8	271.4	26.4	101.4
50	474.6	555.8	315.6	373.4	370.6	522.4	53.2	273.8
100	651.2	604.2	466.4	616.2	468.2	727.4	57.8	358.6

1 Total crude protein = T/A (12% moisture) x % protein x 2000 lbs.

TITLE: Spring Barley

PROJECT: Small Grains Investigations MS 756

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperating Agencies - Montana Agricultural Experiment Station
Field Crops Branch ARS USDA

LOCATION: Northwestern Agricultural Research Center and off-station locations.

DURATION: Indefinite

OBJECTIVES:

1. To determine the adapatibility of new and introduced barley varieties in western Montana.
2. To assist in the state breeding program for the development of varieties with increased straw strength and disease resistance.

1978 EXPERIMENTS:

1. Dryland Intrastate Yield Nursery
2. Irrigated Intrastate Yield Nursery
3. Off-Station Yield Nurseries, located in -
   a. Ravalli County (Bill Strange farm)
   b. Lake County (Art Mangles farm)
   c. Missoula County (Harvey Clouse farm)
4. Hector Klages, F6 Yield Nursery, dryland and irrigated
5. White Lemma and Awn Yield Nursery, dryland and irrigated
6. Leaf Width Yield Nursery
7. Tall-Short Barley Nursery
8. Root Maturity Barley Nursery

Experiments five through eight are not a part of this report, but were run as a cooperative effort for R. F. Eslick, E. A. Hockett and some of their graduate students.

RESULTS AND DISCUSSION:

1. Dryland Intrastate - Thirteen varieties in the dryland intrastate nursery produced higher yields than the check, but none of these yields were significantly greater when compared statistically. Purcell, which was the check in this test had a yield of 88.91 bu/a. The highest yield was obtained from Steve (98.36 bu/a). Five entries yielded significantly lower than the check, the lowest being Waxy Titan (64.95 bu/a).

Test weight varied from 46.9 lb/bu for Waxy Titan to 54.7 lb/bu for MT 842148. Purcell was 52.7 lb/bu.

Severe lodging was seen in Washonupana and MT 842148, Klondike, Compana, Dekap and Shabet.

Sixteen entries were significantly taller than the check. The tallest was Morex at 43.3 inches. Two varieties were significantly shorter than the check. They were both VDH varieties. The height range was 26.8 inches to 43.3 inches.

Percent plumpness did not vary significantly from the check except in the cases of Washonupana and Summit which were significantly less.

Spring Barley (con't)

Heading occurred between June 21, and June 30, 1978. Several varieties differed significantly from Purcell, which is a mid-season maturing variety.

A ten year yield summary for the dryland intrastate spring barley yields is given in Table 2. Piroline was used as a check. Steptoe was 17.7% higher, Purcell 13.1%; UT 1009 11.5%; Unitan 10.9%; and Freja 10.8%.

2. Irrigated Intrastate Yield Nursery - The range of the yields for the Irrigated Intrastate Nursery varied from 51.8 bu/a to 120.3 bu/a. Freja was the highest yielding variety (120.28 bu/a). UT 1009 and Purcell along with Freja were significantly greater than Ingrid, the check. Sixty-six percent of varieties tested yielded higher than the check. Washonupana and MT 842148 which were significantly less than the check at 52.3 bu/a and 51.8 bu/a respectively.

Lodging was prevalant throughout the test. Plots in which lodging was very noticable were Dekap (89.0%), MT 842148 (Shonupana)(87.0%), and Washonupana (82.0%).

Test weights ranged from 42.1 lb/bu for WA11312 to 53.59 lb/bu for UD 4674. The rather low test weights on some varieties was caused by sprouting of grain prior to harvest. Lodging was severe in some varieties causing the grain to come into contact with the soil resulting in sprouting, causing a reduction in the test weight. This condition was also responsible for variations in yield between plots and resulted in a high C.V.. The varieties UD 22872, Blazer and Park had the lowest lodging rating in the experiment.

Ninety-eight percent of the entries tested had earlier heading dates than Ingrid which is a late maturing variety. Kimberly was the only variety which headed later than Ingrid.

The abnormally high rainfall for this season can be directly related to the high incidence of leaf scald (Rynchosporium secalis (Oud.) J.J. Davis) and powdery mildew (Erysiphe graminis DC). Severity ratings are on a 1-10 scale, 1 indicating very slight disease pressure, 10 indicating very severe pressure. Varieties very susceptible to scald in this trial were MT 726 (96.4%) and Lud (94.8%). Other varieties with somewhat less severe symptions were CB 7523, 77.6%; VD 26772, 68.2%; Menuet, 60.0%; VD 7272, 56.0%; Freja, 55.0%; VD 4674, 50.8% and Summit, 43.0%. The foregoing listed varieties showed significantly more disease when compared to Ingrid (6%).

Varieties with a high incidence of powdery mildew were Manker, 93.0%; Morex, 69.0%; Glenn, 65.2%; Klondike, 62.8% and Blazer, 61.8%. There were no varieties that were entirely free of either powdery mildew or leaf scald in the irrigated nursery.

Seven entries were significantly lower in percent plump than Ingrid. No variety was found to be significantly greater. The hulless varieties were less as would be expected. Table 3.

A ten year summary for irrigated intrastate spring barley yields is given in Table 4. Sixty-six percent of all varieties tested in the 10 year summary have higher yields than Ingrid.

3. Off-Station Nurseries - Ravalli County - Yields from the Ravalli County Nursery were lower this year when compared to last year. The mean was 80.87 bu/a and the yields ranged from 67.65 bu/a to 92.33 bu/a. The highest yielding entry was Klondike which was the only variety to yield greater than Ingrid, the check. The mean for test weights was 53.31 lb/bu which was higher than last years 48.99 lb/bu. Lodging was severe in the Klondike plots. Slight lodging was observed in Unitan. The percent plump was high for all varieties. The mean was 96.46%. Table 5.

Spring Barley (con't)

Lake County - Yields were abnormally low for Lake County nursery due to a late harvest date and prevalent stem lodging. The mean yield was 32.51 bu/a with the highest yielding variety being Summit with 36.33 bu/a. Ingrid, the check, had a yield of 29.57 bu/a. Test weights varied very little and were all very close to Ingrid which was 50.04 lb/bu. Lodging was most prevalent in Klondike, Manker and Unitan varieties. Slight lodging was observed with Steve, Steptoe, and Fairfield varieties. The mean for percent plump was 96.34%. Fairfield, Freja, Piroline, Manker and Purcell all had significantly greater plump percentages than Ingrid. Table 6.

Missoula County - The nursery in Missoula again showed excellent yields with Steptoe being the highest at 117.07 bu/a. This was the only variety significantly higher in yield than Ingrid (94.65 bu/a) the check. Manker and Klondike yields were significantly lower than the check. Steptoe, Unitan, and Steve all had test weights significant ly less than Ingrid (54.76 lb/bu). The mean test weight was 54.10 lb/bu. Lodging percentages were high in the varieties; Hector, Summit, Fairfield, Piroline, and Klondike. Percent plump was excellent with a mean of 97.6%. Table 7.

Tables 8 and 9 show data for fourteen spring barley varieties grown at four irrigated locations throughout western Montana. Freja had the highest yield at Kalispell and the highest yield average when compared at all four locations. Steptoe, which had the highest yield in Missoula County had the second highest average yield for all locations. Kalispell and Ravalli locations had individual test weights noticably higher than the other two nurseries. The highest average test wieght was Hector at 52.83 lb/bu and 47.37 lb/bu was the lowest average for Steve. Plant heights were greatest at Kalispell. The four location averages for height did not vary greatly. Klondike had the tallest average at 33.83 inches and Purcell the shortest at 29.40 inches. Highest percent plump average was Steptoe at 97.25%. Steptoe was very consistant at all four locations in regard to percent plump. Kimberly had the low plump figure at 94.78%.

4. Hector Klages, F6 Yield Nursery - This test was conducted under both dryland and irrigated conditions. Yields were non significant under irrigated conditions, and the C.V. was high in the test. The yield range was 100.91 bu/a to 77.54 bu/a of the pedigree material. Only two lines exceeded either parent in this test. Table 11.

In the dryland test yield differences were statistically significant with a range of 119.24 to 90.03 bu/a. No line exceeded the female parent (Klages). Eight lines wer e not significantly different in yield from the female parent. Five lines were significantly less in yield. Table 10.

Table 1. Agronomic data from the intrastate barley yield nursery grown at the Northwestern Agriculutral Research Center, Kalispell, MT in 1978. Field No. A1, dryland. Random block design, four replications.

Date seeded: April 14, 1977 Date harvested: August 25, 1978 Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Maturity Date	Lodging %	Lodging Sev.	% Plump
ID 702378	Steve	98.36	48.48	173.75b	32.27	237.00	.00	.00	97.97
UT 1009	SDB1-1009	98.15	47.33	175.00	36.53a	237.00	.00	.00	97.75
VD 5	Pirouette	96.89	53.59	178.75a	29.52	237.00	2.50	.75	98.22
CI 15229	Steptoe	96.61	48.48	172.00b	33.27	237.00	.00	.00	97.50
CI 10421	Unitan	94.49	48.48	172.50b	38.03a	237.00	5.00	1.00	97.75
NA 61076	N2SB 610-76	94.41	53.48	176.00	35.27a	237.00	.00	.00	98.00
CI 15478	Klages	93.43	51.08	177.75	35.27a	237.00	5.00	.75	97.75
CI 15687	Kimberly	91.75	50.56	181.50a	34.77a	237.00	.00	.00	97.75
CI 15514	Hector	91.36	52.64	174.50b	35.53a	237.00	20.00	1.00	97.25
VD 26772	VDH 267-72	90.00	52.12	178.50a	30.52	237.00	.00	.00	97.00
VD 22872	VDH 228-72	89.82	52.33	179.75a	29.77	237.00	.00	.00	97.75
CI 10083	Ingrid	86.63	51.34	179.75a	32.77	237.00	.00	.00	98.72
CI 7130	Freja	89.20	51.81	177.25	30.52	237.00	15.00	1.25	98.00
CI 16181	Purcell[1/]	88.91	52.75	176.50	31.77	237.00	12.50	.75	98.00
CI 13827	Shabet	88.72	51.60	178.25a	33.77	237.00	61.25a	2.50	98.00
CI 9558	Piroline	88.13	52.85	175.50	34.77a	237.00	26.25	1.50	98.00
VD 15472	VDH 154-72	87.94	52.64	180.75a	28.77b	237.00	.00	.00	97.50
VD 3	Menuet	87.44	52.64	179.00a	30.02	237.00	.00	.00	97.75
WA 11312	6194-63/Blazer	87.20	47.53	170.00b	30.52	237.00	.00	.00	97.50
MT 729	Summit	86.28	51.77	177.25	32.02	237.00	.00	.00	96.75b
MT 756	RPB 268-70	85.65	52.12	179.25a	33.53	237.00	.00	.00	97.50
VD 11874	VDH 118-74	85.63	52.12	180.00a	29.52 a	237.00	.00	.00	97.75
RP 45672	RPB 456-72	85.00	52.12	175.75	29.77	237.00	.00	.00	98.00
CI 3351	Dekap	84.63	50.56	173.50b	33.03	237.00	68.50a	4.50	97.25
CI 15768	Park	84.22	49.00	175.25	42.28a	237.00	24.75	1.75	98.22
MT 726	Lud	84.07	53.37	179.50a	32.02	237.00	.00	.00	97.50
MN 25	Morex	83.81	48.79	174.00b	43.28a	237.00	.00	.00	98.25
VD 7272	VDH 072-72	83.63	52.12	178.75a	30.77	237.00	.00	.00	97.75
CI 15549	Manker	83.12	50.35	173.50b	40.03a	237.00	5.00	.75	98.25
VD 4674	VDH 046-74	82.90	52.12	179.25a	26.77b	237.00	.00	.00	98.25
CI 5438	Compana	82.90	51.29	173.25b	31.52	237.00	69.75a	6.25a	97.75
MT 755	Cornel,Cebeco 7291	81.97	52.12	178.50a	30.02	237.00	.00	.00	98.00
NA 46176	N2SB 461-76	81.69	52.85	176.50	32.77	237.00	.00	.00	97.75
MB 323	Klondike	80.50	49.41	176.00	38.78a	237.00	56.00a	3.25a	97.75
AT 506	Fairfield	79.87	52.12	176.75	32.52	237.00	.00	.00	98.00

Table 1 . (con't)

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Maturity Date	Lodging %	Lodging Sev.	% Plump
CI 15769	Glenn	78.98	48.37	172.50b	37.28a	237.00	7.50	1.00	98.00
VD 26170	VDH 261-70A	78.81	51.18	179.00a	29.52	237.00	.00	.00	97.75
CI 15230	Blazer	78.49	47.33	177.00	38.28a	237.00	.00	.00	98.00
MT 842148	Sermo/7*Comp SHT AWN NKD	71.74b	54.73	174.50b	32.52	237.00	73.25a	5.25a	97.00
MT 73331	Washonupana	70.74b	51.92	175.50	32.52	237.00	98.00a	7.00a	96.25b
ES 1	Derived Titan	70.01b	47.74	173.00b	38.28a	237.00	.00	.00	97.75
MT 73518	Hypana/Unitan,F12	68.45b	50.56	173.25b	42.53a	237.00	.00	.00	98.47
ES 2	Waxy Titan	64.95b	46.91	173.00b	39.03a	237.00	7.50	.50	98.00
	$\bar{x}$	85.13	51.01	176.32	33.77	237.00	12.97	.92	97.77
	F 2/	2.00**	.00	23.60	15.31**	.00	6.47**	6.15**	1.33
	S.E.$\bar{x}$	5.54	.00	.57	1.02	.00	9.87	.70	.39
	L.S.D. (.05)	15.55	.00	1.60	2.87	.00	27.63	1.97	1.10
	C.V.%	6.52	.00	.32	3.03	.00	76.08	76.22	.40

1/ Check variety
2/ Value for variety comparison
* Statistically significant at the .05 level
** Statistically significant at the .01 level
a/ Values significantly greater than the check at .05 level
b/ Values significantly less than the check at .05 level

Table 2. Ten year summary of yields for the spring dryland intrastate barley nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT 1969-1978.

C.I. or State No.	Variety	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.	Sta. Years	% Piroline
CI 10421	Unitan	64.5	86.2	78.5	88.9	62.1	75.2	62.9	101.9	55.6	94.5	77.0	10	110.9
CI 9558	Piroline	50.4	78.7	67.7	57.1	61.8	87.1	61.2	80.8	61.9	88.1	69.5	10	100.0
CI 3351	Dekap	53.8	74.8	73.4	68.6	63.9	73.4	52.3	80.9	53.8	84.6	68.0	10	98.0
CI 5438	Compana	44.9	66.2	58.6	44.2	50.3	76.8	49.7	72.7	55.8	82.9	60.2	10	86.6
CI 13827	Shabet	57.8	73.4	68.4	62.6	61.4	84.2	43.7	87.2	56.3	88.7	68.4	10	98.4
CI 15514	Hector	43.1	74.0	77.5	68.1	59.4	80.8	52.1	78.5	57.1	91.4	68.2	10	98.2
CI 15229	Steptoe			97.9	75.9	69.1	83.2	69.0	105.8	68.1	96.6	83.2	8	117.7
MT 729	Summit				70.0	62.9	77.8	44.6	93.3	67.6	86.3	71.8	7	100.9
CI 15478	Klages					62.1	82.2	51.0	96.0	63.1	93.4	74.6	6	101.6
MT 726	Lud					55.3	80.9	56.3	86.4	63.5	84.1	71.1	6	96.7
CI 10083	Ingrid					53.6	82.0	45.4	83.5	62.3	86.6	68.9	6	93.8
CI 16181	Purcell		89.6	82.2	83.2				82.0	65.4	88.9	81.8	6	113.1
MT 756	RPB 268-70							60.5	90.7	69.0	85.7	76.5	4	104.8
MT 755	Cornel, Cebeco 7291							45.7	78.7	62.1	82.0	67.1	4	92.0
AT 506	Fairfield								87.1	52.4	79.9	73.1	3	95.1
RP 45672	RPB-72								76.1	67.7	85.0	76.3	3	99.1
CI 7130	Freja		83.7	72.8	78.9					67.1	89.2	78.3	5	110.8
VD 3	Menuet									64.3	87.4	75.9	2	101.1
VD 5	Pirouette									61.5	96.9	79.2	2	105.6
ID 702378	Steve									61.3	98.4	79.9	2	106.5
VD 7272	VDH 072-72									57.8	83.6	70.7	2	94.3
VD 15472	VDH 154-72									57.2	87.9	72.5	2	96.7
CI 15230	Blazer									51.8	78.5	65.2	2	86.9
ES 2	Waxy Titan									44.8	65.0	54.9	2	73.2
ES 1	Derived Titan									43.8	70.0	56.9	2	75.9
UT 1009	SDB1-1009										98.2	98.2	1	111.5
NA 61076	N2SB 610-76										94.4	94.4	1	107.2
CI 15687	Kimberly										91.8	91.8	1	104.2
VD 26772	VDH 267-72										90.0	90.0	1	102.2
VD 22872	VDH 228-72										89.8	89.8	1	101.9
WA 11312	6194-63/Blazer										87.2	87.2	1	98.9
VD 11874	VDH 118-74										85.6	85.6	1	97.2

Table 2 . (con't)

C.I. or State No.		Variety	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.	Sta. Years	% Priolene
CI	15768	Park										84.2	84.2	1	95.6
MN	25	Morex										83.8	83.8	1	95.1
CI	15549	Manker										83.1	83.1	1	94.3
VD	4674	VDH 046-74										82.9	82.9	1	94.1
NA	46176	N2SB 461-76										81.7	81.7	1	92.7
MB	323	Klondike										80.5	80.5	1	91.4
CI	15769	Glenn										79.0	79.0	1	89.7
VD	26170	VDH 261-70A										78.8	78.8	1	89.4
MT	842148	Sermo/7* Comp Sht Awn Nkd										71.7	71.7	1	81.4
MT	73331	Washonupana										70.7	70.7	1	80.3
MT	73518	Hypana/Unitan, F12										68.5	68.5	1	77.8

Table 3. Agronomic data from the interstate barley yield nursery grown at the Northwestern Agriculutral Research Center, Kalispell, Mt. in 1978. Field No. Y-2 irrigated. Random block design, four replications.

Date seeded: May 5, 1978 Date harvested: September 19, 1978 Size of plot: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Maturity Date	Lodging		Scald		P Mildew		%
							%	Sev.	%	Sev.	%	Sev.	Plump
CI 7130	Freja	120.28a	49.51	189.40b	37.03	262.00	60.0	6.2	55.0a	4.6	.0	.0b	93.40
UT 1009	SDB1-1009	107.02a	44.51	187.80b	39.83	262.00	32.0	5.8	.0	.0	1.0	.6	94.60
CI 16181	Purcell	106.58a	47.33	188.00b	38.03	262.00	52.0	5.6	23.0	4.0	8.0	1.6	92.60
CI 15229	Steptoe	104.36	45.45	183.80b	37.43	262.00	49.0	5.6	5.0	1.0	.0	.0b	97.00
VD 11874	VDH 118-74	103.38	46.18	191.60	39.43	262.00	35.0	4.8	6.0	1.2	.0	.0b	93.20
VD 26170	VDH 261-70A	102.67	50.46	190.60b	36.03b	262.00	33.0	4.0	21.8	1.6	3.0	.8	96.00
VD 22872	VDH 228-72	99.94	50.77	192.40	37.23	262.00	12.0b	2.0b	2.0	.8	.0	.0b	96.40
CI 15230	Blazer	99.03	45.87	188.60b	42.83a	262.00	18.0b	5.2	15.0	.8	61.8a	3.4	97.00
VD 15472	VDH 154-72	97.41	49.41	191.20	37.03	262.00	55.8	6.4	26.0	2.6	.0	.0b	93.40
VD 26772	VDH 267-72	96.94	50.04	190.40b	38.33	262.00	24.0	2.8b	68.2a	4.8	.0	.0b	96.40
WA 11312	6194-63/Blazer	94.49	42.11	180.00b	36.23	262.00	39.0	5.2	.0	.0	50.0a	4.0a	93.80
CB 7523	CEBECO 7523	94.04	50.77	191.20	37.63	262.00	29.0	6.0	77.6a	4.6	.0	.0b	93.60
VD 5	Pirouette	93.58	47.95	190.20b	35.63b	262.00	39.0	6.2	7.0	2.0	.0	.0b	92.20b
RP 45672	RPB 456-72	93.33	43.60	188.40b	38.03	262.00	44.0	6.4	.0	.0	2.0	.4	93.40
ID 702378	Steve	91.62	43.06	187.00b	37.43	262.00	33.0	5.4	.0	.0	35.0a	2.4	95.60
CI 15769	Glenn	90.53	45.35	184.00b	40.83	262.00	50.0	5.4	.0	.0	65.2a	4.2a	96.60
CI 15687	Kimberly	90.40	49.41	193.80	41.63a	262.00	48.0	7.2	4.0	1.2	9.0	2.2	93.60
CI 15478	Klages	89.84	44.83	191.40	39.63	262.00	45.0	5.8	19.0	3.0	14.0	.0b	93.40
VD 3	Menuet	89.09	51.18	189.00b	38.93	262.00	55.0	7.8	60.0a	4.0	.0	.0b	95.80
CI 15514	Hector	89.04	51.39	187.60b	41.83a	262.00	64.0	7.6	6.0	.8	.2	.6	93.40
NA 61076	N2SB 610-76	87.77	51.08	188.40b	42.03a	262.00	44.0	6.0	24.0	3.0	2.0	.6	94.50
MT 729	Summit	86.76	47.74	187.60b	38.63	262.00	57.0	6.4	43.0a	4.6	.0	.0b	91.40b
MB 323	Klondike	85.78	49.41	186.60b	42.23a	262.00	45.0	4.4	.0	.0	61.8a	4.4a	95.80
CI 15768	Park	85.75	46.91	185.60b	43.43a	262.00	22.0b	3.8b	10.0	1.6	.0	.0b	96.20
CI 15549	Manker	84.52	49.00	185.00b	41.23	262.00	42.0	6.6	.0	.0	93.0a	5.6a	96.20
VD 7272	VDH 072-72	83.74	49.41	190.80b	38.23	262.00	69.0	8.0	56.0a	4.4	.0	.0b	93.00
MT 755	Cornel, Cebeco 7291	83.49	49.62	190.00b	38.23	262.00	44.0	6.8	16.0	1.8	.0	.0b	96.00
CI 10083	Ingrid[1/]	82.90	50.25	192.60	38.83	262.00	56.0	7.2	6.0	2.4	7.2	2.0	95.80
VD 4674	VDH 046-74	82.83	53.59	190.60b	35.83b	262.00	33.0	3.6b	50.8a	3.8	.0	.0b	96.40
MT 726	Lud	82.56	46.18	190.40b	37.63	262.00	47.0	4.6	94.8a	6.2a	.0	.0b	94.40
NA 46176	N2SB 461-76	80.80	49.41	188.00b	38.43	262.00	62.0	6.0	4.0	1.0	.0	.0b	91.40b
AT 506	Fairfield	80.05	48.68	188.80b	37.83	262.00	67.0	6.6	16.0	4.6	16.0	1.4	94.40
MN 25	Morex	74.38	46.81	184.80b	43.83a	262.00	61.0	6.8	4.0	.8	69.0a	4.0a	95.00
CI 13827	Shabet	73.99	47.43	190.40b	38.43	262.00	63.0	6.8	1.0	.6	13.0	2.6	92.40

Table 3. (con't)

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Maturity Date	Lodging %	Lodging Sev.	Scald %	Scald Sev.	P Mildew %	P Mildew Sev.	% Plump
MT 73518	Hypana/Unitan'F12	72.80	47.12	184.60b	42.83a	262.00	49.0	6.2	.0	.0	44.0a	4.0a	96.80
CI 9558	Piroline	71.39	48.68	187.60b	39.23	262.00	57.0	5.8	24.0	3.8	.0	.0b	93.60
ES 1	Derived Titan	69.73	46.81	184.20b	39.82	262.00	40.0	4.2	1.0	1.0	31.0a	1.8	95.40
ES 2	Waxy Titan	67.83	45.04	183.60b	38.23	262.00	69.0	6.6	23.0	2.8	1.0	1.0	95.80
MT 756	RPB 268-70	65.19	49.20	191.40	39.43	262.00	76.8	8.0	96.4a	7.0a	.0	.0b	86.60b
CI 5438	Compana	64.10	45.04	189.00b	31.02b	262.00	77.0	8.0	23.0	1.8	1.0	.6	95.80
CI 3351	Dekap	63.63	45.45	189.40b	32.82b	262.00	89.0a	7.8	8.0	1.6	4.0	.6	91.80b
CI 10421	Unitan	62.57	45.76	184.60b	38.23	262.00	47.0	5.0	.0	.0	20.0	2.2	95.60
MT 73331	Washonupana	52.34b	52.33	186.20b	33.23b	262.00	82.0	7.4	3.0	2.0	10.0	1.2	89.80b
MT 842148	Sermo/7*Comp SHT AWN NKD	51.83b	52.95	187.60b	32.78b	262.00	87.0	7.2	14.0	2.2	2.0	.8	88.80b
	$\bar{x}$	85.04	48.14	188.28	38.47	262.00	50.06	5.94	20.76	2.14	14.19	1.20	94.19
	F 2/	3.07**	.00	32.06**	9.10**	.00	2.33**	1.47	6.51**	4.01**	8.51**	5.47**	3.30**
	S.E.$\bar{x}$	8.26	.00	.52	.94	.00	11.68	1.15	10.32	.93	8.17	.66	1.25
	L.S.D..05	23.14	.00	1.45	2.62	.00	32.70	3.23	28.89	2.60	22.87	1.86	3.49
	C.V.%	9.72	.00	.27	2.44	.00	23.33	19.42	49.68	43.46	57.58	55.11	1.32

1/ Check variety
2/ Value for variety comparison
a/ Values significantly greater than the check at the .05 level
b/ Values significantly less than the check at the .05 level
* Statistically significant at the .05 level
** Statistically significant at the .01 level

Table 4. Ten year summary of yields for the spring irrigated intrastate barley nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT 1969-1978

C.I. or State No.	Variety	1968	1969	1970	1971	1972	1973	1974	1976	1977	1978	Ave.	Sta. Years	% Ingrid
CI 10421	Unitan	98.4	92.1	80.0	102.9	92.6	91.9	115.3	77.0	93.8	62.6	90.7	10	101.1
CI 9558	Piroline	93.3	85.3	64.8	88.5	73.6	71.7	105.2	62.1	88.6	71.4	80.5	10	89.8
CI 10083	Ingrid	80.6	109.3	75.0	114.8	75.3	91.2	109.4	69.9	88.0	82.9	89.6	10	100.0
CI 5438	Compana	63.4	72.3	59.9	71.6	53.1	87.9	89.8	57.8	83.3	64.1	70.3	10	78.5
CI 15514	Hector		82.1	62.4	101.6	70.2	100.9	108.3	68.2	86.9	89.0	85.5	9	94.3
CI 13827	Shabet		80.4	67.7	93.6	69.6	81.8	115.0	67.8	90.1	74.0	82.2	9	90.7
CI 15229	Steptoe				116.0	111.3	97.4	145.7	92.4	105.3	104.4	110.4	7	122.3
MT 729	Summit					64.5	96.5	114.5	83.6	84.7	86.8	88.4	6	102.7
CI 16181	Purcell			61.2	106.9	84.3			82.1	98.7	106.6	90.0	6	106.8
CI 15478	Klages						87.0	114.8	80.7	94.0	89.8	93.3	5	105.6
MT 726	Lud						88.9	118.1	99.9	98.8	82.6	97.7	5	110.6
CI 3351	Dekap						80.4	98.5	51.3	81.1	63.6	75.0	5	84.9
MT 756	RPB 268-70								85.0	93.0	65.2	81.1	3	101.0
MT 755	Cornel, Cebeco 7291								90.0	97.4	83.5	90.3	3	112.5
AT 506	Fairfield								78.3	84.0	80.1	80.8	3	100.7
RP 45672	RPB 456-72								82.9	94.7	93.3	90.3	3	112.5
VD 3	Menuet									106.4	89.1	97.8	2	114.4
ID 702378	Steve									104.8	91.6	98.2	2	114.9
VD 5	Pirouette									104.8	93.6	99.2	2	116.1
VD 15472	VDH 154-72									102.9	97.4	100.2	2	117.2
VD 7272	VDH 072-72									97.7	83.7	90.7	2	106.1
CI 7130	Freja									94.9	120.3	107.6	2	125.6
ES 2	Waxy Titan									81.0	67.8	74.4	2	87.1
ES 1	Derived Titan									78.6	69.7	74.2	2	86.8
CI 15230	Blazer									77.6	99.0	88.0	2	103.3
UT 1009	SDB1-1009										107.0	107.0	1	129.1
VD 11874	VDH 118-74										103.4	103.4	1	124.7
VD 26170	VDH 261-70 A										102.7	102.7	1	123.9
VD 22872	VDH 228-72										99.9	99.9	1	120.5
VD 26772	VDH 267-72										96.9	96.9	1	116.9
WA 11312	6194-63/Blazer										94.5	94.5	1	114.0
CB 7523	Cebeco 7523										94.0	94.0	1	113.4
CI 15769	Glenn										90.5	90.5	1	109.2
CI 15687	Kimberly										90.4	90.4	1	109.1

Table 4 . (con't)

C.I. or State No.		Variety	1968	1969	1970	1971	1972	1973	1974	1976	1977	1978	Ave.	Sta. Years	% Ingrid
NA	61076	N2SB 610-76										87.8	87.8	1	105.9
MB	323	Klondike										85.8	85.8	1	103.5
CI	15768	Park										85.8	85.8	1	103.5
CI	15549	Manker										84.5	84.5	1	101.9
VD	4674	VDH 046-74										82.8	82.8	1	99.9
NA	46176	N2SB 461-76										80.8	80.8	1	97.5
MN	25	Morex										74.4	74.4	1	89.8
MT	73518	Hypana/Unitan F12										72.8	72.8	1	87.8
MT	73331	Washonupana										52.3	52.3	1	63.1
MT	842148	Sermo/7#Comp SHT Awn NKD										51.8	51.8	1	62.5

Table 5. Agronomic data from the irrigated off station spring barley nursery grown at the Bill Strange farm, Stevensville, MT in 1978.

Date seeded: April 26, 1978 Date harvested: August 26, 1978
Size of plot: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Maturity Date	Plant Ht.In.	Lodging %	Lodging Sev.	% Plump
MB 323	Klondike 1/	92.33	53.19	238.00	31.27	92.25a	3.00a	96.25
CI 10083	Ingrid 1/	86.75	54.60	238.00	30.77	.00	.00	96.50
ID 702378	Steve	86.27	49.08	238.00	28.27	.00	.00	97.00
CI 7130	Freja	85.54	54.34	238.00	30.52	.00	.00	96.50
CI 15229	Steptoe	85.28	55.00	238.00	25.02b	.00	.00	97.50
MT 729	Summit	83.94	54.89	238.00	29.02	.00	.00	96.50
CI 15478	Klages	81.15	53.84	238.00	29.77	.00	.00	95.50
CI 15514	Hector	80.05	54.26	238.00	31.02	.00	.00	95.50
CI 10421	Unitan	77.82	50.40	238.00	27.77	2.50	.75a	96.75
CI 16181	Purcell	77.58	53.37	238.00	27.77	.00	.00	96.25
CI 15687	Kimberly	77.58	52.23	238.00	32.52	.00	.00	95.50
CI 9558	Piroline	76.84	52.31	238.00	28.52	.00	.00	97.75
AT 506	Fairfield	73.66	54.39	238.00	28.02	.00	.00	96.25
CI 15549	Manker	67.65	53.69	238.00	29.02	.00	.00	96.75
$\bar{x}$ 2/		80.87	53.31	238.00	29.23	6.77	.27	96.46
F 2/		.92	1.32	.00	2.18	580.33**	12.01**	1.50
S.E.$\bar{x}$		6.60	1.41	.00	1.30	1.02	.23	.56
L.S.D. (.05)		18.90	4.04	.00	3.71	2.92	.67	1.60
C.V. %		8.17	2.65	.00	4.44	15.10	87.42	.58

1/ Check Variety
2/ Value for variety comparison
a/ Significantly greater than the check at the .05 level
b/ Significantly less than the check at the .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 6. Agronomic data from the irrigated off station spring barley nursery grown at the Art Mangles farm, Polson, MT in 1978. Random block design, four replications.

Date seeded: May 9, 1978 Date harvested: September 14, 1978
Size of plot: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Maturity Date	Plant Ht.In.	Lodging %	Lodging Sev.	% Plump
MT 729	Summit	36.33a	51.08	257.00	21.02	.00	.00	96.75
AT 506	Fairfield	35.77a	50.35	257.00	22.02a	12.50	1.75	98.00a
CI 15478	Klages	35.51a	49.94	257.00	21.26	.00	.00	95.75
CI 7130	Freja	34.91a	50.15	257.00	19.76	.00	.00	97.25a
CI 15229	Steptoe	34.69a	46.39	257.00	21.52	27.50	3.00	97.00
CI 15687	Kimberly	34.06a	49.00	257.00	21.52	.00	.00	93.50b
CI 10421	Unitan	32.75	46.39	257.00	22.02a	65.00a	6.50a	95.00
CI 9558	Piroline	32.75	51.50	257.00	23.02a	.00	.00	97.50a
MB 323	Klondike	32.56	48.58	257.00	22.02a	95.00a	9.00a	95.75
ID 702378	Steve	30.21	45.66	257.00	19.51	20.00	2.00	97.00
CI 15549	Manker	29.65	48.27	257.00	23.27a	81.25a	7.50a	97.25a
CI 10083	Ingrid 1/	29.57	50.04	257.00	19.51	.00	.00	95.50
CI 16181	Purcell	29.29	50.56	257.00	19.51	.00	.00	97.50a
CI 15514	Hector	27.01	50.04	257.00	22.26a	.00	.00	95.00
	$\bar{x}$	32.51	49.14	257.00	21.30	21.52	2.13	96.34
	F 2/	3.92**	.00	.00	2.95**	11.05**	8.91**	5.03**
	S.E.$\bar{x}$	1.47	.00	.00	.75	10.11	1.07	.57
	L.S.D.(.05)	4.20	.00	.00	2.14	28.89	3.06	1.63
	C.V. %	4.52	.00	.00	3.51	46.98	50.31	.59

1/ Check Variety
2/ Value for variety comparison
a/ Significantly greater than the check at the .05 level
b/ Significnatly less than the check at the .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 7. Agronomic data from the irrigated off station spring barley nursery grown at the Harvey Clouse farm, Missoula, MT in 1978. Random block design, four replications.

Date seeded: April 26, 1978 Date harvested: August 26, 1978
Size of plot: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Maturity Date	Plant Ht. In.	Lodging %	Lodging Sev.	% Plump
CI 15229	Steptoe	117.07a	50.95b	238.00	34.27b	20.00	1.00	97.50
CI 15514	Hector	107.53	55.64	238.00	34.77b	69.50a	2.00	98.97
MT 729	Summit	107.02	55.43	238.00	33.77b	69.50a	2.00	97.00
CI 7130	Freja	103.99	54.86	238.00	32.77b	54.50	2.50	97.25
CI 15687	Kimberly	102.78	54.10	238.00	37.03	.00	.00	96.50
CI 10421	Unitan	100.63	52.12b	238.00	38.28	44.75	1.50	97.25
AT 506	Fairfield	99.23	55.25	238.00	34.53b	74.25a	2.00	97.97
CI 9558	Piroline	95.14	55.38	238.00	35.78	79.25a	4.25a	98.72
CI 10083	Ingrid 1/	94.65	54.76	238.00	37.03	20.00	1.25	97.67
CI 15478	Klages	93.39	54.81	238.00	35.53	.00	.00	98.00
ID 702378	Steve	92.20	51.08	238.00	34.27b	.00	.00	97.75
CI 16181	Purcell	91.18	54.52	238.00	32.27b	62.00	1.75	97.00
CI 15549	Manker	75.87b	54.18	238.00	38.53	.00	.00	97.50
MB 323	Klondike	75.42b	54.58	238.00	39.78a	69.50a	3.00a	97.25
$\bar{x}$ 2/		96.87	54.10	238.00	35.62	40.23	1.52	97.60
F		6.44**	24.29**	.00	8.42**	4.42**	4.55**	1.90
S.E.$\bar{x}$		4.52	.32	.00	.77	15.17	.59	.49
L.S.D.(.05)		12.89	.90	.00	2.20	43.37	1.70	1.39
C.V. %		4.66	.59	.00	2.16	37.72	39.19	.50

1/ Check variety
2/ Value for variety comparison
a/ Values significantly greater than the check at the .05 level
b/ Values significantly less than the check at the .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significnace at the .01 level

Table 8. Summary of yield and test weight data from irrigated spring barley varieties grown at the Northwestern Agricultural Research Center and off-station plots in Lake, Missoula and Ravalli Counties in 1978.

C.I. or State No.	Variety	Yield (bu/a)					Test Weight (lbs/bu)				
		1/	2/	3/	4/	Ave.	1/	2/	3/	4/	Ave.
MB 323	Klondike	85.78	92.33	32.56	75.42	71.52	49.41	51.19	48.58	54.58	50.94
CI 10083	Ingrid	82.90	86.75	29.57	94.65	73.47	50.25	54.60	50.04	54.76	52.41
ID 702378	Steve	91.62	86.27	30.21	92.20	75.08	43.06	49.68	45.66	51.08	47.37
CI 7130	Freja	120.28	85.54	34.91	103.99	86.18	49.51	54.34	50.15	54.86	52.22
CI 15229	Steptoe	104.36	85.28	34.69	117.07	85.35	45.45	55.00	46.39	50.95	49.45
MT 729	Summit	86.78	83.94	36.33	107.02	78.52	47.74	54.89	51.08	55.43	52.29
CI 15478	Klages	89.84	81.15	35.51	93.39	74.97	44.83	53.84	49.94	54.81	50.86
CI 15514	Hector	89.04	80.05	27.01	107.53	75.91	51.39	54.26	50.04	55.64	52.83
CI 10421	Unitan	62.57	77.82	32.75	100.63	68.44	45.76	50.40	46.39	52.12	48.67
CI 16181	Purcell	106.58	77.58	29.29	91.18	76.16	47.33	53.37	50.56	54.52	51.45
CI 15687	Kimberly	90.40	77.58	34.06	102.78	76.21	49.41	52.23	49.00	54.10	51.19
CI 9558	Piroline	71.39	76.84	32.75	95.14	69.03	48.68	52.31	51.50	55.38	51.97
AT 506	Fairfield	80.05	73.66	35.77	99.23	72.18	48.68	54.39	50.35	55.25	52.17
CI 15549	Manker	84.52	67.65	29.65	75.87	64.42	49.00	53.69	48.27	54.58	51.39

Table 9. Summary of height and percent plump data from irrigated spring barley varieties grown at the Northwestern Agricultural Research Center and off-station plots in Lake, Missoula and Ravalli Counties in 1978.

C.I. or State No.	Variety	Height (inches)					% Plump				
		1/	2/	3/	4/	Ave.	1/	2/	3/	4/	Ave.
MB 323	Klondike	42.23	31.27	22.02	39.78	33.83	95.80	96.25	95.75	97.25	96.26
CI 10083	Ingrid	38.83	30.77	19.51	37.03	31.54	95.80	96.50	95.50	97.67	96.37
ID 702378	Steve	37.43	28.27	19.51	34.27	29.87	95.60	97.00	97.00	97.75	96.84
CI 7130	Freja	37.03	30.52	19.76	32.77	30.02	93.40	96.50	97.25	97.25	96.10
CI 15229	Steptoe	37.43	25.02	21.52	34.27	29.56	97.00	97.50	97.00	97.50	97.25
MT 729	Summit	38.63	29.02	21.02	33.77	30.61	91.40	96.50	96.75	97.00	95.41
CI 15478	Klages	39.63	29.77	21.26	35.53	31.55	93.40	95.50	95.75	98.00	95.66
CI 15514	Hector	41.83	31.02	22.26	34.77	32.47	93.40	95.50	95.00	98.97	95.72
CI 10421	Unitan	38.23	27.77	22.02	38.28	31.58	95.60	96.75	95.00	97.25	96.15
CI 16181	Purcell	38.03	27.77	19.51	32.27	29.40	92.60	96.25	97.50	97.00	95.84
CI 15687	Kimberly	41.63	32.52	21.52	37.03	33.18	93.60	95.50	93.50	96.50	94.78
CI 9558	Piroline	39.23	28.52	23.02	35.78	31.64	93.60	97.75	97.50	98.72	96.89
AT 506	Fairfield	37.83	28.02	22.02	34.53	30.60	94.40	96.25	98.00	97.97	96.66
CI 15549	Manker	41.23	29.02	23.27	39.78	33.33	96.20	96.75	97.25	97.25	96.86

1/ Northwestern Agricultural Research Center, Kalispell
2/ Ravalli County
3/ Lake County
4/ Missoula County

Table 10. Agronomic data from the Hector/Klages dryland nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1978. Field No. Y-2. Random block design, four replications.

Date seeded: May 5, 1978 Date harvested: August 28, 1978
Plot size; 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt. Lbs/Bu.	Heading Date	Height Inches	% Plump
CI 15229	Steptoe[1/]	129.39	48.15	185.00	36.00	98.00
CI 15478	Klages	119.24	52.48a	193.33a	40.67a	99.00
MT 547276	Hector/Klages	114.27	52.17a	193.00a	41.33a	98.67
MT 547123	Hector/Klages	110.42	52.37a	189.67a	40.00a	99.33
MT 547270	Hector/Klages	107.80b	50.51a	192.00a	38.33	99.00
MT 547103	Hector/Klages	107.67b	51.10a	193.67a	43.33a	97.00
MT 547255	Hector/Klages	104.40b	52.00a	188.67a	41.67a	97.67
MT 547234	Hector/Klages	104.23b	52.96a	191.33a	41.67a	98.67
MT 547354	Hector/Klages	103.97b	51.82a	188.67a	41.67a	98.33
MT 547143	Hector/Klages	102.78b	52.27a	191.67a	41.33a	99.00
CI 15514	Hector	101.91b	52.82a	189.00a	41.00a	97.67
MT 547125	Hector/Klages	97.49b	52.24a	190.00a	39.33	99.33
MT 547236	Hector/Klages	95.98b	51.89a	192.67a	38.00	97.33
MT 547263	Hector/Klages	95.72b	51.99a	189.67a	38.67	97.33
MT 547242	Hector/Klages, F6	95.13b	52.34a	189.67a	39.67a	98.33
MT 547316	Hector/Klages	90.03b	52.55a	188.67a	40.33a	97.67
	$\bar{x}$	105.03	51.85	190.42	40.19	98.27
	F[2/]	2.12*	6.62**	16.28**	2.04*	1.44NS
	S.E. $\bar{x}$	6.84	.45	.57	1.27	.64
	L.S.D.(.05)	19.76	1.30	1.63	3.66	1.83
	C.V. %	6.52	.87	.30	3.15	.65

1/ Check variety
2/ F-value for variety comparison
a/ Value significantly greater than the check (.05) level.
b/ Value significantly less than the check (.05) level.
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

Table 11. Agronomic data for the Hector/Klages irrigated nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1978. Field No. Y-2. Random block design, four replications.

Date seeded: May 4, 1978 Date harvested: August 28, 1978
Plot size; 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt. Lbs/Bu.	Heading Date	Height Inches	% Plump
MT 547270	Hector/Klages	100.91	52.57a	191.50a	40.25a	99.50a
MT 547263	Hector/Klages	100.39	52.00a	188.25a	38.00	97.50
CI 15478	Klages	98.79	52.96a	192.25a	38.75	96.50
CI 15514	Hector	98.01	53.12a	189.00a	42.00a	97.50
MT 547234	Hector/Klages	96.91	53.56a	190.50a	39.25a	98.25
CI 15229	Steptoe 1/	96.24	48.00	185.00	34.25	97.25
MT 547276	Hector/Klages	96.22	52.24a	192.00a	39.00a	96.75
MT 547125	Hector/Klages	93.66	53.01a	190.50a	38.50	98.00
MT 547242	Hector/Klages, F6	91.80	52.96a	189.50a	37.50	98.50
MT 547354	Hector/Klages	91.69	52.36a	188.50a	40.00a	97.50
MT 547236	Hector/Klages	91.61	52.75a	192.75a	37.50	97.00
MT 547255	Hector/Klages	91.26	52.94a	189.25a	38.25	97.75
MT 547143	Hector/Klages	89.98	52.65a	191.50a	37.25	98.75
MT 547103	Hector/Klages	89.86	52.36a	193.00a	38.50	97.75
MT 547123	Hector/Klages	85.25	53.48a	189.25a	36.75	98.00
MT 547316	Hector/Klages	77.54	53.17a	189.50a	38.00	97.50
	$\bar{x}$	93.14	52.51	190.14	38.36	97.75
	F 2/	.43NS	9.26**	15.12**	1.15NS	1.30NS
	S.E.$\bar{x}$	9.11	.42	.53	1.58	.67
	L.S.D. (.05)	25.95	1.20	1.50	4.51	1.89
	C.V. %	9.78	.80	.28	4.13	.68

1/ Check variety
2/ F-value for variety comparison
a/ Value significnatly greater than the check at the .05 level.
b/ Value significantly less than the check at the .05 level.
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

TITLE: Winter Barley

PROJECT: Small Grains Investigations MS756

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Feed Crops Committee, MSU

LOCATION: Northwestern Agricultural Research Center, Kalispell

OBJECTIVES:
1. To determine the adaptability of new and introduced barley lines for western Montana.
2. To select from the world population new promising lines for use in western Montana.

1978 EXPERIMENTS:
1. Uniform Winter Barley Nursery (Hardy Varieties)
2. Western Winter Barley Nursery

RESULTS AND DISCUSSION:

1. Uniform Winter Barley Nursery (Hardy Varieties) -

This year winter barley yields were extremely low. This is believed to be due to the high incidence of snow mold and extreme wind erosion in the spring. The highest yield for the Uniform Nursery was 29.7 bu/a which was Michigan 69-534-8. The check variety was Hudson which yielded 22.6 bu/a. The overall mean yield was 18.0 bu/a. Five varieties had yields significantly less than the check, the lowest being 3.9 bu/a for OK 77401. The test weights obtained did not vary from the expected. The mean was 48 lbs/bu.

Slight lodging was seen in the varieties PA 76-49 and Post. Winter survival ranged from 4% in the OK 77401 variety to 59% in Michigan 69-534-8.

Winter kill was so severe in two varieties that no test weight data could be obtained. The mean survival for the test was 26.8%.

Table 2 gives a summary of yields for winter barley nurseries grown at the Northwestern Agricultural Research Center from 1968 to 1978, excluding 1973. Hudson is used as a check. There are no varieties which equal Hudson over the 10 year period.

2. Western Winter Barley Nursery -

Yields were very low due to snow mold and wind erosion. The highest yield 36.8 bu/a was obtained from 73 Ab169 and the lowest of 18.6 bu/a from WA 2196-68. WA 2464-70 and WA 2196-68 and Ackerman's 989 yielded significantly less than the check (31.3 bu/a). Test weights were slightly higher but did not vary greatly between varieties. The mean test weight was 50.2 lbs/bu. Three varieties headed at a significantly earlier date than the check. These were Hudson, Kamiak and NY 6005-18. Winter survival percentage ranged from 14% (WA 2196-68) to 68% (73 Ab489). The mean was 33% and the check variety, Alpine, had a survival rating of 44%. Three varieties were significantly greater in survival than the check. Nine were significantly less. Table 3.

Table 1. Agronomic data from the Uniform Winter Barley Nursery grown at Kalispell, MT in 1978. Random block design, four replications. Field No. R-6a.

Date seeded: September 21, 1977 Date harvested: August 1, 1978
Size of plot: 44 sq. ft.

Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Lodging %	% Survival
Maury (VA 70-44-213)	22.9	47.1	160	25	1.00	25
MO B2126	20.1	50.9	160	30	.00	45a
MO 2487	20.4	47.5	157	22	.00	39
Post	10.3b	46.2	164	22	6.00	6b
Hudson 1/	22.6	49.5	160	27	.00	26
NE 73264	18.9	48.0	167	25	3.00	26
Kamiak	27.6	50.5	157	26	.00	32
PA 76-6	10.5b	48.0	162	25	5.00	6b
PA 76-32	14.4b	42.9	165	25	3.00	7b
PA 76-49	10.9b	46.5	156	27	8.00	12
Michigan 69-523-5	26.0	48.6	154	28	.00	47a
Michigan 69-534-8	29.7a	48.6	163	32	1.00	59a
OK 77401	3.9b	-	165	26	3.00	4b
MO B 2632	22.9	50.5	158	28	.00	44a
MO B 2633	7.9b	-	163	28	.00	6b
MO B 2639	18.8	49.6	156	28	.00	39
MO B 2690	17.8	50.0	157	25	.00	32
VA 73-42-19	18.8	44.0	161	23	1.00	24
$\bar{x}$	18.0	48.0	160.3	26.0		26.8
F 2/	16.53**	.0	.308NS	.770NS		7.65**
S.E.$\bar{x}$	1.74	.0	6.64	2.89		6.07
L.S.D.(.05)	4.96	.0	18.86	8.21		17.24
C.V. %	9.67	.0	5.85	15.74		32.00

1/ Check variety
2/ Value for variety comparison
a/ Significantly greater than the check at the .05 level
b/ Significantly less than the check at the .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 2 . Summary of yields for the Uniform Barley Nursery grown at Kalispell, MT 1968-1978.

C.I. or State No.	Variety	1968	1969	1970	1971	1972	1974	1975	1976	1977	1978	Ave.	Sta. Yrs.	% Hudson
CI 8067	Hudson	109.7	42.8	74.2	107.4	61.1	53.1	78.1	73.7	70.0	22.6	69.3	10	100.0
CI 15197	Kamiak					57.8	57.7	77.0	69.6	64.9	27.6	59.1	6	98.9
	MO B 2126						39.0	51.0	38.6	60.3	20.1	41.8	5	70.3
NE 72637	Nebr. Sel.							53.8	44.3	54.2	18.9	42.8	4	70.1
	MO.2487								56.2	58.5	20.4	45.0	3	81.2
VA 70-44-213	Maury								51.7	91.4	22.9	55.3	3	99.8
CI 15695	Post (OK 7110566)									62.3	10.3	36.3	2	78.4
	PA 76-6 Larker x (Pennrad x Wong)									66.1	10.5	38.3	2	82.7
	PA 76-32 Larker x (Pennrad x Wong)									53.1	14.4	33.8	2	72.9
	PA 76-49 Larker x (Pennrad x Wong)									47.2	10.9	29.1	2	62.7
	Michigan 69-523-5										26.0	26.0	1	115.0
	Michigan 69-534-8										29.7	29.7	1	131.4
	OK 77401										3.9	3.9	1	17.3
	MO B 2632										22.9	22.9	1	101.3
	MO B 2633										7.9	7.9	1	35.0
	MO B 2639										18.8	18.8	1	83.2
	MO B 2690										17.8	17.8	1	77.8
	VA 73-42-19										18.8	18.8	1	83.2

Table 3. Agronomic data from the Western Winter Barley Nursery grown at Kalispell MT in 1978. Random block design, four replications. Field No. R-6a.

Date seeded: September 21, 1977 Date harvested: August 9, 1978
Size of plot: 44 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Lodging %	% Survival
CI 13340	Luther	28.7	49.9	174	22	.00	16b
CI 8067	Hudson	24.2	51.5	161b	25	.00	25
CI 15197	Kamiak	24.2	51.0	160b	24	2.50	20b
CI 11887	Schuyler	27.2	50.0	174	23	.00	16b
CI 15559	Boyer	24.9	50.3	173	20	.00	21b
	Ackerman's 989	20.8b	51.0	163	24	.00	24b
	WA 2464-70	18.9b	50.7	166	24	.00	36
	WA 2196-68	18.6b	49.7	173	18	.00	14b
	WA 3021-70	23.2	49.9	176	19	.00	28
	NY 6005-18	35.9	49.7	160b	27	.00	35
	WA 1245-68	22.4	51.0	168	20	1.00	18b
	WA 1331-68	29.4	49.6	176	21	.00	20b
	OR-FB 73123	28.4	51.4	171	21	.00	26
	OR-FB 73130	30.6	50.3	173	21	.00	36
	OR-FB 73186	24.4	49.7	174	20	.00	21b
	OR-FB 73594 D15	33.7	50.2	166	22	.00	64a
	OR-FB 73596 D26	25.6	46.8	164	21	.00	60
	73Ab169	36.8	51.5	178	21	.00	64a
	73Ab176	31.6	48.6	174	20	.00	52
	73Ab489	35.7	49.8	177	20	.00	68a
CI 9478	Alpine 1/	31.3	50.5	181	25	2.50	44
	$\bar{x}$	27.45	50.20	162.43	20.57		33.0
	F 2/	2.622**	.00	32.188**	4.455**		7.68**
	S.E.$\bar{x}$	3.37	.00	6.65	2.46		6.79
	L.S.D. (.05)	9.53	.00	19.00	6.96		19.22
	C.V. %	17.35	.00	11.19	16.91		29.09

1/ Check variety
2/ Value for variety comparison
a/ Significantly greater than the check .05 level
b/ Significantly less than the check .05 level
* Indicates statistically significance at the .05 level
** Indicates statistically significance at the .01 level

TITLE: Spring Oats

PROJECT: Small Grains Investigations MS 756

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Feed Crops Committee, MAES, MSU

LOCATION: Northwestern Agricultural Research Center. Field No. Y-2

DURATION: Indefinite

OBJECTIVE: To determine the adaptability of new or introduced oat varieties.

SUMMARY OF 1978 RESULTS:

This year yields were above average. Table 1. The mean yield was 147.26 bu/a. Kelsey was the highest yielding variety with 198.98 bu/a. The two varieties, Basin and Terra had the only yields that were significantly less than the check. Their yields were 119.94 bu/a and 90.68 bu/a respectively. The yield for Otana, which was the check, was 160.82 bu/a.

The mean test weight was 38.64 lb/bu. The highest yielding variety Kelsey had a test weight of 40.75 lb/bu and the check was 36.99 lb/bu. The lowest test weight was WA6391 at 34.69 lb/bu and the highest was 42.42 lb/bu for Terra, which also had the lowest yield.

Some lodging was observed in Otana, Russell and WA6394 varieties. Twelve varieties headed out earlier than Otana, six later and ten varieties headed approximately the same time.

A ten year summary for oat yields is given in Table 2. Park is compared to all varieties as a check. Compared on a ten year basis both Basin and Cayuse out produced Park by 2.6 and 13.0% respectively. Yields for Random were greater by 15.7% over an eight year period. Otana was 25% greater in yield over a seven year period than Park.

Table 1. Agronomic data from the Uniform Northwestern States Oat Nursery grown on the Northwestern Agricultural Research Center at Kalispell, MT in 1978. Random block design, three replications.

Date seeded: May 5, 1978 Date harvested: August 30, 1978
Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt. Lbs/Bu	Heading Date	Height Inches
CI 8171	Kelsey	198.98	40.75	191.00b	55.0a
OT 726	Random/Forward	179.65	40.12	194.00b	54.67
CI 9081	Random	177.08	37.51	190.00b	50.67
CI 9264	Cayuse/Orbit	177.00	39.39	195.67	48.00
OT 719	Cavell (OT703/Glen)	175.13	39.60	191.67b	51.33
WA 6014		165.31	38.03	196.33	47.67
ID 742300	Otana//Cokerx848-1-1-2/	160.82	36.99	196.33	48.33
ID 742608	Cayuse/Otana	157.05	38.23	194.00b	47.01
WA 6393	Minn.II-22-220/Cayuse	155.35	37.41	201.00a	48.67
WA 6161	CI 2874/Cayuse	153.06	37.82	200.00a	48.33
CI 8263	Cayuse	152.31	38.76	194.00b	46.67
WA 6394	Minn.II-22-220/Cayuse	150.97	35.73	203.33a	49.01
ID 721729	Minn.II-22-220/Cayuse	148.34	38.03	199.33a	47.67
WA 6160	CI2874/Cayuse	144.27	36.99	196.67	45.33
WA 6391	Minn.II-22-220/Cayuse	143.10	34.69	190.67b	47.67
CI 7557	Russell	141.10	39.50	192.67b	53.67
WA 6392	Minn.II-22-220/Cayuse	140.64	38.66	198.67a	47.01
CI 9266	Cayuse/Orbit	135.65	38.66	195.33	45.67
CI 6611	Park	135.45	39.60	196.33	52.34
ID 721723	Minn.II-22-220/Cayuse	134.90	35.83	201.00a	45.33
ID 741952	Cokerx848-1-B-1/Cayuse	132.33	35.63	196.00	41.67b
WA 6159	CI2874/Cayuse	131.52	36.05	197.33	47.67
CI 2053	Markton	128.09	39.18	192.00b	57.33a
ID 712506	CI5345/Zanster	124.63	41.59	193.67b	50.00
CI 9252	Otana (63AB5280-7)	122.65	41.38	195.00b	50.67
CI 5346	Basin	119.94b	39.91	195.67	50.34
OT 195	Terra	90.68b	42.42	190.67b	45.67
	$\bar{x}$	147.26	38.46	195.49	49.01
	F - value for variety comparison	2.52**	.00	57.79**	2.39**
	S.E. $\bar{x}$	4.34	.00	.46	2.23
	L.S.D. (.05)	40.68	.00	1.30	6.34
	C.V. %	9.73	.00	.23	4.56

Table 2. Summary of oat yield data from the Uniform Oat Nursery, Northwestern Agricultural Research Center, Kalispell, Mt, 1969-78.

C.I. or State No.	Variety	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.	Sta. Years	% Park
CI 5346	Basin	151.5	148.7	177.0	144.2	114.4	181.6	143.4	71.0	122.2	119.9	137.4	10	102.6
CI 6611	Park	171.4	127.1	190.6	67.8	115.1	123.2	170.0	108.0	130.2	135.5	133.9	10	100.0
CI 8263	Cayuse	138.1	158.7	195.9	140.7	113.6	162.5	171.8	127.7	151.4	152.3	151.3	10	113.0
CI 2053	Markton	120.2	120.5	175.1	77.5	87.1	147.0	130.1	75.6	125.1	128.1	118.6	10	88.6
CI 8171	Kelsey	142.5	127.6	195.3	89.3	115.7	193.4	-	89.5	134.2	199.0	142.9	9	98.7
CI 9081	Random			197.7	106.9	116.5	193.0	166.9	93.5	152.2	177.1	150.5	8	115.7
CI 9252	Otana				142.9	127.6	183.6	180.4	142.8	162.2	122.7	151.7	7	125.0
WA 6014						118.3	183.9	148.0	103.7	143.4	165.3	143.8	6	110.3
WA 6159	CI2874/Cayuse							162.8	96.0	156.6	131.5	136.7	4	100.6
WA 6160	CI2874/Cayuse							181.3	118.9	158.1	144.3	150.6	4	110.8
WA 6161	CI2874/Cayuse							182.4	108.9	167.9	153.1	153.1	4	112.6
ID 712506	CI5345/Zanster							167.8	113.5	171.7	124.6	144.4	4	106.2
ID 721723	Minn.II-22-220/Cayuse							175.6	89.3	148.4	134.9	137.1	4	100.8
CI 7557	Russell							150.2	102.2	126.2	141.1	129.9	4	95.6
OT 195	Terra								57.4	116.5	90.7	88.2	3	70.8
CI 9266	Cayuse/Orbit									174.6	135.7	155.2	2	116.8
ID 742300	Otana//Cokerx848-1-1-2/C									163.6	160.8	162.2	2	122.1
CI 9264	Cayuse/Orbit									152.2	177.0	164.6	2	123.9
ID 741952	Cokerx848-1-B-1/Cayuse									146.0	132.3	139.2	2	104.7
ID 742608	Cayuse/Otana									145.2	157.1	151.2	2	113.8
ID 721729	Minn.II-22-220/Cayuse										148.3	148.3	1	109.5
OT 726	Random/Forward										179.7	179.7	1	132.6
OT 719	Cavell (OT703/Glen)										175.1	175.1	1	129.2
WA 6393	Minn.II-22-220/Cayuse										155.4	155.4	1	114.7
WA 6394	Minn.II-22-220/Cayuse										151.0	151.0	1	111.4
WA 6391	Minn.II-22-220/Cayuse										143.1	143.1	1	105.6
WA 6392	Minn.II-22-220/Cayuse										140.6	140.6	1	103.8

TITLE: Spring Wheat

PROJECT: Small Grain Investigations MS 756

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Technician - Todd Keener
Cooperators - Montana Agricultural Experiment Station
Field Crops Branch ARS USDA
Montana Research and Marketing Committee

OBJECTIVES:
1. To determine the adaptability of new and introduced spring wheat varieties and selections.
2. To aid in the basic genetic research programs in spring wheat.

RESULTS AND DISCUSSIONS:

The mean this year for spring wheat yields was down slightly from last year. The mean this year was 75.55 bu/a. The range of yields was from 43.90 bu/a to the high yield of MP-122 which was 92.91 bu/a. The check, Newana, had a yield of 82.59 bu/a which was 15% less than last year. Test weights varied little from the mean which was 57.31 lbs/bu. Six varieties had significantly early heading dates as compared with the check and five others were significantly later in heading. Table 1. Stem lodging was severe in varieties MP-122, NHS 183-74, Fortuna, and Thatcher. Leaf rust was severe in Cebeco 1024 and Thatcher. Five additional varieites demonstrated moderate leaf rust susceptibility. Table 1.

Table 1. Agronomic data from the Private Variety Yield Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT in 1978. Field No. Y-2. Random block design, four replications.

Date seeded: May 5, 1978 Date harvested: September 23, 1978
Plot size: 32 sq. ft.

C.I. or State No.		Variety	Yield Bu/A	Test Wt Lbs/Bu.	Heading Date	Plant Ht.In.	Lodging %	Leaf Rust %
WS	122	MP-122	92.91	59.00	196.75a	39.25a	61.33	.00
AG	1	Solar	92.83	58.80	194.25a	37.25a	33.33	.00
CI	13986	Era	90.19	58.60	194.00a	36.25	8.33	8.33
TR	3	Octo Bulk-Bush (Triticale)	88.50	49.40	188.00b	39.00a	.00	5.00
NK	55114	75S 5511-4	83.40	58.00	192.00	38.75a	.00	.00
CI	17430	Newana, MT 7156 1/	82.59	59.00	192.25	35.00	40.00	5.00
NK	55112	75S 5511-2	81.88	59.60	192.25	38.00a	30.00	20.00
NK	5509	75S 5509	81.36	57.90	190.00b	37.50a	1.67	.00
NK	55111	75S 5511-1	77.44	59.50	191.75	37.50a	8.33	15.00
TR	1	Navojoa (Triticale)	74.17	53.90	188.25b	35.75	.00	20.00
NA	18374	NHS 183-74	73.61	57.50	188.25b	34.50	78.33	20.00
CI	13596	Fortuna	71.55	57.60	191.25b	44.25a	60.00	6.67
MT	34	Prodax	64.36b	56.10	192.25	36.75a	.00	28.33a
NK	5508	75 S 5508	62.95b	57.40	194.25a	32.75b	30.00	21.67
CI	10003	Thatcher	47.20b	56.90	189.75b	48.50a	61.67	96.00a
CE	1024	Cebeco 1024	43.90b	57.70	196.50a	41.75a	43.33	80.00a
		$\bar{x}$ 2/	75.55	57.31	191.98	38.30	28.52	20.38
		F 2/	6.91**	.00	73.13**	40.04**	1.86NS	19.78**
		S.E.$\bar{x}$	5.63	.00	.32	.61	19.72	6.32
		L.S.D. (.05)	16.03	.00	.91	1.74	56.16	17.99
		C.V. %	7.45	.00	.17	1.60	69.13	31.00

1/ Check variety
2/ Value for variety comparison
a/ Value significantly greater than the check at the .05 level
b/ Value significantly less than the eheck at the .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

TITLE: Winter Wheat

PROJECT: Small Grains Investigations MS756

YEAR: 1978

PERSONNEL: Leader - Vern R. Stewart
Research Technician - Todd Keener
Cooperator - G. A. Taylor
Cooperating Agencies - Montana Agricultural Experiment Station
Montana Wheat Research & Marketing Committee

LOCATION: Northwestern Agricultural Research Center, L. B. Claridge farm, Kalispell, MT

OBJECTIVES:

1. To obtain information necessary to make varietal recommendations and evaluate new varieties and selections.
2. To cooperate in the breeding program in northwestern Montana designed to produce a high yielding variety with particular emphasis on quality, disease resistance to dwarf smut and stripe rust. Other agronomic characteristics such as straw strength and winter hardiness will be evaluated.

1978 EXPERIMENTS:

1. Western Regional Hard Red Winter Wheat Nursery
2. Western Regional White Winter Wheat Nursery
3. Elite Yellow Rust Nursery
4. Seed Treatment Study
5. Special lines from Sunderman

1978 RESULTS:

Western Regional Hard Red Winter Wheat Nursery - Kalispell

Yields in 1978 were very low with a mean of 25.07 bu/a. This low yield was caused by a high level of snow mold. Crest, the check variety, was about equal in yield to the other varieties and had a better than average survival level. ID745520 was the highest yielding entry but not statistically significant. The high C.V. can be accounted for in part because of the uneven stands. Test weights were all below standard in the test.

High levels of dwarf smut were found in this test. Only one variety ID154 was free of this disease. ID745520 the highest yielding line, had only 1.25% smut which does indicate some resistance. Table 1.

Western Regional Hard Red Winter Wheat Nursery - Stillwater

This was seeded later than the Creston location. This delay in seeding resulted significantly in better stands and little or no loss due to snow mold. There was a relatively high level of dwarf smut infection, therefore giving a significant reading as to resistance. The highest yielding entry is UT89099 with 97.29 bu/a. It had a relatively low level of dwarf smut - .75%. Three Utah lines were the highest yielding lines in this study.

Test weights were low and can be accounted for because of the heavy rainfall and delayed harvest. UT890152 showed no evidence of dwarf smut and was second in yield. ID126 also showed no dwarf smut, but had a very weak straw and a low yield.

Kharkof, one of the more susceptable checks had a dwarf smut level of 21.25%. Therefore, we feel this is a pretty good test of the varieties in the nursery. The mean yield for the nursery was 65.37 bu/a. The C.V. is somewhat higher than we would like to see, but this is due in part to lack of uniformity in the field. Table 2.

1978 Results (con't)

Western Regional White Winter Wheat Nursery - Kalispell

In 1978 we had the lowest yields of white wheats ever grown in this location. There was a very high level of dwarf smut. The mean yield for the nursery was 25 bu/a and we would anticipate a mean yield of 60 to 70 bu/a. Hyslop was the highest yielding entry at 36.94 bu/a. It had a smut reading of 5.75%. McDermid the check variety, was found to be significantly lower in yield than other lines and had a smut reading of 9.75%. There were no lines with 0.0% smut readings.

Stand loss is due to high levels of snow mold. The soft white variety survival level is much lower than the hard red winter varieties. In 1978 there are few or no promising lines in the white wheats. Luke had a smut reading of 7.25%, which is much higher than we can tolerate. Table 3.

Western Regional White Winter Wheat Nursery - Stillwater

Yields were above average for the Stillwater location. We had a mean yield of 69 bu/a, which ordinarily we would expect at the Kalispell location. McDermid was used as the check variety.

Smut levels were not as high as at Kalispell. We had excellent stand as seen by the yields. There are no varieties that have what I consider an acceptable dwarf bunt resistance level, however ID755312 was quite low at 1.25% and ID745318 at 1%. Luke, a smut resistant variety had a dwarf smut reading of 1.25%. Kharkof, one of the checks had a reading of 8.25%. Table 4.

In Table 5 is a summary of the yields for the Western Regional White Wheat Nurwery at the Northwestern Agricultural Research Center for 1968-78. Nugaines is used as the check. Hyslop compared over the 11 years is 11.4% higher in yield.

Elite Yellow Rust Nursery - Kalispell

The hard red wheat lines in this nursery are being evaluated for resistance to stripe rust and dwarf smut. There were differences in survival due to snow mold. MT7789 is the highest yielding entry in the test, but it is not significantly higher in yield than Crest which we used as a check. There were no lines in this test that were completely immuned to dwarf smut, however there were six lines that were less than 1% dwarf smut. Some varieties had very good straw strength. MT77077 and MT 77079 have some resistance to dwarf smut. MT77079 does not have as strong a straw, but probably would be acceptable. MT77066 has good straw but has a high dwarf smut reading. Westmont, which is a dwarf smut susceptable variety, has a smut reading of 30.75% which indicates that many of the lines in this test do show some promise for resistance. Table 6.

Elite Yellow Rust Nursery - Stillwater

This nursery has the same objectives as the previous one. Mean yield of 51.72 bu/a, is very high for this location for hard reds. The dwarf smut level was not as high as the Kalispell location, however high enough to give us information on the resistance of most lines. MT77056 showed no smut, had good straw strength and yielded 66.97 bu/a. MT77069 also had a 0.0% reading on dwarf smut. C.V.'s are very high, this can be accounted for in part because of the unevenness in stand at this location which was due to water standing in the field in early spring. Table 7.

Special Lines from Sunderman

Six hard red wheat lines from the breeding program at Aberdeen, Idaho were evaluated for yield and dwarf smut resistance. Two lines were found to be free of dwarf smut. A7014W-16-1 was the highest yielding line, had good straw strength, fair test weight and .0% smut. Two of these hard red lines need to be evaluated further. Table 8.

1978 Results (con't)

Seed Treatment Study

Dwarf smut levels were quite high in this study. Westmont, a very susceptable variety, had a reading of 38%. Stands were uneven throughout the study. An error made in harvesting made it impossible to obtain a statistical analysis of the yield data. Thus the yield data shown is the average of the number of plots harvested from each treatment, which may vary from one to three.

The major information from this study is the smut data for each of the fungicide treatments. Thiabendazole (TBZ) at two and four ounces per bush provide fairly effective control of dwarf smut in all varieties. Resistant varieties treated with TBZ decreased smut levels some. The variety Crest when treated with TBZ at two ounces had a reading of 0%, 4 oz., .7 % and the check 3.3%. The two and four ounce rates of TBZ on Luke provided 100% control of the dwarf smut.

Benomyl did not give effective control of dwarf smut in Westmont and McDermid, but did reduce smut readings as much as 50%. However, this is not an acceptable smut level for commercial production. Benomyl and Uniroyal H719 did not increase the dwarf smut control in the resistant varieties Luke, Hansel and Crest.

In summary we conclude that TBZ did give us effective control of dwarf smut in 1978, which we have seen in our work since 1972. The combination of resistant varieties and seed treatment should give us an effective tool for controlling this disease. Table 9.

Table 1. Agronomic data from the western regional hard red winter wheat nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1978. Field No. E-1. Random block design, four replications.

Date seeded: September 15, 1977 Date harvested: August 29, 1978
Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Height Inches	% Survival	Dwarf Smut
ID 745520	Bezo//Burt/PI178383	34.74	59.00	163.25a	39.00a	83.75	1.25
ID 75537	WA4765//Burt/PI 178383	31.51	55.10	167.00a	31.00b	76.25	2.00
UT 890152	Utah Sel. 890152	31.41	57.60	169.00a	34.00	78.75	1.25
ID 156	A7037W-3-3-1	29.71	56.60	165.00a	36.50a	70.00	6.00
UT 890123	Utah Sel. 890123	28.71	57.40	164.00a	35.00	80.00	2.25
CI 13880	Crest 1/	28.68	56.50	160.75	33.25	82.50	1.00
ID 745130	Ark Sib//NRN 10-ST/2*CNN	27.91	57.50	169.00a	32.75	75.00	.75
WA 6364	Koelz 7941/2*McCall	27.73	58.40	166.50a	34.25	75.00	38.00a
UT 890143	Utah Sel. 890143	27.01	57.60	167.00a	35.00	70.00	.75
ID 74747	Ark Sib	26.08	59.40	176.00a	39.75a	68.75	1.25
ID 154	Bsn//KO/CI#3/ II60/CI#	25.88	57.50	169.00a	36.00a	56.25b	.00
ID 114	CI14106/McCall,Sel.2	25.38	57.20	167.50a	34.75	68.75	1.25
UT 89033	Utah Sel 89033	25.23	57.70	168.50a	35.50a	57.50b	.50
WA 6365	Koelz 7941/2*McCall	25.16	58.10	170.00a	36.25a	67.50	36.50a
ID 745102	Bex//Burt/178383/3/ Ark	25.13	57.00	165.00a	39.00a	71.25	4.25
WA 6473	14484/3B1/BK1205// 13438	23.88	57.40	168.00a	29.50b	61.25b	41.50a
ID 158	Heglar/ID 5006	23.51	58.00	169.00a	33.25	76.25	50.00a
ID 157	14106/MC/3/WR// KO/178383	23.13	57.50	167.00a	34.75	62.50b	1.75
ID 155	Heglar/Ranger	23.06	57.20	162.50	34.25	67.50	.25
CI 13844	Wanser	22.78	56.50	165.00a	36.25a	51.25b	34.75a
UT 89099	Utah Sel. 89099	22.71	57.10	161.50	31.50	48.75b	.50
ID 126	A68227W-B-7-14-3-1	22.03b	57.50	160.75	35.00	80.00	.25
MT 7216	YG/CNN1155//YG4662-20411	21.16b	58.20	166.00a	33.00	75.00	25.75a
CI 12933	Itana	20.01b	57.20	168.00a	38.25a	56.25b	35.25a
CI 1442	Kharkof	15.36b	53.60	172.50a	41.50a	58.75b	44.50a
WA 6367	Suwon 92/Burt// Wanser	13.80b	55.50	165.00a	27.50b	27.50b	38.75a
	$\bar{x}$	25.07	57.24	166.64	34.88	67.16	14.24
	F 2/	3.93**	.00	29.82**	18.38**	3.53**	33.33**
	S.E.$\bar{x}$	2.34	.00	.64	.73	6.72	3.17
	L.S.D.(.05)	6.58	.00	1.80	2.06	18.89	8.93
	C.V. %	9.33	.00	.38	2.10	10.00	22.29

1/ Check variety
2/ F-value for variety comparison
a/ Values significantly greater than the check .05 level
b/ Values significantly less than the check .05 level
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

Table 2. Agronomic data from the western regional hard red winter wheat nursery grown on the Lance Claridge farm, Kalispell, MT in 1978. Random block design, four replications.

Date seeded: September 27, 1977 Date harvested: September 21, 1978
Size of plot: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Height Inches	Lodging Type	Lodging %	Lodging Sev	Dwarf Smut
UT 89099	Utah Sel. 89099	87.29a	58.60	36.00	.00b	.00b	.00b	.75
UT 890152	Utah Sel. 890152	84.48a	57.80	38.50	.00b	.00b	.00b	.00
UT 890123	Utah Sel. 890123	80.99a	58.60	41.00a	.00b	.00b	.00b	.50
WA 6364	Koelz7941/2*McCall	80.38a	59.30	37.50	.00b	.00b	.00b	15.00a
UT 890143	Utah Sel. 890143	78.04a	57.70	37.00	.00b	.00b	.00b	1.25
ID 155	Heglar/Ranger	77.00a	59.60	41.50a	4.33	33.33	6.00	.75
ID 75537	WA4765//Burt/PI 178383	75.76a	53.50	33.00	.00b	.00b	.00b	1.00
ID 114	CI14106/McCall,Sel.2	73.39a	57.60	40.00a	.00b	19.67	1.67b	1.50
WA 6365	Koelz7941/2*McCall	70.39	57.80	42.25a	.00b	.00b	.00b	14.75a
ID 745130	Ark Sib//NRN 10-ST/2*CNN	69.34	56.60	35.50	.00b	.00b	.00b	4.00
WA 6473	14484/3/Bl/BK1205// 13438	68.42	57.70	28.75b	.00b	.00b	.00b	17.75a
UT 89033	Utah Sel 89033	67.42	57.50	40.00a	.00b	.00b	.00b	2.25
WA 6367	Suwon 92/Burt//Wanser	61.76	55.70	30.50	.00b	.00b	.00b	8.50a
ID 745102	Bez//Burt/178383/3/ Ark	60.62	57.00	43.50a	2.33	16.67	3.00	2.75
ID 154	BSN//KO/CI#/3/II 60/ CI#	60.37	59.40	39.25	.00b	.00b	.00b	.75
ID 157	14106/MC/3/WR//KO/ 178383	60.32	57.20	38.25	2.00	43.33	6.00	1.50
ID 745520	Bezo//Burt/PI178383	59.99	60.00	38.75	.00b	.00b	.00b	1.00
ID 156	A7037W-3-3-1	58.91	56.80	41.25a	9.00	60.00	9.00	5.00
ID 74747	ARK SIB	58.71	57.70	47.25a	.00b	.00b	.00b	2.75
CI 12933	Itana	57.72	57.50	42.25a	2.33	3.33	3.00	12.25a
MT 7216	YG/CNN1155//YG4662-20411	55.67	58.40	38.50	.00b	.00b	.00b	11.50a
CI 13844	Wanser	55.24	56.60	37.50	.00b	.00b	.00b	16.00a
ID 158	Heglar/ID 5006	52.82	58.50	34.75	.00b	.00b	.00b	18.00a
ID 126	A6822W-B-7-14-3-1	51.74	57.20	40.25a	5.33	46.67	6.00	.00
CI 13880	Crest 1/	48.98	57.20	35.50	5.33	33.33	6.00	2.75
CI 1442	Kharkof	43.80	53.00	46.00a	6.00	31.67	6.00	21.25a
	$\bar{x}$	65.37	57.48	38.63	1.41	11.08	1.79	6.29
	F 2/	2.10**	.00	8.68**	3.99**	2.56**	3.46**	14.54**
	S.E.$\bar{x}$	8.02	.00	1.44	1.25	11.43	1.51	1.81
	L.S.D.(.05)	22.55	.00	4.04	3.52	32.14	4.26	5.10
	C.V.%	12.26	.00	3.72	88.65	103.15	84.31	28.82

1/ Check variety
2/ F-value for variety comparison
a/ Values significantly greater than the check at .05 level
b/ Values significantly less than the check at .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 3. Agronomic data from the western regional white winter wheat nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1978. Field No. E-1. Random block design, four replications.

Date seeded: September 15, 1977 Date harvested: August 29, 1978
Size of plot: 16 sq. ft.

C. I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Height Inches	% Survival	Dwarf Smut
CI 14564	Hyslop	36.94a	55.50	171.50	29.25	42.50	8.75
WA 6363	Luke/WA5829	34.16a	57.00	172.25	29.25	77.50a	2.00
ID 755312	WA4765//Burt/PI178383	30.21a	56.00	172.00	31.00	63.75a	1.00
WA 6472	Semidwarf Multiline Club	30.11a	53.50	172.00	29.25	58.75a	8.50
WA 6362	Luke Mutant, LMI14	29.98a	57.40	174.25a	28.25	83.75a	1.25
WA 6470	Luke/Norco,VH 74333	29.76a	56.20	173.25a	30.25	90.00a	3.75
CI 14586	Luke	29.66a	56.80	173.50a	29.75	78.75a	7.25
ID 755314	WA4765//Burt/PI178383	29.13a	55.70	172.00	36.75a	70.00a	2.50
OR 680073	Yamhill/Hyslop	29.11a	53.40	172.25	32.75a	55.00a	24.00a
ID 775323	WA4765//Burt/PI178383	28.66a	54.80	171.75	29.75	56.25a	1.25
OR 74131	Pendleton 1-372	28.41	54.50	171.75	29.25	66.25a	5.25
OR 7142	C.I.13748/Moro,142	28.33	53.70	168.75	30.25	60.00a	3.50
CI 13740	Moro	27.78	53.80	170.50	34.25a	75.00a	3.75
CI 17590	Faro	25.41	52.40	171.50	27.50	31.25	4.50
ID 745318	WA4765//Burt/PI178383	25.28	54.50	170.25	29.25	62.50a	1.25
OR 68007	Yamhill/Hyslop	25.11	53.60	172.25	31.00	58.75a	10.25
WA 6242	Luke//Itana/CI 13431	23.51	55.10	170.25	28.00	41.25	5.50
CI 17596	Stephens	23.43	53.70	166.50b	30.00	42.50	17.25
OR 7141	CI13748/Moro,Sel. 38	23.01	54.00	170.00	28.25	48.75	1.50
CI 17419	Daws	22.91	56.60	170.00	28.75	61.25a	15.25
OR 67237	CD/101//55-1744/3/DC	21.41	53.80	170.25	30.50	48.75	21.25a
CI 11755	Elgin	21.28	55.40	172.00	34.25a	52.50a	40.25a
WA 6471	CI 15923//N D/2*101	19.46	54.40	170.50	29.75	32.50	25.00a
CI 13968	Nugaines[1/]	18.93	56.50	171.50	28.50	27.50	17.00
CI 14565	McDermid[1/]	18.63	53.70	170.25	29.25	33.75	9.75
CI 1442	Kharkof	16.88	56.10	169.75	37.25a	52.50a	13.00
OR 739401	Oregon Sel. R73-9401	15.31	52.70	171.75	29.00	26.25	17.50
OR 7493	Pendleton I-607	10.40	52.20	172.75a	28.25	33.75	11.75
	$\bar{x}$	25.11	54.75	171.26	30.34	54.69	10.13
	F[2/]	2.86**	.00	4.38**	13.27**	10.08**	8.32**
	S.E.$\bar{x}$	3.50	.00	.75	.69	5.50	3.25
	L.S.D.(.05)	9.85	.00	2.10	1.93	15.48	9.13
	C.V.%	13.94	.00	.44	2.26	10.06	32.04

1/ Check Variety
2/ F-value for variety comparison
a/ Values significantly greater than the check at .05 level
b/ Values significantly less than the check at .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 4. Agronomic data from the western regional white winter wheat nursery grown on the Lance Claridge farm, Kalispell, MT in 1978. Random block design, four replications.

Date seeded: September 27, 1977 Date harvested: September 21, 1978
Plot size: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Height Inches	Dwarf Smut
WA 6471	CI 15923//N D/2*101	99.37a	54.30	30.00	2.00
OR 680073	Yamhill/Hyslop	86.28	50.60	33.00	6.50a
WA 6242	Luke//Itana/CI13431	86.14	50.70	30.50	4.00
ID 755312	WA 4765//Burt/PI 178383	83.88	54.00	37.00a	1.25
ID 775323	WA 4765//Burt/PI 187383	83.60	51.20	32.00	1.50
WA 6363	Luke/WA 5829	82.93	55.70	28.50	2.75
ID 745318	WA 4765//Burt/PI 178383	82.05	52.60	31.25	1.00
OR 67237	CD/101//55-1744/3/DC	79.70	53.90	30.50	8.25a
OR 7493	Pendleton I-607	78.33	51.30	28.50	2.00
OR 7142	C.I. 13748/Moro,142	76.64	52.20	32.25	5.00
WA 6472	Semidwarf Multiline Club	74.22	52.50	32.50	5.75
CI 17419	Daws	73.25	55.50	32.00	5.75
CI 17596	Stephens	72.82	54.20	32.25	5.75
OR 74131	Pendleton I-372	72.15	53.60	32.00	6.75a
WA 6470	Luke/Norco, VH 74333	71.54	56.00	28.50	6.25a
WA 6362	Luke Mutant, LM-14	69.79	56.70	25.75	3.00
ID 755314	WA 4765//Burt/PI 178383	68.75	57.40	38.00a	1.25
CI 14586	Luke	67.62	52.70	29.25	1.25
OR 7141	CI 13748/Moro, Sel. 38	64.38	53.30	31.25	2.25
CI 13968	Nugaines	61.53	55.60	33.00	4.25
CI 14565	McDermid[1/]	60.76	54.00	29.50	2.25
CI 17590	Faro	59.76	51.60	30.75	3.00
CI 14564	Hyslop	59.43	54.50	28.50	5.50
CI 11755	Elgin	59.24	54.50	37.25a	9.50a
OR 68007	Yamhill/Hyslop	50.28	49.70	27.50	7.50a
CI 13740	Moro	47.84	49.40	32.50	1.25
CI 1442	Kharkof	47.08	55.20	38.50a	8.25a
OR 739401	Oregon Sel. R73-9401	37.89	52.30	24.75	4.25
	$\bar{x}$	69.90	53.40	31.33	4.21
	F[2/]	1.38	.00	2.22	3.87
	S.E.$\bar{x}$	11.93	.00	2.26	1.28
	L.S.D.(.05)	33.55	.00	6.36	3.61
	C.V.%	17.06	.00	7.22	30.43

1/ Check variety
2/ F-test for variety comparison
a/ Values significantly greater than the check at the .05 level
b/ Values significantly less than the check at the .05 level
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 5. Summary for yields for the western regional white winter wheat nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT 1968-78.

C.I. or State No.	Variety	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.	Sta. Yrs.	% Mugaines
CI 1442	Kharkof	58.5	58.9	56.4	62.1	59.7	45.3	27.7	37.4	61.1	50.7	16.9	48.6	11	69.8
CI 11755	Elgin	80.5	51.2	74.1	73.0	70.8	50.9	59.2	42.3	67.6	57.8	21.3	59.0	11	84.7
CI 13740	Moro	86.3	65.7	75.4	68.3	68.5	65.6	60.3	44.0	69.8	57.0	27.8	62.6	11	89.9
CI 13968	Mugaines	85.8	63.2	77.6	102.8	73.0	68.5	77.9	51.8	80.2	66.0	18.9	69.6	11	100.0
CI 14564	Hyslop	90.1	62.7	87.3	113.1	90.1	63.1	96.3	56.8	87.7	68.3	36.9	77.5	11	111.4
CI 14565	McDermid			88.8	111.9	95.8	63.4	84.7	57.1	93.3	72.9	18.6	76.3	9	89.7
CI 17596	Stephens (OR 65116)						61.6	81.2	52.3	82.1	60.6	23.4	60.2	6	99.4
CI 17419	Daws							89.0	56.3	92.8	68.7	22.9	65.9	5	111.8
CI 17590	Faro							85.4	53.5	74.9	65.2	25.4	60.9	5	103.3
OR 7142	C.I. 13748/Moro,142								51.4	74.1	66.9	28.3	55.2	4	101.8
OR 68007	Yamhill/Hyslop									92.1	75.5	25.1	64.2	3	116.7
OR 67237	CD/101//55-1744/3/DC									89.9	68.8	21.4	60.0	3	109.1
ID 755312	WA 4765/Burt/PI 178383									88.4	66.9	30.2	61.8	3	112.4
ID 755314	WA 4765/Burt/PI 178383									86.5	60.6	29.1	58.7	3	106.7
OR 739401	Oregon Sel. R73-9401									83.8	66.4	15.3	55.2	3	100.2
WA 6242	Luke//Itana/CI 13431									83.2	61.7	23.5	56.1	3	102.0
OR 7141	CI 13748/Moro, Sel. 38									76.3	59.4	23.0	52.9	3	96.1
WA 6362	Luke Mutant LH-14, VH74629										66.1	30.0	48.0	2	113.2
WA 6363	Luke/WA 5829										70.2	34.2	52.2	2	123.0
OR 74131	Pendleton Sel. No. I-372										63.2	28.4	45.8	2	107.9
OR 7493	Pendleton Sel. No. I-607										63.2	10.4	36.8	2	86.7
ID 775323	WA4765//Burt/PI 178383											28.7	28.7	1	151.9
ID 754318	WA4765//Burt/PI 178383											25.3	25.3	1	133.9
WA 6470	Luke/Norco, VH 74333											29.8	29.8	1	157.7
WA 6471	CI 15923//ND/2*101											19.5	19.5	1	103.7
WA 6472	Semidwarf Multiline Club											30.1	30.1	1	159.3
CI 14586	Luke											30.0	30.0	1	158.7
OR 680073	Yamhill/Hyslop											29.1	29.1	1	154.0

Table 6. Agronomic data from the Elite Yellow Rust Smut winter wheat nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1978. Field E-1. Random block design, four replications.

Date seeded: September 16, 1977 Date harvested: August 30, 1978
Plot size: 16 sq. ft.

C.I. or State No	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Height Inches	% Survival	% Lodging	Dwarf Smut
MT 77089	DM/CRT	33.99	59.46	167.00a	37.78a	70.00	.00	2.00
MT 77068	C61-9/WLT//CRT	32.36	60.40	172.50a	37.28a	55.00b	.00	1.50
MT 77080	DM/CRT	32.03	60.40	168.00a	40.28a	43.75b	.00	.75
MT 77070	VT27500/CRT	30.48	59.98	165.50a	36.78a	63.75	.00	1.50
MT 77090	DM/CRT	30.33	60.60	165.50a	38.03a	37.50b	.00	.50
MT 77077	C61-9/WLT//CRT	30.33	60.29	171.75a	38.03a	55.00b	.00	.75
MT 77079	C61-9/WLT//CRT	30.07	60.29	171.50a	37.53a	51.25b	13.33	.25
MT 77066	C61-9/WLT//CRT	29.61	60.29	172.75a	36.03	53.75b	.00	2.00
CI 17296	Hansel	28.76	59.77	167.00a	41.78a	61.25	46.33	1.75
MT 77091	DM/CRT	27.51	60.29	164.00	37.03a	57.50	3.33	9.00a
CI 13880	Crest 1/	27.33	57.72	161.75	34.53	76.25	23.33	3.00
MT 77056	C61-9/WLT//CRT	27.21	59.67	170.25a	37.78a	57.50	.00	2.00
CI 15317	Franklin	26.04	60.29	170.25a	42.53a	60.00	16.67	.75
CI 17295	Cardon	24.86	60.40	168.50a	36.03	50.00b	40.00	1.50
MT 77057	DM/CRT	22.99b	58.15	169.00a	38.78a	48.75b	.00	3.00
MT 77092	VT27500/CRT	22.88b	58.74	162.50	36.53	70.00	.00	1.75
MT 77084	C61-9/WLT//DM	21.73b	57.30	164.50a	39.03a	56.25	.00	33.00a
CI 12930	Westmont	21.20b	58.74	162.50	35.53	57.50	.00	38.75a
MT 77069	DM/CRT	20.88b	56.27	172.75a	38.53a	18.75b	8.33	1.00
	$\bar{x}$	27.41	59.42	167.76	37.88	54.93	7.96	4.99
	F 2/	1.12 NS	.00	21.37**	8.10**	3.18**	2.17*	51.68**
	S.E.$\bar{x}$	3.81	.00	.80	.71	7.10	9.64	1.35
	L.S.D.(.05)	10.80	.00	2.26	2.01	20.12	27.31	3.81
	C.V. %	13.90	.00	.48	1.87	12.93	120.99	26.99

1/ Check variety
2/ F-value for variety comparison
a/ Values significantly greater than the check at the .05 level.
b/ Values significantly less than the check at the .05 level
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

Table 7. Agronomic data from the Elite Yellow Rust Smut Winter Wheat Nursery grown on the Lance Claridge Farm, Kalispell, MT in 1978. Random block design, four replications.

Date seeded: September 27, 1977 Date harvested: September 22, 1978
Plot size: 32 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Height Inches	Lodging Angle	Lodging %	Lodging Stage	Dwarf Smut
MT 77077	C61-9/WLT//CRT	87.29	59.16	41.53	.00	.00	.00	2.00
MT 77080	DM/CRT	80.60	60.81	39.53	.00	.00	.00	3.50
CI 13880	Crest 1/	73.22	57.82	34.77	1.67	16.67	3.00	2.50
MT 77089	DM/CRT	71.42	59.36	41.03	.00	.00	.00	4.25
MT 77056	C61-9/WLT//CRT	66.97	58.23	40.03	.00	.00	.00	.00
CI 17295	Cardon	66.45	59.16	40.78	.00	.00	.00	2.50
MT 77066	C61-9/WLT//CRT	59.27	57.72	39.03	.00	.00	.00	1.75
MT 77091	DM/CRT	55.49	59.36	36.78	.00	.00	.00	18.50a
MT 77069	DM/CRT	53.50	56.07	41.03	.00	.00	.00	.00
MT 77057	DM/CRT	52.58	56.07	38.53	.00	.00	.00	6.25
MT 77090	DM/CRT	50.94	60.29	35.27	.00	.00	.00	.75
MT 77079	C61-9/WLT//CRT	50.14	58.64	37.03	.00	.00	.00	1.00
MT 77084	C61-9/WLT//DM	48.51	57.20	36.03	.00	.00	.00	11.75a
MT 77068	C61-9/WLT//CRT	48.43	59.27	35.27	.00	.00	.00	1.00
MT 77070	VT27500/CRT	47.57	57.71	36.53	1.67	3.33	3.00	.25
MT 77092	VT27500/CRT	44.98	57.92	35.27	2.67	10.00	2.33	1.25
CI 17296	Hansel	44.47	58.95	39.53	3.33	40.00a	6.00	.75
CI 15317	Franklin	42.47	58.03	39.53	1.00	13.33	3.00	.75
CI 12930	Westmont	41.31	59.26	34.77	.00	.00	.00	13.75a
	$\bar{x}$	57.13	58.48	38.02	.54	4.39	.91	3.82
	F 2/	1.29	.00	.96NS	1.00NS	1.88*	1.31NS	15.19**
	S.E.$\bar{x}$	11.85	.00	2.43	1.03	7.29	1.50	1.33
	L.S.D.(.05)	33.59	.00	6.90	2.92	20.67	4.24	3.78
	C.V. %	30.04	.00	6.41	189.26	166.27	164.05	34.97

1/ Check variety
2/ F-value for variety comparison
a/ Values significantly greater than the check at the .05 level.
b/ Values significantly less than the check at the .05 level.
* Indicates statistical significance at the .05 level.
** Indicates statistical significance at the .01 level.

Table 8. Agronomic data from Dwarf Bunt Resistant Hard Red Winter Wheat Nursery grown at Stillwater location, Kalispell, MT in 1978. Random block design, four replications.

Date seeded: October 3, 1977 Date harvested: September 22, 1978
Plot size: 32 sq. ft.

Variety	Yield Bu/A	Test Wt Lbs/Bu.	Plant Ht.In.	Dwarf Smut %	Lodging %
D-3-12-20	41.7	58.2	33.3	.5	2.5
A7014W-24	40.8	58.2	33.5	.0	22.5
A68228W-B-2-4-3-1	25.8	52.4	30.8	.25	20.0
A7014W-16-1	54.5	59.8	39.3	.0	.0
A70244SW-B-3-1-4-4	31.4	59.4	31.3	.0	18.8
A7175W-10-3	25.6	58.5	32.3	1.0	10.0
$\bar{x}$	36.6		33.4		
F 1/	2.68NS		3.59*		
S.E.$\bar{x}$	6.86		1.62		
L.S.D.(.05)	20.65		4.88		
C.V. %	26.47		6.87		

1/ F value for variety comparisons

Table 9. Agronomic data from the winter wheat seed treatment nursery grown on the Lance Claridge farm, Kalispell, MT in 1978. Random block design, three replications.

Date seeded: September 27, 1977 Date harvested: September 22, 1978
Plot size: 32 sq. ft.

Variety	Chemical	Rate Oz/A	Yield Bu/A	Test Wt Lbs/Bu	Dwarf Smut %	Height Inches
Luke	Check	0	32.2	56.6	1.7	30.0
Luke	TBZ 1/	2	54.2	57.6	.0	29.0
Luke	TBZ	4	88.6	56.7	.0	31.7
Luke	Benomyl 2/	2	78.0	56.3	2.0	32.3
Luke	Benomyl	4	53.9	56.9	1.3	27.7
Luke	Uniroyal H719 3/	2	64.9	56.3	2.0	27.6
Luke	Uniroyal H719	4	95.9	56.9	1.7	31.3
McDermid	Check	0	69.5	55.0	25.7	27.0
McDermid	TBZ	2	92.2	54.8	.0	29.7
McDermid	TBZ	4	68.3	54.4	.3	29.7
McDermid	Benomyl	2	91.3	54.7	22.3	30.7
McDermid	Benomyl	4	45.0	54.0	9.3	28.3
McDermid	Uniroyal H719	2	66.7	53.9	12.3	29.0
McDermid	Uniroyal H719	4	70.8	54.2	11.7	29.7
Hansel	Check	0	58.3	60.1	.7	43.3
Hansel	TBZ	2	38.5	59.5	.3	40.0
Hansel	TBZ	4	37.9	59.4	.0	41.0
Hansel	Benomyl	2	45.5	59.7	.3	41.0
Hansel	Benomyl	4	23.3	59.9	.3	38.0
Hansel	Uniroyal H719	2	78.0	59.5	.3	34.7
Hansel	Uniroyal H719	4	39.9	59.3	.3	38.0
Crest	Check	0	76.9	57.4	3.3	33.0
Crest	TBZ	2	16.1	57.4	.0	28.7
Crest	TBZ	4	31.0	57.2	.7	30.0
Crest	Benomyl	2	30.5	57.5	1.0	28.7
Crest	Benomyl	4	28.7	57.2	.7	31.7
Crest	Uniroyal H719	2	27.4	57.8	1.3	26.3
Crest	Uniroyal H719	4	41.1	57.8	3.0	31.3
Westmont	Check	0	28.1	57.5	38.0	31.7
Westmont	TBZ	2	32.9	58.4	1.3	35.0
Westmont	TBZ	4	65.3	59.5	1.7	35.7
Westmont	Benomyl	2	65.8	58.4	27.7	38.3
Westmont	Benomyl	4	70.3	58.7	12.7	36.7
Westmont	Uniroyal H719	2	69.6	58.4	21.7	37.7
Westmont	Uniroyal H719	4	42.1	57.9	22.0	30.3

Products used in this experiment:

Common Name	Trade Name	Chemical Name	Company
1/ TBZ	Mertect	2-(4'-thiazolyl)-benzimidole	Merck Chem. Div.
2/ Benomyl	Benlate	Methyl 1-(butylcarbamoyl-2-benzimidazolecarbamate	Dupont
3/	Uniroyal H719	Chemistry unknown	Uniroyal

YEAR: 1978

TITLE: Investigation of cropping sequences on the productivity and quality of cereal grains.

LOCATION: Northwestern Agricultural Research Center, Agricultural Experiment Station, Kalispell, MT 59901

PERSONNEL: Vern R. Stewart

OBJECTIVES:

1. To determine the most productive cropping sequence.
2. To determine the effect of cropping sequence on:
   (a) weed populations
   (b) fertility levels
   (c) protein levels of wheat
3. To determine the economics of a particular cropping sequence.

PROCEDURE:

A total of five cropping sequences were established in 1972. These were established in plots 3.3 acres in size which allows the use of field equipment in all operations. Fertilizer application rates were based on soils analysis and experience over the past 10 to 12 years in these fields. Protein data was obtained using the Udy method of anlaysis. An economic evaluation was made of this study for the seven year period. In this evaluation we have subtracted only the cost of the fertilizer from the gross income. The value of the crop is based on actual sales, or prices of hay, wheat and barley in the month of December in the year grown. Fertilizer costs were the actual cost of the fertilizer when purchased.

RESULTS AND DISCUSSIONS:

Moisture for the crop year 1977-78 was 28.96 inches which was 9.73 inches higher than the long term mean at the research center. Precipitation amounts in April, May and July were considerably above normal. The June precipitation was slightly below the average. In August 3.34 inches of precipitation was recorded which caused considerable delay in harvest of winter wheat. The rain in September delayed the harvest still further and caused considerable damage to winter wheat.

Sequence R-2 - Yields of white winter wheat in R-2 were considerably below the other cropping sequences. There was a stand loss in McDermid because of snow mold and additional yield loss because of the high level of dwarf smut, up to 15 percent. This variety has now been dropped from the cropping sequence study. Barley yields were 68.3 bu/a, and are comparable to the other cropping sequences; however they are somewhat higher than we found in R-4a which was 53.4 bu/a. This difference is partly due to stand and green manure being used in the R-2 Sequence.

Sequence R-3 - Winter wheat yields were excellent when compared to Sequence R-2. This sequence continues to be the highest producing of our five sequences. The return per acre ofr this sequence is $120.13. Hay yields were excellent at about 3.7 T/A.

Sequence R-4 - This sequence has been compared to R-2a in previous discussions. Barley yields are slightly below R-2, wheat yields are considerably above. Dollar return from this sequence is somewhat higher than we find in R-2.

Results and Discussion (con't)

Sequence R-5 - The hard red winter wheat sequence yields are very low. This is due in part to stand thinning as a result of snow mold. Alfalfa yields were excellent, 3.8 T/A. It had the third highest dollar return in 1978.

Sequence R-7 - The continuous cropping sequence was second in dollars of return in 1978. This is due to the high level of barley production because of the high rainfall. We did resolve some of our quackgrass problems by making an application of Roundup prior to seeding, however we delayed the seeding to accomplish this. We probably would have had better success with the control of quackgrass if we had made our application in the fall of 1977. Alfalfa yields were 3.4 T/A. The net in 1978 was $105.76. Table 1.

Seven Year Economic Evaluation - In this years summary we have only subtracted fertilizer costs when making analysis. At the conclusion of this experiment we should consider a complete economic analysis of all costs other than what we use on an annual basis. We have sufficient records so most of the costs could be calculated.

In Sequence R-3, fifteen years - five years legume, winter wheat, fallow alternating, continues to be the most productive sequence in this study with a mean of $90.46 per acre. This is an increase from the six year average of $86.40. Over the seven year period Sequence R-5 is second with $80.53, however this is just a few cents more than Sequence R-4. These comparisons can be seen in Tables 2, 3, 4, 5, and 6.

Over the years much of the decline we have had in dollar values has been due to reduction in commodity prices. In 1977 there was a considerable reduction because of the low rainfall.

This study will be phased out in 1979 or 1980 and a final summary will be presented to the scientific community.

Table 1. Annual data from cropping sequence study. Northwestern Agricultural Research Center, Kalispell, MT 1978.

Field Number	Crop	Variety	Pounds/Acre N	P_2O_5	S	% Protein	Test Weight Lbs/Bu	Yield Per Acre	Price Unit Dollars	Gross Dollars	Fertilizer Cost	Net per Sequence	Dollars per Acre
		Crop Sequence - 3 years: fallow, winter wheat, spring grain seed legume with spring grain and plow down as green manure											
R-2a	Barley	Purcell	52	27	-	-	48.0	68.3bu	3.05cwt	99.99	14.48		
R-2b	Fallow												
R-2c	W. Wheat	McDermid	90	43	31	-	52.8	38.2bu	2.88bu	110.02	23.61		
						Total				210.01	38.09	171.92	57.30
		Crop Sequence - 15 years: five years legume, winter grain, fallow alternating											
R-3a	W. Wheat	Luke	87	47	33	-	55.2	76.5bu	2.88bu	220.32	26.42		
R-3b	Fallow												
R-3c	Forage	Thor	-	-	-	-	-	3.7T	45.00T	166.50			
						Total				386.82	26.42	360.40	120.13
		Crop Sequence - 3 years: fallow, winter wheat, spring grain											
R-4a	Barley	Purcell	52	27	-	-	48.0	53.4bu	3.05cwt	78.18	14.65		
R-4b	Fallow												
R-4c	W. Wheat	Luke	84	44	31	-	54.9	68.7bu	2.88bu	197.85	25.06		
						Total				276.03	39.71	236.32	78.78
		Crop Sequence - 9 years: three years legume, winter grain fallow alternating											
R-5a	W. Wheat	Crest	34	42	-	12	56.0	30.0bu	2.89bu	86.70	14.72		
R-5b	Fallow												
R-5c	Forage	Thor	-	-	-	-	-	3.8T	45.00T	171.00			
						Total				257.70	14.72	242.98	80.99
		Crop Sequence - Continuous cropping including a legume											
R-7a	Barley	Purcell	53	27	-	-	48.0	71.4bu	3.05cwt	104.53	14.77		
R-7b	Forage	Thor	-	-	-	-	-	3.4T	45.00T	153.00			
R-7c	Barley	Purcell	52	27	-	-	48.0	60.7bu	3.05cwt	88.86	14.34		
						Total				346.39	29.11	317.28	105.76

Table 2. Summary data from cropping sequence study - three years, fallow, winter wheat, spring grain. Field R-2abc at the Northwestern Agricultural Research Center, Kalispell, MT 1972-78.

	1972	1973	1974	1975	1976	1977	1978	$\bar{x}$	7 Yr. Ave/A
					BARLEY				
Yield Bu/A	46.9	47.8	43.8	32.3	83.4	43.0	68.3	52.2	
Fertilizer Cost	8.72	17.29	14.92	25.76	16.59	14.62	14.48	16.05	
Price/cwt	2.50	4.50	6.40	4.10	3.75	3.35	3.05	3.95	
Gross $	56.30	103.25	134.55	63.57	150.12	69.14	99.99	96.70	
Net/Acre	47.58	85.96	119.63	37.81	133.53	54.52	85.51	80.64	
					WHEAT				
Yield Bu/A	53.9	48.7	62.1	65.8	77.0	33.4	38.2	54.2	
Fertilizer Cost	6.53	13.60	26.30	30.31	33.91	21.20	23.61	22.21	
Price/bu	1.95	4.20	4.36	3.11	2.08	2.29	2.88	2.98	
Gross $	105.11	204.54	270.76	204.63	160.16	76.49	110.02	161.67	
Net/Acre	98.58	190.94	244.46	174.32	126.25	55.29	86.41	139.46	73.37

Table 3. Summary data from cropping sequence study - fifteen years, five years legume, winter grain, fallow alternating. Field R-3abc at the Northwestern Agricultural Research Center, Kalispell, MT 1972-1978.

	1972	1973	1974	1975	1976	1977	1978	$\bar{x}$	7 Yr. Ave/A
					ALFALFA				
Yield T/A	.6	2.7	4.2	3.3	3.0	.7	3.7	2.6	
Fertilizer Cost	7.60					15.53		3.30	
Price/Ton	25.00	45.00	40.00	45.00	50.00	50.00	45.00	42.86	
Gross $	15.00	121.50	168.00	148.50	150.00	35.00	166.50	114.93	
Net/Acre	7.40	121.50	168.00	148.50	150.00	19.47	166.50	111.55	
					WHEAT				
Yield Bu/A	56.3	58.1	60.7	64.0	53.4	58.1	76.5	61.0	
Fertilizer Cost	13.24	26.46	26.96	30.31	30.45	21.30	26.42	25.02	
Price/bu	2.11	4.25	4.36	3.11	2.08	2.29	2.88	3.01	
Gross $	118.79	246.93	264.65	199.04	111.07	133.05	220.32	184.84	
Net/Acre	105.55	220.47	237.69	168.73	80.62	111.75	193.90	159.82	90.46

Table 4. Summary data from cropping sequence study - three years, fallow, winter grain, spring grain. Field R-4abc at the Northwestern Agricultural Research Center, Kalispell, MT 1972-1978.

	1972	1973	1974	1975	1976	1977	1978	$\bar{x}$	7 Yr. Ave/A
					BARLEY				
Yield Bu/A	60.4	42.3	42.3	35.0	76.8	45.7	53.4	50.8	
Fertilizer Cost	8.71	17.29	17.26	24.47	17.97	10.44	14.65	15.83	
Price/cwt	2.50	4.50	6.40	4.15	3.75	3.35	3.05	3.96	
Gross $	72.47	88.51	129.95	69.72	138.24	73.49	78.18	92.94	
Net/Acre	63.76	71.22	112.69	45.25	120.27	63.05	63.53	77.11	
					WHEAT				
Yield Bu/A	71.5	48.6	65.2	66.7	67.7	52.5	68.7	63.0	
Fertilizer Cost	13.24	26.46	25.64	30.31	30.45	21.43	25.06	24.66	
Price/Bu	2.11	4.25	4.36	3.11	2.08	2.29	2.88	3.01	
Gross $	150.87	206.55	284.27	207.44	140.82	120.23	197.85	186.86	
Net/Acre	137.63	180.09	258.63	177.13	110.37	98.80	172.79	162.21	79.77

Table 5. Summary data from cropping sequence study - nine years, three years legumes, winter wheat, fallow alternating. Field R-5abc, at the Northwestern Agricultural Research Center, Kalispell, MT 1972-78.

	1972	1973	1974	1975	1976	1977	1978	$\bar{x}$	7 Yr. Ave/A
					ALFALFA				
Yield T/A	3.2	.2	4.2	3.4	.7	3.7	3.8	2.7	
Fertilizer Cost		14.58			18.93			5.58	
Price/Ton	25.00	45.00	40.00	45.00	50.00	50.00	45.00	42.86	
Gross $	80.00	9.00	168.00	153.00	35.00	185.00	171.00	114.43	
Net/Acre	80.00	- 5.58	168.00	153.00	16.07	185.00	171.00	109.64	
					WHEAT				
Yield Bu/A	62.0	41.9	39.5	56.6	48.1	50.7	30.0	47.0	
Fertilizer Cost	6.53	13.60	14.42	13.20	20.61	15.92	14.72	14.57	
Price/Bu	2.11	4.20	4.46	3.43	2.36	2.87	2.89	3.19	
Gross $	130.82	175.98	176.17	194.14	113.51	145.51	86.70	146.12	
Net/Acre	124.29	162.38	161.75	180.94	92.90	129.59	71.98	131.98	80.53

Table 6. Summary data from cropping sequence study - continuous cropping, legumes and small grains, winter and spring. Field R-7abc at the Northwestern Agricultural Research Center, Kalispell, MT 1972-78.

	1972	1973	1974	1975	1976	1977	1978	$\bar{x}$	7 Yr. Ave/A
				ALFALFA					
Yield T/A	.7	.15	2.9	2.2	2.5	.5	3.4	1.7	
Fertilizer Cost		14.76				16.88		5.27	
Price/Ton	25.00	45.00	40.00	45.00	50.00	50.00	45.00	42.85	
Gross $	17.50	6.75	116.00	99.00	125.00	25.00	153.00	77.46	
Net/Acre	17.50	- 8.01	116.00	99.00	125.00	8.12	153.00	72.94	
				SPRING GRAIN					
	Wheat[1/]	Barley				Wheat[2/]	Barley		
Yield Lbs/A	1656	1752	2189	1512	3024	1794	3427	2193	
Fertilizer Cost	10.47	16.07	16.80	24.98	16.00	23.41	14.77	17.50	
Price/Bu	1.92					2.75			
Price/Cwt	3.20	4.50	6.40	4.10	3.75	4.58	3.05	4.23	
Gross $	52.99	78.84	140.08	61.99	113.40	82.22	104.53	90.58	
Net/Acre	42.52	62.77	123.28	37.01	97.40	58.81	89.76	73.08	
				Wheat[2/]			Barley		
Yield Lbs/A	1590	1848	2436	1782	2622	1950	2914	2163	
Fertilizer Cost	6.53	13.60	27.18	30.31	31.08	23.41	14.34	20.92	
Price/Bu	1.90	4.20	4.46	3.55	2.36	3.07			
Price/Cwt	3.17	7.00	7.43	5.92	3.93	5.12	3.05	5.09	
Gross $	50.35	129.36	181.08	105.44	103.13	99.78	88.86	108.29	
Net/Acre	43.82	115.76	153.90	75.13	72.05	76.37	74.15	87.31	77.78

1/ Spring Wheat
2/ Winter Wheat