TWENTY-EIGHTH ANNUAL REPORT

1976

Research Report No. 121

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

1570 Montana 35
Kalispell, Montana

Prepared By

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Associate Professor of Agronomy and Superintendent

Leon E. Welty
Assistant Professor

ADMINISTRATION 750

Personnel and the direction of research projects are the concerns of this project. People and their enthusiasm for a job well done is the core of any successful operation. Following is a list of full time and part-time employees of the Northwestern Agricultural Research Center for the year 1976.

Vern R. Stewart - Associate Professor of Agronomy and Superintendent began working at the research center in April 1, 1952. He assumed the duties of superintendent in 1970. Many noticeable improvements and additions have been instigated under his direction.

Leon E. Welty - Assistant Professor, has been at the center since January 15, 1983. His responsibilities include forage investigations, irrigated pasture studies using yearling steers and pasture renovation.

Nancy Campbell - Ag Research Specialist I, has been employed at the research center since August 15, 1974. She works under the direction of Mr. Stewart. Her responsibilities are setting up and collecting data for small grains and weed investigations.

Jeanette Calbick - Secretary since September, 1963. This position required working 30 hours per week, but has become full time since November 1974. Her duties are mainly clerical.

Harold Gullickson - Farm/Ranch Hand III. Harold has been at the research center since May, 1974. His main responsibilities are general farm work and the maintenance and care of all vehicles and farm equipment. He also builds or reconstructs research equipment when necessary.

The CETA program continued until July 1976. This was a Federally funded program and was used as interim employment until a steady position was found.

Calvin Westphal worked from August, 1975 until April 23, 1976. He had trained as a cook and found employment in that field.

Replacing Calvin was Louis Hodgson. Louis was here for one month until he found other employment.

In June, John Reid was hired and worked until the 9th of September. After the CETA funds ran out John's salary was paid from station funds until he resigned.

Every summer there are several high school seniors or college young people hired to assist the staff. Below is a list of the summer employees for 1976.

Louis Feicht a 1976 graduate from Flathead High assisted Harold with the general farm responsibilities. Louis enrolled at Montana State University this fall to study microbiology.

Susanne Carlson, another 1976 Flathead High graduate, assisted Nancy in small grains and weed investigations. She left to attend Montana State University and to begin a career in the field of nursing.

Theodore Johnson, a student from the University of Colorado at Boulder, originally from Illinois, assisted Nancy in small grains and weed investigations. He planned on enrolling in Flathead Valley Community College to pursue an education in the field of surveying.

Tiena Harris, a Sophmore at Montana State University, began working at the Northwestern Agricultural Research Center the middle of June. She assisted Leon with his forage investigations. Tiena returned to MSU to continue in the field of physical education.

Kevin Kephart, a freshman at Montana State University, was Leon's right hand man and was responsible for forage investigations and irrigated pasture work. Kevin returned to MSU to continue his education in agriculture.

Janis Elliott, a Junior at Montana State University, worked with Nancy on small grains and weed investigations. She returned to MSU to complete her senior year.

Two young men working for the Federally funded program entitle SPEDY assisted at the Northwestern Agricultural Research Center for a few weeks. They were Dave Carlson and Bill Thomas. Dave had been a freshman at Stanford University at Stanford, CA. He worked from the middle of June until the middle of July when he quit after finding a better paying position at the Cherry Warehouse. Bill worked for us part of the summer of 1975. Bill was a good, steady worker and came back in July of 1976. He worked until the program ran out of funds the last part of August. Bill was going to be a sophmore in high school.

The summer crew of 1976 seemed very compatable and in most incidences worked well together. Assisted by the staff they accomplished the tasks required of them.

Following are lists of activities of staff members and visitors at the research center. The list of visitors is not complete because it does not include those attending Field Day activities and the several neighbors and farmers that use the truck scale. Therefore, the list includes only those that stop in the office and request specific information, or just to visit.

ACTIVITIES

DATE	ACTIVITY	STAFF	LOCATION
January			
5	Extension Service Program	Stewart	Missoula
6	Extension Service Program	Stewart	Hamilton
6	Extension Service Program	Stewart	Stevensville
7	Extension Service Program	Stewart	Plains
7	Extension Service Program	Stewart	Polson
8	Extension Service Program	Stewart	Eureka
8	Extension Service Program	Stewart	Kalispell
13	Ag Council	Stewart	Kalispell
31	Talk at Farmers Union Annual Meeting	Stewart	Kalispell
February			
10	Attend Agricultural Chemical Meeting	Stewart	Kalispell
	Presented program at Ag Council	Stewart	Kalispell
	Presented program at Ag Council	Welty	Kalispell
13	Presented program at Eastside Grange	Stewart	Creston
	Presented program at Eastside Grange	Welty	Creston
17	Advisory Committee Meeting	Welty	Polson
24-25	Agriculture Business Assoc. Meeting	Stewart	Billings
March			
1- 5	Planning Conference	Stewart	Bozeman
	Planning Conference	Welty	Bozeman
10-11	Presented talk for Farmers at Res. Center	Welty	Huntley
11	Potato Growers Meeting	Stewart	Polson
15-18	Western Society Weed Science Meeting	Stewart	Portland, OR
23	Presented talk for Farmers	Stewart	Kalispell
26	County Agents Up-Dating Meeting	Stewart	Ronan
	County Agents Up-Dating Meeting	Welty	Ronan
May			
27	Tour FFA boys and girls	Stewart	Res. Center
	Tour FFA boys and girls	Welty	Res. Center
28	Montana Stock Growers Meeting	Stewart	Kalispell
June			
3	Health Insurance Meeting	Stewart	Bozeman
5	Hehn retirement Party	Stewart	Bozeman
15	Tour by American Society of Horticulturists	Stewart	Res. Center
20-23	Crop Science Meetings	Stewart	Pullman, WA
	Crop Science Meetings	Welty	Pullman, WA
24	Wheat Workers Conference	Stewart	Pullman, WA
July			
6- 8	Summer Staff Conference	Stewart	Moccasin
	Summer Staff Conference	Welty	Moccasin
12	Wheat Research & Marketing Committee	Stewart	Kalispell
13	Tour by Wheat Research & Marketing Comm.	Stewart	Res. Center
29	Field Day	Stewart	Res. Center
	Field Day	Welty	Res. Center
August			
16-20	Barley Tour	Welty	Around State
26	Planning Meeting of State Assoc. of Weed Sci.	Stewart	Kalispell

Activities (Con't)

DATE	ACTIVITY	STAFF	LOCATION
September 8	Gulf Oil Chemical Co. Seminar	Stewart	Kansas City,KA
October 8	State Grange Convention	Stewart	Kalispell
20	Ag Council Meeting	Stewart	Bozeman
November 4	CRD Meeting	Stewart	Kalispell
10	Potato Growers Meeting	Stewart	Kalispell
18-19	Talked at Montana Weed Control Meeting	Stewart	Kalispell
December 1	Research Center Staff Assoc. Meeting	Stewart	Lewistown
	Research Center Staff Assoc. Meeting	Welty	Lewistown
16-17	Meeting with Forage Committee	Stewart	Bozeman
	Meeting with Forage Committee	Welty	Bozeman
27	Meeting with Teacher Retirement Personnel	Stewart	Helena
	Meet with Advisory Comm. of Old West Commission	Welty	Helena

VISITORS:

DATE	VISITOR	REPRESENTING	ADDRESS
Jan. 8	Art Shaw	Extension Service, MSU	Bozeman
15	Paul Tutvedt	Farmer	Kalispell
22	Jim Schubert	Monsanto Chemical Co	Billings
27	Robert McCallum	Farmer	Columbia Falls
28	Jess Blasdel	Farmer	Kalispell
29	Tom O'Hare	American Cyanamid	Pocatello, ID
Feb. 2	John Sheldon	Farmer	Kalispell
2	Tom Smith	Liberty Drilling	Kalispell
2	Bill Osborne	Liberty Drilling	Kalispell
4	Walter Sundelius	Farmer	Kalispell
5	Pat Ottman	Job App;icatn	Kalispell
10	Ernie Hildebrand	Gulf Oil Chemical Co.	Billings
10	Frank Lapp	Farmer	Columbia Falls
Mar. 4	Ross Peace	Farmers Union	Fairfield
12	Jim Rieben	Water Resources Board	Kalispell
12	Tom Patton	Water Resources Board	Kalispell
15	Ray Sherlock	Farmer	Whitefish
15	Tom Smith	Liberty Drilling	Kalispell
15	Bill Osborne	Liberty Drilling	Kalispell
17	Harold Kair	Small Farmer	Kalispell
17	Charles Schweigert	Northrup King	Billings
17	Jim Gowin	Kalispell Feed & Grain	Kalispell
17	Jim Rieben	Water Resources Board	Kalispell
17	Bill Lang	Neighbor	Kalispell
17	Les Mahugh	Neighbor	Kalispell
17	John Heikens	Farmer	Bigfork
18	Mr. Winkler	Farmer	Bitterroot Area
18	Al Sparr	Parttime Farmer	Columbia Falls
18	John Alton	Parttime Farmer	Columbia Falls
22	Ted Johnson	Job Applicant	Boulder, CO
22	Burton Isch	Farmer	Kalispell
22	Tom Mahugh	Teacher	Kalispell
24	Tiena Harris	MSU Studnet	Bozeman
25	Les Mahugh	Neighbor	Kalispell
29	Jim Rodebush	Stauffer Chemicals	Three Forks
30	Jim Rodebush	Stauffer Chemicals	Three Forks
Apr. 2	Jim Rieben	Water Resources Board	Kalispell
2	Bob Danielson	Water Resources Board	Kalispell
5	Bob Danielson	Water Resources Baord	Kalispell
5	Russell Sutton	Farmer	Kalispell
5	Mr. Fields	Farmer	Kalispell
5	Bill Osborne	Liberty Drilling	Kalispell
5	Lew Bain	O'Neil Office Supplies	Kalispell
6	Ivan Taylor	Farmer & Pilot	Columbia Falls
6	Clyde Pederson	Neighbor & Farmer	Kalispell
6	Myron Mast	Neighbor & Farmer	Kalispell
6	Clifford Brenneman	Farmer	Kalispell
6	Thad Wojciechowski	Extension Coordinator	Missoula

Visitors (con't)

DATE	VISITOR	REPRESENTING	ADDRESS
Apr. 7	Marvin Mattson	CIBA-Geigy	Moorhead, MN
7	Norman Wendt	Farmer	Kalispell
7	Ken Kruger	Farmer	Kalispell
8	Jerry Mayer	Helena Chemical	Great Falls
8	Linda Robison	Housewife	Kalispell
8	Jack Gorton	Equity Supply	Kalispell
8	Larry Bellmore	Neighbor	Kalispell
8	Lew Bain	O'Neil Office Supply	Kalispell
9	Don Graham	Western Agric. Res. Center	Corvallis
9	Homer Metcalf	Plant & Soil Science, MSU	Bozeman
12	Mrs. Frank Pelino	Farmer	Columbia Falls
12	Ted & Wilma Cooper	Farmers	Durange, CO
13	Larry Stidman	Kalispell Livestock News	Kalispell
13	Dave Reynolds	Alpine Nursery	Kalispell
13	Walter Sundelius	Farmer	Kalispell
19	Don Arthur	Parttime Farmer	Kalispell
19	Don Real	Job Applicant	Kalispell
27	Harold Jorgenson	Farmer	Kalispell
30	Sue Carlson	Job Applicant	Columbia Falls
May 7	Richard Rominger	Monsanto	Great Falls
12	Beryl Mahlum	Farmer	Somers
12	Jack Martin	Neighbor	Kalispell
12	Jim Reiben	Water Resources Board	Kalispell
12	Clifford Brenneman	Farmer	Kalispell
18	Diane Perry	Job Applicant	Kalispell
28	J. A. Asleson	Dir. MT. Agric. Exp. Stn.,MSU	Bozeman
28	M. J. Burris	Assoc. Dir. MT Ag. Exp. Stn.,MSU	Bozeman
June 2	Dan Casazza	Job Applicant	Kalispell
4	Cheryl Williams	Job Applicant	Kalispell
4	Ralph Dulin	Farmer	Kalispell
7	Dale Newlin	ASCS	Bozeman
8	John Ried	Job Applicant	Kalispell
10	Al Scoggan	Chem Agro	Boise, ID
11	Gordon Harris	U.S. Borax	Anaheim, CA
15	Jim Rodebush	Stauffer Chemical	Three Forks
15	Jeff D'Atri	Builder	Kalispell
16	Jim Rodebush	Stauffer Chemical	Three Forks
17	Gene Milus	Graduate Student, WSU	Pullman, WA
18	Richard Rominger	Monsanto	Great Falls
29	Paul Mayland	American Hoechst Crop.	Fargo, N.D.
30	Jack Carter	Farmer	Littleton, CO
July 2	Al Carlton	Montana Seeds, Inc.	Conrad
2	Allen Taylor	Plant & Soil Science, MSU	Bozeman
14	Terry Gregoire	The Ansul Company	Fargo, ND
15	Ray Volin	Agricultural Experiment Stn.	Homestead, FL
16	Bill Owens	Glacier Herald	Kalispell
16	Mary Pickett	Daily InterLake	Kalispell
19	Kathy Harvey	Kalispell Lovestock News	Kalispell
19	Jaye Johnson & family	Farmer	Ronan
20	Charles Bowman	Agric. Engineering, MSU	Bozeman
20	Don Graham	Western Agric. Res. Center	Corvallis

Visitors (con't)

DATE	VISITORS	REPRESENTING	ADDRESS
July 21	Merle Lyda	Flathead County Ext. Agent	Kalispell
21	Jerry Westenson	Ag. Engineering, MSU	Bozeman
21	Joan Speelman	Missoulian	Kalispell
21	Steve Fetveit	KCFW-TV	Kalispell
21	Clee Bratt	Farmer	Kalispell
27	Don Graham	Western Agric. Res. Center	Corvallis
28	E. R. Hehn	Retired Agronomist	Bozeman
30	Tom Ramage	ARS-USDA	Tuson, AZ
30	Coit Suneson	Retired Agronomist	Polson
Aug. 3	Marshell Beatty	Farmer	Somers
4	Steve White	Dept. Natural Resources	Helena
6	Charlie Simmons	Farmer	Charlo
16	Mr.&Mrs. Mulholland	Canadian Extension Ser.	Canada
17	Wes Roath	Retired Agronomist	Bigfork
18	Charles Bowman	Agricultural Engineering, MSU	Bozeman
19	Charles Bowman	Agricultural Engineering, MSU	Bozeman
20	Rick Harada	Northern Agric. Res. Center	Havre
24	Steve White	Dept. Natural Resources	Helena
Sept. 1	Tony Hoyt & daughter	Small Farmer	Arlee
9	Maynard Crunder	Retired Agronomist	Washington St.
13	Don Miller	Forest Service	Whitefish
13	Alan Reinarz	Student U of Minnesota	St. Paul, MN
16	Steve White	Dept. Natural Resources	Helena
22	Roger Smith	Wilbur-Ellis Co.	Spokane, WA
29	Jim Hoffman	USDA	Logan, UT
29	Blair Goates	USDA	Logan, UT
29	Jack Walder	USDA-ARES	Pullman, WA
Oct. 5	Jim Rodebush	Stauffer Chemical	Three Forks
6	Jim Rodebush	Stauffer Chemical	Three Forks
7	John Gaiser	Wilbur-Ellis Company	Spokane, WA
8	Richard McConnen	Agric. Economics, MSU	Bozeman
12	Lloyd Hall	Farmer	Kalispell
15	Mr.&Mrs. Geo. Judy	Tomato Growers	N. Ridgeville, OH
19	Vernon Johnson	Farmer	Kalispell
27	Charles Siderius	Farmer	Kalispell
28	Bill Ambrose	Farmer	Kalispell
Nov. 8	Clyde Pederson	Farmer	Kalispell
8	Bill Ambrose	Farmer	Kalispell
9	Bill Ghrames	Cherry Grower	Rollins
10	Howard Bowman	Plant & Soil Science, MSU	Bozeman
10	Henry Ficken	Mint Grower	Somers
15	Walt Sundelius	Farmer	Kalispell
17	Ernie Hildebrand	Gulf Oil Chemical Co.	Billings
18	Jim Rodebush	Stauffer Chemical	Three Forks
18	Jack Weber	Farmer	Bigfork
24	Dick & Kim Cates	Students	Bozeman
Dec. 8	Tom O'Hare	American Cyamid	Pocatello, ID

PHYSICAL PLANT 751

Any repairs or improvements affecting buildings, residences or other areas of the research center are considered under this project.

Several (100) feet of fence was repaired and new fences constructed in the spring of 1976. The total cost of fencing including posts and wire was $329.20.

Gravel was purchased to improve the driveway by the residences and in front of the office. We hauled and spread the gravel ourselves. The cost for this project was $127.84.

New carpet was laid in the living room and two small bedrooms in Residence #1. The total cost for this project was $511.94. Throughout the year several small repairs were needed in both residences for a total of $59.38. An additional amount of $48.16 was spent for remodeling and redocorating the upstairs of Residence #2.

A Royal 5000 typewriter was purchased. It replaces an Olympia electric typewriter. The Royal has a changeable type element which will be an asset when different size or style of type is desired. It also has many other new features which the old typewriter did not have.

GENERAL FARM 752

This is the supportive project for all research.

Several pieces of equipment were purchased. Some of the items were secured by using only state monies while others were purchased with only grant funds, or a combination of the two.

A cub cadet tractor with attachments was purchased from Big Red Equipment for a total cost of $1900. This is used for research and for lawn care.

The scale bed rotted out and needed to be replaced. Total cost of this project was $205.44.

A new piece of equipment which will be an asset to the small grains project is a Hegi combine. This will enhance the harvesting of small grain nurseries by reducing the amount of time spent and also the number of persons required. The Hegi was purchased by using $4080 from grant monies and $5000 from state funds.

Other pieces of needed equipment purchased with grant monies were: a grain auger with hopper and spout for $690.05, a moisture tester for $155 and an used chain saw for $125.

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1976 Northwestern Agricultural Research Center Report

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2	Office of Director, Montana Agricultural Experiment Station
1	Plant and Soil Science Department - Dr. K. C. Feltner
4	Research Staff at Northwestern Agricultural Research Center
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5	Northwest Montana Banks Bank of Columbia Falls Conrad National Bank - Kalispell The First Northwestern National Bank of Kalispell Valley Bank - Kalispell Western Montana National Bank - Missoula
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1	Soil Conservation Service - Oscar Pederson
4	Feed Mills
	Equity Supply Company - Kalispell Kalispell Feed & Grain Supply Inc. - Kalispell Peavey Company Producer Service - Ronan 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 data. Maximum and minimum temperatures, amount of precipitation and amount of snow on the ground are data which are recorded daily. Also, maximum and minimum soil temperatures at the four and eight inch level are recorded. These readings are made each morning at 8:00 a. m.

Summary for 1975-76 Crop Year

There were 109 frost free days during the 1975-76 crop year, which is the same as the previous year and also one day more than the long term average. The last killing frost occurred on May 21, 1976 (32°) and the first killing frost on September 8, 1976.

Total precipitation for the crop year was 19.97 inches which is 0.96 inch above the long term average. The mean temperature was 43.4°F. This is almost the same as the long term average which is 43.3°F (Talbe 1).

September 1975: Precipitation was slightly below normal. Temperatures were above average. August moisture was responsible in part, for the excellent stands of winter wheat by the end of the month. Temperatures dropped to 30°F on September 8, however the potatoes did not freeze down completely on this date.

October 1975: Precipitation was 1.44 inches above normal. Winter wheat made excellent growth this month and winter grain looked excellent at the end of the month. Temperatures were just slightly below normal.

November 1975: The first measurable snow fell on the 11th (2½"). This all melted, however by the end of the month there were 4 inches of snow on the ground . Precipitation was 0.66 inch below the average. The mean temperature was 1.1 degrees above average. The low for the month was -6°F.

December 1975: The first day of the month snow accumulated to 8 inches, by the last day there were only 3 inches. There was snow cover throughout the month except from the 3rd through the 11th. Precipitation level was 0.25 inches below the average. The temperature average was 2.2°F above normal. Low for the month was -3°F.

January 1976: Precipitation was below normal, and temperatures were 5.7° above the long time average. The high for the month was 52°F on the 17th. The low of -3°F occurred on the first day of the month. Snow cover during the month was light and by the end of the month the snow was gone.

February 1976: Precipitation was equal to the long time average. Mean temperature was 1.8 degrees above average, however on the 4th, the temperature dropped to -4°F, with high winds giving a chill factor of -18°F. Winter wheat at this date was exposed and very brown in color.

March 1976: Precipitation and mean temperatures were below normal. Precipitation was 0.7 inches below the long time average. The low temperature of -3°F occurred the 2nd and 3rd. The high was 57°F on the 18th. Snow was gone by the 4th.

April 1976: Precipitation was 0.64 inch above average with temperatures above by .1°F. Weather and field conditions during the month permitted the earliest seeding date ever on the station. The first seeding was done on the 12th.

May 1976: Precipitation was 0.08 inch below the long time average. Temperatures were slightly above the long time average. The last freeze date of the spring occurred on the 21st. All crops were in good condition at the end of the month.

June 1976: Precipitation was 0.48 inch below normal and mean temperatures were somewhat lower than the average. Precipitation levels in this month have been below normal for the past four years. When records were first begun this month had an average of 3.0 plus inches; this has continued to decline over the past four years. The highest occurred in 1966 when 6.57 inches were recorded; the lowest was 0.57 inch in 1963.

July 1976: A precipitation level of 1.49 inches was 0.02 inch above average. Temperatures were somewhat below normal, however the highest temperature of the year occurred on the 27th (90°F).

August 1976: During this month 3.42 inches of precipitation fell which was 1.79 inches above the monthly average. These rains occurred about harvest time hindering this operation for both hay and small grains. This moisture did enhance seed beds for winter grain seeding.

Table 1. Summary of climatic data by months for the 1975-76 crop year (September to August) and average for the period 1949-76 at the Northwestern Agricultural Research Center, Kalispell, Montana.

Item	Sept. 1975	Oct. 1975	Nov. 1975	Dec. 1975	Jan. 1976	Feb. 1976	Mar. 1976	Apr. 1976	May 1976	June 1976	July 1976	Aug. 1976	Total or Average Growing Season
Precipitation (inches)													
Current Year	1.18	2.96	.85	1.39	.91	1.12	.34	1.92	1.90	2.49	1.49	3.42	19.97
Ave. 1949 to 1975-76	1.45	1.52	1.51	1.64	1.59	1.11	1.04	1.28	1.98	2.97	1.29	1.63	19.01
Mean Temperature (F)													
Current Year	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
Ave. 1949 to 1975-76	53.6	43.5	33.0	26.4	22.1	28.1	32.8	42.8	51.7	58.3	64.4	63.0	43.3
Last killing frost in spring*													
1976					May 21 (30 degrees)								
Ave. 1949-76					May 27								
First killing frost in fall*													
1976					September 8 (30 degrees)								
Ave. 1949-76					September 12								
Frost-free period													
1976					109 days								
Ave. 1949-76					108 days								
Maximum summer temperature					90 degrees F on July 27, 1976								
Minimum winter temperature					4 degrees below zero on February 5, 1976								

* 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, 1976.

	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	53.8	45.9	31.5	29.5	20.2	27.7	27.0	42.1	50.0	54.2	64.7	60.4	42.3
1951-52	50.6	40.8	30.8	16.9	18.0	26.6	29.3	45.8	52.4	56.7	61.8	62.8	41.0
1952-53	56.0	45.5	30.4	27.6	36.0	32.9	37.2	41.2	49.5	54.6	64.3	63.1	44.9*
1953-54	56.1	46.2	37.0	31.3	21.1	31.2	29.6	40.8	52.5	54.9	63.4	60.1	43.7*
1954-55	52.9	41.5	38.8	28.8	25.7	22.1	24.5	39.1	47.7	58.8	62.7	62.2	42.1
1955-56	52.5	44.6	23.5	21.8	23.3	20.9	31.5	44.2	54.0	59.0	64.8	62.0	41.8
1956-57	55.2	44.1	30.9	28.5	10.2	23.4	33.3	43.7	55.6	59.7	65.4	62.4	42.7
1957-58	55.8	41.4	32.1	32.4	29.1	30.4	32.2	43.6	59.6	62.3	65.2	67.9	46.0*
1958-59	55.5	44.6	32.8	28.2	24.7	23.1	35.3	45.2	48.1	59.9	64.5	61.0	43.6*
1959-60	53.0	43.9	25.5	27.6	19.4	25.2	32.3	44.3	50.6	59.6	68.8	60.6	42.6
1960-61	55.0	45.2	34.4	24.9	27.8	37.0	38.3	42.0	52.6	64.7	66.2	67.8	46.3*
1961-62	49.6	42.3	28.2	23.6	17.4	25.7	30.9	47.2	51.5	58.6	62.1	62.1	41.6
1962-63	54.7	44.7	38.0	32.5	11.8	33.1	38.7	43.2	51.4	59.4	63.0	64.9	44.6*
1963-64	58.7	47.4	35.8	24.0	28.5	28.3	30.6	42.8	51.1	58.7	64.3	58.9	44.1*
1964-65	51.2	43.7	33.7	22.1	30.2	28.7	28.6	45.2	50.6	57.6	64.6	63.6	43.3*
1965-66	46.4	47.6	35.0	28.8	26.3	27.7	34.5	42.9	54.3	56.0	64.5	61.7	43.8*
1966-67	59.3	43.4	33.4	30.2	31.0	33.2	32.9	40.6	52.2	59.4	66.1	67.2	45.7*
1967-68	61.0	45.9	33.8	25.1	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*
$\bar{x}$	53.6	43.5	33.0	26.4	22.1	28.1	32.8	42.8	51.7	58.3	64.4	63.0	

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, 1976.

	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
$\bar{x}$	68.7	55.0	40.2	32.9	29.6	36.4	42.6	54.5	65.3	71.8	81.1	79.5	

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, 1976.

	Average minimum temperature by month and year Degree 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*
$\bar{x}$	38.4	32.1	25.6	19.9	14.4	19.7	22.9	31.0	37.9	44.7	47.6	46.3	

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, 1976

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*
$\bar{x}$	1.45	1.52	1.51	1.64	1.59	1.11	1.04	1.28	1.98	2.97	1.29	1.63	

Mean precipitation for all crop years: 19.01

* Denotes years above average precipitation.

Table 6. Precipitation by day for crop year, September 1, 1975 thru August 31, 1976. Northwestern Agricultural Research Center, Kalispell, Montana

Date	Sept. 1975	Oct. 1975	Nov. 1975	Dec. 1975	Jan. 1976	Feb. 1976	Mar. 1976	Apr. 1976	May 1976	June 1976	July 1976	Aug. 1976
1	.23			.42	T			.17		.06		
2	.16			.11	T			T		.22		.06
3	T			T	.01		T		T	.01		
4		.27			.11		T			.03		.50
5		T		T	.24				.41		.05	.05
6		.11			T				.01			
7		.86	T	.02	.01					.03		.55
8		.16	T	.11	.33						.05	T
9		.05		T	T					.03	.15	.25
10		.04	T					T		T	T	.05
11		.03	.17	T	T	T	T		.23	.02		T
12		.09		.03	.01	.15				.04	.56	
13		T			T	.29	T	.62		.10	.20	
14				T	.01	.15		.13		.29	T	
15		.05	T	.27	.15	T		.08	.06	T		.40
16		.07			T	.13		.13		.46		1.03
17	.51		T		T	.16		.15		.15		.15
18	.28	.04	T		T	.09		T				T
19							.14	.10				T
20		T					.03	.10	.33			.03
21		.07					T	.05	.01	.01	.15	
22		.46						T		.25	T	
23		.15	.04	T	.04			.02	.03	.65		.06
24		.25	.19	T					.08	.04	T	.23
25		T	.02	.07	T		.07	.29	.02		.12	
26		.11	.32	.08	T	.03	.02	.08		.10		.06
27		T	.11		T	.04	.07	T				T
28		.10		.08	T	.05	T		.33			
29		T		.08		.03	.01					
30			T	T							.08	
31		.05		.12					.39		.13	
Total	1.18	2.96	.85	1.39	.91	1.12	.34	1.92	1.90	2.49	1.49	3.42

Table 7. Frost free period at the Northwestern Agricultural Research Center from 1950 thru 1976.

Year	Date Last Freeze	Temperature	Date First Freeze	Temperature	Frost Free Season
1950	June 10	32	Sept. 11	29	92 93
1951	June 1	29	Sept. 15	29	106
1952	June 14	32	Sept. 8	29	85 86
1953	May 23	32	Sept. 16	31	108 116
1954	May 29	31	Sept. 30	26	123 124
1955	May 25	28	Sept. 13	31	108 111
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	109 110
1976	May 21	30	Sept. 8	30	109 110 133
$\bar{x}$ for all years	May 27	30	Sept. 12	30	108

Table 8. Temperature extremes at the Northwestern Agricultural Research Center, Kalispell, Montana, from 1950 thru 1976.

Year	Minimum		Maximum	
	Date	Temperature Degrees F	Date	Temperature Degrees F
1950	Jan. 30	-40	Aug. 31	88
1951	Jan. 28	-25	Aug. 2	92
1952	Jan. 1	-14	Aug. 31	90
1953	Jan. 6	8	July 12	97
1954	Jan. 20	-32	July 6	90
1955	Mar. 5	-20	June 22	96
1956	Feb. 16	-25	July 22	90
1957	Jan. 26	-34	July 13	91
1958	Jan. 1	2	Aug. 11	94
1959	Nov. 16	-30	July 23	96
1960	Mar. 3	-32	July 19	98
1961	Jan. 2	0	Aug. 4	100
1962	Jan. 21	-32	Aug. 16	92
1963	Jan. 30	-24	Aug. 9	94
1964	Dec. 17	-28	July 8	91
1965	Mar. 24	-10	July 31	89
1966	Mar. 4	- 7	Aug. 2, 25	91
1967	Jan. 24	2	Aug. 19	95
1968	Jan. 21	-23	July 7	94
1969	Jan. 25	-13	Aug. 24	97
1970	Jan. 15	-14	Aug. 21, 25	92
1971	Jan. 12	- 8	Aug. 6, 9	96
1972	Jan. 28	-24	Aug. 9, 10	92
1973	Jan. 11	-22	July 11	97
1974	Jan. 5	-18	June 16, 20	93
1975	Jan. 12 & Feb. 9	-16	July 12	96
1976	Feb. 5	- 4	July 27	90

Table 9. Summary of temperature records obtained at the Northwestern Agricultural Research Center, January 1950 thru December 1976.

	Average Temperature by Month and Year Degrees Fahrenheit												$\bar{x}$ for
Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
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*
$\bar{x}$	22.1	28.1	32.8	42.8	51.7	58.3	64.4	63.0	53.7	43.5	32.8	26.5	

Mean Temperature For All Years = 43.3

* Denotes years above average mean.

Table 10. Summary of precipitation records obtained at the Northwestern Agricultural Research Center, Kalispell, MT, January 1950 thru December 1976.

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
$\bar{x}$	1.59	1.11	1.04	1.28	1.98	2.97	1.29	1.63	1.45	1.51	1.47	1.64	

Mean annual precipitation for 27 years = 18.96

* Denotes years above average.

YEAR: 1976

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

LOCATION: Paul Boss farm, Kalispell, MT and Beryl Mahlum farm, Somers, MT

PERSONNEL: Vern R. Stewart, Leader
Cooperators - Weed Research Committee, MAES, MSU

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

SIGNIFICANT FINDINGS:

Experiment I - The combination of triallate with other post emergence herbicides resulted in the best wild oat control and the highest yield. Split applications of barban are superior to single applications. HOE 23408 gave better wild oat control when applied at the 3-5 leaf stage, and in combination with the surfactant Renex 36. The lower rates of HOE 23408 were more satisfactory for wild oat control than the 1 lb/a rate in barley.

Experiment II - HOE 23408 at .75 lb/a gave 80% weed control in a very high wild oat population.

MATERIALS AND METHODS:

Two wild oat studies were conducted in 1976. The experiment on the Paul Boss farm contained 48 treatments with two crops; spring wheat (Norana), and spring barley (Freja). Herbicides used and rates are found in Table 1 and 2. The soil type was classified as Swims silty clay loan, with a high percentage of clay.

The small grains were seeded with a 12' International Harvester press drill with a 7" spacing. Seeding rate for barley was 80 pounds and spring wheat 70 pounds. The grain was seeded the entire length of the field, alternating spring barley and spring wheat strips. Herbicide plots were applied at right angles to the seeded strips.

The treated areas for herbicides were 260 square feet. Eight square feet were harvested from the center of each plot with a Jeri power harvester for yield information.

Weed control evaluations were made prior to harvest. These are scored on a 0-10 basis where 0 is no control, and 10 is complete control.

Yield and weed control data were analyzed using the analysis of variance technique.

RESULTS AND DISCUSSION:

Experiment I - Three replications were planned and established for this study. Wheat and barley appeared to emerge normally. When observed several days following emergence we noticed the strip of barley was being clipped off, or so it appeared. We could not find any animal tracks. We also noted that the wild oats were not growing in this strip. The wheat plants were normal except for some areas of chemical residue from last years experiments. Because of these conditions, the third replication was dropped.

Results and Discussion (con't)

A - Spring Wheat, Variety Norana

(a) Triallate and combinations - Triallate at the 1.00 lb/a and 1.25 lb/a alone, provided fair weed control, but with no significant yield increase. We noted some thinning of stand at the 1.25 lb/a rate. The combination of triallate and difenzoquat resulted in a significant yield increase and about 70% wild oat control. The combination with barban resulted in 90% weed control, and a reduction in yield when compared to the triallate-difenzoquat combination.

(b) Dinitramine - This product did not give effective weed control and I do not have an explanation for the significant yield increase at the .66 lb/a rate.

(c) R33222 - Wild oats were not controlled with R33222 and yields were not improved over the check.

(d) HOE 23408 - This American Hoechst product was used extensively in this experiment. It was applied at the 1-3 leaf stage and 3-5 leaf stage of growth, alone at three rates, and with two different surfactants. The 1 lb/a rate gave the best wild oat control regardless of the stage of growth at which it was applied. We also found applications made at the 3-5 leaf stage of growth gave better wild oat control, particularly, at the .75 and 1.00 lb/a rates. Yields were higher also when applied at this stage of growth.

The combination of HOE 23408 and surfactant B gave better wild oat control than HOE 23408 and the combination of HOE 23408 and surfactant A. However, yield differences are not significantly different when the products were applied at the 1-3 leaf stage of growth. When applied at the 3-5 leaf stage of growth HOE 23408 in combination with surfactant B, gave better wild oat control at the lower rate and significant yield increases were noted.

(e) Barban and combinations - The data found in Table 2 would indicate that there is little difference in the formulations of barban as related to wild oat control. Wild oat control was much more effective when applied as a split application, .25 lb/a at the two-leaf stage; .25 lb/a at the four-leaf stage. The combination of barban with bromoxynil and MCP did not give effective wild oat control, but did give effective control of the broadleaved weeds.

(f) Difenzoquat and combinations - At 1.00 lb/a difenzoquat only gave about 60% weed control. Yields were somewhat higher than the check, however not significantly so. These data would suggest that the combination of a phenoxy and difenzoquat result in less wild oat control and yield decrease. The volume of water used with difenzoquat did change the percent of wild oat control.

B - Spring Barley, Variety Freja

(a) Triallate and combinations - Wild oat control with triallate was 60% to 90% alone and in combination with other post emergence wild oat herbicides. The highest yielding treatment in the study at 39.2 bu/a was triallate in combination with difenzoquat, followed closely by triallate in combination with HOE 23408.

(b) Dinitramine - Wild oats were not controlled with dinitramine at any rate of application and yields were about equal to the check.

(c) R33222 - This compound did not control wild oats, and yield levels were below the check.

(d) HOE 23408 - HOE 23408 when applied at the 1-3 leaf stage provided only fair wild oat control. Wild oat control was significantly better when applied at the 3-5 leaf stage. Generally the .5 lb/a and .75 lb/a rates had less effect on yields. The best HOE 23408 treatment in this study was .5 lb/a applied at the 3-5 leaf stage which resulted in a yield of 37.2 bu/a and 80% wild oat control.

Surfactant B was more effective than surfactant A in combination with HOE 23408. HOE 23408 when used alone in this study was equal to or superior in wild oat control than when in combination with the surfactants.

Results and Discussion (con't)

(e) Barban - Barban applied at the 1-2 leaf stage gave better wild oat control than when applied in the 4 leaf stage. No difference was noted between formulations of barban.

The split application of barban enhanced wild oat control when applied at the 2 leaf stage and 4 leaf stage of growth. Barban at the .5 lb/a rate was not as effective as the split application in wild oat control and did decrease yields somewhat. The addition of MCP plus bromoxynil resulted in a higher wild oat control level. It should be noted that the broadleaf weed control compound was applied with the second application of barban in the case of the split applications.

(f) Difenzoquat - The best wild oat control with this product was at .75 lb/a resulting in 78% weed control and a fairly high yield level. The combination of difenzoquat and the phenoxy compound resulted in less wild oat control and lower yields. Increased water volume decreased yields and wild oat control, however these differences are not significant.

There was statistical significance in plumpness of barley. Treatments found to have a reduction in the number of plump kernels were HOE 23408 at .5 lb/a and .75 lb/a; barban .5 lb/a plus MCP .375 lb/a plus Bromoxynil .375 lb/a; and barban .5 lb/a. The latter two treatments were applied at the 4 leaf stage of growth. The HOE 23408 treatments were applied at the 1-3 leaf stage.

Experiment II - An experiment to control wild oats in spring wheat was established on the Beryl Mahlum farm near Somers, Montana. Applications were made when wild oats were in the 3-5 leaf stage.

Weed readings were made only on part of the plots. The farmer cut into the experiment resulting in the loss of one-third of the plots in all three replications. The data in Table 4, is what could be salvaged from this experiment. The only product showing any effectiveness in the test was HOE 23408, but it should be noted that was only one observation. There was a very high population of wild oats in this location.

Experiment III - HOE 23408 was studied in this test. The objectives of the experiment were: (1) to determine residue of the herbicide in the crop and soil; (2) to determine the effect of the herbicide on yield of winter wheat.

Soil samples were taken on the day of application at 0-3", 3-6" and 6-12". This was repeated at harvest time. Soil samples were submitted to American Hoechst Corp. for analysis. Forage samples were secured immediately after application of the herbicide. Grain and straw samples were obtained at harvest time and sent to American Hoechst for residue analysis.

The study was observed May 8, eight days following application of the herbicide. At the 1.25 lbs/a rate we noted some plant distortion similar to those noted in grain sprayed with dicamba. I also noted at this rate a reduction in the height of winter wheat.

Yields were found to be non-significant when analyzed statistically. Table 5 gives yield and application data.

Table 1. Products used in these experiments.

Common Name	Trade Name or Other	Chemical Name	Company
barban		4-chloro-2-butynyl m-chlorocarbanilate	Gulf Chem.
bromoxynil	Brominal Buctril	3,5-dibromo-4-hydroxybenzonitrile	Amchem Rhodia
difenzoquat	Avenge	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium	American Cyanamid
	HOE 23408	methyl [2-4-(2,4-dichorophenoxy)phenoxy] propanote	American Hoechst
MCPA		[(4-chloro-o-tolyl)oxy]acetic acid	Amchem
MSMA	Ansar 529HC	Monosodium methanearsonate	Ansul
triallate	Fargo	S-(2,3,3-trichloroally)diisopropylthio-carbamate	Monsanto
2,4-D	2,4-D	(2,4-dichlorophenoxy)acetic acid	-
vernolate	Vernam	S-propyl dipropylthiocarbamate	Stauffer
dinitramine	Cobex	N^4,N^4-diethyl-α,α,α-trifluoro-3,5-dinitrotoluene-2,4-diamine	U.S. Borax
	R33222	No chemistry available	Stauffer

Table 2. Summary of results of a selective herbicide experiment for the control of wild oats in spring wheat, conducted by the Northwestern Agricultural Research Center on the Paul Boss farm, Kalispell MT in 1976. Random block design, two replications.

Date seeded: May 12, 1976 Date harvested: September 14, 1976
Size of plot: 8 sq. ft.

Treatment Herbicide	Rate #/A	Yield Bu/A	Wild Oats 0-10	Maturity[10]	Remarks
Pre emergence post plant incorporate[12]					
Triallate	1.00	17.4	6.5	S	Some thin wheat
Triallate	1.25	12.4	6.5	S-L	Few thin wheat spots
Triallate + HOE23408[1]	1.00 + .375	14.5	7.0	L	Thin wheat in spots
Triallate + barban[1]	1.25 + .25	13.4	9.0a	S-L	
Triallate + difenzoquat[2]	1.00 + .625	18.7a	7.0	S-L	Thin wheat in spots
Dinitramine	.33	13.1	6.0	S-L	Grayed wheat spots
Dinitramine	.66	18.2a	2.5	S-L	
R33222[3]	1.00	11.0	1.0	S	
R33222[3]	2.00	9.2	1.5	S-L	Some thin wheat spots
1-3 Leaf Stage					
HOE23408	.50	16.8	4.5	S	
HOE23408	.75	17.7	6.0	L	Little thin wheat
HOE23408	1.00	14.2	5.5	S-L	Thin wheat spots
HOE23408 + Surfactant A[4]	.50	13.5	4.0	S	Some thin wheat
HOE23408 + Surfactant A[4]	.75	19.0	5.0	S-L	Some thin wheat
HOE23408 + Surfactant A[4]	1.00	11.9	6.5	S	A little stunted, thin wheat
HOE23408 + Surfactant B[4]	.50	13.6	4.0	S-L	Thin wheat
HOE23408 + Surfactant B[4]	.75	14.8	5.5	S	Little thin wheat
HOE23408 + Surfactant B[4]	1.00	15.8	7.0	S	Little thin wheat
Surfactant A	-	11.2	2.0	S	Little thin, grayed wheat in spots
Surfactant B	-	10.7	1.0	S	Grayed wheat in spots
2 Leaf Stage					
Barban[5]	.375	13.6	4.5	S	Little thin wheat
Barban[5][6]	.25 + .25	18.1a	7.0	S-L	Grayed wheat
Barban[5][6] + MCP + bromoxynil	(.25 + .25)[5] .375 + .375	13.3	7.5a	S-L	Some thin, grayed, stunted wheat
Barban[5][7]	.25 + .25	20.7a	6.5	S	
Barban[5][7] + MCP + bromoxynil	(.25 + .25)[5] .375 + .375	14.5	5.0	S-L	Thin, stunted wheat
4 Leaf Stage					
Barban[6]	.50	12.7	6.5	S-L	Some thin, stunted wheat
Barban[7] + MCP + Bromoxynil	.50 + .375 + .375	9.9	2.5	L	Some grayed, thin, stunted wheat
Barban[7]	.50	10.6	4.5	L	Some thin, stunted wheat
Barban[7] + MCP + bromoxynil	.50 .375 + .375	11.9	3.0	L	Thin, slightly stunted wheat

Table 2. (con't)

Treatment Herbicide	Rate #/A	Yield Bu/A	Wild Oats 0-10	Maturity[10]	Remarks
		3-5 Leaf Stage			
HOE 23408	.50	16.7	5.5	S	
HOE 23408	.75	17.2	8.0	S	Few thin wheat spots
HOE 23408	1.00	19.0a	8.0	S-L	Little thin wheat
HOE23408 + Surfactant A[4]	.50	11.6	4.5	S	Thin wheat spots
HOE 23408 + Surfactant A[4]	.75	16.3	7.0	L-S	Some thin wheat
HOE23408 + Surfactant A[4]	1.00	19.8a	9.0a	S-L	Thin wheat spots
HOE23408 + Surfactant B[4]	.50	18.8a	8.0	S	
HOE23408 + Surfactant B[4]	.75	22.1a	8.0	S-L	Thin wheat spots
HOE23408 + Surfactant B[4]	1.00	17.4	9.5	S	A little thin wheat
Difenzoquat	.625	14.2	3.0	S	
Difenzoquat	.75	16.7	5.5	S-E	Thin wheat spots
Difenzoquat	1.00	15.2	6.0	S	Thin wheat
Difenzoquat + 2,4D amine[8]	.75 + .375	10.9	1.5	S	Thin wheat spots
Difenzoquat + 2,4D amine[9]	.75 + .375	12.7	4.0	S	Thin wheat in center
Difenzoquat + 2,4D LVester	.75 + .375	11.9	2.0	S	Thin wheat spots
Difenzoquat + 2,4DB ester	.75 + .375	10.2	5.5	L	Thin wheat spots
Difenzoquat (15 gpa)	.75	12.5	3.5	S	Thin wheat
Difenzoquat (20 gpa)	.75	17.1	3.5	S	
Check	0.0	11.7	0.0	S	
	$\bar{x}$	14.7	5.1		
	F[11]	2.09**	7.22**		
	S.E.$\bar{x}$	2.21	.86		
	L.S.D.(.05)	6.3	2.44		
	C.V.%	15.03	16.75		

1/ Apply 1-3 leaf stage
2/ Apply 3-5 leaf stage
3/ Surface applied following seeding, no incorporation
4/ .5% by volume
5/ Split application: ½ at 2 leaf stage, ½ at 4 leaf stage
6/ New formulation of barban 2 lbs/gal
7/ Old formulation of barban 1 lb/gal
8/ Amine salt
9/ Amine
10/ Maturity rating: S = same as check; L = later than check; E = earlier than check
11/ Value for treatment comparison
12/ Incorporate with spike tooth harrow, with two harrows at right angles to one another

Surfactant A = Triton X100
Surfactant B = Renex 36

** Indicates statistical significance at the .01 level
a/ Value significantly greater than the check .05
b/ Value significantly less than the check .05

Table 2. (con't)

Application Data:

Date	5/14/76	5/29/76		6/11/76			
Wind Velocity	0-8 mph	0-2 mph		0-7 mph			
Temperature	50°F	50°F		68°F			
Soil Temperature	-	52°F		62°F			
Humidity	60%	40%		36%			
Cloud Cover	P/C	P/C		P/C			
Stage of growth of wild oats	PE	1-3		3-5			
Soil Type	Silty clay loam	Silty clay loam		Silty clay loam			
Sprayer Information:							
Volume gpa	9.8	9.8[1]	6.9[2]	9.8[1]	6.9[2]	15.2[3]	21.2[4]
PSI	40	40	45	40	45	32	40
Nozzle Size	8001	8001	800067	8001	800067	8003	8003

1/ HOE 23408 and other applications
2/ Barban applications
3/ Difenzoquat applications
4/ Difenzoquat applications

Table 3. Summary of results of a selective herbicide experiment for the control of wild oats in spring barley, conducted by the Northwestern Agricultural Research Center on the Paul Boss farm, Kalispell, MT in 1976.

Date seeded: May 12, 1976 Date harvested: September 9, 1976
Size of plot: 8 sq. ft.

Treatment									
Herbicide	Rate #/A	Yield Bu/A	Test Wt Lbs/Bu	Wild Oats 0-10	Maturity[10]	% Plump	Lodging %	Lodging Sev.	Remarks
Pre emergence									
Triallate	1.00	29.3	46.0	6.0	S-L	79.0	35	6	Some stunted, thin barley
Triallate	1.25	28.2	46.6	7.0	S	79.0	40	5	
Triallate + HOE23408[1]	1.00 + .375	37.3a	45.5	9.0c	S	75.0	45	6	Thin barley
Triallate + Barban[1]	1.25 + .25	30.6	46.2	8.0c	S	77.5	60	7	
Triallate + difenzoquat[2]	1.00 + .625	39.2a	45.2	7.0	S	74.0	65	7	Thin barley spots
Dinitramine	.33	23.1	44.7	4.0	S	71.0	55	7	
Dinitramine	.66	33.0	44.3	-	S	69.5	85	7	Grayed barley
R 33222[3]	1.00	19.2	-	1.0c	S	69.0	80	8	Grayed barley
R 33222[3]	2.00	19.8	-	2.0c	S-L	76.0	55	6	Thin barley
1-3 Leaf Stage									
HOE 23408	.50	30.7	45.4	4.5	S	71.5	60	7	
HOE 23408	.75	36.7a	46.6	6.0c	S-L	75.5	60	7	Thin,grayed barley
HOE 23408	1.00	29.4	45.1	5.5	S	76.5	55	6	Thin,grayed barley
HOE 23408 + Surfactant A[4]	.50	30.1	46.3	2.0c	S	78.5	45	6	Grayed,stunted barley
HOE 23408 + Surfactant A[4]	.75	27.2	45.2	-	S	75.0	60	8	Grayed & few thin barley
HOE 23408 + Surfactant A[4]	1.00	17.7	-	6.0c	S	68.5	16	3b	Thin,grayed, stunted bar.
HOE 23408 + Surfactant B[4]	.50	20.1	42.6	5.0c	S	64.0b	58	8	Grayed, thin barley spots
HOE 23408 + Surfactant B[4]	.75	23.9	41.2	5.5	S	63.5b	65	7	Little grayed barley, thin in spots
HOE 23408 + Surfactant B[4]	1.00	28.1	42.9	6.0	S-L	74.5	55	6	Grayed,thin bar. in spots
Surfactant A[4]	-	24.6	44.6	4.0c	S	75.0	75	8	Thin,grayed bar. in spots
Surfactant B[4]	-	24.8	44.4	1.0c	S	75.0	60	8	Grayed barley
2 Leaf Stage									
Barban[6]	.375	25.3	43.6	5.5	S	74.0	65	3b	Little,grayed stunted bar.
Barban[5/6]	(.25+.25)[5]	34.8	44.9	6.0c	S	76.5	45	6	Some grayed barley
Barban[5/6] + MCP + bromoxynil	(.25+.25)[5] + .375 + .375	30.3	42.9	8.0	S	71.5	35	5	Little thin, stunted,grayed barley

Table 3. (con't)

Treatment Herbicide	Rate #/A	Yield Bu/A	Test Wt Lbs/Bu	Wild Oats 0-10	Maturity[10]	% Plump	Lodging %	Lodging Sev.	Remarks
Barban[5/7]	(.25+.25)[5]	27.9	45.1	5.5	S	75.5	30	4b	Grayed barley
Barban[5/7] + MCP + bromoxynil	(.25+.25)[5] .375 + .375	36.0a	44.9	6.0	S	77.0	20	4b	Thin,slightly stunted bar.
		4 Leaf Stage							
Barban[6]	.50	22.5	44.2	5.5	S-L	75.0	35	6	Thin slightly stunted bar.
Barban[6] + MCP + bromoxynil	.50 + .375 + .375	28.2	42.8	2.5	S-L	66.5b	40	6	Some thin, stunted bar.
Barban[7]	.50	22.1	43.2	4.5	L	68.0b	30	4b	Some thin, stunted bar.
Barban[7] + MCP + bromoxynil	.50 + .375 + .375	22.8	43.6	3.0	S	65.0b	25	4b	Thin,stunted barley
		3-5 Leaf Stage							
HOE 23408	.50	26.1	45.5	5.5	S	80.0	50	8	Few thin barley spots
HOE 23408	.75	24.6	46.7	8.0	S	81.0	40	5	Thin stunted barley
HOE 23408	1.00	24.7	45.5	8.5	S	71.0	55	5	Thin barley
HOE 23408 + Surfactant A[4]	.50	25.0	47.5	3.0	S	83.5	65	6	Some thin barley
HOE 23408 + Surfactant A[4]	.75	29.7	47.0	7.0	S-L	81.0	55	6	Some thin barley
HOE 23408 + Surfactant A[4]	1.00	29.4	46.9	8.5	S-L	80.5	30	4	Thin,stunted bar. in spots
HOE 23408 + Surfactant B[4]	.50	37.2a	45.3	8.0c	S	78.0	78	8	
HOE 23408 + Surfactant B[4]	.75	31.9	46.0	8.0	S-L	78.5	20	3b	Little grain in tire track slightly,stunted,thin bar.
HOE 23408 + Surfactant B[4]	1.00	23.2	44.7	9.0	S_L	78.0	10	3b	Thin,stunted barley
Difenzoquat	.625	23.0	45.1	3.5	S	76.0	55	7	
Difenzoquat	.75	33.4	-	7.8	S-E	77.0	55	7	Thin barley
Difenzoquat	1.00	21.9	45.1	6.5	S	77.0	80	7	Few thin barley spots
Difenzoquat[8] + 2,4D amine	.75 + .375	30.6	-	2.0c	S-L	77.5	50	6	Thin barley spots
Difenzoquat[9] + 2,4D amine	.75 + .375	23.5	44.5	-	S	73.5	80	8	
Difenzoquat + 2,4LV ester	.75 + .375	25.4	-	2.0	S-L	79.5	60	3b	Thin barley
Difenzoquat + 2,4D Butyl ester	.75 + .375	26.4	-	5.5	S-L	77.0	35	5	Thin barley
Difenzoquat(15gpa)	.75	22.7	45.0	5.0c	S	78.0	65	8	
Difenzoquat(20gpa)	.75	21.7	43.6	3.5	S	70.5	50	6	Little thin Barley
Check	.0	24.7	-	0.0	S	77.5	85	8	

Table 3. (con't)

Treatment Herbicide	Rate #/A	Yield Bu/A	Test Wt Lbs/Bu	Wild Oats 0-10	Maturity[10]	% Plump	Lodging %	Lodging Sev.	Remarks
	$\bar{x}$	27.3	-	-	-	74.8	51.4	6.0	
	F[12]	1.77*	-	-	-	1.87*	1.161	2.90*	
	S.E.$\bar{x}$	3.91	-	-	-	3.38	17.16	.93	
	L.S.D.(.05)	11.1	-	-	-	9.61	N.S.	2.63	
	C.V. %	14.32	-	-	-	4.52	33.36	16.04	

1/ Apply 1-3 leaf stage
2/ Apply 3-5 leaf stage
3/ Surface applied following seeding, no incorporation
4/ .5% by volume
5/ Split application - ½ at 2 leaf stage, ½ at 4 leaf stage
6/ New formulation of barban 2 #/gal
7/ Old formulation of barban 1 #/gal
8/ Amine salt
9/ Amine
10/ Maturity rating = S- same as check, L-later than the check, E-earlier than check
11/ Barley remaining on top of 6/64 sieve
12/ Value for treatment comparison

Surfactant A - Triton X100
Surfactant B - Renex 36

* Indicates statistical significance at the .05 level
a/ Value significantly greater than the check .05
b/ Value significantly less than the check .05
c/ These values are based on only one replication. Because of severe lodging it was not possible to obtain a good reading on the wild oat population

Application data:

Date	5/14/76	5/29/76	6/11/76
Wind Velocity	0-8 mph	0-2 mph	0-7 mph
Temperature	50°F	50°F	68°F
Soil Temperature	-	52°F	62°F
Humidity	60%	40%	36%
Cloud Cover	P/C	P/C	P/C
Stage of growth of wild oats	PE	1-3	3-5
Soil Type	Silty clay loam	Silty clay loam	Silty clay loam

Sprayer Information:							
Volume gpa	9.8	9.8[1]	6.9[2]	9.8[1]	6.9[2]	15.2[3]	21.2[4]
PSI	40	40	45	40	45	32	40
Nozzle Size	8001	8001	800067	8001	800067	8003	8003

1/ HOE 23408 and other applications
2/ Barban applications
3/ Difenzoquat applications
4/ Difenzoquat applications

Table 4. Weed score readings from herbicide study conducted on spring wheat for the control of wild oats on the Beryl Mahlum farm, Somers, MT in 1976.

Treatment		Wild Oat Score 0-10			
Herbicide	Rate #/A	I	II	III	x
MSMA	4.0	7	-	4	5.5
MSMA	5.0	7	-	7	7.0
MSMA + HOE 23408	2.0 + .5	7	-	7	7.0
HOE 23408	.5	4	6	-	5.0
MSMA + difenzoquat	2.0 + .5	4	-	4	4.0
Difenzoquat	.5	3	3	3	3.0
MSMA + barban	2.0 + .25	5	-	-	5.0
Barban	.25	1	2	1	1.3
Barban + HOE 23408	.215 + .375	7	4	6	5.7
Barban + HOE 23408	.125 + .5	6	7	4	5.7
HOE 23408	.75	-	8	-	8.0
Barban	.50	-	5	-	5.0
Barban	.80	-	6	2	4.0
Check	0.0	-	0	-	0.0
Barban + MCP + Bromoxynil	.375 + .375 + .375	-	4	5	4.5

NOTE: Farmer cut off some of the plots making it impossible to secure readings on three replications. No yield data was obtained.

Application Data:

Date	5/26/76
Wind Velocity	4-6 mph
Temperature	52°F
Soil Temperature	58°F
Humidity	41%
Cloud Cover	P/C
Stage of growth of W.O.	3-5 leaf
Soil Type	Silty Clay Loam

Spraying Information:

Volume gpa	6.9[1]	9.8[2]
PSI	45	40
Nozzle Size	800067	8001

1/ Barban application
2/ Other products

Table 5 . Effect of HOE23408 on Crest winter wheat when applied early spring following "green up". Northwestern Agricultural Research Center, Kalispell, MT in 1976. Field R-5a

Date Seeded: September 18, 1975 Date Harvested: August 31, 1976
Size of Plot Harvested: 16 sq. ft.

Treatment		Plot Yield in Grams				Yield	
Herbicide	Rate #/A	I	II	III	$\bar{x}$	Bu/A	Remarks 1/
HOE 23408	1.25	627	569	542	579.3	57.9	Height reduction 2/
HOE 23408	2.00	723	662	604	663.0	63.3	Height reduction
Check	0.0	502	657	614	591.0	59.1	

$\bar{x}$	61.1
F 3/	1.187
S.E.$\bar{x}$	4.158
L.S.D.(.05)	N.S.
C.V.%	6.81

1/ Evaluation made 8 days following application
2/ Malformation similar to what we see with dicamba injury
3/ Value for treatment comparison

APPLICATION DATA:

Date	4/30/76
Temperature	45°F
Soil Temperature	43°F
Humidity	70% estimated
Wind Velocity	Calm
Cloud Cover	Clear
Soil Type	Creston silt loam

YEAR: 1976

TITLE: Chemical Control of Weeds in Small Grains

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT.
Field Nos. R-14 and R-13

PERSONNEL: Vern R. Stewart, Leader
Cooperators - Weed Research Committee, MAES, MSU

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

SIGNIFICANT FINDINGS:

(a) RH5205 WP25 gave the best control. The EC formulation of RH5205 caused considerable damage to wheat stands and gave limited weed control. Bifenox and RH5205, diphenylethers did not give good weed control.

(b) We found little difference in performance of the two formulations of bromoxynil alone and in combination with MCP. Yields decreased as the rate of SD39109 increased.

MATERIALS AND METHODS:

Three separate experiments were conducted in 1976. They were (1) Control of winter annuals in winter wheat with fall applications of herbicides. (2) Control of winter annuals in winter wheat with a spring application of herbicides. (3) Control of annual broadleaved weeds in spring wheat and barley. The herbicides used in these studies are listed in Table 1. Most of the herbicides were used post emergence of the crop, however three were applied pre emergence, they are indicated in the tabulated data.

In the winter wheat studies herbicide plots were applied at right angles to established crop of winter wheat. The plot size was 10 x 20 feet. The spring grain plots were rod row type plots. Grain was seeded in 20 foot rows, spaced one foot. Each herbicide plot contained four rows of spring wheat (Morana) and four rows of spring barley (Ingrid). Seeding rate of barley was 50 lbs/a, wheat 60 lbs/a.

Herbicides were applied with a research type sprayer. Rates and pressures are found in the tabulated data.

Weed species found in a natural state in these experiments were: field gromwell (Lithospermum arvense (L)); false flax (Camelina microcarpa (Andz)); tumble mustard (Sisymbrium altissimum (L.)); field pennycress (fanweed) (Thlaspi arvense (L.)); chickweed (Stellaria media (L.)); tansy mustard (Descurainia sophia (Walt)); henbit (Lamium amplexicaule (L.)); lambsquarter (Chenopodium album (L.)); plantain (Plantago sp); wild buckwheat (Polygonum convolvulus (L.)); shepherdspurse (Capella bursa-pastoris (L.)Medic); catchfly group (Silene conidea); quackgrass (Agropyron repens (L)); Canada thistle (Cirsium arvense (L.)); bedstraw (Galium aparine (L.)); mullen (Verbascum thapsus (L)).

Where applicable data was analysed statistically using the Analysis of Variance method.

RESULTS AND DISCUSSION:

Experiment I - Control of winter annuals in winter wheat, with fall application of herbicides.

A moderate population of quackgrass throughout the test area had an adverse effect on yield, but is not included in the evaluation of weed scores.

There were rather high populations of henbit and field gromwell when applications of herbicides were made in the fall. On May 8, 1976, when stand levels were evaluated, I noted a significant population of these two weeds in the check plot. When evaluations were made of weed populations prior to harvest, these two weeds had dried up and are not listed in the summary data.

A. Pre emergence

(a) RH5205 (WP 25%) - A 30% stand reduction was noted at the .25 and .5 lb/a rate and 50% at the 1.0 lb/a rate. Yields were not different from the check even with a 50% stand reduction. Weed control was up to 80% at 1.0 lb/a,but the .5 lb/a rate was 70% and yields somewhat higher. We obtained excellent control of henbit and gromwell. The weeds present are spring emerging annuals.

(b) Bifenox (WP 80%) - This product did control henbit and gromwell, but did not have any residue effect on spring germinating annuals. Yields were not materially reduced even with a 30% stand reduction.

B. Post emergence

(a) RH5205 EC - This product applied post emergence was quite severe on stands. Yields are lower, but not to the extent that would be expected. This could have been over come by tillering and more moisture and plant nutrients available for the remaining plants. Weed control was poor, however henbit and gromwell were controlled.

(b) Bifenox EC - Post emergence bifenox EC increased stand reduction, provided little or no control of spring emerging annuals, however it controlled gromwell and henbit.

(c) Bromoxynil - This is our standard treatment for fall applications to control winter annual weeds. It does not control spring emerging annuals. We would expect a high population of field pennycress in the spring.

(d) Terbutryn - Good control of gromwell and henbit, but no control of spring emerging annuals.

When the data was analysed statistically we found the yields to be non significant. All stands were reduced below the check at a statistically significant level. Weed control in most cases was significant when measured statistically, however the C.V. is quite high on this parameter.

Experiment II - Control of winter annuals in winter wheat with a spring application of herbicides.

The area in which this study was located was sprayed in the fall with bromoxynil to control winter annuals.

Results and Discussion (con't)

(a) R33222 - Both rates of this product gave identical weed control, yields were above the check, however these differences were not statistically significant at the 5% level.

(b) SD39109 - At all three rates of this Shell product weed control was 50%. Yields were reduced below the check at the 1.0 lb/a and 2.0 lb/a rates. It also left considerable field pennycress.

(c) Bromoxynil and the new formulation of bromoxynil in combination with MCP - Very few weeds remained when these products were used. It is doubtful that the readings of seven and eight are significantly different. The new formulations of bromoxynil with MCP may have a slight edge over the older formulation. Table 4.

Experiment III - Control of annual broadleaved weeds in spring wheat and barley.

In this location a high population of wild oats became noticable several weeks after application of herbicides. To control the wild oats the test area was sprayed with HOE23408, a new wild oat herbicide, at 1.0 lb/a. Considerable damage was noted on Ingrid barley. This accounts in part, for the low barley yields in this test.

A. Post emergence (small grain crop in the three to five leaf stage)

(a) R33222 - We noted slight damage to barley, mainly chlorotic spots. This product did provide fairly good weed control at the higher rates of application.

(b) Combination of bromoxynil and MCP - Weed control is less than we would expect, however this combination has not given us control of chickweed because of the late germination of the species. There was no crop injury.

(c) Bifenox (flowable) - Barley was injured by this product, and injury increased as the rate increased. We note severe damage to barley in the tractor tracks. Wheat was not affected as much as barley. Overall weed control rating was poor.

(d) Bifenox (EC) - Tip burning on the barley. The wheat was somewhat stunted. The higher the rate, the greater the injury. Weed control was not satisfactory.

(e) RH5205 (WD) - The injury noted on barley was greater than on wheat. The rate of application did not seem to make too much difference on crop injury or rate of weed control. Weed control was fair, however lambsquarter was not completely controlled.

(f) Gulf 6139 - Motling of leaves was noted on barley at the low rate. At 1.0 lb/a barley was severely damaged and wheat was stunted. Weed control was fair at 1.0 lb/a, but did not give effective control of Silene sp.

(g) SD39109 - This product caused injury on both wheat and barley, but was more severe on barley. It delayed the maturity of both crops. Overall weed control was poor.

Results and Discussion (con't)

(h) MSMA - This product caused no crop injury and was not effective in weed control. This herbicide is being discontinued for further evaluation.

B. Pre emergence

(a) Bifenox (Flowable) - No crop injury with bifenox when applied pre emergence. Weed control was also less when compared to the post emergence application.

(b) Bifenox (WP) - No crop injury, and very poor weed control rating.

(c) RH5205 (WP) - No crop injury and very poor weed control.

C. Yields

(a) Wheat - Spring wheat yields were found to be significantly different statistically. However, I cannot see any pattern in the yield configuration. The higher rates of a herbicide may have resulted in an increased yield or a decrease in yield. We don't see increased yields as weed control was increased. In fact, the highest yield was in a plot rated at 30% weed control where we used the herbicide bifenox (WP) at 1.5 lbs/a pre emergence. This could have resulted from early weed control, with the small grains having less competition in the very early growth stages. It is interesting to note most of the pre emergence applications did result in yields higher than the check.

(b) Barley - Barley yields were found to be non-significant when analyzed statistically. The highest barley yields were obtained from the bifenox (WP) treatment at 1.5 lbs/a, but only gave 30% weed control (see under wheat section above for explanation).

(c) Barley Plumpness - It appears from these data that barley plumpness was affected by weed population and perhaps some chemicals. A significant reduction in plumpness (top of 6/64 sieve) was noted with the 2.0 lbs/a rate of SD39109.

Table 1. Products used in these experiments.

Common Name	Trade Name or Other	Chemical Name	Company
bifenox	Modown	methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate	Mobil
bromoxynil	Buctril Brominal	3,5-dibromo-4-hydroxybenzonitrile	Rhodia Amchem
MCPA		(4-chloro-o-tolyl)oxy acetic acid	
terbutryn	Igran	2-(tert-butylamino)-4-(ethylamino)-6-(methylthio)-s-triazine	CIBA-Geigy
2,4-D	2,4-D	(2,4-dichlorophenoxy)acetic acid	
	RH5205	chemistry confidential	Rohmn-Hass
	R33222	chemistry not available	Stauffer
	SD39109	chemistry confidential	Shell
	74A344	new formulation of bromoxynil	Amchem
	74A348	new formulation of the combination of bromoxynil and MCP	Amchem
	6139	chemistry not available	Gulf
MSMA	Ansar 529HC	monosodium methanearsonate	Ansul

Table 2. Summary of weed control and yield data obtained from a herbicide study on winter wheat (Nugaines) at the Northwestern Agricultural Research Center, Field R-14, Kalispell, MT in 1976.

Date seeded: September 23, 1975 Date harvested: August 30, 1976
Size of plot: 16 sq. ft.

Herbicide	Rate #/A	Weed Score 0-10 3/4/	% Stand Reduction	Yield Bu/A	Test Weight Lbs/Bu	Remarks 1/5/ Pc	Qg	Ff	Wb	Lq	Ssp	CT	Bs
Pre emergence													
RH 5205(WP25%)	.25	6a	30a	55.9	56.7	f	x			f_7	f^7	x^7	
RH 5205(WP25%)	.50	7a	30a	64.4	57.1	f	p			f^7		f	
RH 5205(WP25%)	1.00	8a	50a	57.0	56.8	f	p					f_7	x^7
Bifenox(WP80%)	1.50	3a	30a	49.5	56.6	x	x	f^7	f^7	f^7	f_7		
Bifenox(WP80%)	2.00	6a	30a	53.7	56.5	x	x				f^7		
Post emergence													
RH5205(EC)	.188	3a	73a	55.5	56.9	x	p		f_7^7	f	f_7^7		f^7
RH5205(EC)	.25	1	82a	41.9	56.4	x	p		f^7	f_7	f_7^7		
RH5205(EC)	.33	4a	87a	33.3	57.0	x	p			f^7	f^7		x^7
Bifenox (EC)	.50	3a	47a	51.9	56.9	x	p						
Bifenox (EC)	.75	4a	60a	47.8	57.1	x	p			f_7			
Bifenox (EC)	1.00	2	60a	45.8	57.0	x	p			f_7^7	f^7		
Bromoxynil	.375	4a	20a	49.3	56.9	x	p		f^7	f^7			
Terbutryn	.50	5a	35a	54.6	56.3	x	p	f^7					
Terbutryn	1.00	6a	33a	48.0	56.7	x	p	f_7	f_7				
Check	0.0	0	0	57.2	56.3	x	x	f^7	f^7				
$\bar{x}$ 2/		4	44	51.0	56.7								
F 2/		4.76**	13.13**	1.43	.0								
S.E.$\bar{x}$		1.01	6.66	53.54	.0								
L.S.D.(.05)		2.92	19.30	N.S.	.0								
C.V. %		25.23	14.98	10.50	.0								

1/ Weed species present following application of herbicides
2/ Value for treatment comparison
3/ 0-10 = 0 = no control; 10 = complete control
4/ Score related only to broadleaved weeds. Quackgrass present was excluded from the scoring.
5/ Pc = Pennycress (fanweed)
Qg = Quackgrass
Ff = False flax
Wb = Wild buckwheat
Lg = Lambsquarter
Ssp= Silene species
CT = Canada Thistle
Bs = Bedstraw
6/ p = the predominate species, high population throughout the plot
x = denotes presence of the weed throughout the plot in moderate numbers
f = few plants, 2 or 3 of the species present
7/ Found in only one replication

APPLICATION DATA:

Date -	9/30/75	11/3/75
Temperature	60°F	52°F
Humidity	44%	58%
Wind velocity	0	0-7
Cloud cover	Clear	P/C
Soil type	Silt loam	Silt loam
Stage of growth	Pre-emergence	Post-emergence
Water volume	23.37gpa	23.37gpa
Soil moisture	Good	Good

Table 3. Summary of weed control and yield data obtained from a spring applied herbicide study on winter wheat (Nugaines) at the Northwestern Agricultural Research Center, Field R-14, Kalispell, MT in 1976.

Date seeded: September 23, 1975 Date harvested: August 30, 1976
Size of plot: 16 sq. ft.

Treatment		Weed Score	Yield	Test Weight	Remarks 3/5/					
Herbicide	Rate #/A	0-10	Bu/A	Lbs/Bu	Pc	Qg	Bs	CT	Ssp	M
R33222 50W	1.0	6	51.80	56.1	f	x	f		f[6]	f[6]
R33222 50W	2.0	6	50.07	56.2	f	x	f[6]	f[6]	f	
SD39109	.5	5	50.44	56.2	f	x	x		f	
SD39109	1.0	6	42.37	55.6	f	x	x[6]	x[6]	f[6]	
SD39109	2.0	5	43.41	55.7	x	x			f	
Bromoxynil	.25	7	44.11	55.5	f	x	x[6]	x[6]		
Bromoxynil	.375	8	40.51	55.0	f	x	f		f[6]	x[6]
Bromoxynil + MCP	.25 + .25	7	46.07	56.0	f[6]	p	f[6]		f	f
Bromoxynil + MCP	.375 + .375	8	41.84	56.1		x		f[6]	f	
74A344 1/	.25	8	46.57	56.0	f[6]	p	f[6]	x		x[6]
74A344 1/	.375	7	44.91	55.6	f[6]	x	f[6]	f	f	x[6]
74A348 2/	.25 + .25	9	50.14	55.9	f	p			f[6]	f[6]
74A348 2/	.375 + .375	9	46.11	56.0		p	f[6]	f[6]	f[6]	f[6]
Check	0.0	0	41.71	56.1	x	x	x[6]			
$\bar{x}$ 4/		6	45.72	55.9						
F		5.18**	N.S.	.0						
S.E.$\bar{x}$		.99	53.19	.0						
L.S.D.(.05)		2.88	15.49	.0						
C.V. %		15.43	11.63	.0						

1/ Bromoxynil butyrate
2/ Bromoxynil butyrate + MCP
3/ Weed species present following application of herbicide
4/ Value for treatment comparison
5/ Pc = Pennycress (fanweed)
Qg = Quackgrass
Bs = Bedstraw
CT = Canada Thistle
Ssp = Silene species
M = Mullein
6/ Found only in one replication
p = The predominate species, high population throughout the plot
x = Denotes presence of weed throughout the plot in moderate numbers
f = Few plants, two or three of the species present
** Indicates statistical difference at the .01 level.

APPLICATION DATA:

Date	4/13/76
Temperature	50°F
Humidity	65%
Wind Velocity	calm
Cloud Cover	clear
Soil type	silt loam
Soil Temperature	45°F
Water volume	9.8 gpa

Table 4. Summary of data obtained from selective herbicides used to control broadleaved weeds in spring barley and wheat, at the Northwestern Agricultural Research Center, Field R-13, in 1976.

Date seeded: May 12, 1976 Date harvested: Barley - September 1, 1976
Size of plot: 16 sq. ft. Wheat - September 14, 1976

Herbicide	Rate #/A	Yield Bu/A		Test Wt.	% Plump	Weed Score		Weed Species[3]								
		Sp. Wheat	Sp. Bar.	Sp. Bar.	Sp. Bar.	0-100[1]	0-10[2]	Lg	Ssp	Wb	Hb	Cw	Qg	Gw	Pc	Ms
Post emergence																
R33222	1.0	21.5	42.9	49.7	86	46.7a	7.0a	f	f$_5$	f$_5$	f	x	f			
R33222	2.0	19.7	35.1	50.6	92a	83.3a	8.3a		f$_5$	f$_5$		f	f			
Bromoxynil + MCP	.375+.375	26.1	44.8	50.3	92a	60.0a	7.7a		f	f$_5$		f	x	f^5		
Bifenox (Flowable)	.5	18.6	34.8	50.3	94a	43.3a	4.0a		x	f$_5$		x	f		f$_5$	
Bifenox (Flowable)	.75	21.1	38.4	51.9	93.a	16.7	3.7a	f^5	x	f$_5$		f	f	f	x^5	
Bifenox (Flowable)	1.0	29.1	37.5	52.0	90	38.3a	4.7a		f	f$_5$		x	f		f	
Bifenox (EC)	.5	24.3	41.9	51.7	92a	40.0	4.3a		x	f$_5$		x	f		f$_5$	f^5
Bifenox (EC)	.75	17.8	38.5	52.2	90	41.7a	5.3a		f	f$_5$	f^5	f	f		x^5	
Bifenox (EC)	1.00	20.5	36.1	51.7	92a	16.7	4.7a		f$_5$	f$_5$		p	f		x	
RH5205 (WP)	.125	20.8	42.5	51.9	93a	85.0a	7.7a	f	f$_5$	f$_5$		f	f			
RH5205 (WP)	.188	18.4	40.9	52.0	93a	83.3a	8.0a	f$_5$	f^5	f$_5$		f	f			
RH5205 (WP)	.25	19.5	53.9	51.8	91	80.0a	7.7a	f^5		f$_5$		f	f			
Gulf 6139	.5	20.1	39.9	51.8	91	26.7	4.3a	f^5	x	f		f	f			
Gulf 6139	1.0	19.9	37.9	50.8	83	50.0a	7.0a	f	x	f	f^5	f^5	f			
SD39109	.5	25.6	35.9	50.3	81	38.3a	4.3a		x	f		x	f		f	
SD39109	1.0	19.5	36.6	50.1	80	61.7a	2.3		x	f	f^5	f				
SD39109	2.0	30.8	20.2	-	72b	71.7a	4.7a		x	f	f^5	f	f^5			
MSMA	2.0	27.7	42.8	51.1	85	15.0	4.7a	f	f	f	f^5	f	f^5		f	
MSMA	3.0	25.7	46.3	51.2	92a	23.3	5.7a		x	f		x	f		f	
Pre emergence																
Bifenox (Flowable)	1.0	24.6	45.3	51.3	87	23.3	2.0		x	f$_5$	f^5	x	f$_5$		x^5	
Bifenox (Flowable)	1.5	25.6	38.5	51.9	87	26.7	3.3a		x	f^5		x	f^5	f^5	x^5	
Bifenox (WP)	1.0	32.0	51.4	51.7	89	16.7	1.3		x	f$_5$		x	x		f	
Bifenox (WP)	1.5	33.7a	55.6	51.1	85	33.3a	3.0a		x	x^5		x	f		f	
RH5205 (WP)	.125	28.2	42.2	50.9	87	36.7a	2.7a	f^5	x	f		p	f			
RH5205 (WP)	.188	27.6	49.0	50.7	85	70.7a	6.7a	x^5	x	f		x	f			
RH5205 (WP)	.25	22.7	47.7	50.1	84	61.7a	4.3a	x^5	x	f		x	f			
Check	0.0	25.4	40.1	50.7	82	0.0	0.0	f	x	x	f	x^5				

Table 4 . (con't)

Herbicide	Rate #/A	Yield Bu/A Sp. Wheat	Yield Bu/A Sp. Bar.	Test Wt. Sp. Bar.	% Plump Sp. Bar.	Weed Score 1/ 0-100	Weed Score 2/ 0-10	Weed Species 3/ Lq Ssp Wb Hb Cw Qg Gw Pc Ms
	$\bar{x}$ 4/	23.9	41.4		87.8	44.1	4.8	
	F	2.57**	1.66		2.55**	4.62**	6.17**	
	S.E.$\bar{x}$	2.79	5.43		3.28	11.24	.877	
	L.S.D. (.05)	7.9	N.S.		9.3	31.9	2.5	
	C.V. %	11.67	13.16		3.74	25.49	18.48	

1/ Weed Score taken: June 17 & 21, 1976
2/ Weed Score taken: August 5, 1976
3/ Weed species found at harvest time.
Lq = Lambsquarter
Ssp = Silene coniedia
Wb = Wild buckwheat
Hb = Henbit
Cw = Chickweed
Qg = Quackgrass
Gm = Gromwell
Pc = Pennycress (fanweed)
Ms = Mustard
p = Weeds found predominently throughout the plot(high population)
x = Weeds present in plot in moderate numbers
f = Weeds present in small(two or three) numbers
4/ Value for treatment comparison
5/ Found in only one replication
** Denotes statistical significance at the .01 level
a/ Values significantly greater than the check .05 level
b/ Values significantly less than the check .05 level

APPLICATION DATA:

Date	5/15/76	6/9/76
Temperature	35°F	62°F
Humidity	72%	60%
Wind Velocity	0	5-10
Cloud Cover	Clear	P/C
Soil Type	Silt loam	Silt loam
Stage of growth	Pre emergence	Post emergence
Water volume	9.8	9.8
PSI	32	32
Soil moisture	good	good

C

YEAR: 1976

TITLE: Chemical Control of Weeds in Small Grains (Special Studies)

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT
Field No. R-9 and R-14.

PERSONNEL: Vern R. Stewart, Leader
Cooperators - Weed Research Committee, MAES, MSU

OBJECTIVES:
1. To determine the effectiveness of certain herbicides in the control of weeds in small grains when applied in the fall or spring.
2. To study the effect of herbicides on small grains that could cause injury to small grain.

SIGNIFICANT FINDINGS:

Experiment I - Metribuzin with a rate range of .25 lb/a up to .5 lb/a gave excellent weed control. Yields were not found statistically significant in the study, but yield increases were noted where weed control was rated a 10 (0-10 scale; 0 = no control, 10 = complete control).

Experiment II - Fall applied vernolate in several different formulations did not reduce stands of barley when seeded the following spring. Spring applied vernolate 4S pre plant incorporate reduced yields of barley. Seed treated with a protectant (R32882) resulted in higher yields than non-treated seed when seeded in soil treated with several formulations of vernolate.

Experiment III - Fair weed control was obtained with dicamba at 4 lbs/a rate, but this rate resulted in reduced yields of both wheat and barley.

MATERIALS AND METHODS:

Three separate experiments were conducted in 1976.

Experiment I - Metribuzin was applied to an established stand of spring wheat, variety Fielder. Plots were 10 x 20 feet and replicated three times. Application data and weed species are found in Table 2.

Experiment II - Different formulations of vernolate were used in this test. These were applied in the fall and in spring. Some were incorporated at time of application,other surface applied. Details of application methods are given in Table 3. Plots were 20 feet long and 10 feet wide, with 8 rows per plot. Four rows were seeded with barley treated with R32882 (1% active), a seed protectant. Four rows were seeded with non-treated barley. The variety of barley was Ingrid. Data secured were weed control readings, crop injury rating and yields. Application data are given in Table 3. Weeds were a natural infestation and included red root pigweed (Amaranthus retroflexus L.); lambsquarter (Chenopodium album L.); field pennycress (fanweed) (Thlaspi arvense L.); henbit (Lamium amplexicaule L.); wild buckwheat (Polygonum convolvalus L.); shepherd's purse (Capella bursa-pastoris L.).

Experiment III - The herbicides used in this study were provided by Velsicol Chemical Corp. The objective of this experiment was to determine the effectiveness of this group of herbicides when fall applied, to an area to be seeded to spring wheat and barley. Herbicides were applied in the fall to the soil surface in early November. Plots were 10 x 20 feet or 200 square feet. Spring grains were seeded in May 1976, with barley and spring wheat in 4 row plots spaced 1 foot, making a total of eight rows of small grain per treatment. Weed control evaluations were made using a occur scale of 0-10, where 0 is no control, ten is complete control. Weed species in this experimentwere the same as are found in Experiment II. Application data, dates etc, were made a part of the tabular data in Tables 4 and 5.

RESULTS AND DISCUSSION:

Experiment I - The best weed control rating was at .5 lb/a, but not significantly better than the .25 lb/a + .357 lb/a. Yields were found to be non-significant when analyzed statistically. It is interesting to note that the high rate of metribuzin did not reduce yields which I would have anticipated. Table 2.

Experiment II- The highest yields were obtained where we had applied the vernolate 4S on the surface in the fall. However, this did not vary significantly from the vernolate 4S applied pre plant incorporated in the fall. It should also be noted that in these two treatments we obtained little or no weed control, but it appears evident from these data that the fall applications of the vernolate prior to spring seeding of the barley had no effect on germination or stand of barley. Vernolate, surface applied in the fall, had no effect on yield when compared to the check. The spring application of vernolate 4S did reduce yields significantly, particularly when applied PPI. Surface applied vernolate 4S reduced the yield. When measured statistically the herbicide treatments used did have a significant effect on yield. Seed treated with the protectant resulted in significant differences when analyzed statistically - 73.1 bu/a for treated, 67.3 bu/a for untreated.

The percent of plump kernels was found to be nonsignificant when analyzed statistically for both herbicide treatments and seed treatment.

Test weights were not analyzed statistically. Seed treatment means were not different. There were some variations in herbicide treatments. When vernolate 4S was applied in the spring at the 4 lb/a rate we noted a slight reduction in test weight when compared with the hand weeded check. However, these differences could be due to chance or sampling error.

Weed control was not very effective when carbamates were applied in the fall. When carbamates were pre plant incorporated in the spring we obtained our best control. None of the fall treatments gave what we consider satisfactory weed control. It should be noted that where we had better weed control, we also had a significant reduction in yield.

The complete tabulation of these data are found in Table 3.

Experiment III - As rates of dicamba or formulation and combinations with 2,4D were increased weed control increased slightly. The best weed control was obtained where dicamba at 4 lbs/a was used. Barley yields were increased slightly over the check, but were not statistically significant. Lowest barley yield was at the 4 lb/a rate of dicamba. Table 4. Spring wheat yields were reduced significantly when dicamba at 4 lbs/a was applied in the fall. No yields were statistically greater than the check. Table 5.

Table 1. Chemicals used in the experiments.

Common Name	Trade Name or Other	Chemical Name	Company
metribuzin	Sencor Lexon	4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H)one	Chemagro DuPont
vernolate	Vernam Vel 4207	S-propyl dipropylthiocarbamate	Stauffer Velsicol
dicamba	Banvel	3,6-dichloro-o-anisic acid	Velsicol
2,4D		(2,4-dichlorophenoxy)acetic acid	Velsicol

Table 2. Summary of weed control and yield data obtained from a study using metribuzin on established stands of spring wheat (Fielder) in 1976 at the Northwestern Agricultural Research Center, Field R-9.

Date Seeded: May 3, 1976 Date Harvested: September 3, 1976
Size of Plot: 16 sq. ft.

Treatment		Grams/Plot					Yield	Weed Score
Herbicide	Rate #/A	I	II	III	Total	$\bar{x}$	Bu/A	0-10 1/
metribuzin	.25	467	453	533	1453	484	48.4	9.3
metribuzin	.357	343	627	560	1530	510	51.0	9.
metribuzin	.500	633	505	759	1897	632	63.2	10.0
Check	0.0	489	436	619	1544	515	51.5	0.0
					$\bar{x}$		53.5	
					F 2/		1.40	
					S.E.$\bar{x}$		5.57	
					L.S.D.(.05)		N.S.	
					C.V. %		10.42	

1/ Weed Control = 0-10
0 = No control; 10 = Complete control
2/ Value for treatment comparison

APPLICATION DATA:

Date	6/16/76
Temperature	58°F
Humidity	53%
Wind Velocity	calm
Cloud Cover	cloudy
Soil Type	silt loam
Volume	15.2
P.S.I.	32

WEED SPECIES:
Henbit - 2-5 leaf stage
Field pennycress - flowering
Wild buckwheat
Lambsquarter
Silene species
Setaria species

Table 3. Effect of vernolate on the production of spring barley when applied at various times and methods, using seed-treated with a "safner" and untreated seed with the same vernolate application methods. Northwestern Agricultural Research Center, Kalispell, MT in 1976. Field No. R-14.

Date seeded: May 17, 1976 Date harvested: September 8, 1976 Size of plot: 16 sq. ft.

Treatment		Yield Bu/A[1]			Percent Plump[2]			Test Weight Lbs/Bu			Weed Control
Herbicide	Rate #/A	Untreated	Treated[3]	x̄	Untreated	Treated	x̄	Untreated	Treated	x̄	0-10[5]
Vernolate 4S[6]	2	61.8	76.8	69.3abcd[4]	89.7	87.3	88.5	50.4	50.4	50.4	.33
Vernolate 4S[6]	4	64.7	67.7	66.2bcd	94.7	94.0	94.3	51.8	51.9	51.9	.67
Vernolate 4S[7]	2	83.2	81.4	82.3a	88.7	86.7	87.7	50.7	50.5	50.6	.00
Vernolate 4S[7]	4	73.1	80.7	76.9abc	89.7	88.0	88.8	50.3	50.5	50.4	.33
Vernolate 4S[8]	2	62.9	62.8	62.9cd	87.0	87.0	87.0	50.1	50.0	50.1	3.67
Vernolate 4S[8]	4	43.3	70.2	56.8d	79.0	87.3	83.2	47.9	50.3	49.1	7.00
Vernolate 4S[9]	2	66.9	69.3	68.1bcd	85.0	82.7	83.8	49.8	48.9	49.4	5.00
Vernolate 4S[9]	4	60.2	71.9	66.1bcd	83.0	81.0	82.0	49.2	48.5	48.9	6.33
Vernolate 3S + R25788[6]	2	78.3	75.7	77.0abc	86.0	82.0	84.0	48.7	48.5	48.6	2.67
Vernolate 3S + R25788[6]	4	67.2	73.7	70.5abcd	88.7	84.3	86.5	49.6	50.7	50.2	2.00
Vernolate 3S + R25788[7]	2	73.1	72.1	72.6abc	87.3	87.7	87.5	50.3	50.1	50.2	.00
Vernolate 3S + R25788[7]	4	61.8	76.0	68.9abcd	86.7	86.7	86.7	49.5	49.6	49.6	2.00
Vernolate 6E[6]	2	58.7	72.2	65.4bcd	93.3	91.0	92.2	51.6	51.2	51.4	.67
Vernolate 6E[6]	4	69.5	61.0	65.3bcd	89.3	93.0	91.2	51.5	51.2	51.4	2.00
Vernolate 6.7E+R25788[6]	2	66.0	79.0	72.5abc	88.7	85.3	87.0	50.5	49.9	50.2	.33
Vernolate 6.7E+R25788[6]	4	79.3	75.5	77.4ab	90.0	84.0	87.0	50.6	49.7	50.2	.67
Check	0	70.8	75.3	73.0abc	91.7	88.7	90.2	51.2	50.5	50.9	.00
Check (hand-weeded)	0	70.7	74.8	72.8abc	83.3	83.0	83.2	49.1	48.7	48.9	10.00
Seed Treatment x̄		67.3	73.1		87.9	86.6		50.2	50.1	50.2	
Overall x̄				70.2			87.3				
L.S.D. Herbicides				11.6			N.S.				
L.S.D. Seed Treatment				4.1			N.S.				
C.V. Herbicides				3.57%			3.64%				
C.V. Seed Treatment				2.05%			.56%				

1/ Yield average of three replications
2/ Top of 6/64 sieve
3/ Seed treated with a herbicide protectant (Stauffer Chemical Co. No. R32882) 80% sp. 1% on an active basis
4/ Items having common letters are not significantly different one from another using Duncan's Multiple Range Test
5/ 0 = no control; 10 = complete control
6/ PPI fall applied
7/ Surface fall applied
8/ PPI spring applied
9/ Surface spring applied

Table 3 . (con't)

Statistical Analysis:

	YIELD		
Variation due to:	D.F.	Mean Square	F
Replications	2	15,948.40	2.48
Herbicides	17	14,341.25	2.23*
Error a	34	6,444.18	
Main plots	53		
Seed treatment	1	58,566.89	8.20**
ST x H	17	7,232.62	1.01
Error b	36	7,144.53	
Total	107		

* Indicates statistical significance at 0.05 level

Herbicides SE diff $\sqrt{\frac{6444.18 \times 2}{6}}$ = 46.34717 x .125 = 5.793 bu/a x t(2.03)= 11.6 bu/a LSD 5%

Seed Treatment SE diff $\sqrt{\frac{7144.53 \times 2}{54}}$ = 16.2669 x .125 = 2.033 bu/a x t(2.03) = 4.1 bu/a LSD 5%

Herbicides C.V. = $\frac{\sqrt{\frac{6444.18}{16}}}{561.55} \times 100 = 3.57\%$

Seed Treatment C.V. = $\frac{\sqrt{\frac{7144.53}{54}}}{561.55} \times 100 = 2.05\%$

Table 3 . (con't)

Statistical Analysis:

Variation due to:	% Plump D.F.	Mean Square	F
Replications	2	34.03704	.37
Herbicides	17	65.90632	.73
Error a	34	90.00763	
Main plots	53		
Seed treatment	1	40.3333	3.14
ST x H	17	15.41176	1.20
Error b	36	12.85185	
Total	107		

C.V Herbicides $\sqrt{\frac{90.60763}{9}} \div 87.3 \times 100 = 3.64\%$

C.V. Seed Treatment $\sqrt{\frac{12.85185}{54}} \div 87.3 \times 100 = 0.56\%$

Table 4. Summary of data obtained from herbicide study conducted on spring barley for control of broadleaf weeds. Herbicides were fall applied and crop seeded in the spring. Northwestern Agricultural Research Center in 1976. Field No. R-14

Date seeded: May 17, 1976 Date harvested: September 8, 1976
Size of Plot: 16 sq. ft.

Treatment		Yield	Test Wt.	%	Weed Score
Herbicide	Rate #/A	Bu/A	Lbs/Bu.	Plump	0-10 [1]
Vel. 4207 [3]	1.0	64.9	48.0	84	3.0
Vel. 4207	2.0	65.8	48.9	82	3.3
Vel. 4207	4.0	70.0	48.8	83	2.7
Dicamba	1.0	62.1	47.7	81	3.3
Dicamba	2.0	59.7	46.6	83	4.7
Dicamba	4.0	46.1	44.2	85	8.7
Weed Master [4]	1.0	66.4	49.4	87	1.3
Weed Master	2.0	68.6	46.6	83	3.7
Weed Master	4.0	62.9	47.9	83	4.7
Weed Master	8.0	66.6	47.5	83	4.7
Check	0.0	58.1	47.5	79	0.0
	$\bar{x}$	60.5		83.1	3.6
	F [2]	.909		1.17	1.46
	S.E.$\bar{x}$	6.684		1.93	1.82
	L.S.D.(.05)	N.S.		N.S.	N.S.
	C.V. %	11.04		2.33	50.11

APPLICATION DATA:

Date	11/5/75
Temperature	36°F
Humidity	85%
Wind Velocity	calm
Cloud Cover	P/C
Soil Type	silt loam

1/ Weed Score: 0 = No control; 10 = Complete control
2/ Value for treatment comparison
3/ Slow release formulation of dicamba
4/ Combination of dicamba and 2,4D

Table 5. Summary of data obtained from a herbicide study conducted on spring wheat (Norana) for the control of broadleaved weeds. Herbicides were fall applied and the crop seeded in the spring. Northwestern Agricultural Research Center, Kalispell, MT. Field No. R-14.

Date seeded: May 17, 1976 Date harvested: September 14, 1976
Size of plot: 16 sq. ft.

Treatment		Yield	Test Wt.	Weed Score
Herbicide	Rate #/A	Bu/A	Lbs/Bu.	0-10 1/
Vel 4207 2/	1.0	36.81	58.5	3.0
Vel 4207	2.0	41.73	59.2	3.3
Vel 4207	4.0	41.74	59.4	2.7
Dicamba	1.0	44.67	60.2	3.3
Dicamba	2.0	41.57	59.9	4.7
Dicamba	4.0	27.05b	- 4/	8.7
Weed Master 3/	1.0	41.67	59.0	1.3
Weed Master	2.0	43.94	60.4	3.7
Weed Master	4.0	41.04	59.3	4.7
Weed Master	8.0	42.24	59.5	4.7
Check	0.0	39.74	59.7	0.0
	$\bar{x}$ 5/	40.1		
	F	2.39*		
	S.E.$\bar{x}$	3.11		
	L.S.D.	9.2		
	C.V.%	7.74		

1/ Weed score: 0-10; 0 = no control, 10 = complete control
2/ Slow release formulation of dicamba
3/ Combination of dicamba and 2,4D
4/ Not enough seed for test weight
5/ Value for treatment comparison
* Indicates statistical difference at the .05 level
a/ Values significantly more than the check .05
b/ Values significantly less than the check .05

APPLICATION DATA:

Date -	November 5, 1975
Temperature -	36° F
Humidity -	85%
Wind Velocity -	calm
Cloud cover -	P/C
Soil type -	silt loam

TITLE: Chemical Weed Control in Legumes

PROJECT: Weed Investigations MS 754

YEAR: 1976

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

LOCATION: Northwestern Agricultural Research Center, Field No. R-14

OBJECTIVES: To find a herbicide that will effectively control weeds the entire season in a new legume seeding.

SIGNIFICANT FINDINGS:

Yields were not significant in the study.

UB3153 and dinitramine gave the most effective weed control.

MATERIAL AND METHODS:

The legume nursery studied this season is a continuation of one established in 1975. Details of the study and weeds found in the experiment are recorded on Page 38 of the 1975 Annual Report of the Northwestern Agricultural Research Center, Report No. 97.

Yields were secured by harvesting 40 square feet of the 240 square feet of area. Yields are reported on a 12 percent moisture base.

Weed control scores are observations made November 4, 1975. The predominate weed at the fall observation was redroot pigweed (Amaranthus retroflexus (L.)).

RESULTS AND DISCUSSION:

Yields were non significant when analyzed statistically. It is interesting to note that yields are very close in all treatments after the seeding year.

Weed scores obtained November 4, 1975 rated UB3153 as the best treatment at the .66 and 1.0 lbs/a rates. The dinitramine treatments were also fairly effective in this study with the higher rates resulting in more effective weed control. Table 2.

Table 1. Herbicides used in these experiments.

Common Name[1/]	Trade Name or Other	Chemical Name	Company
EPTC	Eptam	S-ethyl dipropylthiocarbamate	Stauffer
vernolate	Vernam	S-propyldipropylthiocarbamate	Stauffer
dinitramine	Cobex	N^4,N^4-diethyl-2,2,2-trifluoro-3,5-dinitrotoluene-2,4-diamine	U.S. Borax
UB3153	UB3153	Chemistry not available	U.S. Borax
profluralin	Tolban	N-(cyclopropylmethyl)-2,2,2-trifluoro-2,6-dinitro-N-propyl-p-toluidine	CIBA-Geigy
penoxalin	Prowl	N-(1-ethylpropyl-3,4-dimethyl-2,6-dinitrobenzenamine	American-Cyanamid
fluchloralin	Basalin	N-(2-chloroethyl)-2,6dinitro-N-propyl-4-(trifluoromethyl)aniline	BASF
2,4-DB	Butoxone	4-(2,4dichlorophenoxy)butyric acid	Rhodia

1/ Designation used in this report.

Table 2. Effect of several herbicides on the yield of alfalfa the first harvest year following application. Northwestern Agricultural Research Center, Kalispell, Montana in 1976. Field No. R-14. Plot size: 40 sq. ft.

1st cutting: June 28, 1976 2nd cutting: August 6, 1976

Treatment			Yield Ton/Acre					Weed Score 0-10[1/]
Herbicide	Rate #/A	Cutting	I	II	III	x̄	Total	
Check (weedy)	0	1	1.93	1.79	2.30	2.01		
		2	1.17	1.27	1.33	1.26		
		Total	3.10	3.06	3.63	3.27	9.79	0.0
EPTC +[5/]	3.0	1	2.07	2.25	2.27	2.20		
		2	1.41	1.62	1.26	1.43		
		Total	3.48	3.87	3.53	3.63	10.88	2.7
EPTC +[5/]	4.0	1	2.20	2.70	3.19	2.70		
		2	1.29	1.43	1.21	1.31		
		Total	3.49	4.13	4.40	4.01	12.02	4.0
Vernolate+[2/]	3.0	1	2.03	1.80	3.15	2.33		
		2	1.50	1.28	1.23	1.34		
		Total	3.53	3.08	4.38	3.67	10.99	2.7
Vernolate	3.0	1	2.08	2.70	2.36	2.38		
		2	1.19	1.12	1.28	1.20		
		Total	3.27	3.82	3.64	3.58	10.73	6.3
Dinitramine	.5	1	2.00	2.73	2.76	2.50		
		2	1.82	1.49	1.25	1.52		
		Total	3.82	4.22	4.01	4.02	12.05	6.7
Dinitramine	.66	1	2.30	2.45	2.75	2.50		
		2	1.25	1.56	1.41	1.41		
		Total	3.55	4.01	4.16	3.91	11.72	8.3
Dinitramine	1.0	1	2.10	2.32	2.67	2.36		
		2	1.59	1.47	1.30	1.45		
		Total	3.69	3.79	3.97	3.81	11.45	8.3
UB3153	.5	1	2.13	2.65	2.59	2.46		
		2	1.24	1.59	1.35	1.39		
		Total	3.37	4.24	3.94	3.85	11.55	8.0
UB3153	.66	1	1.60	2.11	2.42	2.04		
		2	1.64	1.57	1.48	1.56		
		Total	3.24	3.68	3.90	3.60	10.82	9.0
UB3153	1.0	1	2.36	2.15	2.39	2.30		
		2	1.19	1.25	1.20	1.21		
		Total	3.55	3.40	3.59	3.51	10.54	9.0
Profluralin	.75	1	2.62	1.97	2.18	2.26		
		2	1.55	1.35	1.49	1.46		
		Total	4.17	3.32	3.67	3.72	11.16	8.3
2,4DB[3/]	1.0	1	1.90	2.07	2.77	2.25		
		2	1.17	1.09	1.33	1.20		
		Total	3.07	3.16	4.10	3.45	10.33	7.0

Table 2. (con't)

Treatment			Yield Tons/Acre					Weed Score
Herbicide	Rate #/A	Cutting	I	II	III	x	Total	0-10[1]
EPTC + 2,4DB[3]	3.0 + 1.0	1	2.16	2.42	2.27	2.28		
		2	1.44	1.27	1.42	1.38		
		Total	3.60	3.69	3.69	3.66	10.98	6.3
Penoxlin	1.5	1	1.95	2.42	2.52	2.30		
		2	1.09	1.43	1.25	1.26		
		Total	3.04	3.85	3.77	3.56	10.66	5.0
Penoxlin	2.0	1	2.22	1.98	2.78	2.33		
		2	1.36	1.48	1.48	1.44		
		Total	3.58	3.46	4.26	3.77	11.30	5.3
Penoxlin	3.0	1	1.96	2.22	2.56	2.25		
		2	1.26	1.28	1.55	1.36		
		Total	3.22	3.50	4.11	3.61	10.83	6.7
Fluchoralin	.75	1	2.27	2.07	2.53	2.29		
		2	1.37	1.35	1.29	1.34		
		Total	3.64	3.42	3.82	3.63	10.88	7.7
Fluchoralin	1.0	1	1.80	2.48	2.25	2.18		
		2	1.08	1.24	1.23	1.18		
		Total	2.88	3.72	3.48	3.36	10.08	7.0
Check (hand weeded)	0.0	1	2.01	2.60	3.04	2.55		
		2	1.17	1.42	1.43	1.34		
		Total	3.18	4.02	4.47	3.89	11.67	10.0
		$\bar{x}$				3.67		
		F[4]				1.25		
		S.E.$\bar{x}$				.18040		
		L.S.D. (.05)				N.S.		
		C.V. %				4.91		

1/ Weed Score Obtained: November 4, 1975
0 = No control; 10 = Complete control

2/ Safner added to Vernolate

3/ Post emergence

4/ Value for treatment comparison

5/ "safner" included in the formulation

TITLE: Chemical control of weeds in potatoes.

PROJECT: Weed Investigations MS 754

YEAR: 1976

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

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

OBJECTIVES:
1. To measure the effectiveness of several herbicides for the control of weeds in potatoes.
2. Determine the effects of herbicides on growth of the potato plant.
3. Determine the effect of herbicides on yield and grade of tubers.

SIGNIFICANT FINDINGS:

Penoxalin applied post plant pre emergence resulted in significant yield increase above the hand-weeded check and gave 80% to 90% weed control.

Metribuzin (.5 lb/a) applied post emergence when potatoes were four inches tall was equal in yield to metribuzin .5 lb/a applied post plant pre emergence. However, the post emergence application resulted in some reduction of No. 1 tubers.

Vernolate gave effective weed control at all rates with little or no effect on yield when compared to the hand-weeded check.

MATERIALS AND METHODS:

Seven herbicides were evaluated at different rates and in various combinations. Plots were 12 x 30 feet, replicated three times. Each plot consisted of four rows, one of the center rows was harvested for yield. Herbicides were applied in an aqueous solution. Herbicides were applied perplant incorporated, post plant pre emergence and post emergence. The preplant materials were incorporated with a tandem disk. The post plant incorporate materials were incorporated with a Lilliston rolling cultivator after the potatoes were hilled.

Weed species found in this study were: Canada thistle (Cirsium arvense (L.)); quackgrass (Agropyron repens (L.)); field pennycress (Thlaspi arvense (L.)); red root pigweed (Amaranthus retroflexus (L.)); lambsquarter (Chenopodium album (L.)); green foxtail (Setaria viridis (L.)); knotweed (Polygonum aviculare (L.)); chickweed (Stellaria media (L)); wild buckwheat (Polygonum convolvulus (L.)); mustard (Sisymbrium altissimum (L.)); perennial sowthistle (Sonchus arvensis L.).

RESULTS AND DISCUSSION:

Overall potato yields were lower than in 1975 by about 100 cwt. This can be due in part, to the reduction in 1976 of the growing season. Potatoes were first frosted on September 8, with subsequent frost later in the month, causing all growth of tubers to cease. In 1975 we harvested potatoes the third week in October, in 1976 they were harvested the first week in October.

Each herbicide will be discussed as relates to yield and weed control. All yield comparisons are made with the check, hand-weeded (H-W).

Vernolate - The 2.2 lbs/a rate resulted in a significant yield reduction when compared with the check (H-W), and gave only 70% weed control. The 3 lbs/a and 4 lbs/a rates were about equal to the check. Yield of No. 1 potatoes was re-

Results and Discussion (con't)

duced significantly, however the yield of seed size potatoes were significantly increased at 3 lbs/a. This could indicate a reduction in tuber size because of the herbicide. Weed control at 3 and 4 lbs/a was about 90% or better.

EPTC - This herbicide gave 70% weed control. Yields are considerably below the check, but were not measured as statistically significant at .05 level.

MV 687 - Weed control was scored at 80%. Considerable injury to plants was noted at emergence. Yield reductions were statistically significant when compared with the check.

R24315 - Weed control was poor with this product, rating only 40%. Crop injury at time of emergence was severe. Yields were reduced at both rates, however the 4 lbs/a rate caused very severe yield reductions, which were due to the poor stands.

Dinitramine - The method of application of this herbicide (PPI or post plant pre emergence) did not affect materially the weed control score or yield of tubers at the .50 and .66 lb/a rate. However, the 1 lb/a rate did result in a statistically significant yield reduction, most of which occurred in the seed size category when applied preplant and incorporated.

Penoxalin + EPTC - Excellent weed control, yield almost equal that of the check (H-W).

Penoxalin + metribuzin - Excellent weed control, however yields were reduced, but did not reach statistical significane when compared to the check. Part of the yield loss, I feel, is due to the reduction in tuber size which we have noted sometimes in the past when metribuzin is used at .5 lb/a.

Dinitramine + metribuzin - This was a good combination in 1976 as it has been in the past three to four years of evaluation. Weed control was rated at 90% to 100%. The higher rate of dinitramine, .5 lb/a PPI plus metribuzin .25 lb/a, post plant pre emergence, resulted in yields almost equal of the check. When these same combinations were used with the dinitramine .33 lb/a applied post plant incorporated and metribuzin .25 lb/a applied resulted in yields approaching the check (H-W). The higher rate of dinitramine, post plant pre emergence in combination with metribuzin caused some yield reduction, but was not measured as being statistically significant.

Metribuzin - We have noted some reduction in No. 1 potatoes with this rate of metribuzin over several years of testing. The overall yield at the .05 lb/a rate is equal to the check. Metribuzin applied post emergence in a split application caused yield reductions. The .50 + .50 lb/a rate caused statistically significant reduction in yield of No. 1 tubers. The post emergence rate at .50 lb/a applied when potatoes were four inches tall, caused a significant reduction of No. 1 tubers, but did not result in a reduction in overall yield. When this herbicide was applied at .5 lb/a three weeks after the four inch stage yields were reduced and the number of cull potatoes were increased.

Penoxalin - This product applied post plant pre emergence gave excellent weed control at all rates. Yields were excellent. The highest yield in the experiment, 333.15 cwt was obtained from the 1 lb/a rate.

See Tables 2 and 3 for complete details, crop injury, weed control scores and yields.

Table 1. Herbicides used in the experiments.

Common Name	Trade Name or Other	Chemical Name	Company
EPTC	Eptam	S-ethyl dipropylthiocarbamate	Stauffer
vernolate	Vernam	S-propyl dipropylthiocarbamate	Stauffer
metribuzin	Sencor	4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H)one	Chemagro
dinitramine	Cobex	N^4,N^4-diethyl-2,2,2-trifluoro-3,5-dinitrotoluene-2,4-diamine	U.S. Borax
penoxalin	Prowl	N-(1-ethylpropyl-3,4-dimethyl-2,6-dinitrobenzenamine	American Cyanamid
	MV687	chemistry not available	Stauffer
	R24315	chemistry not available	Stauffer

Table 2. Crop injury and weed control ratings of a herbicide study on potatoes. Northwestern Agricultural Research Center, Kalispell, MT in 1976. Field No. X-4.

Injury rating made - June 21, 1976
Weed control rating made - October 1, 1976

Treatment			Weed	Remarks
Herbicide	Rate lbs/A	Injury Remarks	Score 0-10[1]	Weeds present at time of evaluation[2]
Preplant Incorporate				
Vernolate 7E	2.2	Slow to emerge, appear slightly deformed	7	Setaria, perennial sow thistle, pigweed, lambsquarter, fanweed
Vernolate 7E	3.0	Slow to emerge, appear slightly deformed	9	fanweed, Setaria
Vernolate 7E	4.0	Slow to emerge, appear slightly deformed	9	pigweed, Setaria
EPTC 7E	4.0	No injury	7	fanweed, setaria, pigweed
MV687	3.0	Slow to emerge, leaves curled, yellowish tinge	8	fanweed, pigweed
MV687	6.0	Same as above except more severe	8	fanweed, pigweed
R24315(50W)	2.0	Slow to emerge	4	fanweed, Setaria, pigweed
R24315(50W)	4.0	Few have emerged	4	Setaria, pigwee, perennial sow thistle, fanweed, shephardspurse
Dinitramine	.50	Delayed emergence	9	Setaria, shephardspurse
Dinitramine	.66	Delayed emergence	9	Setaria, quackgrass
Dinitramine	1.0	Delayed emergence	9	fanweed, perennial sow thistle Setaria
Penoxalin + EPTC[3]	.75 3.0	No injury	9	fanweed, Setaria
Preplant Incorporate + Post plant Pre emergence				
Penoxalin[4] + metribuzin[5]	.75 .50	No injury	10	pigweed
Dinitramine[4] + metribuzin[5]	.33 .25	Delayed emergence	9	Setaria
Dinitramine[4] + metribuzin[5]	.50 .25	Delayed emergence	10	Setaria
Post plant Incorporate + Post plant Pre emergence				
Dinitramine[6] + metribuzin[5]	.33 .25	No injury	9	Setaria, pigweed, perennial sow thistle
Dinitramine[6] + metribuzin[5]	.50 .25	No injury	9	Setaria
Post plant Pre emergence				
Metribuzin	.50	No injury	9	Setaria, quackgrass
Penoxalin	.75	No injury	8	Setaria
Penoxalin	1.00	No injury	8	Setaria
Penoxalin	1.50	No injury	9	Setaria, fanweed, shephardspurse

Table 2. (con't)

Treatment			Weed	Remarks
Herbicide	Rate lbs/A	Injury Remarks	Score 0-10[1]	Weeds present at time of evaluation[2]
		Post plant Pre emergence Incorporate		
Dinitramine	.50	No injury	9	Setaria, fanweed
Dinitramine	.66	No injury	9	Setaria, fanweed
Dinitramine	1.00	No injury	9	Setaria
		Post emergence		
Metribuzin[7]	.25+.25	Not applicable	9	Setaria
Metribuzin[7]	.50+.50	Not applicable	10	
Metribuzin[8]	.5	Not applicable	9	Setaria
Metribuzin[9]	.5	Not applicable	9	Setaria
Check		No injury	0	
Check (H.W)		No injury	8	Setaria

1/ 0-10: 0 = no control; 10 = complete control
2/ Indicates weeds are present at time of evaluation, weed score is indicative of the population
3/ Tank mix
4/ Preplant incorporate
5/ Post plant pre emergence
6/ Post plant incorporated
7/ Split application: 1. at 4"; 2. stage of growth or 3 weeks
8/ Applied at 4" height of potatoes
9/ Three weeks after potatoes had reached 4" height

NOTE: Application data are found in Table 3.

Table 3. Summary of weed control, yield and grade data from various herbicides used on netted gem potatoes in 1976. Northwestern Agriculutral Research Center. Field No. X4

Date seeded: May 24, 25, 1976 Date harvested: October 5, 6,1976
Plot size: 90 sq. ft.

Treatment		Grade - Cwt/Acre					Weed Score 0-10[1]
Herbicide	Rate Lb/A	No. 1	No. 2	Seed	Culls	Total	
Preplant Incorporated[2]							
Vernolate 7E	2.2	91.15b	8.87	131.48	8.07	239.57b	7
Vernolate 7E	3.0	79.86b	12.10	195.21a	12.91	300.08	9
Vernolate 7E	4.0	122.61	12.91	154.88	6.45	296.86	9
EPTC 7E	4.0	118.58	2.42	148.43	8.07	277.50	7
MV687	3.0	72.60b	11.29	158.11	11.29	253.29b	8
MV687	6.0	87.93b	4.03	121.81	13.71	227.48b	8
R24315(50W)	2.0	109.71	13.71	95.19b	15.33	233.94b	4
R24315(50W)	4.0	36.30b	4.84	43.56b	25.81	110.51b	4
Dinitramine	.50	142.78	14.52	147.62	4,84	309.76	9
Dinitramine	.66	102.45	16.13	142.78	17.75	279.11	9
Dinitramine	1.00	139.55	3.23	100.03b	16.13	258.94b	9
Penoxalin + EPTC[3]	.75 3.00	138.75	8.07	139.55	10.49	296.86	9
Preplant Incorporate[2] + Post plant Pre emergence[4]							
Penoxalin[5] + metribuzin[6]	.75 .50	100.83	6.45	164.56	1.61	273.45	10
Dinitramine[5] + metribuzin[6]	.33 .25	121.81	6.45	141.97	11.29	281.52	9
Dinitramine[5] + metribuzin[6]	.50 .25	145.20	7.26	144.39	9.68	306.53	10
Post plant Incorporate[4] + Post plant Pre emergence[4]							
Dinitramine[7] + metribuzin[6]	.33 .25	124.23	16.13	158.11	4.03	302.50	9
Dinitramine[7] + metribuzin[6]	.50 .25	109.71	8.07	144.39	11.29	273.46	9
Post plant Pre emergence[4]							
Metribuzin	.50	117.77	7.26	162.95	15.33	303.31	9
Penoxalin	.75	109.71	8.07	174.24	16.13	308.15	8
Penoxalin	1.00	151.65	8.87	162.14	10.49	333.15	8
Penoxalin	1.50	99.22	16.13	164.56	8.87	288.78	9
Post plant Pre emergence Incorporate[4]							
Dinitramine	.50	96.80	12.10	179.08	8.87	296.85	9
Dinitramine	.66	92.77b	18.55	154.07	9.68	275.07	9
Dinitramine	1.00	147.62	8.87	130.68	8.07	295.24	9

Table 3. (con't)

Treatment Herbicide	Rate Lb/A	Grade - Cwt/Acre No. 1	No. 2	Seed	Culls	Total	Weed Score 0-10 1/
		Post emergence 4/					
Metribuzin 8/	.25+.25	121.00	3.23	133.91	11.29	269.43	9
Metribuzin 8/	.50+.50	91.15b	7.26	169.40	9.68	277.49	10
Metribuzin 9/	.50	91.96b	18.55	187.95	8.07	306.53	9
Metribuzin 10/	.50	100.83	12.10	146.81	17.75	277.49	9
Check (weedy)		116.16	8.07	175.85	9.68	309.76	0
Check (H.W.)		137.13	16.13	147.62	9.68	310.56	8
$\bar{x}$		110.6	10.1	147.4	11.08	279.1	8.2
F 11/		3.162*	.909	4.00*	1.00	5.91*	6.18*
S.E.$\bar{x}$		14.3	4.89	14.84	4.77	16.56	.837
L.S.D.		40.5	N.S.	41.98	N.S.	46.84	2.4
C.V. %		12.93	48.68	10.07	43.06	5.93	10.23

1/ 0-10: 0 = no control, 10 = complete control
2/ Application rate 15.3 gpa
3/ Tank mix
4/ Application rate 36.2 gpa
5/ Preplant incorporate
6/ Post plant pre emergence
7/ Post plant incorporated
8/ Split application: 1. 4"; 2. 3 weeks later
9/ Applied at 4" height of potatoes
10/ Applied three weeks after potatoes had reached 4"
11/ F value for treatment comparison

APPLICATION DATA:	1st	2nd	3rd
Date	5/21/76	6/28/76	7/19/76
Temperature	60°F	80°F	77°F
Humidity	28%	15%	49%
Wind velocity	calm	calm	calm
Cloud cover	clear	clear 1/	clear
Soil temperature	--	--	76°F
Soil type	silt loam	silt loam	silt loam

1/ Bright day, scattered clouds

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TITLE: Evaluation of Five Irrigated Pastures When Grazed by Yearling Steers

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

OBJECTIVES: Determine forage yields and utilization, carrying capacity and beef gain per acre of five irrigated pastures.

DURATION: Indefinite

PROCEDURES:

Five irrigated pasture treatments (Ladino clover-Chinook orchardgrass, Thor alfalfa - Potomac orchardgrass - Troy bluegrass, Melrose sainfoin - Empire birdsfoot trefoil - Manchar smooth bromegrass, Thor alfalfa - Regar bromegrass, and Thor alfalfa alone) were grazed in 1976. The clover-orchardgrass (CO) and sainfoin-trefoil-bromegrass (STB) pastures were established in the spring of 1973. The alfalfa-orchardgrass-bluegrass (AOB) and pure alfalfa (A) pastures were established in mid-August of 1974. The mixture of alfalfa and bromegrass (AB) was established in late July of 1975. STB and CO pastures were two acres in size and subdivided into four, one-half acre paddocks (sub-pastures). AOB and A pastures were also two acres in size, but were subdivided into five paddocks. The AB pasture was one and one-third acre in size and was subdivided into three paddocks. AB was originally two acres in size, but much of the pasture was drowned out due to standing water.

Each pasture was provided with 180 pounds of P_2O_5 at time of seeding. Nitrogen applications for pastures that contained grasses were as follows: STB - 100 lbs/a (fall 1975 = 60 lbs/a and summer 1976 = 40 lbs/a); CO - 100 lbs/a (fall 1975 = 60 lbs/a and summer 1976 = 40 lbs/a); AOB - 100 lbs/a (spring 1976 = 60 lbs/a and summer 1976 = 40 lbs/a); and AB - 68 lbs/a (summer 1976).

Immediately after grazing each pasture was clipped and dragged to provide uniform regrowth and disperse cattle droppings. All pastures were irrigated five times in 1976 with two inches being applied per irrigation.

Three samples of 3 x 10 feet were taken from each paddock before and after grazing for the first three rotations to determine forage yield and forage consumption. In at least one paddock per rotation the three samples were hand separated to determine species composition by weight. No forage data was obtained in the fourth rotation, which essentially was a fall grasing rotation.

Hereford yearling steers were used to graze the pastures in 1976. Each steer was implanted with 36 milligrams of Ralgro. The steers were received in early May and weighed prior to assignment to the pastures. Three steers that weighed approximately 500 pounds were assigned to each pasture treatment as "tester" steers. These steers remained on the study throughout the season. In addition, steers with similar initial weights were assigned at random to each pasture treatment. These "put and take" steers were added to or taken off the study as the forage demanded. At the end of each rotation the "tester" steers were shrunk over night (off feed and water for 16 hours) and weighed the following morning. No concentrates were fed to the steers throughout the grazing season. A mineral supplement (block form) was provided for the STB steers. Initally the A, AOB, AB and CO steers were provided Bloat Guard (block form) which contained the antibloat compound, poloxalene. However, later in the season AB and AOB steers were converted to the mineral block because bloat hazard was minimal due to the low percentage of alfalfa in the mixture. There were no signs of bloat in steers grazing the alfalfa and clover in 1976.

RESULTS AND DISCUSSION:

It is apparent that whenever alfalfa is included in a pasture mixture, the yield of the mixture is increased (Tables 1 and 2). However in 1976 the AB pasture had the second to the lowest yields. This was due to the low percentage of alfalfa in the mixture.

Even though the addition of a legume increases yield and quality of a pasture it is very difficult to keep the legume in the stand, especially sainfoin, when intensively grazing the pasture (Tables 3 and 4). When alfalfa was intensively grazed the percent of weeds in the pasture increased from 19 in 1975 to 50 in 1976.

The AB pasture was utilized the least of all the pastures (Table 5). Percent consumption is directly related to the number of paddocks per rotation. Since the AB pasture was reduced from five to three paddocks because of loss of stand due to standing water, percent consumption was lower.

Detailed performance data on each rotation for each pasture are presented in Tables 7 - 11. Generally, gain per acre and carrying capacity were greater in the first rotation and decreased in each succeeding rotation. No performance data was obtained in the third and fourth rotations for the AOB pasture (Table 11). The steers (including "testers") in this pasture contracted coccidiosis and as a result lost weight. Some of the steers developed secondary infections and this further reduced their weight gain. Coccidiosis is usually considered to be a feedlot problem where large numbers of animals are concentrated in a small area. It is interesting to note that the carrying capacity on this pasture was greater than the other pastures before and at the time the disease was contracted.

CO had the greatest beef gain per acre and carried the most steers per acre for the longest period of time (Table 12). AB produced the least amount of beef per acre and had the lowest average daily gains, due in part to the fact that there were only three paddocks in the pasture.

Performance data for each pasture since its initiation are presented in Tables 13-16. Total beef gaine per acre were the greatest year after seeding and decreased in each succeeding year for all pastures. In these tables gain per acre values for past years are not the same as those reported in past reports. In the past total gain was determined by adding total weight gain of "testers" and "put and take" steers. This author has changed to a more acceptable method for determining total gains. This method is as follows: Total gain per acre per rotation = average daily gain x number of steers per acre x number of days per rotation. Then total gain per acre for the entire season equals the addition of total gains for each rotation. This computational system reduces variability that one encounters when weighing the "put and take" animals.

Table 1. Forage yields of five irrigated pasture treatments in 1976.

	Tons per acre at 12 percent moisture			
	First Rotation	Second Rotation	Third Rotation	Total
Sainfoin-trefoil-bromegrass	1.41	0.82	0.73	2.96
Clover-orchardgrass	1.64	0.79	1.00	3.43
Alfalfa-grass	2.04	1.63	1.06	4.73
Alfalfa	2.18	1.43	1.13	4.74
Alfalfa-bromegrass	1.65	0.67	0.89	3.21

Table 2. Forage yields of irrigated pasture treatments from 1974-1976.

	Tons per acre at 12 percent moisture			
	First Rotation	Second Rotation	Third Rotation	Total
Sainfoin-trefoil-bromegrass				
1974	1.34	1.00	0.73	3.07
1975	1.28	1.27	0.70	3.25
1976	1.41	0.82	0.73	2.96
Clover-orchardgrass				
1974	1.04	1.23	1.21	3.48
1975	1.11	1.16	0.76	3.03
1976	1.64	0.79	1.00	3.43
Alfalfa-grass				
1975	1.73	1.71	1.08	4.52
1976	2.04	1.63	1.06	4.73
Alfalfa				
1975	1.62	1.26	1.37	4.25
1976	2.18	1.43	1.13	4.74

Table 3. Percent species composition by weight of five irrigated pasture treatments in 1976.

	First Rotation	Second Rotation	Third Rotation	Mean
Sainfoin-trefoil-bromegrass				
sainfoin	1	0	0	0.3
trefoil	2	1	4	2.3
bromegrass	78	82	74	78.0
weeds	19	17	22	19.3
Clover-orchardgrass				
clover	9	6	38	17.7
orchardgrass	83	88	54	75.0
weeds	8	6	8	7.3
Alfalfa-grass				
alfalfa	7	4	2	4.3
grass 1/	87	89	92	89.3
weeds	6	7	6	6.3
Alfalfa-bromegrass				
alfalfa	13	28	16	19.0
bromegrass	83	63	83	76.3
weeds	4	9	1	4.7
Alfalfa				
alfalfa	45	43	63	50.3
weeds	55	57	37	49.7

1/ Predominately orchardgrass and some bluegrass

Table 4. Percent species composition by weight of irrigated pasture treatments from 1974-1976.

	1974	1975	1976
Sainfoin-trefoil-bromegrass			
sainfoin	15	4	0
trefoil	11	5	2
bromegrass	70	86	78
weeds	4	5	19
Clover-orchardgrass			
clover	61	33	18
orchardgrass	37	63	75
weeds	2	4	7
Alfalfa-grass			
alfalfa	-	31	4
grass 1/	-	61	89
weeds	-	8	6
Alfalfa			
alfalfa	-	81	50
weeds	-	19	50

1/ Predominately orchardgrass and some bluegrass

Table 5. Percent consumption of five irrigated pasture treatments by yearling steers in 1976.

	First Rotation	Second Rotation	Third Rotation	Mean
Sainfoin-trefoil-bromegrass	81	68	86	78
Clover-orchardgrass	81	75	84	80
Alfalfa-grass	87	90	80	86
Alfalfa	81	68	79	76
Alfalfa-bromegrass	65	67	81	71

Table 6. Percent consumption by yearling steers of irrigated pasture treatments from 1974-1976.

	1974	1975	1976
Sainfoin-trefoil-bromegrass	79	77	78
Clover-orchardgrass	86	79	80
Alfalfa-grass	-	86	86
Alfalfa	-	81	76

Table 7. Performance of yearling steers by rotation when grazing a mixture of Melrose sainfoin, Manchar smooth bromegrass and Empire birdsfoot trefoil in 1976.

	First Rotation 5/18-6/28	Second Rotation 6/29-8/2	Third Rotation 8/3-9/20	Fourth Rotation 9/21-10/14	Total	Mean
No. of days/rotation	42	35	49	24	150	-
Gain/acre (lbs)	342.9	196.0	140.9	65.9	745.7	-
ADG - testers (lbs)	1.44	1.86	1.58	1.88	-	1.65[1/]
No. of steers/acre	5.67	3.01	1.82	1.46	-	3.12[1/]
No. of AUM's[2/]	5.3	2.4	2.0	.8	10.5	-
12% hay intake/steer/day (lbs)	9.6	10.6	14.1	-	-	10.7 [1/]
12% hay/lb of beef (lbs)	6.7	5.7	8.9	-	-	6.8 [1/]

1/ Weighted mean
2/ 1 AUM = 1½ steers

Table 8. Performance of yearling steers by rotation when grazing a mixture of Ladino clover and Chinook orchardgrass in 1976.

	First Rotation 5/18-6/27	Second Rotation 6/28-8/2	Third Rotation 8/3-9/20	Fourth Rotation 9/21-10/14	Total	Mean
No. of days/rotation	41	36	49	24	150	-
Gain/acre (lbs)	547.3	100.8	128.0	108.5	884.6	-
ADG - testers (lbs)	2.16	0.90	0.96	1.51	-	1.36[1/]
No. of steers/acre	6.18	3.11	2.72	2.99	-	3.80[1/]
No. of AUM's[2/]	5.7	2.5	3.0	1.6	12.8	-
12% hay intake/steer/day (lbs)	10.5	10.6	12.6	-	-	11.0 [1/]
12% hay/lb of beef (lbs)	4.9	11.8	13.1	-	-	7.1 [1/]

1/ Weighted mean
2/ 1 AUM = 1½ steers

Table 9. Performance of yearling steers by rotation when grazing Thor alfalfa in 1976.

	First Rotation 5/25-7/8	Second Rotation 7/9-8/21	Third Rotation 8/22-9/25	Fourth Rotation 9/26-10/6	Total	Mean
No. of days/rotation	45	44	35	11	135	-
Gain/acre (lbs)	440.5	169.1	149.2	28.7	787.5	-
ADG - testers (lbs)	2.19	1.33	1.44	0.88	-	1.61[1/]
No. of steers/acre	4.47	2.89	2.96	2.96	-	3.44[1/]
No. of AUM's[2/]	4.5	2.8	2.3	0.7	10.3	-
12% hay intake/steer/day (lbs)	17.6	15.3	17.3	-	-	16.7 [1/]
12% hay/lb of beef (lbs)	8.0	11.5	12.0	-	-	9.5 [1/]

1/ Weighted mean
2/ 1 AUM = 1½ steers

Table 10. Performance of yearling steers by rotation when grazing a mixture of Thor alfalfa and Regar bromegrass in 1976.

	First Rotation 5/19-6/23	Second Rotation 6/24-8/9	Third Rotation 8/10-9/17	Fourth Rotation 9/18-10/8	Total	Mean
No. of days/rotation	36	47	39	21	143	-
Gain/acre (lbs)	443.5	109.2	120.1	59.7	732.5	-
ADG - testers (lbs)	2.06	0.89	1.03	1.27	-	1.28 1/
No. of steers/acre	5.98	2.61	2.99	2.24	-	3.51 1/
No. of AUM's 2/	4.8	2.7	2.6	1.1	11.2	-
12% hay intake/steer/day (lbs)	10.0	7.3	12.4	-	-	10.0 1/
12% hay/lb of beef (lbs)	4.8	8.2	12.0	-	-	6.8 1/

1/ Weighted mean
2/ 1 AUM = 1½ steers

Table 11. Performance of yearling steers by rotation when grazing a mixture of Thor alfalfa, Potomac orchardgrass and Troy bluegrass in 1976.

	First Rotation 5/19-7/7	Second Rotation 7/8-8/19	Third Rotation 3/ -	Fourth Rotation 3/ -	Total	Mean
No. of days/rotation	50	43	-	-	93	-
Gain/acre (lbs)	536.9	244.8	-	-	781.7	-
ADG - testers (lbs)	1.71	1.24	-	-	-	1.50 1/
No. of steers/acre	6.28	4.59	-	-	-	5.50 1/
No. of AUM's 2/	7.0	4.4	-	-	11.4	-
12% hay intake/steer/day (lbs)	11.3	14.9	-	-	-	12.8 1/
12% hay/lb of beef (lbs)	6.6	12.0	-	-	-	8.4 1/

1/ Weighted mean
2/ 1 AUM = 1½ steers
3/ No performance data was obtained due to the occurrence of coccidiosis

Table 12. Performance of yearling steers when grazing five irrigated pasture treatments in 1976.

	Sainfoin trefoil brome-grass	Clover orchard-grass	Alfalfa	Alfalfa brome-grass	Alfalfa orchard-grass bluegrass 1/
Grazing season (days)	150	150	135	143	93
Gain/acre (lbs)	745.7	884.6	787.5	732.5	781.7
ADG - testers (lbs)	1.65	1.36	1.61	1.28	1.50
No. of steers/acre	3.12	3.80	3.44	3.51	5.50
No. of AUM's	10.5	12.8	10.3	11.2	11.4
12% hay intake/steer/day (lbs)	10.7	11.0	16.7	10.0	12.8
12% hay/lb of beef (lbs)	6.8	7.1	9.5	6.8	8.4

1/ Data obtained from first and second rotations only. See results and discussion for explanation.

Table 13. Performance of yearling steers when grazing a sainfoin-trefoil-bromegrass mixture from 1974 through 1976.

	1974	1975	1976	Mean
Grazing season (days)	136	135	150	140
Gain/acre (lbs)	847.5 1/	758.4 1/	745.7	783.9
ADG - testers (lbs) 2/	1.96	1.68	1.65	1.76
No. of steers/acre 2/	2.94	3.19	3.12	3.08
No. of AUM's	8.9	9.6	10.5	9.7
12% hay intake/steer/day (lbs) 2/	13.1	12.6	10.7	12.1
12% hay/lb of beef (lbs) 2/	5.9	7.0	6.8	6.6

1/ These values are different than those reported in 1974 and 1975 annual report. See results and discussion for explanation.
2/ Weighted means

Table 14. Performance of yearling steers when grazing a clover-orchardgrass mixture from 1974 through 1976.

	1974	1975	1976	Mean
Grazing season (days)	150	147	150	149
Gain/acre (lbs)	942.2 1/	897.3 1/	884.6	908.0
ADG - testers (lbs) 2/	1.97	1.74	1.36	1.69
No. of steers/acre 2/	3.17	3.27	3.80	3.41
No. of AUM's	10.6	10.7	12.8	11.4
12% hay intake/steer/day (lbs) 2/	14.2	11.2	11.0	12.1
12% hay/lb of beef (lbs) 2/	7.2	5.7	7.1	6.7

1/ These values are different than those reported in 1974 and 1975 annual report. See results and discussion for explanation.
2/ Weighted means

Table 15. Performance of yearling steers when grazing a pure stand of alfalfa in 1975 and 1976.

	1975	1976	Mean
Grazing season (days)	143	135	139
Gain/acre (lbs)	885.2 1/	787.5	836.4
ADG - testers (lbs) 2/	1.82	1.61	1.72
No. of steers/acre 2/	3.31	3.44	3.38
No. of AUM's	10.6	10.3	10.5
12% hay intake/steer/day (lbs) 2/	17.3	16.7	17.0
12% hay/lb of beef (lbs) 2/	9.3	9.5	9.4

1/ This value is different than the one reported in the 1975 annual report. See results and discussion for explanation.
2/ Weighted means

Table 16. Performance of yearling steers when grazing alfalfa-orchardgrass-bluegrass mixture in 1975 and 1976.

	1975	1976[3]	Mean
Grazing season (days)	148	93	121
Gain/acre (lbs)	974.4 [1]	781.7	878.1
ADG - testers (lbs)[2]	1.67	1.50	1.59
No. of steers/acre[2]	3.69	5.50	4.60
No. of AUM's	12.2	11.4	11.8
12% hay intake/steer/day (lbs)[2]	15.5	12.8	14.2
12% hay/lb of beef (lbs)[2]	8.7	8.4	8.6

1/ This value is different than the one reported in the 1975 annual report. See results and discussion for explanation.
2/ Weighted means
3/ Data based upon first and second rotations only. See results and discussion for explanation.

Table 17. Summary of yearling steer performance data when grazing five irrigated pasture treatments.

	Sainfoin trefoil brome-grass[1]	Clover orchard-grass[1]	Alfalfa[2]	Alfalfa brome-grass[3]	Alfalfa orchard-grass bluegrass[4]
Grazing season (days)	140	149	139	143	121
Gain/acre (lbs)	783.9	908.0	836.4	732.5	878.1
ADG - testers (lbs)	1.76	1.69	1.72	1.28	1.59
No. of steers/acre	3.08	3.41	3.38	3.51	4.60
No. of AUM's	9.7	11.4	10.5	11.2	11.8
12% hay intake/steer/day (lbs)	12.1	12.1	17.0	10.0	14.2
12% hay/lb of beef (lbs)	6.6	6.7	9.4	6.8	8.6

1/ Mean of data from 1974, 1975 and 1976.
2/ Mean of data from 1975 and 1976.
3/ Data from 1976 only.
4/ Mean of data from 1975 and 1976. 1976 data consisted of only two rotations due to the occurrence of coccidiosis.

TITLE: Effect of Seeding Rate on Emergence and Yield of Thor Alfalfa

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: Through 1977

OBJECTIVES: Determine relationship among seeding rates, seedling emergence, occupancy and forage yield.

PROCEDURES:

Thor alfalfa was planted at 13 seeding rates varying from 0.5 lb/a to 20 lbs/a (PLS) in a randomized complete block design with four replications on May 10, 1976. Each plot consisted of 4 rows, 20 feet in length, spaced 1 foot apart. One hundred and eighty pounds of P_2O_5 was applied prior to seeding. Data collected included forage yields, percent occupancy and stand counts. Occupancy counts were obtained in each row of each plot in every replication using an occupancy quadrant that was 36 inches in length divided into 20, 1.8 inch rectangles. A rectangle was occupied when one plant appeared within it. Stand counts were made in 6 feet of each row in each plot over all replications. The entire nursery was irrigated several times during germination and emergence.

RESULTS AND DISCUSSION:

Excluding the 14 lb/a seeding rate no significant yield increases were obtained when seeding at rates over the 7 lb/a recommended rate (Table 1). All seeding rates below 7 lbs/a produced significantly less forage than the 7 lbs/a rate.

In 1974 in a similar study with Thor alfalfa the 20 lbs/a rate produced substantially more forage than the 10 lbs/a rate. In 1976 this difference was not realized. The differing results, I believe, are due to the amount of moisture available during establishment. In 1974 the nurseries were established with only one irrigation, whereas in 1976 the entire nursery was kept damp during germination and emergence. In this optimum environment germination and emergence was exceptionally high, particularly at the lower seeding rates.

Table 1. Effect of seeding rate on emergence and yield of Thor alfalfa.

Seeding Rate (lbs/a)	Harvest	Tons per acre at 12% moisture — Replication I	II	III	IV	Total	Mean	Percent Occupancy [2]	# of Plants/ Sq. Ft. [3]	Percent Emergence [4]
0.05	First	1.19	1.23	1.28	1.08	4.78	1.20aa			
	Second	0.95	0.96	1.03	0.87	3.81	0.95aa			
	Total	2.14	2.19	2.31	1.95	8.59	2.15aa	47	3.8	145
1.0	First	1.39	1.40	1.13	1.42	5.34	1.34aa			
	Second	1.16	1.17	0.95	0.99	4.27	1.07a			
	Total	2.55	2.57	2.08	2.41	9.61	2.41aa	54	6.2	118
2.0	First	1.78	1.61	1.67	1.49	6.55	1.64aa			
	Second	1.25	1.33	1.21	1.03	4.82	1.21			
	Total	3.03	2.94	2.88	2.52	11.37	2.84aa	81	10.8	103
4.0	First	1.84	1.63	1.69	1.60	6.76	1.69aa			
	Second	1.31	1.22	1.10	1.11	4.74	1.19			
	Total	3.15	2.85	2.79	2.71	11.50	2.88aa	86	15.1	72
6.0	First	1.46	1.73	1.77	1.78	6.74	1.69aa			
	Second	1.07	1.26	1.10	1.27	4.70	1.18			
	Total	2.53	2.99	2.87	3.05	11.44	2.87aa	94	22.4	71
7.0 [1]	First	2.09	2.05	2.07	1.88	8.09	2.02			
	Second	1.29	1.14	1.28	1.32	5.03	1.26			
	Total	3.38	3.19	3.35	3.20	13.12	3.28	98	27.9	76
8.0	First	2.10	2.28	2.04	2.07	8.49	2.12			
	Second	1.28	1.40	1.43	1.27	5.38	1.35			
	Total	3.38	3.68	3.47	3.34	13.87	3.47	97	26.8	64
10.0	First	2.01	2.04	2.29	2.14	8.48	2.12			
	Second	1.20	1.42	1.12	1.32	5.06	1.27			
	Total	3.21	3.46	3.41	3.46	13.54	3.39	97	29.5	56
12.0	First	2.07	2.02	2.19	1.92	8.20	2.05			
	Second	1.16	1.10	1.29	1.27	4.82	1.21			
	Total	3.23	3.12	3.48	3.19	13.02	3.26	98	37.5	60
14.0	First	2.39	2.34	2.23	2.11	9.07	2.27b			
	Second	1.32	1.38	1.37	1.70	5.77	1.44b			
	Total	3.71	3.72	3.60	3.81	14.84	3.71bb	99	41.9	57
16.0	First	2.37	1.87	2.21	2.14	8.59	2.15			
	Second	1.32	1.29	1.24	1.32	5.17	1.29			
	Total	3.69	3.16	3.45	3.46	13.76	3.44	99	46.8	56
18.0	First	2.31	1.97	2.40	1.88	8.56	2.14			
	Second	1.30	1.33	1.35	1.17	5.15	1.29			
	Total	3.61	3.30	3.75	3.05	13.71	3.43	99	46.9	50
20.0	First	2.19	2.12	2.07	1.90	8.28	2.07			
	Second	1.25	1.21	1.19	1.26	4.91	1.23			
	Total	3.44	3.33	3.26	3.16	13.19	3.30	100	52.5	50

Table 1 .(con't)

	First Harvest	Second Harvest	Total
Harvest dates:	8-5	9-28	
Mean yields (T/A):	1.88	1.22	3.11
F-value for treatment yield comparison:	26.2 **	5.51 **	24.2 **
S.E.$\bar{x}$ (T/A):	0.067	0.052	0.092
S.E.$\bar{d}$ (T/A):	0.094	0.073	0.131
C.V. = 100s/$\bar{x}$ (%):	7.1	8.5	5.9
L.S.D. at 0.05 (T/A):	0.191	0.149	0.266
L.S.D. at 0.01 (T/A):	0.257	0.200	0.356

a/ Indicates a significantly lower yield than the check at 0.05 for that cutting or for the season total.

aa/ Indicates a significantly lower yield that the check at 0.01 for that cutting or for the season total.

b/ Indicates a significantly higher yield than the check at 0.05 for that cutting or for the season total.

bb/ Indicates a significantly higher yield than the check at 0.01 for that cutting or for the season total.

1/ Check treatment

2/ Mean of four plots

3/ Mean of six feet of row for all four rows per plot across four replications.

4/ Based upon 228,000 seeds per pound.

TITLE: Effect of cutting height and harvest frequency on forage yields of spring-planted Crest winter wheat.

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: Through 1977

OBJECTIVE: Determine proper cutting height and optimum harvest schedule to produce maximum forage yields of spring-planted winter wheat.

PROCEDURES:

Crest winter wheat was seeded on May 10, 1976 at a rate of 100 pounds per acre in a randomized complete block design. Plots consisted of four rows spaced one foot apart, 12 feet in length. Twenty square feet was harvested from each plot. The entire nursery was irrigated four times, with two inches being applied per irrigation. Sixty pounds of nitrogen and forty pounds of P_2O_5 per acre was broadcasted after emergence.

RESULTS AND DISCUSSION:

Crest forage yields were greatest the first cutting and declined in subsequent cuttings when harvested at one and two week intervals (Tables 1 and 2). Yields of the three and four week harvest interval treatments were greatest for the second harvest (Tables 3 and 4). Overall seasonal forage distribution was better the longer the regrowth period. Total season yields increased as regrowth intervals increased for both cutting heights (Table 5). Forage yields were slightly, but significantly, increased when cutting at a three inch height as compared to a five inch height.

Table 1. Effect of cutting height on forage yields of spring-planted Crest winter wheat when harvested at seven day intervals.

Cutting Height	Harvest Date	Tons per acre at 12 percent moisture Replications I	II	III	IV	Total	Mean
5 inches	7- 2	0.33	0.59	0.42	0.81	2.15	0.54
"	7- 9	0.11	0.18	0.12	0.24	0.65	0.16
"	7-17	0.26	0.31	0.27	0.34	1.18	0.30
"	7-23	0.11	0.14	0.10	0.14	0.49	0.12
"	8- 2	0.14	0.14	0.11	0.15	0.54	0.14
"	8-10	0.07	0.07	0.05	0.05	0.24	0.06
"	8-17	0.02	0.03	0.02	0.01	0.08	0.02
"	8-24	0.03	0.04	0.02	0.02	0.11	0.03
"	8-31	0.01	0.02	0.01	0.01	0.05	0.01
	Total	1.08	1.52	1.12	1.77	5.49	1.38
3 inches	7- 2	0.69	0.79	0.68	0.78	2.94	0.74
"	7- 9	0.08	0.16	0.08	0.11	0.43	0.11
"	7-17	0.33	0.37	0.32	0.35	1.37	0.34
"	7-23	0.11	0.13	0.04	0.11	0.39	0.10
"	8- 2	0.11	0.12	0.12	0.12	0.47	0.12
"	8-10	0.04	0.04	0.05	0.04	0.17	0.04
"	8-17	0.01	0.01	0.01	0.01	0.04	0.01
"	8-24	0.01	0.01	0.02	0.01	0.05	0.01
	Total	1.38	1.63	1.32	1.53	5.86	1.47

Table 2. Effect of cutting height on forage yields of spring-planted Crest winter wheat when harvested at fourteen day intervals.

Cutting Height	Harvest Date	Tons per acre at 12 percent moisture Replications I	II	III	IV	Total	Mean
5 inches	7- 2	0.56	0.54	0.60	0.41	2.11	0.53
"	7-17	0.50	0.53	0.55	0.49	2.07	0.52
"	8- 2	0.34	0.40	0.38	0.33	1.45	0.36
"	8-17	0.19	0.19	0.21	0.15	0.74	0.19
"	8-31	0.17	0.16	0.15	0.12	0.60	0.15
	Total	1.76	1.82	1.89	1.50	6.97	1.75
3 inches	7- 2	0.66	0.90	0.67	1.05	3.28	0.82
"	7-17	0.45	0.60	0.46	0.56	2.07	0.52
	8- 2	0.27	0.37	0.11	0.36	1.11	0.28
"	8-17	0.18	0.17	0.11	0.18	0.64	0.16
"	8-31	0.13	0.13	0.06	0.11	0.43	0.11
	Total	1.69	2.17	1.41	2.26	7.53	1.89

Table 3. Effect of cutting height on forage yields of spring-planted Crest winter wheat when harvested at twenty-one day intervals.

Cutting Height	Harvest Date	Tons per acre at 12 percent moisture					
		Replications					
		I	II	III	IV	Total	Mean
5 inches	7- 2	0.58	0.73	0.31	0.68	2.30	0.58
"	7-23	0.69	0.89	0.55	0.66	2.79	0.70
"	8-17	0.42	0.42	0.42	0.37	1.63	0.41
"	9- 8	0.30	0.41	0.31	0.15	1.17	0.29
	Total	1.99	2.45	1.59	1.86	7.89	1.98
3 inches	7- 2	0.66	0.72	0.68	0.72	2.78	0.70
"	7-23	0.68	0.71	0.55	0.66	2.60	0.65
"	8-17	0.45	0.50	0.42	0.40	1.77	0.44
"	9- 8	0.31	0.30	0.32	0.11	1.04	0.26
	Total	2.10	2.23	1.97	1.89	8.19	2.05

Table 4. Effect of cutting height on forage yields of spring-planted Crest winter wheat when harvested at twenty-eight day intervals.

Cutting Height	Harvest Date	Tons per acre at 12 percent moisture					
		Replications					
		I	II	III	IV	Total	Mean
5 inches	7- 2	0.42	0.65	0.56	0.73	2.36	0.59
"	8- 2	0.89	0.96	0.98	0.97	3.80	0.95
"	8-31	0.59	0.63	0.66	0.52	2.40	0.60
	Total	1.90	2.24	2.20	2.22	8.56	2.14
3 inches	7- 2	0.60	0.78	0.82	0.82	3.02	0.76
"	8- 2	0.85	0.97	0.97	1.01	3.80	0.95
"	8-31	0.58	0.63	0.57	0.48	2.26	0.57
	Total	2.03	2.38	2.36	2.31	9.08	2.28

Table 5. Effect of cutting height and harvest intervals on forage yields of spring-planted Crest winter wheat.

Cutting Height	Tons per acre at 12 percent moisture				
	Harvest Interval				
	7	14	21	28	Mean[1/]
5 inches	1.38	1.75	1.98	2.14	1.81a
3 inches	1.47	1.89	2.05	2.28	1.92b
Mean[2/]	1.43a	1.82b	2.02c	2.21d	

1/ Cutting height means followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

2/ Harvest interval means 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

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: 1973-1976 - Completed

OBJECTIVE: Evaluate four commercial alfalfa varieties for forage production in northwestern Montana.

PROCEDURES:

Four commercial varieties were seeded with two check varieties in Field Y-1 on May 11, 1973 utilizing a randomized complete block design with four replications. Plots were 4 by 20 feet and consisted of four rows spaced one foot apart. Thirty square feet was harvested from each plot. All varieties were harvested on a common date for all cuttings. Four hundred pounds of 0-45-0 was applied in the spring of 1973. In 1976 the nursery was irrigated three times with two inches being applied per irrigation.

RESULTS:

In 1976 A-73-7 and A-73-5 yielded more hay than the check variety, Haymore (Table 1). A-73-6, A-73-7 and A-73-5 produced essentially the same amount of hay as Haymore over a four year period (Table 2). A-73-4 produced less forage than Haymor over the four year period.

After four years of production stand persistence was better for Ladak-65, A-73-5 and A-73-7 than it was for A-73-4, Haymor and A-73-6. Weed invasions of all varieties was considerable by the summer of 1976.

Table 1. Yields obtained from an irrigated alfalfa nursery at Kalispell in 1976.

Variety	Harvest	Tons per acre at 12 percent moisture				
		Replications				
		I	II	III	IV	Mean
A-73-4	First	1.00	1.13	1.22	1.44	1.20
	Second	0.88	0.91	0.77	1.13	0.92
	Total	1.88	2.04	1.99	2.57	2.12
Haymor	First	1.02	1.54	1.55	1.45	1.39
	Second	0.94	1.21	1.10	1.05	1.08
	Total	1.96	2.75	2.65	2.50	2.47
A-73-6	First	0.81	1.48	1.72	1.21	1.31
	Second	0.80	1.08	1.19	0.94	1.00
	Total	1.61	2.56	2.91	2.15	2.31
A-73-7	First	1.36	1.89	1.61	1.70	1.64
	Second	1.24	1.26	1.05	1.05	1.15
	Total	2.60	3.15	2.66	2.75	2.79
A-73-5 (Gladiator)	First	1.39	1.75	1.54	1.60	1.57
	Second	1.13	1.27	1.16	1.09	1.16
	Total	2.52	3.02	2.70	2.69	2.73
Ladak-65	First	1.49	1.58	1.67	1.45	1.55
	Second	1.07	1.14	1.13	1.13	1.12
	Total	2.56	2.72	2.80	2.58	2.67

	First Harvest	Second Harvest	Total
Harvest dates	6-30	8-10	
Mean yields (T/A)	1.44	1.07	2.51
F-value for variety yield comparison	4.35*	2.64NS	4.08*
S.E.$\bar{x}$ (T/A)	0.082	0.057	0.130
S.E.$\bar{d}$ (T/A)	0.117	0.081	0.184
C.V. $\frac{100s}{\bar{x}}$ (%)	11.4	10.7	10.4
L.S.D. at 0.05 (T/A)	0.249	0.173	0.393
L.S.D. at 0.01 (T/A)	0.344	0.239	0.543

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

Table 2. Summary of irrigated alfalfa yield data from 1973-1976.

Variety	Tons per acre at 12 percent moisture				Mean
	1973	1974	1975	1976	
A-73-4	3.50	5.88	5.14	2.12	4.16
Haymor	3.74	6.33	5.28	2.47	4.46
A-73-6	3.83	6.16	5.09	2.31	4.35
A-73-7	3.85	5.78	4.97	2.79	4.35
A-73-5 (Gladiator)	3.62	6.39	5.20	2.73	4.49
Ladak-65	3.59	5.19	4.36	2.67	3.95
Mean yields (T/A)	3.69	5.95	5.00	2.51	
F-value for variety yield comparison	0.77NS	3.44*	5.11**	4.08*	
S.E.$\bar{x}$ (T/A)	0.161	0.239	0.147	0.130	
S,E.$\bar{d}$ (T/A)	0.228	0.339	0.208	0.184	
C.V. = $\frac{100s}{\bar{x}}$ (%)	8.8	8.0	5.9	10.4	
L.S.D. at 0.05 (T/A)	0.486	0.721	0.443	0.393	
L.S.D. at 0.01 (T/A)	0.672	0.998	0.613	0.543	

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

TITLE: Irrigated Commercial Sainfoin Yield Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Ray Ditterline

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: 1973-1976 - Completed

OBJECTIVE: Evaluate two commercial sainfoin varieties for forage production in northwestern Montana.

PROCEDURES:

Five sainfoin varieties were planted on May 11, 1973 in Field Y-1, utilizing a randomized complete block design with four replications. Plot size was 4 x 20 feet with one foot between rows and two feet between plots. Four hundred pounds of 0-45-0 was applied in the spring of 1973. In 1976 thirty square feet was harvested from each plot. During the 1976 growing season the entire nursery was irrigated three times with two inches being applied per irrigation.

RESULTS:

Second harvest yields in 1976 consisted mostly of dandelions. As indicated by the yields, stands were very poor (Table 1). All varieties had similar stand depletions at the end of four years. Remont, the check variety, produced more forage than the other varieties over the four year period (Table 2).

Table 1. Yields obtained from an irrigated sainfoin nursery at Kalispell in 1976.

Variety	Harvest	Tons per acre at 12 percent moisture				
		Replications				Mean
		I	II	III	IV	
Remont	First	1.23	1.69	1.51	1.13	1.39
	Second	0.53	0.78	0.60	0.57	0.62
	Total	1.76	2.47	2.11	1.70	2.01
S-73-2	First	1.11	1.40	1.28	1.21	1.25
	Second	0.64	0.66	0.50	0.60	0.60
	Total	1.75	2.06	1.78	1.81	1.85
S-73-3	First	1.27	1.10	1.30	1.28	1.24
	Second	0.45	0.62	0.68	0.74	0.62
	Total	1.72	1.72	1.98	2.02	1.86
Eski	First	1.29	1.65	1.29	1.65	1.47
	Second	0.67	0.57	0.54	0.55	0.58
	Total	1.96	2.22	1.83	2.20	2.05
Melrose	First	1.49	1.55	1.63	1.84	1.63
	Second	0.52	0.54	0.49	0.76	0.58
	Total	2.01	2.09	2.12	2.60	2.21

	First Harvest	Second Harvest	Total
Harvest dates	6-30	8-10	
Mean yields (T/A)	1.40	0.60	2.00
F-value for variety yield comparison	3.51*	0.16NS	1.67NS
S.E.$\bar{x}$ (T/A)	0.087	0.051	0.114
S.E.$\bar{d}$ (T/A)	0.123	0.072	0.161
C.V. = $\frac{100s}{\bar{x}}$ (%)	12.4	17.0	11.4
L.S.D. at 0.05 (T/A)	0.268	0.157	0.351
L.S.D. at 0.01 (T/A)	0.375	0.220	0.492

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

Table 2. Summary of yield data from an irrigated sainfoin nursery grown at Kalispell, MT from 1973-1976.

Variety	Tons per acre at 12 percent moisture				
	1973	1974	1975	1976	Mean
Remont	2.38	4.78	4.59	2.01	3.44
S-73-2	2.23	4.47	4.34	1.85	3.22
S-73-3	2.23	4.81	4.59	1.86	3.37
Eski	2.99	4.19	3.61	2.05	3.21
Melrose	3.00	4.10	3.67	2.21	3.25
Mean yields (T/A)	2.57	4.47	4.15	2.00	
F-value for variety yield comparison	12.47**	2.22NS	14.50**	1.67NS	
S.E.$\bar{x}$ (T/A)	0.112	0.220	0.127	0.114	
S.E.$\bar{d}$ (T/A)	0.159	0.311	0.179	0.161	
C.V. = $\frac{100s}{\bar{x}}$ (%)	8.8	9.8	6.1	11.4	
L.S.D. at 0.05 (T/A)	0.346	0.679	0.391	0.351	
L.S.D. at 0.01 (T/A)	0.486	0.951	0.548	0.492	

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

TITLE: Irrigated Trefoil Yield Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Ray Ditterline

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: 1973-1976 - Completed

OBJECTIVE: Evaluate several trefoil varieties for forage production in northwestern Montana.

PROCEDURES:

Five trefoil varieties were planted with the check variety, Empire, on May 11, 1973 in Field Y-1 utilizing a randomized complete block design with four replications. Plot size was 4 x 20 feet with one foot between rows and two feet between plots. Thirty square feet was harvested from each plot. Four hundred pounds of 0-45-0 was applied in the spring of 1973. The nursery was irrigated two times in 1973 with two inches being applied per irrigation.

RESULTS:

P-15456, Leo and Empire were the highest yielding varieties in 1976 (Table 1). There didn't seem to be any difference among varieties for stand persistance. Over a four year period Leo and P-15456 produced more hay than the check variety, Empire (Table 2).

Table 1. Yields obtained from an irrigated trefoil nursery at Kalispell in 1976.

Variety	Harvest	Tons per acre at 12 percent moisture				
		Replications				Mean
		I	II	III	IV	
P-15456	First	1.71	1.92	1.96	2.42	2.00
	Second	0.87	0.92	0.83	1.06	0.92
	Total	2.58	2.84	2.79	3.48	2.92
Leo	First	1.91	2.03	1.96	2.04	1.99
	Second	0.97	0.99	1.05	1.08	1.02
	Total	2.88	3.02	3.01	3.12	3.01
Mansfield	First	1.75	1.74	1.74	1.49	1.68
	Second	0.79	0.96	1.01	0.91	0.92
	Total	2.54	2.70	2.75	2.40	2.60
Empire	First	1.97	1.99	2.30	2.06	2.08
	Second	0.83	0.83	0.90	1.06	0.91
	Total	2.80	2.82	3.20	3.12	2.99
Granger	First	1.48	1.40	1.46	1.29	1.41
	Second	0.73	0.83	1.01	0.84	0.85
	Total	2.21	2.23	2.47	2.13	2.26
Tana	First	1.57	1.56	1.61	1.78	1.63
	Second	0.80	0.85	0.83	0.92	0.85
	Total	2.37	2.41	2.44	2.70	2.48

	First Harvest	Second Harvest	Total
Harvest dates	6-30	8-10	
Mean yields (T/A)	1.80	0.91	2.71
F-value for variety yield comparison	10.6**	3.04*	10.1**
S.E.$\bar{x}$ (T/A)	0.081	0.036	0.097
S.E.$\bar{d}$ (T/A)	0.115	0.051	0.138
C.V. $\frac{100s}{\bar{x}}$ (%)	9.0	7.9	7.2
L.S.D. at 0.05 (T/A)	0.245	0.109	0.294
L.S.D. at 0.01 (T/A)	0.338	0.150	0.406

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

Table 2. Summary of yield data of an irrigated trefoil nursery grown at Kalispell from 1973-1976.

Variety	Tons per acre at 12 percent moisture				
	1973	1974	1975	1976	Mean
P-15456	2.65	3.99	3.25	2.92	3.20
Leo	2.49	4.29	3.62	3.01	3.35
Empire	2.30	3.92	3.15	2.60	2.99
Mansfield	2.62	2.97	3.48	2.99	3.02
Granger	2.70	3.36	3.32	2.26	2.91
Tana	2.20	3.46	3.08	2.48	2.81
Mean yields (T/A)	2.50	3.66	3.31	2.71	
F-value for variety yield comparison	4.82**	14.23**	13.60**	10.1**	
S.E.$\bar{x}$ (T/A)	0.093	0.129	0.056	0.097	
S.E.$\bar{d}$ (T/A)	0.131	0.182	0.078	0.138	
C.V. = $\frac{100s}{\bar{x}}$ (%)	7.4	7.0	3.3	7.2	
L.S.D. at 0.05 (T/A)	0.279	0.388	0.166	0.294	
L.S.D. at 0.01 (T/A)	0.386	0.537	0.230	0.406	

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

TITLE: Irrigated Commercial Alfalfa Yield Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project leader - Leon E. Welty
Cooperator - Ray Ditterline

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: Through 1979

OBJECTIVE: Evaluate new alfalfa varieties 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 4 rows, 20 feet in length, spaced one foot apart. Thirty-two square feet was harvested from each plot on a common harvest date for both cuttings. One hundred and eighty pounds per acre of P_2O_5 was broadcasted prior to seeding. The nursery was kept damp till seedlings emerged resulting in excellent stands.

RESULTS:

No variety produced significantly more forage per acre than the check variety, Thor, for either cutting or for the season total. Washoe produced substantially less forage per acre than any of the varieties.

Table 1. Yields obtained from an irrigated commercial alfalfa nursery at Kalispell, MT in 1976.

Variety	Harvest	Tone per acre at 12 percent moisture				
		Replications				
		I	II	III	IV	Mean
Sng XX	First	1.78	1.57	1.60	1.74	1.67
	Second	1.25	1.05	1.16	1.09	1.14
	Total	3.03	2.62	2.76	2.83	2.81
Washoe	First	1.31	1.17	1.17	1.19	1.21
	Second	0.85	0.70	0.69	0.70	0.74
	Total	2.16	1.87	1.86	1.89	1.95
Ladak-65	First	1.69	1.66	1.71	1.77	1.71
	Second	0.72	0.80	0.75	0.81	0.77
	Total	2.41	2.46	2.46	2.58	2.48
Thor	First	1.79	1.86	1.92	1.97	1.89
	Second	1.16	1.14	1.19	1.28	1.19
	Total	2.95	3.00	3.11	3.25	3.08
Apollo	First	1.70	1.75	1.83	1.80	1.77
	Second	1.20	0.97	1.17	1.13	1.12
	Total	2.90	2.72	3.00	2.93	2.89
Victor	First	1.97	1.76	1.89	2.36	2.00
	Second	1.15	1.14	1.12	1.31	1.18
	Total	3.12	2.90	3.01	3.67	3.18
Olympia	First	1.97	2.10	1.83	1.96	1.97
	Second	1.14	1.27	1.21	1.05	1.17
	Total	3.11	3.37	3.04	3.01	3.14
MS-4	First	1.79	1.92	1.85	1.75	1.83
	Second	1.14	1.18	1.13	1.18	1.16
	Total	2.93	3.10	2.98	2.93	2.99

	First Harvest	Second Harvest	Total
Harvest dates	8-5	9-27	
Mean yields (T/A)	1.75	1.06	2.81
F-value for variety yield comparison	18.1**	22.9**	23.0**
S.E.$\bar{x}$ (T/A)	0.058	0.040	0.087
S.E.$\bar{d}$ (T/A)	0.082	0.057	0.122
C.V. - $\frac{100S}{\bar{x}}$ (%)	6.7	7.5	6.2
L.S.D. at 0.05 (T/A)	0.171	0.118	0.254
L.S.D. at 0.01 (T/A)	0.233	0.160	0.345

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

TITLE: Effect of Seeding Rate on Forage Yields of Regar Bromegrass

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Scott Laudert

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: Through 1977

OBJECTIVES: Determine the optimum seeding rate of Regar bromegrass needed to produce maximum stands and yields.

PROCEDURES:

Regar bromegrass was seeded at rates of 4, 8, 12, 16, 20 and 24 pounds per acre on May 10, 1976. The nursery was seeded in Field Y-4 utilizing a randomized complete block design with four replications. Plots consisted of four rows spaced one foot apart and were twenty feet in length. Harvest area was 32 square feet. The nursery was irrigated twice after emergence with two inches being applied per irrigation.

RESULTS:

The nursery was kept damp during establishment resulting in excellent germination and emergence (Table 1). The optimum seeding rate for maximum seeding year yields was the 16 lbs/a rate. Increasing the seeding rate further did not increase forage yields. Regar produced significantly more forage per acre than either Chinook orchardgrass or Troy bluegrass.

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

Treatment	Harvest	Tons per acre at 12 percent moisture: Replications I	II	III	IV	Mean	Percent Occupancy 1/	No. of Plants per Square Foot 2/
Regar 4 lbs/a	First	1.49	1.29	0.81	0.80	1.10	54	6.7
	Second	1.47	1.24	1.64	1.90	1.56		
	Total	2.96	2.53	2.45	2.70	2.66		
Regar 8 lbs/a	First	1.39	1.43	1.42	1.26	1.38	80	11.4
	Second	1.36	2.00	1.56	1.62	1.64		
	Total	2.75	3.43	2.98	2.88	3.02		
Regar 12 lbs/a	First	1.81	1.63	1.68	1.50	1.66	82	17.5
	Second	1.63	1.73	1.90	1.50	1.69		
	Total	3.44	3.36	3.58	3.00	3.35		
Regar 16 lbs/a	First	2.05	1.91	1.80	1.86	1.91	90	22.2
	Second	1.69	1.82	1.60	1.73	1.71		
	Total	3.74	3.73	3.40	3.59	3.62		
Regar 20 lbs/a	First	1.94	1.95	1.80	1.77	1.87	94	23.9
	Second	1.49	1.93	1.44	1.88	1.69		
	Total	3.43	3.88	3.24	3.65	3.56		
Regar 24 lbs/a	First	1.77	2.29	1.83	1.93	1.96	95	28.0
	Second	1.38	1.76	1.43	1.92	1.62		
	Total	3.15	4.05	3.26	3.85	3.58		
Chinook orchardgrass	First	1.80	1.78	1.32	1.10	1.50	97	28.2
	Second	1.60	1.69	1.14	1.29	1.43		
	Total	3.40	3.47	2.46	2.39	2.93		
Troy bluegrass	First	0.53	0.49	0.57	0.31	0.48	99	75.2
	Second	1.42	1.48	1.33	1.07	1.33		
	Total	1.95	1.97	1.90	1.38	1.81		

1/ Mean for four replications - Total of four rows/plot
2/ Mean of four rows/plot 6' long - four replications

	First Harvest	Second Harvest	Total
Harvest dates	8-6	9-26	
Mean yields (T/A)	1.48	1.58	3.06
F-value for treatment yield comparison	36.69**	1.55 NS	16.44**
S.E.$\bar{x}$ (T/A)	0.082	0.111	0.152
S.E.$\bar{d}$ (T/A)	0.117	0.157	0.215
C.V. = $\frac{100s}{\bar{x}}$ (%)	11.2	14.0	9.9
L.S.D. at 0.05 (T/A)	0.243	0.327	0.447
L.S.D. at 0.01 (T/A)	0.331	0.445	0.609

TITLE: Simulated Pasture Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Scott Cooper

LOCATION: Northwestern Agricultural Research Center, Kalispell MT

DURATION: Through 1978

OBJECTIVES: Compare yield and regrowth habits of Regar bromegrass to Manchar smooth bromegrass in pure stands, and in mixtures with four perennial legume species.

PROCEDURES:

The nursery was planted in Field Y-10 on May 2, 1974 utilizing a randomized complete block design with four replications. Regar and Manchar were seeded at 9 pounds per acre in a pure stand and at 4.5 pounds per acre in mixtures. Seeding rates for Thor alfalfa, Ladino clover, Cicer milkvetch and Empire birdsfoot trefoil when seeded with the grasses were 4, 2, 10 and 3.4 pounds per acre respectively. The legume plots were seeded first in one foot rows and the grasses were then seeded between the legume rows. Excellent stands of Manchar were obtained, however stands of Regar were consistently spotty. Plots were 4 feet wide, and 20 feet in length. Thirty-two square feet was harvested from each plot four times in 1976. Thirty-two pounds of P_2O_5 and forty pounds of nitrogen per acre was applied in 1976. The entire nursery was irrigated four times in 1976 with two inches being applied per irrigation. The first replication was eliminated from the analyses because the legumes were hoed out in several of the plots.

RESULTS:

The mean yield in 1976 was 9 percent greater than in 1975. Over the two year period plots that contained Regar produced substantially more forage per acre than those containing Manchar. Pure stands of Regar yielded 1.42 tons per acre more than Manchar over the two year period. The highest yielding plots in the nursery over the two year period were those that contained Ladino clover. Stands of Thor alfalfa decreased considerably in 1976.

Table 1. Yields of two bromegrass species when grown in mixtures with four legume varieties at Kalispell, MT in 1976.

Mixture	Harvest	Tons per acre at 12 percent moisture			
		Replications			
		I	II	III	Mean
Cicer-Manchar	First	2.23	2.08	1.63	1.98
	Second	1.44	1.53	1.25	1.41
	Third	0.27	0.27	0.30	0.28
	Fourth	1.06	1.27	1.01	1.11
	Total	5.00	5.15	4.19	4.78
Cicer-Regar	First	2.26	2.44	2.03	2.24
	Second	1.81	1.60	1.61	1.67
	Third	0.47	0.43	0.35	0.42
	Fourth	1.44	1.23	1.19	1.29
	Total	5.98	5.70	5.18	5.62
Trefoil-Manchar	First	1.73	2.00	2.00	1.91
	Second	1.39	1.64	1.47	1.50
	Third	0.24	0.33	0.38	0.32
	Fourth	0.86	0.86	1.02	0.91
	Total	4.22	4.83	4.87	4.64
Trefoil-Regar	First	2.24	2.44	2.23	2.30
	Second	1.83	1.65	1.25	1.58
	Third	0.44	0.51	0.48	0.48
	Fourth	1.09	1.32	1.11	1.17
	Total	5.60	5.92	5.07	5.53
Ladino-Manchar	First	1.90	1.58	1.53	1.67
	Second	1.85	1.71	1.54	1.70
	Third	0.51	0.57	0.45	0.51
	Fourth	1.38	1.30	1.27	1.32
	Total	5.64	5.16	4.79	5.20
Ladino-Regar	First	2.30	2.15	1.66	2.04
	Second	2.17	1.77	1.99	1.98
	Third	0.73	0.58	0.67	0.66
	Fourth	1.61	1.58	1.39	1.53
	Total	6.81	6.08	5.71	6.21
Thor-Manchar	First	1.80	1.61	1.81	1.74
	Second	1.57	1.37	1.21	1.38
	Third	0.38	0.35	0.38	0.37
	Fourth	1.06	1.11	0.77	0.98
	Total	4.81	4.44	4.17	4.47
Thor-Regar	First	1.95	2.14	2.26	2.12
	Second	1.33	1.62	1.33	1.43
	Third	0.47	0.56	0.55	0.53
	Fourth	0.94	1.15	0.94	1.01
	Total	4.69	5.47	5.08	5.09

Table 1. (con't)

Mixture	Harvest	Tons per acre at 12 percent moisture			
		Replications			
		I	II	III	Mean
Manchar	First	2.06	1.94	1.64	1.88
	Second	1.57	1.37	1.34	1.43
	Third	0.31	0.24	0.33	0.29
	Fourth	1.05	0.92	1.09	1.02
	Total	4.99	4.47	4.40	4.62
Regar	First	1.93	2.40	2.42	2.25
	Second	1.51	1.76	1.18	1.48
	Third	0.37	0.45	0.40	0.41
	Fourth	1.23	1.39	1.03	1.22
	Total	5.04	6.00	5.03	5.36

	First Harvest	Second Harvest	Third Harvest	Fourth Harvest	Total
Harvest dates	6-7	7-19	8-13	10-1	
Mean yields (T/A)	2.01	1.56	0.43	1.16	5.15
F-value for treatment yield comparison	3.02*	4.27**	14.83**	7.68**	6.47**
S.E.$\bar{x}$ (T/A)	0.125	0.089	0.032	0.068	0.214
S.E.$\bar{d}$ (T/A)	0.177	0.126	0.045	0.095	0.302
C.V. = $\frac{100s}{\bar{x}}$ (%)	10.8	9.9	12.6	10.1	7.2
L.S.D. at 0.05 (T/A)	0.372	0.265	0.095	0.200	0.635
L.S.D. at 0.01 (T/A)	0.509	0.363	0.130	0.273	0.869

Table 2. Yields of two bromegrass species when grown in mixtures with four legume varieties in 1975 and 1976.

Mixtures	Tons per acre at 12 percent moisture		
	1975	1976	Mean
Cicer-Manchar	4.26	4.78	4.52
Cicer-Regar	4.77	5.62	5.20
Trefoil-Manchar	4.76	4.64	4.70
Trefoil-Regar	4.85	5.53	5.19
Ladino-Manchar	5.30	5.20	5.25
Ladino-Regar	5.06	6.21	5.64
Thor-Manchar	4.54	4.47	4.51
Thor-Regar	5.45	5.09	5.27
Manchar	3.87	4.62	4.25
Regar	4.55	5.36	4.96
Mean yields (T/A)	4.74	5.15	
F-value for treatment yield comparison	6.69**	6.47**	
S.E.$\bar{x}$ (T/A)	0.182	0.214	
S.E.$\bar{d}$ (T/A)	0.257	0.302	
C.V. = $\frac{100s}{\bar{x}}$ (%)	6.6	7.2	
L.S.D. at 0.05 (T/A)	0.540	0.635	
L.S.D. at 0.01 (T/A)	0.740	0.869	

NOTES:

Cicer milkvetch absent from most plots

Alfalfa stands considerably less than 1975

Trefoil stands somewhat less than 1975

Ladino stands very good in Ladino plots

Ladino invading other plots

TITLE: Effect of row spacing on the seed production of two orchardgrass varieties.

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Loren Wiesner

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: 1973-1976 - Completed

OBJECTIVE: Determine the correct row spacing needed to produce maximum seed production of two orchardgrass varieties.

PROCEDURES:

Pennlate and Potomac orchardgrass were seeded in 6, 12, 24 and 36 inch rows in the northeast corner of Field Y-10 on May 17, 1972. A randomized complete block design with four replications was utilized. Plot size for all row spacings was 9 by 20 feet. Seventy pounds of nitrogen was applied in the spring of 1976.

RESULTS:

Seed yields were greatest at the 24 inch row spacing for both varieties in 1976 (Table 1). Mean yields of Pennlate were about triple those of Potomac.

Seed yields were greatest year after seeding and declined drastically in subsequent years for both varieties (Table 2). Over the three year period Pennlate yielded approximately double that of Potomac. Highest seed yields for both varieties was obtained at the 24 inch row spacing for the three year period. Seed yields were higher at the wider row spacings after the first harvest year indicating a year x row spacing interaction.

Table 1. Effect of row spacing and variety on orchardgrass seed production (pounds per acre) at Kalispell in 1976.

Variety	Replications	Row Spacing (inches) 6	12	24	36	Mean
Pennlate	I	189.3	160.7	288.7	190.6	
	II	126.1	56.3	170.0	119.0	
	III	79.8	163.2	159.9	128.4	
	IV	155.9	173.1	193.0	218.7	
	Mean	137.8	138.3	202.9	164.2	160.8
Potomac	I	25.7	10.6	110.0	183.9	
	II	12.0	27.8	70.3	55.1	
	III	28.1	11.7	30.1	56.4	
	IV	10.7	31.8	89.9	96.4	
	Mean	19.1	20.5	75.6	98.0	53.3

Table 2. Effect of row spacing and variety on orchardgrass seed production (pounds per acre) at Kalispell in 1973, 1975 and 1976.

Variety and Year		Row Spacing (inches) 6	12	24	36	Mean
Pennlate						
	1973	578.1	756.8	706.4	562.1	650.9
	1975	312.2	306.8	623.2	658.1	475.1
	1976	137.8	138.3	202.9	164.2	160.8
	Mean	342.7	400.6	510.8	461.5	428.9
Potomac						
	1973	419.8	508.5	361.6	275.9	391.5
	1975	170.6	201.8	451.7	440.2	316.1
	1976	19.1	20.5	75.6	98.0	53.3
	Mean	203.2	243.6	296.3	271.4	253.6
Grand Mean		273.0	322.1	403.6	366.5	341.3

TITLE: Irrigated Small Grain Forage Trial

PROJECT: Forage Investigations MS 755

PERSONNEL: Project Leader - Leon E. Welty
Cooperator - Scott Laudert

LOCATION: Northwestern Agricultural Research Center, Kalispell, MT

DURATION: Indefinite

OBJECTIVES: Evaluate the forage yield and quality of various species and varieties of small grains grown in northwestern Montana.

PROCEDURES:

Four varieties of barley, two of wheat and two of oats were planted on May 10, 1976 utilizing a randomized complete block design with four replications. Seeding rates for all varieties of barley and oats were 100 pounds per acre. The seeding rate for Thatcher was 100 pounds per acre and for WS-3 wheat was 120 pounds per acre. Seventy pounds of nitrogen and 50 pounds of phosphorous were broadcasted on all plots after emergence. Thirty-two square feet was harvested from each plot at the soft dough stage.

RESULTS:

Forage yields ranged from 3.97 (many nodded dwarf) to 6.03 tons per acre (Otana). Crude protein levels varied considerably depending upon variety; 5.0% (Otana) to 8.4% (Horsford). Lodging for Horsford and Stepford was the most severe of all the varieties. Nitrate levels for all varieties were considered to be in the safe level.

Table 1. Forage yields of eight spring planted small grain varieties.

Variety	Tons per acre at 12% moisture I	II	III	IV	Mean	Percent Crude Protein [1]	Total Crude Protein/a (lbs)	Height [2] (ins)
Ingrid awnless barley	4.80	4.62	4.54	4.49	4.61	6.7	617.7	42
Horsford barley	3.50	3.75	4.14	3.74	3.78	8.4	635.0	45
Stepford barley	4.35	4.49	4.88	5.59	4.83	6.8	656.9	45
Many nodded dwarf barley	3.44	4.55	3.69	4.21	3.97	6.7	532.0	30
WS-3 wheat	4.93	5.10	4.82	4.81	4.92	7.5	738.0	31
Thatcher wheat	4.65	5.07	4.75	4.61	4.77	6.9	658.3	49
Cayuse oats	7.00	5.67	6.62	6.52	6.45	5.2	670.8	51
Otana oats	6.26	7.24	7.54	5.48	6.63	5.0	663.0	52

1/ Mean of two replications
2/ Mean of four replications

NOTES:

	Harvest Date	Lodging %
Ingrid	8-10	0
Horsford	8-13	100
Stepford	8-13	90
Many	8-10	0
WS-3	8-24	0
Thatcher	8-13	30
Cayuse	8-24	70
Otana	8-24	50

Nitrate levels for all varieties were considered to be in the safe level.

TITLE: Spring Barley

PROJECT: Small Grains Investigations MS 756

YEAR: 1976

PERSONNEL: Leader - Vern R. Stewart
Research Technician - Nancy Campbell
Cooperating Agencies - Montana Agricultural Experiment Station
Field Crops Branch ARS, USDA

OBJECTIVES:
1. To determine the adaptation of new and introduced barley varieties in western Montana.
2. To assist in the state breeding program for development of varieties with stiff straw and disease resistance.

1976 EXPERIMENTS:
1. Dryland Intrastate Yield Nursery
2. Irrigated Intrastate Yield Nursery

SUMMARY OF 1976 RESULTS:

Dryland Intrastate Yield Nursery - Yield and test weights were good; the mean yield was 77.66 bu/a and mean test weight was 48.11 lbs/bu. Four varieties yielded significantly higher than the check, Piroline, and eight varieties yielded significantly lower. Many had heading dates significantly later than Piroline and nine were significantly earlier. Five varieties had lodging severities significantly lower than Piroline's 2.75. Table 1.

Piroline was used as a check in the ten year summary of yields. Eight varieties had yields higher than Piroline. Table 2.

Irrigated Intrastate Yield Nursery - The mean yield was a low 69.73 bu/a. This is even below the dryland's mean yield of 77.66 bu/a. A nitrogen deficiency in this field contributed to the drop in yield. Five varieties had yields significantly higher than the check, Ingrid. Numerous varieties had heading dates significantly earlier than Ingrid. Lodging severity readings were bad, but sixteen did have readings significantly lower than Ingrid. Table 3.

In the ten year summary Ingrid was used as a check. Eighteen varieties had yields higher than Ingrid. Table 4.

SPRING BARLEY VARIETIES

SPRING BARLEY VARIETIES RECOMMENDED FOR WESTERN MONTANA

Six-row Type

1. Unitan - dryland and irrigated
2. Steptoe - dryland and irrigated
3. Horsford - dryland

Two-row Type

1. Erbet - dryland or irrigated
2. Piroline - dryland or irrigated
3. Purcell - dryland or irrigated
4. Summit - dryland or irrigated
5. Georgie - irrigated
6. Ingrid - irrigated
7. Lud - Irrigated
8. Shabet - irrigated

CHARACTERISTICS OF RECOMMENDED VARIETIES

1. Unitan
   a. Six-row
   b. High yielding ability
   c. Moderate lodging resistance
   d. Early maturity
   e. Dryland or irrigated
   f. Medium kernel size
   g. Good test weight

2. Steptoe
   a. Six-row
   b. High yielding ability
   c. Good lodging resistance
   d. Early maturity
   e. Dryland or irrigated
   f. Large kernel size
   g. Low test weight

3. Horsford
   a. Six-row
   b. Low grain yielding ability - primary use for hay
   c. Good lodging resistance
   d. Early maturity
   e. Dryland
   f. Medium kernel size
   g. Moderate test weight

4. Erbet
   a. Two-row
   b. Moderate yielding ability
   c. Moderate lodging resistance
   d. Early maturity
   e. Dryland or irrigated
   f. Good kernel size
   g. Good test weight

Recommended Barley (con't)

5. Piroline
   a. Two-row
   b. High yielding ability
   c. Good lodging resistance
   d. Mid-season maturity
   e. Dryland or irrigated
   f. Good kernel size
   g. Good test weight

6. Purcell
   a. Two-row
   b. High yielding ability
   c. Good lodging resistance
   d. Mid-season maturity
   e. Dryland or irrigated
   f. Large kernel size
   g. Good test weight

7. Summit
   a. Two-row
   b. High yielding ability
   c. Good lodging resistance
   d. Mid-season maturity
   e. Dryland or irrigated
   f. Large kernel size
   g. Good test weight

8. Georgie
   a. Two-row
   b. High yielding ability
   c. Good lodging resistance
   d. Late maturity
   e. Irrigated
   f. Large kernel size
   g. Good test weight

9. Ingrid
   a. Two-row
   b. High yielding ability
   c. Good lodging resistance
   d. Late maturity
   e. Irrigated
   f. Large kernel size
   g. Good test weight

10. Lud
   a. Two-row
   b. High yielding ability
   c. Good lodging resistance
   d. Late maturity
   e. Irrigated
   f. Large kernel size
   g. Good test weight

Recommended Barley (con't)

11. Shabet
    a. Two-row
    b. High yielding ability
    c. Moderate lodging resistance
    d. Late maturity
    e. Irrigated
    f. Medium kernel size
    g. Good test weight

Table 1. Agronomic data from the Intrastate Barley Yield Nursery grown at the Northwestern Agricultural Research Center, Kalispell, Montana in 1976. Random block design, four replications. Field No. A-3 (dryland) Date Seeded: April 12, 1976 Date harvested: August 20, 1976 Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	% Plump
CI 15229	Steptoe	105.82a	46.40	173.50b	30.50	12.50	3.25	96.50
CI 10421	Unitan	101.94a	47.00	173.00b	34.25a	62.25a	3.25	95.50
MT 486124	Bomi	96.91a	49.90	183.25a	29.75	11.25	2.75	95.50
CI 15478	Klages	96.03a	50.10	182.00a	28.75	17.50	3.00	93.00
MT 729	Summit	93.25	52.00	181.50a	28.75	7.50	3.25	93.50
MT 756	RPB 268-70	90.69	51.80	184.00a	27.75	99.00a	1.00b	94.50
CI 13827	Shabet	87.22	50.30	181.75a	30.75	35.00	3.75	92.00
AT 506	Fairfield	87.12	52.20	180.75a	30.00	10.00	4.00a	96.75
MT 726	Lud	86.43	51.80	182.25a	27.25b	31.00	2.00	96.25
RP 43971	RPB 439-71	85.31	50.70	180.75a	27.00b	32.25	2.50	91.75
ID 143413	Piroline/Vance Smyrna	83.53	50.10	178.00a	26.75b	10.00	2.75	94.00
CI 10083	Ingrid	83.53	52.00	183.00a	29.25	20.00	3.50	95.25
MT 4524	Ershabet	82.93	50.60	171.25b	27.25b	75.00a	6.25a	91.75
CI 16181	Purcell	81.96	49.80	175.25	26.75b	27.50	4.75a	91.25
CI 3351	Dekap	80.90	49.60	175.25	27.50b	67.50a	6.50a	92.75
CI 9558	Piroline[1/]	80.81	51.70	175.75	29.50	16.25	2.75	93.00
MT 25131	GC/CPN//*7BZ,F9	80.37	50.40	172.50b	27.00b	40.00	4.50a	94.50
MT 125265	Hypana/Unitan, F8	80.12	48.70	174.00b	32.00a	16.25	3.00	98.00
MT 748607	Riso 7	79.34	47.90	184.25a	29.00	6.25	3.00	91.25
MT 148366	Domen/Ingrid	79.28	51.40	181.00a	29.25	28.50	2.00	97.75a
MT 723	Georgie	78.90	51.20	181.00a	24.50b	54.50a	1.75	94.25
MT 755	Cornel, Cebeco 7291	78.74	51.80	180.75a	26.75b	29.75	2.00	95.50
CI 15514	Hector	78.49	51.20	177.00a	29.25	32.50	3.50	95.50
CI 13826	Erbet	78.40	50.90	171.50b	28.00	75.00a	6.00a	90.25
ID 711180	Mentor/Vance Smyrna	77.65	48.40	180.50a	25.75b	35.00	4.75a	91.75
RP 45672	RPB 456-72	76.06	50.30	179.00a	24.25b	29.75	2.25	91.25
MT 25148	GC/CPN//*7BZ,F9	74.49	49.80	172.50b	25.00b	60.00a	5.00a	93.50
PI 384985	Riso 29	74.43	43.20	183.25a	28.00	10.00	2.25	87.25b
CI 10114	Carlsberg II	73.59	49.90	182.75a	26.75b	32.25	2.25	95.50
PI 384987	Riso 86	73.15	38.00	187.00a	27.50b	36.00	2.00	81.50b
MT 267105	Betzes Awned Brachytic	73.15	51.90	180.50a	25.75b	6.25	2.50	93.25
CI 5438	Compana	72.65	49.90	174.25b	29.25	90.00a	7.25a	96.00
MT 7510	Steptoe-Horsford	71.18	45.20	177.00a	33.75a	17.50	3.25	96.75
MS 43	MT Seeds 4-3	70.24	42.90	173.25b	22.25b	22.50	3.75	87.75b

Table 1 . (con't)

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	% Plump
MS 63	MT Seeds 6-3	69.96	46.00	171.50b	22.25b	28.75	6.00a	91.75
CI 1775	Horsford	67.37b	45.90	172.00b	34.75a	22.50	2.75	91.00
MT 3492	MSI*7/SRT Tall	64.52b	49.70	173.50b	28.25	60.00a	5.25a	93.75
MT 9503	Ingrid Awnless	63.99b	47.00	182.75a	26.75b	99.00a	1.00	79.25b
PI 384988	Riso 1508	59.39b	37.90	184.25a	27.25b	53.25a	1.50b	84.75b
MT 748608	Riso 8	58.80b	37.40	184.50a	29.25	79.25a	1.50b	48.50b
PI 384986	Riso 56	55.21b	41.10	187.00a	23.25b	16.25	3.00	88.50b
MT 748613	Riso 13	53.89b	40.70	183.00a	27.00b	75.50a	1.25b	53.00b
MT 748609	Riso 9	51.61b	44.10	184.00a	27.75	94.50a	7.75a	76.00b
	$\bar{x}$	77.66	48.11	178.97	27.96	39.20	3.40	90.26
	F 2/	4.85**	.00	88.81**	11.00**	4.45**	10.20**	31.74**
	S.E.$\bar{x}$	5.49	.00	.50	.82	13.16	.53	1.77
	L.S.D. (.05)	12.88	.00	1.18	1.93	30.87	1.23	4.16
	C.V. %	7.07	.00	.28	2.95	33.58	15.45	1.97

1/ Check Variety
2/ Value for variety comparison
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level
a/ Values significantly greater than the check .05 level
b/ Values significantly less than the check .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. 1967-76.

C.I. or State No.	Variety	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Ave.	Sta. Yrs.	% Piroline
CI 10421	Unitan	60.7	90.1	64.5	86.2	78.5	88.9	62.1	75.2	62.9	101.9	77.1	10	110
CI 9558	Piroline	58.3	96.5	50.4	78.7	67.7	57.1	61.8	87.1	61.2	80.8	70.0	10	100
CI 3351	Dekap	52.4	86.7	53.8	74.8	73.4	68.6	63.9	73.4	52.3	80.9	68.0	10	97
CI 5438	Compana	58.2	89.1	44.9	66.2	58.6	44.2	50.3	76.8	49.7	72.7	61.1	10	87
CI 13826	Erbet	53.3	85.1	66.3	66.9	59.8	40.1	62.3	62.0	47.1	78.4	62.1	10	89
CI 13827	Shabet			57.8	73.4	68.4	62.6	61.4	84.2	43.7	87.2	67.3	8	99
CI 15514	Hector			43.1	74.0	77.5	68.1	59.4	80.8	52.1	78.5	66.7	8	98
CI 15229	Steptoe					97.9	75.9	69.1	83.2	69.0	105.8	83.5	6	120
MT 729	Summit						70.0	62.9	77.8	44.6	93.3	69.7	5	100
MT 723	Georgie						63.1	58.1	72.9	52.0	78.9	65.0	5	93
CI 15478	Klages							62.1	82.2	51.0	96.0	72.8	4	100
MT 726	Lud							55.3	80.9	56.3	86.4	69.7	4	96
CI 10083	Ingrid							53.6	82.0	45.4	83.5	66.1	4	91
MT 267105	Betzes Awned Brachytic								85.4	46.6	73.2	68.4	3	90
MT 148366	Domen/Ingrid								80.7	46.7	79.3	68.9	3	90
MT 125265	Hypana/Unitan,F8								72.6	61.0	80.1	71.2	3	93
CI 16181	Purcell				89.6	82.2	83.2				82.0	84.3	4	118
MT 486124	Bomi									68.1	96.9	82.5	2	116
ID 711180	Mentor/Vance Smyrna									60.5	77.7	69.1	2	97
MT 756	RPB 268-70									60.5	90.7	75.6	2	106
ID 143413	Piroline/Vance Smyrna									59.2	83.5	71.4	2	100
MT 7510	Steptoe-Horsford MT Seed									58.2	71.2	64.7	2	91
PI 384988	Riso 1508									52.2	59.4	55.8	2	79
CI 10114	Carlsberg II									52.2	73.6	62.9	2	89
PI 384987	Riso 86									50.1	73.2	61.7	2	87
PI 384985	Riso 29									48.0	74.4	61.2	2	86
MT 9503	Ingrid Awnless									48.0	64.0	56.0	2	79
CI 1775	Horsford									47.2	67.4	57.3	2	81
MT 755	Cornel, Cebeco 7291									45.7	78.7	62.2	2	88
AT 506	Fairfield										87.1	87.1	1	108
RP 43971	RPB 439-71										85.3	85.3	1	106
MT 4524	Ershabet										82.9	82.9	1	103
MT 25131	GC/CPN//*7BZ,F9										80.4	80.4	1	100
MT 748607	Riso 7										79.3	79.3	1	98
RP 45672	RPB 456-72										76.1	76.1	1	94
MT 25148	GC/CPN//*7BZ,F9										74.5	74.5	1	92

Table 2 . (con't)

C.I. or State No.	Variety	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Ave.	Sta. Yrs.	% Piroline
MS 43	MT Seeds 4-3										70.2	70.2	1	87
MS 63	MT Seeds 6-3										70.0	70.0	1	87
MT 3492	MSI*7/SRT Tall										64.5	64.5	1	80
MT 748608	Riso 8										58.8	58.8	1	73
PI 384986	Riso 56										55.2	55.2	1	68
MT 748613	Riso 13										53.9	53.9	1	67
MT 748609	Riso 9										51.6	51.6	1	64

Table 3. Agronomic data from the Intrastate Barley Yield Nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1976. Field No. Y-6, Irrigated. Random block design, five replications.

Date seeded: April 28, 1976 Date harvested: August 26, 1976
Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev	% Plump
MT 726	Lud	99.86a	58.30	186.00b	35.40	64.00	6.00b	93.60a
MT 723	Georgie	93.56a	50.30	185.20b	34.40b	56.00b	6.00b	85.00a
CI 15229	Steptoe	92.43a	45.20	182.00b	41.20a	61.80	7.60	85.60a
MT 755	Cornel, Cebeco 7291	88.98a	58.80	185.60b	35.60	18.00b	2.80b	96.80a
MT 486124	Bomi	88.25a	50.30	188.20	36.40	58.00b	7.20	86.00a
MT 756	RPB 268-70	84.95	52.50	188.80	36.00	50.00b	5.60b	84.60a
MT 729	Summit	83.60	50.70	186.60b	37.00	40.00b	5.00b	80.40a
MT 148366	Domen/Ingrid	83.15	51.90	185.80b	38.80	60.00b	6.40b	88.00a
RP 45672	RPB 456-72	82.88	48.60	183.40b	34.00b	51.00b	6.20b	69.60
CI 16181	Purcell	82.08	48.70	184.20b	35.00	72.80	7.40	84.00a
MT 748607	Riso 7	81.80	49.40	189.60	35.60	42.00b	5.60	77.40
CI 15478	Klages	80.70	54.50	186.40b	38.60	71.80	6.80b	85.00a
AT 506	Fairfield	78.30	49.60	183.80b	37.40	65.00	7.20	87.40a
CI 10421	Unitan	76.95	47.00	181.60b	42.40a	68.80	7.60	81.80a
MS 63	MT Seeds 6-3	76.58	52.40	179.00b	30.60b	72.00	6.40b	87.80a
MT 4524	Ershabet	74.25	56.70	175.00b	35.00	80.00	6.80b	88.80a
MT 267105	Betzes Awned Brachytic	74.20	55.60	184.80b	33.60b	85.80	7.60	80.80a
MT 25131	GC/CPN//*7BZ,F9	73.55	49.90	177.60b	33.80b	87.80	6.80b	82.80a
CI 10083	Ingrid[1/]	69.90	51.20	188.40	37.00	78.80	8.40	68.00
MT 125265	Hypana/Unitan, F8	69.67	48.30	181.80b	42.20a	72.80	7.40	90.80a
MT 748608	Riso 8	69.60	45.00	189.80	36.60b	42.00b	5.60b	37.60b
ID 143413	Piroline/Vance Smyrna	69.42	45.00	185.00b	37.60b	78.00	7.60	67.00
MT 748613	Riso 13	69.15	44.50	188.00	35.40	34.00b	5.40b	32.20b
CI 15514	Hector	68.15	48.80	182.80b	39.00	73.80	7.60	74.80
CI 13827	Shabet	67.75	46.80	185.60b	36.60b	80.80	7.60	68.20
ID 711180	Mentor/Vance Smyrna	67.00	46.00	185.80b	35.40	82.80	7.80	74.20
CI 13826	Erbet	66.80	48.60	175.00b	35.20	89.80	7.80	77.80a
RP 43971	RPB 439-71	65.55	47.90	186.40b	35.20	69.00	8.20	65.00
MS 43	MT Seeds 4-3	65.27	47.80	182.40b	32.20b	75.00	8.60	70.60
MT 25148	GC/CPN//*7BZ,F9	63.62	46.50	177.80b	34.80	87.80	7.40	76.00
PI 384988	Riso 1508	62.95	47.10	188.20	36.00	51.00b	5.40b	72.60
CI 9558	Piroline	62.05	48.00	184.00b	38.40	69.80	7.40	71.00
CI 10114	Carlsberg II	58.77	46.50	189.20	36.80	71.80	7.60	71.20
PI 384985	Riso 29	58.04	48.40	191.20a	36.00	74.80	8.00	73.20
CI 5438	Compana	57.77	50.90	181.20b	31.00	97.20	8.40	83.80a
MT 7510	Steptoe/Horsford MT Seeds 2	57.67	44.30	185.20b	43.40a	78.00	8.60	89.60a
PI 384986	Riso 56	52.04b	42.30	194.20a	31.40b	86.80	8.40	62.60
MT 3492	MSI*7/SRT Tall	51.42b	49.90	182.00b	30.00b	93.40	8.60	67.20
CI 3351	Dekap	51.34b	45.10	182.80b	35.40	91.60	8.20	69.80
MT 9503	Ingrid Awnless	50.19b	42.10	188.20	37.00	38.00b	4.60b	66.00
CI 1775	Horsford	49.42b	41.20	182.20b	43.00a	87.80	8.80	56.80b
PI 384987	Riso 86	43.91b	43.60	196.00a	35.80	75.80	8.00	48.60b
MT 748609	Riso 9	34.91b	40.20	188.60	34.20b	95.40	8.00	33.40b

Table 3 . (Con't)

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev	% Plump
	$\bar{x}$	69.73	48.52	185.01	36.20	69.32	7.08	74.27
	F 2/	6.88**	.00	67.52**	14.01**	7.48**	5.22**	19.08**
	S.E.$\bar{x}$	5.43	.00	.54	.82	6.71	.56	3.44
	L.S.D.(.05)	15.06	.00	1.49	2.28	18.60	1.55	9.53
	C.V. %	7.79	.00	.29	2.28	9.68	7.92	4.63

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
b/ Values significantly less than the check

Table 4. Ten year summary of yields for the Spring Irrigated Intrastate Barley Nursery grown on the Northwestern Agricultural Research Center, Kalispell MT. 1966-76.

C.I. or State No.	Variety	1966	1967	1968	1969	1970	1971	1972	1973	1974	1976	Ave.	Sta. Yrs.	% Ingrid
CI 10421	Unitan	90.8	128.4	98.4	92.1	80.0	102.9	92.6	91.9	115.3	77.0	96.9	10	105
CI 9558	Piroline	87.3	108.8	93.3	85.3	64.8	88.5	73.6	71.7	105.2	62.1	84.1	10	91
CI 10083	Ingrid	88.9	111.7	80.6	109.3	75.0	114.8	75.3	91.2	109.4	69.9	92.6	10	100
CI 5438	Compana	60.0	85.5	63.4	72.3	59.9	71.6	53.1	87.9	89.8	57.8	70.1	10	76
CI 13026	Erbet		91.4	73.3	76.4	71.1	88.6	73.7	78.8	106.5	66.8	80.7	9	87
CI 15514	Hector				82.1	62.4	101.6	70.2	100.9	108.3	68.2	84.8	7	92
CI 13827	Shabet				80.4	67.7	93.6	69.6	81.8	115.0	67.8	82.3	7	89
CI 15229	Steptoe						116.0	111.3	97.4	145.7	92.4	112.6	5	122
MT 723	Georgie							76.8	100.4	120.0	93.6	97.7	4	113
MT 729	Summit							64.5	96.5	114.5	83.6	89.8	4	104
CI 15478	Klages								87.0	114.8	80.7	94.2	3	104
MT 726	Lud								88.9	118.1	99.9	102.3	3	113
CI 3351	Dekap								80.4	98.5	51.3	76.7	3	85
CI 16181	Purcell					61.2	106.9	84.3			82.1	83.6	4	100
MT 267105	Betzes Awned Brachytic									119.4	74.2	96.8	2	108
MT 148366	Domen/Ingrid									108.8	83.2	96.0	2	107
MT 125265	Hypana/Unitan,F8									113.8	69.7	91.8	2	102
MT 486124	Bomi										88.3	88.3	1	126
ID 711180	Mentor/Vance Smyrna										67.0	67.0	1	96
MT 756	RPB 268-70										85.0	85.0	1	122
ID 143413	Piroline/Vance Smyrna										69.4	69.4	1	99
MT 7510	Steptoe-Horsford MT Seed										57.7	57.7	1	83
PI 384988	Riso 1508										63.0	63.0	1	90
CI 10114	Carlsberg II										58.8	58.8	1	84
PI 384987	Riso 86										43.9	43.9	1	63
PI 384985	Riso 29										58.0	58.0	1	83
MT 9503	Ingrid Awnless										50.2	50.2	1	72
CI 1775	Horsford										49.4	49.4	1	71
MT 755	Cornel, Cebeco 7291										90.0	90.0	1	129
AT 506	Fairfield										78.3	78.3	1	112
RP 43971	RPB 439-71										65.6	65.6	1	94
MT 4524	Ershabet										74.3	74.3	1	106
MT 25131	GC/CPN//*7BZ,F9										73.6	73.6	1	105
MT 748607	Riso 7										81.8	81.8	1	117
RP 45672	RPB 456-72										82.9	82.9	1	119
MT 25148	GC/CPN//*7BZ,F9										63.6	63.6	1	91

Table 4 . (con't)

C.I. or State No.	Variety	1966	1967	1968	1969	1970	1971	1972	1973	1974	1976	Ave.	Sta. Yrs.	% Ingrid
MS 43	MT Seeds 4-3										65.3	65.3	1	93
MS 63	MT Seeds 6-3										76.6	76.6	1	110
MT 3492	MSI*7/SRT Tall										51.4	51.4	1	74
MT 748608	Riso 8										69.6	69.6	1	100
PI 384986	Riso 56										52.0	52.0	1	74
MT 748613	Riso 13										69.2	69.2	1	99
MT 748609	Riso 9										34.9	34.9	1	50

TITLE: Winter Barley

PROJECT: Small Grain Investigations MS 756

YEAR: 1976

PERSONNEL: Leader - Vern R. Stewart
Research Technician - Nancy Campbell
Cooperators - Feed Crops Committee, MSU

LOCATION: Northwestern Agricultural Research Center

DURATION: Indefinite

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

1976 EXPERIMENTS:

1. Uniform Winter Barley Nursery of Hardy Varieties
2. Western Winter Barley Nursery
3. Barley Winterhardiness Nursery

SUMMARY OF 1976 RESULTS:

Uniform Winter Barley Nursery - The nursery's mean yield of 56.4 bu/a is down from last years 60.8 bu/a, even though the nursery's mean percent winter survival for this year is high, 82.1%, compared with last years 49.1%. The nursery's mean test weights and mean percent plump are higher this year than the past two years. Heading dates were earlier this year. No entry's yield was significantly higher than the check, Schuyler. Table 1.

In the summary of the yields Schuyler was used as a check. No entry out yielded Schuyler over the average of years. Table 2.

Western Winter Barley Nursery - The nursery's mean percent winter survival was up this year 80.4% from last years 21.4%. The mean yield was also higher, 68.7 bu/a compared with 60.9 bu/a last year . Heading dates tended to be earlier and percent plump readings tend to be higher this year. Eight entries yielded significantly lower than the check, Schuyler, no entries yielded significantly higher. Table 3.

Barley Winterhardiness Nursery - Tenn. Winter and several winter wheat varieties were used as checks. Forty-five entries had survival levels greater than 50%; twenty of these were equal to or qreater than 90%. Table 4.

Table 1. Agronomic data from the Uniform Winter Barley Nursery grown at Kalispell, Montana in 1976. Random block design, four replications. Field No. R-6a.

Date seeded: September 16, 1975 Date harvested: July 20 & August 2, 1976
Size of plot: 16 sq. ft.

C. I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	% Winter Survival	% Plump	Scald 0-10
	Mich. 69-518-57	53.38b	46.4	149.50b	28.25a	87.50	90.75a	4.50
	Mo. B2146 Mo. B1337/ Tschermak	46.54b	49.2	152.00	32.25a	70.00b	90.50a	4.50
	Mo. B2171 Mo. B1300/ Tschermak	34.04b	51.3	148.50b	31.00a	71.25b	93.75a	5.25
	Va. 72-44-525 Harrison/ 3/C. Capa/Wong//	63.34b	48.9	149.50b	25.00	82.50b	79.25a	5.50
	Va 70-44-213	51.66b	48.0	147.50b	24.75	87.50	83.75a	3.25b
	NE. 72637 Nebar Sel.	44.26b	49.8	159.75b	27.75	83.75b	86.50a	4.75
15486	Nebar. NB. 69135	58.81b	50.1	149.25b	29.25a	87.50	86.25a	5.00
9168	Mo. B-475	57.31b	47.6	147.50b	31.50a	91.25	89.50a	3.00b
	Mo. B2126	38.63b	52.3	152.00	32.25a	82.50b	94.50a	3.75b
	Mo. 2487	56.19b	49.5	143.50b	25.75	88.75	88.00a	4.25
	Mo. 2124	37.38b	51.4	150.75b	29.75a	85.00b	96.00a	3.50b
13855	Okla. S-633717	52.03b	48.1	160.00a	19.50b	86.25	73.00	2.75b
	Ok. 7110566	48.47b	48.5	152.00	26.00	58.75b	90.50a	4.25
15236	OAC WB 55-2	54.53b	47.6	146.50b	27.00	83.75b	92.50a	4.00
	Mo. B2247	43.44b	52.3	154.00	29.50a	72.50	97.00a	4.00
6561	Reno	77.36	46.0	146.75b	31.25a	92.50	89.25a	3.75b
8067	Hudson	73.74	49.4	146.00b	29.00a	91.25	85.25a	2.75b
11887	Schuyler[1/]	77.58	51.0	153.75	25.50	93.75	75.75	5.00
	N.Y. 5619-1E	64.15b	48.2	147.50b	24.75	87.50	87.50a	3.75b
6050	Kentucky 1	58.25b	49.6	153.00	34.75a	87.50	88.25a	3.75b
	Mich. 69-521-10	65.56	49.2	153.50	27.50	80.00b	79.25a	2.75b
15491	OAC WB74-23, Sel.	60.34b	47.4	147.25b	27.00	85.00b	91.25a	3.00b
	NE. 73264	68.68	49.4	152.00	28.00	93.75	85.75a	4.00
15197	Kamiak	69.62	49.4	147.50b	25.75	86.25	91.75a	2.75b
7580	Kearney	57.25b	51.1	147.25b	30.25a	88.75	79.50a	4.75
	Pike	36.51b	50.7	141.00b	21.00b	88.75	90.75a	4.75
	OAC WB90-13	59.40b	49.3	159.00a	29.50a	73.75b	91.25a	3.25b
	Alpine	71.46	49.0	163.50a	33.50a	86.25	82.50a	4.50

Table 1 . (con't)

CI. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	% Winter Survival	% Plump	Scald 0-10
	$\bar{x}$	56.4	49.3	150.4	28.1	82.1	87.4	4.0
	F 2/	7.763**	0.0	28.60**	13.20**	8.83**	25.64**	4.00**
	S.E.$\bar{x}$	4.407	0.0	.905	.966	2.723	1.182	.422
	L.S.D. (.05)	12.401	0.0	2.547	2.719	7.662	3.326	1.187
	C.V. %	7.81	0.0	.60	3.44	3.32	1.35	10.55

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 statistical significance at the .05 level
** Indicates statistical significance at the .01 level

Table 2 . Summary of yields for the Uniform Winter Barley Nursery grown at Kalispell, MT. 1968-76

C.I. or State No.	Variety	1968	1969	1970	1971	1972	1974	1975	1976	Ave.	Sta. Yrs.	% Schuyler
CI 9168	Mo.B 475	81.0	36.4	70.8	88.8	54.2	40.8	66.6	57.3	62.0	8	76
CI 6561	Reno	85.3	47.4	72.7	78.4	69.3	49.9	70.4	77.4	68.9	8	84
CI 8067	Hudson	109.7	42.8	74.2	107.4	61.1	53.1	78.1	73.7	75.0	8	92
CI 11887	Schuyler	114.7	60.1	82.8	113.4	77.6	55.8	70.3	77.6	81.5	8	100
CI 6050	Kentucky I	65.5	42.2	78.0	82.7	70.9	54.4	62.5	58.3	64.3	8	79
CI 7580	Kearney	51.9	35.4	57.2	65.2		31.8	56.8	57.3	50.8	7	62
CI 9478	Alpine		67.3	91.1	114.7	55.5			71.5	80.0	5	97
CI 13855	Okla. S-633717				92.5		69.9	64.3	52.0	69.7	4	88
CI 15486	Nebr. NB 69135					53.7	42.1	60.8	58.8	53.9	4	77
CI 15236	OAC WB 55-2					44.8	43.0	67.8	54.5	52.5	4	75
	N.Y. 5619-1E					12.8	62.6	57.3	64.2	49.2	4	70
CI 15197	Kamiack					57.8	57.7	77.0	69.6	65.5	4	93
	Mo. B2126						39.0	51.0	38.6	42.9	3	63
CI 15491	OAC WB74-23, Sel.						39.1	59.4	60.3	52.9	3	78
Mich 69-518-57								63.3	53.4	58.4	2	79
	Mo.B2146 Mo.B1337/Tschermak							34.3	46.5	40.4	2	55
	Mo.B2171 Mo.B1300/Tschermak							34.3	34.0	34.2	2	46
VA 72-44-525	Harrison/3/C.Capa/Wong//							65.8	63.3	64.6	2	87
NE. 72637	Nebr. Sel.							53.8	44.3	49.1	2	66
	Mo. 2487								56.2	56.2	1	72
	Mo. 2124								37.4	37.4	1	48
OK 7110566									48.5	48.5	1	63
	Mo.B 2247								43.4	43.4	1	56
Mich 69-521-10									65.6	65.6	1	85
NE 73264									68.7	68.7	1	89
	Pike								36.5	36.5	1	47
	OAC WB 90-13								59.4	59.4	1	77
VA 70-44-213									51.7	51.7	1	67

Table 3. Agronomic data from the Western Winter Barley Nursery grown at Kalispell, Montana in 1976. Random block design, four replications. Field No. R-6a. Size of Plot: 16 sq. ft.

Date seeded: September 16, 1975
Date harvested: July 20 & August 2, 1976

Variety/Number	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	% Plump	% Winter Survival	Scald 0-10
Luther/CI 13340	79.2	47.9	162.75a	29.00	64.50b	87.50	4.00
Hudson/CI 8067	62.3b	51.4	147.75b	29.25	82.50	91.25	2.50b
Kamiak/CI 15197	70.0	49.8	148.25b	26.75	91.50a	88.75	2.50b
Schuyler/CI 11887 1/	76.2	50.0	157.75	27.50	81.25	86.25	4.75
Ackerman's 989	55.3b	50.0	157.50	25.75	96.00a	73.75b	3.25b
WA 2464-70	49.7b	51.2	157.50	25.50	96.50a	76.25b	3.25b
WA 1094-67	66.5	48.6	160.00	23.75b	82.50	82.50	3.00b
WA 2196-68	61.7b	48.0	158.75	21.25b	72.00b	87.50	2.75b
WA 3021-70	70.2	47.9	162.25a	22.00b	78.75	85.00	2.75b
NY 6005-18	78.2	49.4	149.75b	30.25	87.00a	92.50	5.00
OR 7129	69.5	47.5	154.50b	24.50b	56.00b	83.75	3.00b
W 6529	66.2b	52.2	151.75b	33.25a	57.25b	95.00a	4.75
W 6531	68.1	50.8	155.00b	31.50a	84.50	86.25	3.50b
W 6823	71.7	49.4	153.75b	34.75a	59.00b	93.75	4.00
WA 1245-68	59.5b	48.9	156.25	20.25b	86.00	83.75	2.50b
WA 1331-68	76.2	48.3	161.00a	25.75	80.50	82.50	3.50b
72 Ab 89	81.4	48.2	161.00a	23.50	82.25	85.00	2.75b
72 Ab 265	72.6	48.6	168.00a	26.75	77.75	76.25b	2.25b
OR FB 73123	77.6	47.9	154.60b	22.75	79.50	88.75	4.25
OR FB 73130	80.7	46.7	161.75a	23.75	72.75b	83.75	3.25b
OR FB 73186	75.8	48.1	162.00a	25.00	63.00b	88.75	3.25b
72 Ab 334	47.7b	46.0	166.75a	30.75a	67.75b	11.25b	3.00b
73 Ab 519	64.1b	45.8	171.00a	23.50	68.00b	40.00b	2.75b
$\bar{x}$ 2/	68.7	48.8	158.23	26.39	76.82	80.43	3.3
F	5.75**	0.0	48.10**	19.59**	40.86**	46.41**	4.90**
S.E.$\bar{x}$	3.94	0.0	.869	.872	1.84	2.73	.355
L.S.D.(.05)	11.14	0.0	2.45	2.47	5.2	7.69	1.01
C.V. %	5.73	0.0	.55	3.31	2.39	3.39	10.658

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

Table 4. Survival data from the 1975-76 Barley Winterhardiness Nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT.

C.I. No.	Variety	Survival %		
		Rep. I	Rep. 2	Ave.
6034	Tenn. Winter (check)	5	1	3
15197	Kamiak	85	75	80
15559	Boyer (a)	75	60	68
	WN 1245-68	80	80	80
	WN 4170/12222	25	15	20
	WN 4072/13161 (b)	50	40	45
12218	Blackhawk (wheat)	100	100	100
14025	Kenosha (wheat)	100	100	100
5529	Dicktoo	90	90	90
936	Trebi	1	0	1
6034	Tenn. Winter (check)	1	1	1
	PA 46 (c)	90	90	90
	PA 47 (c)	75	65	70
	PA 51 (c)	75	60	68
	PA 77 (c)	60	40	50
	PA 78 (c)	75	75	75
	PA 88 (c)	60	75	68
	PA H125 (d)	95	95	95
	PA H125-1 (d)	95	75	85
	PA F_1 CMS x PBW (e)	90	80	85
6034	Tenn. Winter (check)	1	2	2
6728	Wong	95	95	95
15235	Paoli	95	95	95
15621	Pike (f)	95	95	95
	OK 7110566	75	75	75
	OK 7110729	80	75	78
	OK 6915604	80	80	80
6561	Reno	95	95	95
15493	Kanby	75	85	80
6050	Kentucky 1	90	90	90
6034	Tenn. Winter (check)	3	2	3
9168	Mo. B-475	90	85	88
	Mo. B2126	60	75	68
	Mo. B2487	85	90	88
	Mo. B2500	90	90	90
	Mo. B2146	85	85	85
	Mo. B2171	55	75	65
	Mo. B2247	55	60	58
	Mo. B2318	60	20	40
	Mo. B2414	85	80	83
6034	Tenn. Winter (check)	1	1	1
	Mo. B2124	75	75	75
	Mo. B2544 (g)	50	50	50
6051	Mo. Ey. Bdls.	85	75	80
1442	Kharkof (wheat)	100	100	100
15486	Nebar	90	95	93
	NE 72637	95	90	93
	NE 73104 (h)	95	95	95

Table 4 . (con't)

C.I. No.	Variety	Survival %		
		Rep. I	Rep. 2	Ave.
	NE 73191 (i)	95	95	95
	NE 73221 (i)	95	95	95
6034	Tenn. Winter (check)	3	1	2
	NE 73264 (i)	95	95	95
	NE 73266 (i)	90	95	93
7580	Kearney	90	95	93
	Va. 70-44-213	95	90	93
	Va. 72-11-18	90	85	88
	Va. 72-44-362	80	80	80
	Va. 72-44-525	90	90	90
	OAC WB 90-13 (j)	80	90	85
	OAC WB 90-26 (j)	95	90	93

a/ Formerly called WN 1094-67 (E3)
b/ Parentage not received (E6)
c/ Betzes//Pennrad/Wong (E12,13,14,15,16,17)
d/ Larker//Wong/Pennrad (E18,19)
e/ F_1 Cytoplasmic male sterile/3/Betzes//Pennrad/Wong (E20)
f/ Formerly called Purd.466A1-17-15-25-15-5-8-2-5 (E24)
g/ Mo. B2544/Carstens (E43)
h/ Will//Sabbaton/Meimi (E48)
i/ Sabbaton/Meimi//Decatur (E49,50,52,53)
j/ OAC Selections from U.S. male sterile composite cross bulk (E59,60)

TITLE: Spring Oats

PROJECT: Small Grains Investigations MS 756

YEAR: 1976

PERSONNEL: Leader - Vern R. Stewart
Research Technician - Nancy Campbell
Cooperators - Feed Crops Committee, MSU

LOCATION: Northwestern Agricultural Research Center

DURATION: Indefinite

OBJECTIVES: To determine the adaptation of new and introduced oat varieties.

1976 EXPERIMENTS:
Uniform Northwestern States Oat Nursery

SUMMARY OF 1976 RESULTS:

Uniform Northwestern States Oat Nursery - Yields were low this year with a mean yield of 102.41 bushels per acre. When searching for a reason for the yield decrease, it was discovered that the field this nursery was planted in was quite low in nitrogen. Consequently, an insufficient amount of fertilizer was added to give optimum yields. The low nitrogen level and adverse weather conditions at harvest both contributed to the low yields. No entries yielded significantly higher than the check, Cayuse. Eleven varieties yielded significantly lower than Cayuse. Lodging was severe this year. The lodging severity mean was 7.49. No variety had a lodging severity significantly less than Cayuse, but two were significantly higher. Due to the unfavorable weather conditions at harvest time straw grain ratios and forage yields were unobtainable. Table 1.

Using Park as a check over several years, many varieties showed a yield superior to that of Park. Otana (ID 635280-7) had a 33% higher yield than Park over a five year period. Table 2.

SPRING OAT VARIETIES

SPRING OAT VARIETIES RECOMMENDED FOR WESTERN MONTANA

1. Cayuse - irrigated or dryland
2. Park - irrigated or high moisture conditions
3. Basin - dryland
4. Otana - irrigated or high moisture conditions

CHARACTERISTICS OF RECOMMENDED VARIETIES

1. Cayuse
   a. Pale green plant color, yellow kernels at maturity, developed in New York
   b. High Yielding ability
   c. Low test weight
   d. Maturity - early to mid-season
   e. Very strong straw strength
   f. Resistant to Victoria blight and Helmenthosporium blight
   g. Tolerant to "red leaf" disease of oats

2. Park
   a. White, plump, short kernels, developed by Idaho & Montana
   b. High yielding ability
   c. High test weight
   d. Maturity - mid-season
   e. Strong straw strength
   f. Susceptible to Victoria blight
   g. Resistant to prevalent stem rust races

3. Basin
   a. White, short, plump kernels with occasional weak awns, developed in Montana
   b. High yielding ability
   c. High test weight
   d. Strong straw strength
   e. Maturity - mid-season
   f. Resistant to covered and loose smut
   g. Resistant to most common stem rust races (not to races 7 & 7A)
   h. Excellent oat for combining

4. Otana
   a. Kernel white and plump
   b. Dark or blue green foliage
   c. High yielding
   d. Excellent test weight
   e. Medium to strong straw
   f. Maturity - mid-season
   g. Resistant to Victoria blight

Table 1. Agronomic data from the Uniform Northwestern States Oat Nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1976. Random block design, three replications.

Date seeded: April 28, 1976 Date harvested: August 24, 1976
Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.
CI 9252	Otana (63AB5280-7)	142.80	35.9	189.33	38.00a	53.33	6.00
CI 8263	Cayuse 1/	127.67	31.2	189.67	33.33	76.67	7.00
ID 71694	71AB694	127.23	31.6	189.67	31.00	81.67	7.67
ID 71670	71AB670	125.23	28.6	190.00	33.67	76.67	7.67
ID 71692	71AB692	122.85	34.7	189.67	35.00	60.00	6.33
WA 6013		120.35	28.4	194.00a	34.00	86.67	8.00
WA 6160	CI2874/Cayuse	118.91	34.2	191.33a	32.00	70.00	7.67
ID 683975	Cayuse x Glen	113.79	31.3	189.67	33.33	86.67	8.33
ID 712506	CI5345/Zanster	113.47	35.9	190.33	37.33a	63.33	7.00
ID 71716	71AB716	113.10	33.9	190.00	31.33	63.33	7.67
WA 6161	CI2874/Cayuse	108.91	28.1	193.33a	32.00	86.67	8.33
CI 6611	Park	107.97	33.0	191.33a	37.00a	80.00	8.00
WA 6014		103.66	27.9	191.67a	33.00	89.67	8.00
CI 7557	Russell	102.22	35.5	189.67	38.67a	56.67	6.33
ID 721076	65AB4602/Cayuse	97.59b	33.5	193.00a	33.00	66.67	7.67
WA 6159	CI2874/Cayuse	96.03b	30.9	191.67a	30.00	90.00	8.67a
CI 9081	Random	93.47b	31.1	189.00	34.33	80.00	7.00
CI 8171	Kelsey	89.53b	35.7	189.00	34.00	83.33	7.00
ID 721723	Minn.II-22-220/Cayuse	89.34b	26.1	195.33a	33.00	83.33	8.33
WA 6015		88.59b	26.5	192.00a	33.33	93.00	8.67a
CI 6661	Rodney	79.21b	35.3	191.00a	39.33a	70.00	7.00
CI 2053	Markton	75.59b	28.0	189.00	36.00	71.67	7.00
CI 2027	Gopher	74.34b	33.0	189.00	37.33a	86.67	7.00
CI 5346	Basin	70.96b	34.5	191.33a	36.00	83.33	7.33
OT 195	Random-Vicar/Random	57.39b	34.6	189.00	37.67a	60.00	7.67
	$\bar{x}$	102.41	32.0	190.76	34.55	75.97	7.49
	F 2/	4.56**	0.0	25.80**	4.77**	1.63NS	2.15*
	S.E.$\bar{x}$	9.84	0.0	.34	1.17	9.12	.49
	L.S.D. (.05)	27.93	0.0	.97	3.33	25.90	1.40
	C.V. %	9.61	0.0	.18	3.39	12.01	6.56

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

Table 2. Summary of the oat yield data from the Uniform Oat Nursery, Northwestern Agricultural Research Center, Kalispell, MT, 1967-1976.

C.I. or State No.	Variety	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Ave.	Sta Yrs	% Park
CI 5346	Basin	120.2	149.1	151.5	148.7	177.0	144.2	114.4	181.6	143.4	71.0	140.1	10	108
CI 6611	Park	108.3	120.3	171.4	127.1	190.6	67.8	115.1	123.2	170.0	108.0	130.2	10	100
CI 6661	Rodney	126.2	121.4	126.2	132.2	169.9	87.9	104.0	180.2	114.6	79.2	124.2	10	95
CI 2027	Gopher	116.8	101.0	134.9	127.4	168.9	76.7	99.0	149.8	122.4	74.3	117.1	10	90
CI 8263	Cayuse	142.6	130.0	138.1	158.7	195.9	140.7	113.6	162.5	171.8	127.7	148.2	10	114
CI 2053	Markton	89.9	101.7	120.2	120.5	175.1	77.5	87.1	147.0	130.1	75.6	112.5	10	86
CI 8171	Kelsey			142.5	127.6	195.3	89.3	115.7	193.4		89.5	136.2	7	106
ID 683975	Cayuse x Glen					183.6	103.2	124.9	154.2	161.1	113.8	140.1	6	108
CI 9081	Random					197.7	106.9	116.5	193.0	166.9	93.5	145.7	6	113
CI 9252	Otana (63AB5280-7)						142.9	127.6	183.6	180.4	142.8	155.5	5	133
ID 71694	71AB694							125.9	178.9	164.5	127.2	149.1	4	115
WA 6014								118.3	183.9	148.0	103.7	138.5	4	107
ID 71716	71AB716							118.2	198.6	162.1	113.1	148.0	4	115
ID 71692	71AB692							113.1	182.4	162.8	122.8	145.3	4	112
ID 71670	71AB670							110.7	161.2	176.3	125.2	143.3	4	111
WA 6013								108.7	190.7	174.3	120.3	148.5	4	115
WA 6015								104.2	170.6	148.2	88.6	127.9	4	99
WA 6159	CI2874/Cayuse									162.8	96.0	129.4	2	93
WA 6160	CI2874/Cayuse									181.3	118.9	150.1	2	108
WA 6161	CI2874/Cayuse									182.4	108.9	145.6	2	105
ID 712506	CI5345/Zanster									167.8	113.5	140.6	2	101
ID 721076	65AB4602/Cayuse									148.9	97.6	123.2	2	89
ID 721723	Minn.II-22-220/Cayuse									175.6	89.3	132.4	2	95
CI 7557	Russell									150.2	102.2	126.2	2	91
OT 195	Random-Vicar/Random										57.4	57.4	1	44

TITLE: Spring Wheat

PROJECT: Small Grains Investigation MS 756

YEAR: 1976

PERSONNEL: Leader - Vern R. Stewart
Research Technician - Nancy Campbell
Cooperators - F. H. McNeal and M. A. Berg
Cooperating Agencies - Montana Agricultural Experiment Station
Field Crops Branch, ARS, USDA
Montana Wheat Research & Marketing Committee

OBJECTIVES:
1. To determine the adaptability of new introduced spring wheat varieties and selections by comparisons with recommended varieties.
2. Study the semi-dwarf strains of spring wheat for use under irrigated conditions.
3. To aid in basic genetic research in spring wheat and the overall breeding program.

1976 EXPERIMENTS:
1. Advanced Yield Nursery (dryland)
2. Western Regional Spring Wheat Nursery (dryland)
3. Private Variety Nursery (dryland)

1976 RESULTS BY NURSERY:

Advanced Yield Nursery - The mean yield is down this year, 65.21 bu/a as compared to last year's 78.45 bu/a. It was discovered that this field was quite low in N, therefore the usual level of N added to this nursery was inadequate for optimum yield growth. No entries had yields significantly higher than the check Norana, but eight yielded significantly lower. Many entries had heading dates significantly earlier than Norana; Lew and Wared were significantly later. As last year rainy weather conditions hindered harvest and contributed to the low test weights. Lodging severity wasn't quite as severe this year with a mean of 5.31 compared to last years 6.02. Many entries had a lodging severity significantly greater than Norana, no entries were significantly less. MT737, Rolette, and Tioga had stripe rust severity readings significantly greater than Norana, nine were significantly less. Table 1.

In the ten year summary all varieties yielded higher than Thatcher. Table 2.

Western Regional Spring Wheat Nursery - Yields were low this year due to a low N fertility. WA6105 had a yield significantly greater than the check, Fielder; thirteen had yields significantly less. There were 15 hard red varieties and 12 soft white varieties. In comparing the red and white varieties, it was found that the "reds" mean yield was higher than the white; 65.35 bu/a and 53.22 bu/a respectively. Test weights were low due to the rainy harvest season. Table 3.

In a summary of yields over several years Fielder was used as a check. Three varieties, ID112, UT670, and UT497 with one station year of data had yields higher than Fielder. Table 4.

Private Variety Nursery - This nursery contains lines and varieties developed by commercial companies which were compared to several established varieties used as checks. Two entries, NA13374 and Profit 75, yielded significantly higher than the check, Newana; Thatcher and WS701 yielded significantly lower. Test weights were low with NK5511 having the highest at 58.60 lbs/bu. Table 5.

Table 1. Agronomic data from the Advanced Yield Spring Wheat Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT in 1976. Field No. Y-6 (dryland) Random block design, four replications.

Date seeded: April 28, 1976 Date harvested: September 13, 1976 Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	Stripe Rust Prev.%	Stripe Rust Sev.
CI 17267	Borah	76.45	56.50	183.75b	28.25	75.00a	6.25a	7.50	2.00
ND 522	ND491/Fletcher	75.25	55.40	187.25b	33.00	62.50a	6.50a	2.50	1.00b
MT 7437	Redr68-Crim/3/N/B//4*Cnt	74.42	59.20	183.75b	30.75a	40.00	3.75	.00b	.00b
MT 746	Redr68-SI/3/N10/B14//5*C	73.27	58.50	185.75b	30.75a	82.50a	6.25a	6.25a	2.75
MT 749	Redr68-SI/3/N10/B14//5*C	72.57	59.50	185.25b	31.25a	62.50a	5.50a	3.75	2.25
CI 17282	Crosby	70.67	58.80	186.25b	39.00a	65.00a	5.25a	7.50	3.25
CI 15927	Norana (MT 7042) 1/	69.85	57.20	188.50	27.75	32.50	3.75	7.50	3.25
MT 7421	Redr68/3/N10/B14//6*Cnt	69.82	58.40	186.75b	32.00a	49.75	3.25	2.50	1.50b
CI 15892	Ward (Durum)	69.10	58.80	186.00b	37.25a	57.50	5.75a	6.25	3.75
CI 17430	Newana, MT 7156	68.32	57.10	188.50	29.00	26.25	4.00	6.25	3.25
MT 737	MRN10/BVR14//6*CNT/3/SI	68.05	58.50	187.50b	31.75a	57.25a	3.00	13.75	5.00a
MT 747	Redr68-SI/3/N10/B14//5*C	67.95	56.70	182.75b	27.25	82.50a	5.50a	16.25a	3.25
MT 7031	JT/3/MRN10/BVR14//4*CNT	67.55	56.40	186.00b	30.50	55.00	5.50a	.00b	.00b
MT 7537	SI/3/N10-B//4*CNT/4/Polk	67.40	57.40	188.75	31.25a	41.00	3.25	1.25	.50b
CI 15930	Olaf	67.22	57.70	186.00b	29.50	47.50	5.00	1.25	.50b
MT 7422	Redr68/3/N10/B14//6*CNT	66.32	54.70	187.50b	31.25a	40.00	4.75	5.00	2.50
CI 15926	Wared	65.30	57.50	189.50a	31.25a	50.00	5.25a	5.00	2.75
MT 7416	Redr68/3/N10/B14//6*CNT	65.15	58.10	183.50b	29.50	60.00a	5.25a	6.25	3.75
MN 6427	II-55-14/II-60-105	63.57	56.80	187.00b	30.25	67.50a	6.75a	5.00	2.50
CI 13775	Manitou, R.L. 4159	63.17	58.10	186.75b	37.00a	72.50a	5.00	.00b	.00b
MT 7448	PK 176/Sheridan	61.90	57.80	183.75b	29.00	65.00a	5.25a	15.00	4.00
ND 519	ND480//Polk/Wisc 261	61.40	59.10	184.50b	30.50	50.00	5.50a	8.75	2.75
CI 15326	Rolette (Durum)	59.94b	58.80	184.50b	37.75a	45.00	5.00	20.00a	5.25a
MT 7449	PK 176/Sheridan	59.47b	56.30	185.50b	27.25	56.25	5.75a	.00b	.00b
CI 13596	Fortuna	58.82b	57.30	187.75	37.25a	90.00a	6.50a	6.25	2.75
CI 17429	Lew, MT 711	58.17b	58.30	190.00a	36.50a	85.00a	6.50a	8.75	3.25
CI 13333	Wells	57.34b	56.90	188.75	42.25a	62.50a	6.00a	11.25	4.25
CI 17297	Kitt, MN 6433	54.12b	53.80	188.75	28.25	82.50a	7.00a	12.50	3.75
CI 10003	Thatcher	52.27b	56.70	186.50	36.25a	82.50a	6.25a	.00b	.00b
CI 17286	Tioga	51.52b	57.40	189.00	37.75a	87.50a	6.00a	43.75a	7.00a
	$\bar{x}$	65.21	57.46	186.53	32.28	61.10	5.31	7.67	2.56
	F 2/	4.09**	.00	46.75**	16.94**	3.18**	4.44**	7.66**	16.04**
	S.E.$\bar{x}$	3.29	.00	.29	.98	9.64	.52	3.10	.44
	L.S.D.(.05)	9.24	.00	.81	2.75	27.07	1.45	8.70	1.23
	C.V.%	5.04	.00	.15	3.02	15.77	9.73	40.42	17.18

Tabel 1 (con't)

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

Table 2. Summary of dryland hard red spring wheat yields for the Advanced Yield Nursery Grown at the Northwestern Agricultural Research Center, Kalispell, MT. 1967-76.

C.I. or State No.	Variety	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Ave.	Sta. Yrs.	% Thatcher
CI 10003	Thatcher	60.6	63.4	69.5	55.5	72.5	64.7	55.0	71.9	65.9	52.3	63.1	10	100
CI 13333	Wells	62.8	63.1	64.8	53.7	66.8	54.1	49.9	83.8	78.8	57.3	63.5	10	101
CI 13775	Manitou	57.5	57.6	70.7	66.9	67.1	61.5	53.8	77.5	69.3	63.2	64.5	10	102
CI 13596	Fortuna	56.4	74.7	88.9	41.9	76.8	56.2	60.5	81.9	68.9	58.8	66.5	10	105
CI 15927	Norana					90.8	87.6	69.7	98.4	72.7	69.8	81.5	6	128
CI 17430	Newana (MT 7156)						83.9	72.7	99.1	85.2	68.3	81.8	5	132
CI 17429	Lew (MT 711)						71.9	67.3	88.6	65.3	58.2	70.3	5	113
CI 17286	Tioga						62.7	58.6	80.9	63.3	51.5	63.4	5	102
CI 17297	Kitt (MN 6433)							61.5	88.7	81.9	54.1	71.5	4	117
CI 17267	Borah							69.5	102.9	95.0	76.5	86.0	4	140
CI 15930	Olaf							58.0	84.8	82.6	67.2	73.2	4	119
CI 15926	Wared								98.0	74.1	65.3	79.1	3	125
CI 15892	Ward (Durum)								93.4	77.8	69.1	80.1	3	126
MT 737	NRN10/BVR14//6*CNT/3/SI								90.3	83.3	68.1	80.6	3	127
MT 749	Redr 68-SI/3/N10/B14//5*CNT									96.7	72.6	84.6	2	143
MT 7416	Redr 68/3/N10/B14//6* CNT									90.0	65.2	77.6	2	131
MT 7421	Redr 68/3/N10/B14//6*CNT									80.9	69.8	75.3	2	127
MT 747	Redr 68-SI/3/N10/B14//5*CNT									80.5	68.0	74.2	2	126
CI 17282	Crosby									79.6	70.7	75.1	2	127
MT 746	Redr 68-SI/3/N10/B14//5*CNT									72.2	73.3	72.7	2	123
ND 522	ND491/Fletcher										75.3	75.3	1	144
MT 7437	Redr 68-Crim/3/N/B//4*CNT										74.4	74.4	1	142
MT 7031	JT/3/NRN10/BVR14//4*CNT										67.6	67.6	1	129
MT 7537	SI/3/N10-B//4*CNT/4/Polk										67.4	67.4	1	129
MT 7422	Redr 68/3/N10/B14//6*CNT										66.3	66.3	1	127
MN 6427	II-55-14/II-60-105										63.6	63.6	1	122
MT 7448	PK 176/Sheridan										61.9	61.9	1	118
ND 519	ND 480//Polk/Wisc. 261										61.4	61.4	1	117
CI 15326	Rolette (Durum)										59.9	59.9	1	114
MT 7449	PK 176/Sheridan										59.5	59.5	1	114

Table 3. Agronomic data from the Western Regional Spring Wheat Nursery grown on the Northwestern Agricultural Research Center, Kalispell MT in 1976. Field No. Y-6 (dryland). Random block design, four replications.

Date seeded: April 28, 1976 Date harvested: September 13, 1976 Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	Stripe Rust Prev %	Stripe Rust Sev.
WA 6105	HRY/KRN//AO/HRPC/3/13730	77.63a	55.40	188.25	33.50a	82.50	5.75	2.50	.75b
WA 6158	HRY/KRN//AO/HRPC/3/13730	73.65	54.70	189.50a	35.00a	45.00	5.00b	17.50a	3.25
ID 112	TZPP/SN64//B61-136	72.92	55.10	187.25	30.75a	70.00	6.25	1.25	.50b
CI 17267	Borah	72.77	56.20	184.25b	27.75	75.00	6.75	3.75	1.75
CI 17425	Fieldwin, ID 87	71.90	55.60	190.50a	30.75a	67.50	6.00	3.75	2.00b
UT 670	UT S15 and UT S16	69.10	54.90	185.75b	30.50a	67.50	6.50	.00	.00b
UT 497	UT S15 and UT S16	68.75	56.40	185.75b	28.00	65.00	7.00	2.50	1.00b
CI 17268	Fielder 1/	68.60	55.00	187.75	27.75	65.00	6.50	5.00	3.75
CA 70293	Inia 66/Anza	68.22	57.30	182.75b	27.25	67.50	6.00	5.00	1.75b
ID 106	Twin/Triple Dirk	66.95	50.10	189.50a	30.25a	62.50	6.50	.00	.00b
ID 107	TZPP/3*AN//B61-136	66.95	58.90	189.25	31.50a	32.50b	4.75b	1.25	.75b
WA 6108	WA5243/3/C3845/H7-536	63.95	52.10	190.75a	28.75	30.00b	5.25	.00	.00b
WA 6109	WA5243/3/C3845/H7-536	62.40	51.20	191.25a	26.75	25.00b	5.75	.00	.00b
CA 70285	Azteca 67/Anza	61.37	56.40	185.25b	25.50	50.00	5.00b	1.25	.75b
WA 6101	NRN 10/BVR11//P14/3/101	59.97b	56.00	194.25a	31.25a	12.50b	2.75b	.00	.00b
UT 4303	Utah 256-3-15-16/Delmar	59.44b	51.40	186.75b	26.25	60.00	5.25	3.75	1.75b
WA 6277	Spring Luke	59.22b	53.10	197.00a	30.50a	17.50b	3.25b	.00	.00b
CI 17424	Sawtell, ID 47	57.19b	53.40	187.25	29.00	52.50	6.25	8.75	3.50
UT 437	UT S15 & UT S16	54.52b	48.20	188.25	29.50	65.00	6.75	2.50	1.50b
WA 6276	Spring Luke	51.72b	50.70	196.25a	31.25a	35.00b	4.25b	.00	.00b
UT 517	UT S15 and UT S16	51.34b	48.10	190.75a	29.50	75.00	7.00	3.75	2.00b
ID 105	Twin*3//227196/A63166S	48.64b	47.50	190.00a	31.00a	82.50	7.75	.00	.00b
WA 6163	Norco Sel.	46.44b	53.20	195.50a	28.00	10.00b	3.00b	.00	.00b
ID 725078	Idaed 59/4*Lemhi 62	46.32b	52.40	190.25a	37.50a	87.50a	6.50	2.50	.50b
ID 104	SPF*3/3/ULKA/FR//LMH 66	40.49b	46.90	187.75	29.00	72.50	7.25	3.75	1.25b
WA 6157	N6600313/Twin	39.76b	47.20	190.00a	31.75a	75.00	7.00	.00	.00b
CI 4734	Federation	38.66b	49.80	189.25	36.75a	70.00	5.50	42.50a	6.00a
	$\bar{x}$	59.96	52.86	189.30	30.19	56.30	5.76	4.12	1.21
	F 2/	15.98**	.00	34.72**	11.29**	11.54**	7.78**	4.58**	8.13**
	S.E.$\bar{x}$	2.83	.00	.59	.87	6.61	.46	3.97	.52
	L.S.D.(.05)	7.95	.00	1.66	2.46	18.61	1.31	11.18	1.47
	C.V.%	4.71	.00	.31	2.89	11.75	8.06	96.45	42.94

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

Table 4 . Summary of the Western Regional Spring Wheat nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT. 1971-76.

C.I. or State No.	Variety	1971	1972	1973	1974	1975	1976	Ave.	Sta. Yrs.	% Fielder
CI 4734	Federation	51.3	65.3	69.4	69.4	40.7	38.7	55.8	6	59
CI 17268	Fielder	106.0	93.4	94.8	108.8	95.5	68.6	94.5	6	100
CI 17267	Borah	89.2	88.3	93.1	89.5	94.4	72.8	87.9	6	93
CI 17424	Sawtell (ID 47)			94.1	107.0	89.2	57.2	86.9	4	95
ID 725078	Idaed 59/4* Lemhi 62			80.9	76.4	76.8	46.3	70.1	4	76
CI 17425	Fieldwin, ID 87				107.2	78.6	71.9	85.9	3	95
WA 6101	NRN10/BVR11//P14/3/101					86.3	60.0	73.2	2	89
WA 6105	HRY/KRN//AO/HRPC/3/13730					83.6	77.6	80.6	2	98
ID 106	Twin/Triple Dirk					81.2	67.0	74.1	2	90
ID 107	TZPP/3*AN//B61-136					78.2	67.0	72.6	2	88
WA 6158	HRY/KRN//AO/HRPC/3/13730					75.6	73.7	74.7	2	91
ID 105	Twin*3//227196/A63166S					64.5	48.6	56.6	2	69
ID 104	SPF*3/3/ULKA/FR//LMK66					64.3	40.5	52.4	2	64
WA 6157	N6600313/Twin					54.3	39.8	47.1	2	57
ID 112	TZPP/SN64//B61-136						72.9	72.9	1	106
UT 670	UT S15 and UT S16						69.1	69.1	1	101
UT 497	UT S15 and UT S16						68.8	68.8	1	100
CA 70293	INIA 66/ANZA						68.2	68.2	1	99
WA 6108	WA 5243/3/C3845/H7-536						64.0	64.0	1	93
WA 6109	WA 5243/3/C3845/H7-536						62.4	62.4	1	91
CA 70285	Azteca 67/ANZA						61.4	61.4	1	90
UT 4303	Utah 256-3-15-16/Delmar						59.4	59.4	1	87
WA 6277	Spring Luke						59.2	59.2	1	86
UT 437	UT S15 & UT S16						54.5	54.5	1	79
WA 6276	Spring Luke						51.7	51.7	1	75
UT 517	UT S15 and UT S16						51.3	51.3	1	75
WA 6163	Norco Sel.						46.4	46.4	1	68

Table 5. Agronomic data from the Private Variety Nursery grown on the Northwestern Agricultural Research Center, Kalispell, MT in 1976. Random block design, four replications.

Date seeded: April 28, 1976 Date harvested: September 13, 1976 Size of plot: 16 sq. ft.

C.I. or State No	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	Stripe Rust Prev.%	Stripe Rust Sev.
NA 18374	NHS 183-74	76.25a	55.90	186.50b	30.25	35.00	5.00b	5.00	2.00
MT 45	Profit 75(W.S.)	73.65a	56.10	187.00	29.75	62.50	5.75	2.50	1.50
CI 13596	Fortuna	69.77	57.00	188.00	35.25a	82.50a	6.25	5.00	2.00
NK 5511	75 V 5511	67.50	58.60	188.00	30.00	47.50	5.25	5.00	2.50
NA 712	6WA-712 Early	67.05	54.50	188.25	26.25	70.00a	6.75	2.50	1.25
CE 1024	Cebeco 1024	65.87	55.80	187.50	30.25	57.50	6.00	5.00	1.25
CI 13986	ERA	65.47	55.30	190.25a	30.00	57.50	7.25	8.75	3.25
NK 5508	75V 5508	61.82	52.60	190.00	29.00	55.00	6.25	5.00	3.25
CI 17430	Newana, MT 7156[1/]	61.07	55.50	188.50	28.50	45.00	6.25	3.75	2.50
MT 44	Bounty 309(Cargill)	58.82	54.50	186.50b	29.00	52.50	5.00b	1.25	.50b
WS 25	World Seeds 25	58.64	54.00	186.50b	30.50	65.00	6.75	.00	.00b
MT 34	Prodax	55.69	54.00	187.00	29.00	65.00	6.25	5.00	2.25
NK 5507	75 V 5507	54.67	54.60	187.25	28.50	62.50	6.75	3.75	2.00
CI 10003	Thatcher	51.27b	54.10	187.50	38.25a	75.00a	6.25	2.50	.75
WS 701	World Seeds 701	50.62b	54.40	189.50	32.75a	65.00	7.00	.00	.00b
	$\bar{x}$	62.54	55.13	187.88	30.48	59.83	6.18	3.67	1.67
	F[2/]	4.98**	.00	4.56**	12.79**	2.33*	2.57**	1.53NS	2.47**
	S.E.$\bar{x}$	3.47	.00	.58	.82	7.87	.43	1.85	.66
	L.S.D.(.05)	9.91	.00	1.65	2.36	22.49	1.23	5.28	1.90
	C.V. %	5.54	.00	.31	2.70	13.15	6.98	50.38	39.81

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

TITLE: Winter Wheat

PROJECT: Small Grains Investigations MS 756

YEAR: 1976

PERSONNEL: Leader - Vern R. Stewart
Research Technician - Nancy Campbell
Cooperator - G. A. Taylor
Cooperating Agencies - Montana Agricultural Experiment Station
Montana Wheat Research and Marketing Committee

OBJECTIVES:

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

1976 EXPERIMENTS:

1. Western Regional Hard Red Winter Nursery
2. Off Station Nurseries
3. Western Regional White Winter Nursery

SUMMARY OF 1976 RESULTS:

Western Regional Hard Red Winter Nursery -

Kalispell - Four varieties yielded significantly higher than the check, Crest, and three yielded significantly lower. The rain at harvest time contributed to the low test weights. Lodging was fairly severe this year. No variety's lodging severity was significantly less than Crest, but four were significantly greater. Dwarf smut readings were very low this year. Since there was a low level of dwarf smut even in the susceptible varieties it cannot be deduced that the low readings indicate resistance. Table 1.

Stillwater - Yield data obtained from this nursery was found to be non-significant. Yields were good for the location with a mean yield of 41.49. Test weights tend to be low. Dwarf smut readings tend to be lower this year with varieties exhibiting lower readings or no dwarf smut that have shown higher readings in previous years. No variety has a dwarf smut reading significantly lower than Crest, but seven are significantly higher. Table 2.

Table 3, gives a summary of the data from the two locations. Yields were good this year, but test weights were low.

Off Station Nurseries -

Four off station nurseries were planted in the fall of 1975. The nursery in Missoula County was abandoned because of poor stands. The other three are reported below.

Lake County - The nursery's mean yield was 46.67 bu/a. All but two varieties yielded significantly higher than the check, Crest. Test weights were low. Five varieties had lodging severities less than Crest. Table 4.

Summary of 1976 Results (con't)

Ravalli County - Seven varieties yielded significantly lower than the check Crest, no varieties were significantly higher. The nursery's mean yield was 53.81 bu/a. Test weights ran a little low. Most varieties had lodging severity readings significantly lower than Crest. Table 5.

Sanders County - The mean yield was 16.41 bu/a. Four varieties had yields significantly higher than the check Crest. Only two test weights were obtainable, the other had insufficient amounts of grain. Sprague and Luke had lodging severity readings significantly higher than Crest. Table 6.

Western Regional White Winter Wheat Nursery -

Kalispell - The nursery's mean yield was 80.0 bu/a. Four varieties yielded significantly higher than the check, Nugaines and four varieties yielded significantly lower. Test weights tended to be low. Nine varieties had heading dates significantly later than Nugaines and four varieties were significantly earlier. Table 7.

In the summary over several years Nugaines was used as a check. Fourteen varieties had yields higher than Nugaines. Table 8.

Stillwater - This was the first year this nursery was grown at this location. Yields were good for this area, with a mean of 45.59 bu/a. Six varieties yielded significantly higher than the check, Nugaines. Elgin had the highest level of dwarf smut and was the only variety whose level was significantly higher than Nugaines. No variety was free of dwarf smut. Sprague with a dwarf smut reading of .50% was the lowest. Table 9.

A summary of the data from both locations was compiled. Yields were farily good, but test weights tend to be low. Dwarf smut readings were obtained only from the Stillwater location and all varieties were affected. Table 10.

Table 1. Agronomic data from the Western Regional Hard Red Winter Wheat Nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT. in 1976. Field E-3. Random block design, four replications.

Date seeded: September 18, 1975 Date harvested: August 30, 1976 Size of Plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/a	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	Dwarf Smut %	% Leaf Rust	Stripe Rust %	Stripe Rust Sev.
CI 13844	Wanser	79.38a	58.30	161.50	43.75	75.00	5.00	.00	2.25	3.75	1.00
ID 103	II-60-157/Wanser//McCall	78.68a	57.30	161.00	35.25b	72.50	6.00	.00	10.00	1.25	.25
WA 6239	Burt/Falco//Burt	78.63a	55.80	164.25a	38.50	55.00	5.25	.00	6.25	2.50	1.00
UT 88616	Utah Sel. 88616	73.52a	55.70	161.00	41.00	82.50	6.25	.00	1.25	.50	.25
ID 92	Minn2601255/CI14106//Mc	71.62	57.50	164.25a	38.50	85.00	6.75	.00	6.25	6.25	2.00
WA 6243	Washington Sel. 6243	71.60	55.80	161.25	40.75	75.00	6.75	.50	6.25	15.00	2.75
ID 755519	BZ//Burt/PI178383	70.95	59.60	169.00a	47.25a	85.00	6.00	.00	6.75	6.25	2.75
ID 745101	ID 5011/ID 5006	69.77	55.90	169.00a	38.25	70.00	7.50a	.00	4.25	3.75	2.00
WA 7003	PI173467/IT//Wanser	68.62	57.70	165.00a	43.75	90.00a	6.50	1.00a	5.00	5.00	.75
ID 101	A68229WA185	67.65	56.20	163.75a	41.25	85.00	7.50a	.00	3.75	5.00	1.75
ID 75537	WA4765//Burt/PI178383	66.37	50.60	165.00a	35.25b	92.25a	8.00a	.00	4.25	5.00	1.25
UT 819164	DM/CLM//Burt/PI178383	64.67	60.50	165.75a	48.75a	82.50	5.75	.00	12.50	2.50	.50
UT 81909	DM/CLM//Burt/PI178383	64.42	60.50	161.50	47.75a	82.50	6.25	.00	6.25	1.25	.25
ID 102	A68230W-D-3-1-1	64.00	57.40	165.50a	46.00a	85.00	6.50	.00	6.25	42.50a	5.25a
CI 12933	Itana 1/	61.47	58.90	163.25a	46.75a	82.50	6.50	.75	5.00	61.00a	5.50a
CI 13880	Crest 1/	61.20	57.90	161.00	42.00	70.00	6.00	.00	6.25	3.75	1.25
ID 113	CI 14106/MCCall,Sel.1	60.82	57.80	163.25a	41.00	77.50	7.00	.00	5.00	6.25	2.75
ID 745102	BEZ//Burt/178383/3/Ark	59.57	58.20	162.75a	45.25	67.50	6.50	.00	10.00	6.25	1.25
ID 114	CI 14106/McCall,Sel.2	59.49	56.20	163.00a	43.50	90.00a	8.75a	.00	15.00a	13.75	2.25
UT 819506	DM/CLM//Burt/PI178383	56.02	56.90	167.25a	49.25a	73.75	7.25	.00	5.00	.00	.00
ID 745103	Pope//Bex/3/Burt/178383	55.87	56.30	171.25a	49.00a	72.50	6.50	.00	3.00	3.75	1.00
UT 82380	Caddo//Burt/PI178383	55.77	60.00	163.00a	45.75	72.50	6.25	.00	18.75a	12.50	1.00
UT 819533	DM/CLM//Burt/PI178383	49.52b	59.50	169.00a	44.25	65.00	4.75	.00	4.25	6.25	3.25a
CI 1442	Kharkof	46.62b	56.90	168.00a	47.25a	65.00	6.50	.00	3.50	15.00	2.75
CI 17296	Hansel	44.41b	59.60	164.50a	45.75	67.50	7.25	.00	5.00	3.75	1.50
	$\bar{x}$ 2/	64.03	57.48	164.56	43.43	76.84	6.53	.09	6.48	9.31	1.77
	F 2/	5.84**	.00	63.03**	9.19**	2.26**	3.69**	5.19**	1.81*	4.53**	6.37**
	S.E.$\bar{x}$	3.92	.00	.37	1.36	6.19	.47	.11	2.97	6.44	.56
	L.S.D..(05)	9.24	.00	1.04	3.84	17.47	1.31	.32	8.38	18.17	1.59
	C.V.%	6.12	.00	.22	3.13	8.06	7.12	126.28	45.88	69.22	31.78

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

Table 2. Agronomic data from the Western Regional Hard Red Winter Wheat Nursery grown at the Lance Claridge farm, Kalispell, MT, in 1976. Ramdom block design, four replications.
Date seeded: September 25, 1975 Date harvested: September 1, 1976
Size of plot: 16 sq. ft.

C.I. or State No	Variety	Yield Bu/A	Test Wt Lbs/Bu	Plant Height	Lodging %	Lodging Sev.	Dwarf Smut %	Stripe Rust %	Stripe Rust Sev.
ID 75537	WA4765//Burt/ PI 178383	49.39	57.00	31.00	24.75	.25b	.50	.00	.00
UT819533	DM/CLM//Burt/ PI 178383	46.42	59.90	39.50a	.00	.00b	.00	1.25	1.25
UT819506	DM/CLM//Burt/ PI 178383	46.37	56.80	41.50a	36.00	2.00	.25	.00	.00
ID 114	CI 14106/McCall, Sel.2	44.69	59.20	33.25	99.00a	1.00b	.00	.00	.00
ID 102	A6823OW-D-3-1-1	44.19	58.70	33.75	26.25	3.00	.50	3.75a	2.75a
ID755519	BZ//Burt/ PI178383	44.06	61.80	38.75a	74.25a	.75b	.25	1.25	.75
WA 6243	Washington Sel. 6243	43.69	58.70	30.50	76.75a	1.25b	9.00a	3.75a	2.25a
WA 6239	Burt/Falco// Burt	43.64	55.70	31.75	74.25a	.75b	7.75a	.00	.00
UT819164	DM/CLM//Burt/ PI178383	42.86	61.40	40.50a	1.25	.75b	.50	.00	.00
UT 81909	DM/CLM//Burt/ PI178383	42.74	61.40	39.25a	74.25a	.75b	.25	.00	.00
CI 13880	Crest 1/	42.09	58.50	32.00	12.50	3.00	.25	.00	.00
ID 101	A68229WA185	41.96	59.80	32.75	28.50	1.00b	.50	.00	.00
UT 88616	Utah Sel. 88616	41.74	60.70	32.00	49.50	.50b	1.00	.00	.00
ID 113	CI14106/McCall Sel.1	41.66	60.10	31.00	75.50a	1.50b	.75	1.25	.75
ID745101	ID5011/ID5006	41.64	59.00	29.00b	.00	.00b	.75	.00	.00
UT 82380	Caddo//Burt/ PI178383	40.91	61.00	37.25a	74.25a	.75b	.00	.00	.00
CI 17296	Hansel	40.84	60.80	39.25a	49.75	2.25	.75	.00	.00
WA 7003	PI173467/IT// Wanser	40.79	57.70	33.00	53.25	1.25b	9.50a	.00	.00
ID745102	BEZ//Burt / 178383/3/Ark	40.09	58.50	38.25a	28.50	2.50	1.25	.00	.00
ID745103	Pope//BEZ/3/ Burt/178383	39.39	57.90	39.25a	76.75a	1.50b	2.25	.00	.00
ID 92	Minn2601255/ CI14106//MC	39.36	58.10	30.00	24.75	.25b	.00	.00	.00
CI 12933	Itana	37.11	59.70	37.25a	78.00a	1.50b	7.00a	5.00a	3.50a
CI 1442	Kharkof	35.94	60.40	40.75a	10.00	3.00	9.50a	1.25	.75
ID 103	II-60-157/ Wanser//McCall	33.94	59.40	29.25b	.00	.00b	17.25a	.00	.00
CI 13844	Wanser	31.74	56.80	35.25a	76.75a	1.25b	20.75a	1.25	.75
	$\bar{x}$	41.49	59.16	35.04	44.99	1.23	3.62	.75	.51
	F 2/	.78NS	.00	26.76**	2.48**	6.50**	9.11**	4.67**	4.54**
	S.E.$\bar{x}$	4.40	.00	.79	19.91	.37	1.89	.65	.45
	L.S.D.(.05)	12.41	.00	2.23	56.14	1.04	5.33	1.82	1.27
	C.V. %	10.61	.00	2.26	44.25	29.91	52.23	86.25	88.46

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

Table 3. Summary of agronomic data from the Western Regional Hard Red Winter Wheat Nursery grown at the Northwestern Agricultural Research Center and Stillwater in 1976.

CI or State No	Variety	Yield Bu/A[1]	Test Wt Lbs/Bu[1]	Heading Date[2]	Plant Height[1]	Lodging[1] %	Lodging[1] Sev.	% Dwarf Smut[3]
CI 13844	Wanser	55.56	57.55	161.50	39.50	75.88	3.13	20.75a
ID 103	II-60-157/ Wanser//McCall	56.31	58.35	161.00	32.25	36.25	3.00	17.25a
WA 6239	Burt/Falco//Burt	61.14	55.80	164.25a	35.13	64.63	3.00	7.75a
UT 88616	Utah Sel. 88616	57.63	58.20	161.00	36.50	66.00	3.38	1.00
ID 92	Minn. 2601255/ CI14106//Mc	55.49	57.30	164.25a	34.25	54.88	3.50	.00
WA 6243	Washington Sel. 6243	57.65	57.25	161.25	35.63	75.88	4.00	9.00a
ID755579	BZ//Burt/PI178383	57.51	60.70	169.00a	43.00	79.63	3.38	.25
ID745101	ID 5011/ID 5006	55.71	57.45	169.00a	33.63	35.00	3.75	.75
WA 7003	PI173467/IT// Wanser	54.71	57.70	165.00a	38.38	71.63	3.88	9.50a
ID 101	A68229 WA185	54.81	58.00	163.75a	37.00	56.75	4.25	.50
ID 75537	WA4765//Burt/ PI 178383	57.88	53.80	165.00a	33.13	58.50	4.13	.50
UT819164	DM/CLM//Burt/ PI 178383	53.77	60.95	165.75a	44.63	41.88	3.25	.50
UT 81909	DM/CLM//Burt/ PI 178383	53.58	60.95	161.50	43.50	78.38	3.50	.25
ID 102	A68230W-D-3-1-1	54.10	58.05	165.50a	39.88	55.66	4.75	.50
CI 12933	Itana[4]	49.29	59.30	163.25a	42.00	80.25	4.00	7.00a
CI 13880	Crest[4]	51.65	58.20	161.00	37.00	41.25	4.50	.25
ID 113	CI 14106/McCall, Sel. 1	51.24	58.95	163.25a	36.00	76.50	4.25	.75
ID745102	Bez//Burt/ 178383/3/Ark	49.83	59.35	162.75a	41.75	48.00	4.50	1.25
ID 114	CI14106/McCall, Sel. 2	52.09	57.70	163.00a	38.38	94.50	4.88	.00
UT819506	DM/CLM//Burt/ PI 178383	51.20	56.90	167.25a	45.38	54.88	4.63	.25
ID745103	Pope//Bez/3/ Burt/178383	47.63	57.10	171.25a	44.13	74.63	4.00	2.25
UT 82380	Caddo//Burt/ PI 178383	48.34	60.50	163.00a	41.50	73.38	3.50	.00
UT819533	DM/CLM//Burt/ PI 178383	49.97	59.70	169.00a	41.88	35.50	2.80	.00
CI 1442	Kharkof	41.28	58.65	168.00a	44.00	37.50	4.75	9.50a
CI 17296	Hansel	42.63	60.20	164.50a	42.50	58.63	4.75	.75

1/ $\bar{x}$ for Northwestern Agricultural Research Center and Stillwater
2/ $\bar{x}$ for Northwestern Agricultural Research Center only
3/ $\bar{x}$ for Stillwater only
4/ Check variety
a/ Value significantly greater than the check (.05)
b/ Value significantly less than the check (.05)

Table 4. Agronomic data from the off station winter wheat nursery grown in Lake County on the Norman (Bud) Trost farm, Ronan, MT. in 1976. Random block design, four replications.

Date seeded: September 24, 1975 Date harvested: August 25, 1976
Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/a	Test Wt Lbs/Bu	Plant Height	Lodging %	Lodging Sev.
MT 6829		43.40	54.8	33.00a	60.00	4.25a
17295	Cardon	49.32a	55.8	37.75a	52.50	3.50
8885	Cheyenne	44.65a	55.8	35.75a	45.00	3.25
WA 5826		47.30a	52.8	26.00b	0.00	0.00b
15317	Franklin	54.50a	55.8	40.00a	62.50	3.75
WA 6099		47.97a	54.0	28.00	74.25	0.75b
ID 0037	Jeff	45.62a	56.7	38.00a	22.50	3.00
17296	Hansel	34.85	55.9	38.00a	25.00	3.00
17298	Peck	46.42a	55.3	31.00a	76.75	1.50
13968	Nugaines	46.85a	55.2	27.25	57.00	2.00
14586	Luke	58.74a	51.1	26.25b	54.50	2.00
14564	Hyslop	50.84a	52.8	25.25b	74.25	0.75b
OR 7147		44.80a	53.2	24.25b	74.25	0.75b
14485	Paha	44.72a	54.9	29.75	49.50	0.50b
13880	Crest 1/	35.13	55.2	28.75	34.75	2.50
15376	Sprague	51.50a	51.0	29.00	47.50	4.25a
	$\bar{x}$	46.67	54.4	31.13	50.64	2.23
	F 2/	4.02**	0.0	55.93**	N.S.	10.15**
	S.E.$\bar{x}$	30.30	0.0	0.70	19.37	0.44
	L.S.D.(.05)	8.61	0.0	1.99	55.05	1.25
	C.V.%	6.49	0.0	2.25	38.24	19.72

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

Table 5. Agronomic data from the off station winter wheat nursery grown in Ravalli County on the Ross McIntyre farm, Stevensville, MT in 1976. Random block design, four replications.

Date Seeded: September 23, 1975 Date Harvested: September 27, 1976
Size of Plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/a	Test Wt Lbs/Bu	Plant Height	Lodging %	Lodging Sev.
MT 6829		56.82	59.1	34.50	2.50b	0.50b
17295	Cardon	61.54	60.4	36.75	33.50	2.25
8885	Cheyenne 3/	38.83b	57.4	39.00a	30.00	2.25
WA 5826		49.55b	54.7	24.75b	0.00b	0.00b
15317	Franklin	42.70b	55.7	39.75a	0.00b	0.00b
WA 6099		63.29	58.1	27.00b	0.00b	0.00b
ID 0037	Jeff	45.50b	58.9	38.50a	57.50	3.75
17296	Hansel	55.67	60.9	39.75a	40.00	2.75
17298	Peck 3/	67.06	57.8	33.00	0.00b	0.00b
13968	Nugaines 3/	61.06	57.9	24.50b	0.00b	0.00b
14586	Luke	51.24b	54.0	24.75b	0.00b	0.00b
14564	Hyslop	40.20b	54.6	26.25b	0.00b	0.00b
OR 7147		54.27	56.5	28.75b	0.00b	0.00b
14485	Paha 3/	45.57b	56.4	26.25b	0.00b	0.00b
13880	Crest 1/	61.79	60.0	33.50	38.75	3.00
15376	Sprague 3/	65.76	58.9	28.25b	0.00b	0.00b
	$\bar{x}$ 2/	53.81	57.6	31.58	12.64	0.92
	F 2/	4.33**	0.0	18.84**	3.86**	7.12**
	S.E.$\bar{x}$	44.61	0.0	1.35	10.08	0.52
	L.S.D.(.05)	12.67	0.0	3.85	28.64	1.47
	C.V.%	8.29	0.0	4.29	79.71	56.13

1/ Check variety
2/ Value for variety comparison
3/ Some smut balls found
* Indicates statistical significance at the .05 level
** Indicates statistical significance at the .01 level
a/ Values significantly greater than the check (.05)
b/ Values significantly less than the check (.05)

Table 6. Agronomic data from the off station winter wheat nursery grown in Sanders County on the Jack Marranin farm, Perma, MT in 1976. Random block design four replications.

Date seeded: September 23, 1975 Date harvested: August 10, 1976
Size of plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Plant Height	Lodging %	Lodging Sev.
MT 6829		17.80	-	18.50	76.75	1.25
17295	Cardon	12.15	-	17.75	0.00	0.00
8885	Cheyenne	20.20a	-	17.75	52.00	1.25
WA 5826		12.63	-	14.75	0.00	0.00
15317	Franklin	15.50	-	19.25	49.50	0.50
WA 6099		22.48a	59.4	16.50	74.25	0.75
ID 0037	Jeff	20.68a	-	20.00a	24.75	0.25
17296	Hansel	13.93	-	22.50a	53.25	1.25
17298	Peck	17.45	-	16.25	24.75	0.25
13968	Nugaines	12.23	-	16.75	0.00	0.00
14586	Luke	14.75	-	18.75	13.75	4.25a
14564	Hyslop	21.95a	58.5	18.75	74.25	0.75
OR 7147		17.63	-	14.00	0.00	0.00
14485	Paha	16.10	-	15.75	0.00	0.00
13880	Crest 1/	13.25	-	16.75	49.50	0.50
15376	Sprague	13.98	-	18.00	16.25	3.50a
	$\bar{x}$ 2/	16.41	59.0	17.63	31.81	0.91
	F 2/	2.67*	0.0	4.06**	2.28*	13.61**
	S.E.$\bar{x}$	21.22	0.0	1.03	19.37	0.34
	L.S.D.(.05)	6.03	0.0	2.94	55.05	0.97
	C.V. %	12.93	0.0	5.86	60.88	37.52

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

Table 7. Agronomic data from the Western Regional White Winter Wheat Nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT in 1976. Random block design, four replications.
Date Seeded: September 22, 1975 Date Harvested: August 13, 1976 Size of Plot: 16 sq. ft.

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Heading Date	Plant Height	Lodging %	Lodging Sev.	Leaf Rust %	Stripe Rust Prev.%	Stripe Rust Sev 3/
CI 14565	McDermid	93.28a	57.10	165.25	33.25	74.25a	.75	1.25	2.50	1.50
WA 6099	WA4877/VB66336	92.83a	59.30	165.25	33.75	.00	.00b	2.50	.00	.00
OR 68007	Yamhill/Hyslop	92.13a	57.70	169.50a	36.50a	.00	.00b	.00	.00	.00
OR 67237	CD/101//55-1744/3/DC	89.85a	58.80	167.00	34.25a	24.75	.25	1.25	1.25	.75
WA 6156	71R261/Aline CI 13438	89.23	59.60	163.50b	37.25a	76.75a	1.50	2.50	2.50	1.25
ID 755312	WA 4765//Burt/PI 178383	88.43	56.30	165.50	35.75a	27.25	1.00	.00	.00	.00
CI 14564	Hyslop	87.65	58.40	166.00	32.00	.00	.00b	.00	1.25	.75
ID 755314	WA 4765//Burt/PI 178383	86.53	60.70	168.25a	42.50a	7.50	2.00	1.25	1.25	.25
WA 6241	VH 66354/WA 5827	84.63	55.00	168.75a	30.75b	50.75	1.25	3.75	.00	.00
OR 739401	Oregon Sel. R73-9401	83.80	55.20	166.50	33.00	24.75	.25	2.50	2.50	1.75
WA 6242	Luke//Itana/CI 13431	83.23	58.80	166.25	33.50	74.25a	.75	2.50	3.75	2.25
OR 65116	Nord Desprez/Sel. 101	82.13	57.10	164.25b	33.25	.00	.00b	2.50	2.50	1.50
CI 13968	Nugaines 1/	80.15	59.40	166.50	32.50	7.50	1.50	5.00	2.50	1.50
CI 15376	Sprague	79.83	55.40	166.00	37.25a	76.00a	7.75a	7.50	1.25	1.00
WA 6240	VD 68245/Luke	79.48	57.00	170.50a	32.25	53.25	1.25	.00	1.25	.50
CI 17294	Rew	78.80	59.90	168.25a	40.00a	31.00	2.50	5.00	2.50	1.75
WA 6238	CI 13749/Omar//Delos	76.93	57.90	165.25	35.75a	7.50	4.00a	10.00	10.00	4.00a
OR 7141	CI 13748/Moro, Sel. 38	76.30	56.60	164.25b	35.75a	13.75	4.00a	6.25	5.00	1.25
OR 7138	OM/CI 13749, Sel. 3862	75.62	59.50	167.00	36.50a	54.50a	2.00	3.75	15.00a	4.50a
CI 14485	Paha	75.37	57.40	166.75	36.75a	29.75	2.25	6.25	22.50a	4.25a
OR 7388	27-15//R-R/3/EG/4/13748	75.20	58.30	168.75a	37.50a	29.75	1.75	3.75	5.00	3.25
OR 7147	C.I. 13748/Moro, 905	74.87	55.40	165.75	34.50a	12.50	4.00a	7.50	.00	.00
OR 7142	C.I. 13748/Moro, 142	74.12	57.90	165.75	36.25a	13.75	3.25a	6.25	2.50	1.50
OR 67205	Cap. Desp./Sel. 101//DRV	72.77	53.90	170.00a	29.00b	.00	.00b	1.25	3.75	1.25
CI 13740	Moro	69.80b	57.50	167.50	42.00a	22.50	4.50a	5.00	.00	.00
WA 6155	13431/7805/13447/3*Omar	68.27b	55.50	168.75a	34.50a	34.75	2.50	5.00	7.50	1.75
CI 11755	Elgin	67.60b	60.20	168.25a	42.00a	7.50	3.00a	5.00	6.25	4.00a
CI 1442	Kharkof	61.05b	60.60	164.50b	46.00a	50.00	4.00a	3.75	10.00	3.50
	$\bar{x}$ 2/	80.00	57.73	166.78	35.87	28.72	2.00	3.62	4.02	1.57
	F	6.42**	.00	14.07**	46.53**	2.43**	15.27**	1.60*	1.87*	3.26**
	S.E.$\bar{x}$	3.27	.00	.49	.56	16.40	.47	2.05	3.74	.79
	L.S.D.(.05)	9.19	.00	1.38	1.58	46.13	1.32	5.78	10.51	2.21
	C.V. %	4.08	.00	.29	1.57	57.09	23.41	56.83	93.00	50.02

Table 7. (con't)

1/ Check variety
2/ Value for variety comparison
* Indicates statistical significance at .05 level
** Indicates statistical significance at .01 level
a/ Values significantly greater than the check .05
b/ Values significantly less than the check .05
3/ Rate 0-9

Table 8. Summary for yields for the Western Regional White Winter Wheat Nursery grown at the Northwestern Agricultural Research Center, Kalispell, MT. 1967-76

C.I. or State No.	Variety	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Ave.	Sta. Yrs.	% Nugaines
CI 1442	Kharkof	47.4	58.5	58.9	56.4	62.1	59.7	45.3	27.7	37.4	61.1	51.5	10	70
CI 11755	Elgin	49.6	80.5	51.2	74.1	73.0	70.8	50.9	59.2	42.3	67.6	61.9	10	84
CI 13740	Moro	57.2	86.3	65.7	75.4	68.3	68.5	65.6	60.3	44.0	69.8	66.1	10	89
CI 13968	Nugaines	58.7	85.8	63.2	77.6	102.8	73.0	68.5	77.9	51.8	80.2	73.9	10	100
CI 14485	Paha		98.1	65.4	87.0	101.2	88.9	71.1	95.0	55.6	75.4	82.0	9	108
CI 14564	Hyslop		90.1	62.7	87.3	113.1	90.1	63.1	96.3	56.8	87.7	83.0	9	110
CI 14565	McDermid				88.8	111.9	95.8	63.4	84.7	57.1	93.3	85.0	7	112
OR 67205	Cap. Desp./Sel. 101// DRV							63.3	100.0	56.0	72.8	73.0	4	105
OR 65116	Nord Desprez/Sel 101							61.6	81.2	52.3	82.1	69.3	4	100
WA 6099	WA4877/VB66336								89.0	56.3	92.8	79.4	3	113
OR 7147	C.I. 13748/Moro, 905								85.4	53.5	74.9	71.3	3	102
CI 15376	Sprague								81.7	47.5	79.8	69.7	3	100
OR 7142	C.I. 13748/Moro, 142									51.4	74.1	62.8	2	95
CI 17294	Rew									50.4	78.8	64.6	2	98
OR 68007	Yamhill/Hyslop										92.1	92.1	1	115
OR 67237	CD/101//55-1744/3/DC										89.9	89.9	1	112
WA 6156	71R261/Aline CI 13438										89.2	89.2	1	111
ID 755312	WA4765//Burt/PI 178383										88.4	88.4	1	110
ID 755314	WA 4765//Burt/PI 178383										86.5	86.5	1	108
WA 6241	VH 66354/WA 5827										84.6	84.6	1	105
OR 739401	Oregon Sel. R73-9401										83.8	83.8	1	104
WA 6242	Luke//Itana/CI 13431										83.2	83.2	1	104
WA 6240	VD 68245/Luke										79.5	79.5	1	99
WA 6238	CI 13749/Omar//Delos										76.9	76.9	1	96
OR 7141	CI 13748/Moro, Sel. 38										76.3	76.3	1	95
OR 7138	OM/CI 13749, Sel. 3862										75.6	75.6	1	94
OR 7388	27-15//R-R/3/EG/4/13748										75.2	75.2	1	94
WA 6155	13431/7805/13447/3*Omar										68.3	68.3	1	85

Table 9. Agronomic data from the Western Regional White Winter Wheat Nursery grown on the Lance Claridge farm, Kalispell, Montana in 1976. Random block design, four replications.

Date seeded: September 24, 1975 Size of Plot: 16 sq. ft.
Date harvested: September 1, 1976

C.I. or State No.	Variety	Yield Bu/A	Test Wt Lbs/Bu	Plant Height	Lodging %	Lodging Sev.	Dwarf Smut %
WA 6240	VD 68245/Luke	57.44a	57.00	27.00	.00	.00	1.75b
OR 7138	OM/CI13749, Sel. 3862	52.04a	58.20	28.25	.00	.00	23.75
CI 15376	Sprague	51.97a	57.60	27.50	33.50	2.50a	.50b
CI 14565	McDermid	51.87a	55.60	28.00	52.00	1.00	11.50
OR 7142	C.I. 13748/Moro, 142	50.47a	57.80	27.50	26.00	1.00	10.25
CI 13740	Moro	50.24a	56.50	32.75a	49.50	2.50a	1.25b
OR 739401	Oregon Sel. R73-9401	48.89	57.50	27.50	.00	.00	16.25
ID 755314	WA 4765//Burt/PI 178383	48.52	57.50	34.00a	74.25	.75	1.75b
WA 6241	VH 66354/WA 5827	48.19	55.60	26.50	74.25	.75	13.75
OR 7388	27-15//R-R/3/EG/4/13748	47.54	58.00	28.75	.00	.00	15.00
OR 65116	Nord Desprez/Sel. 101	47.29	57.20	28.00	49.50	.50	17.50
CI 14564	Hyslop	47.24	57.10	26.50	74.25	.75	16.25
OR 68007	Yamhill/Hyslop	46.44	56.10	29.00a	.00	.00	16.25
WA 6155	13431/7805/13447/3*Omar	46.39	56.60	25.75	24.75	.25	20.00
ID 755312	WA 4765//Burt/PI 178383	46.27	57.70	29.00a	74.25	.75	3.00b
OR 7141	CI 13748/Moro, Sel. 38	45.39	57.50	27.50	24.75	.25	5.25b
OR 7147	C.I. 13748/Moro, 905	45.21	56.70	26.50	.00	.00	4.00b
OR 67237	CD/101//55-1744/3/DC	45.14	56.20	28.75	74.25	.75	25.00
WA 6242	Luke//Itana/CI 13431	43.51	57.20	26.50	49.50	.50	2.75b
OR 67205	CAP. Desp./Sel. 101//Drv	43.14	56.30	24.75	.00	.00	15.00
WA 6099	WA4877/VB66336	42.81	59.50	28.00	.00	.00	9.00
CI 14485	Paha	42.69	57.10	30.25a	49.50	.50	22.50
WA 6238	CI 13749/Omar//Delos	41.26	56.50	28.50	24.75	.25	27.50
CI 13968	Nugaines[1/]	40.36	59.10	26.00	49.50	.50	18.75
WA 6156	71R261/Aline CI 13438	39.31	57.50	28.50	99.00	1.00	25.00
CI 1442	Kharkof	39.14	59.50	35.50a	17.50	3.00a	17.50
CI 11755	Elgin	35.44	56.70	33.00a	24.75	.25	31.25a
CI 17294	Rew	32.26	58.20	31.75a	52.00	1.00	27.50
	$\bar{x}$	45.59	57.29	28.62	35.63	.67	14.28
	F[2/]	2.91**	.00	6.13**	2.15**	2.66**	4.93**
	S.E.$\bar{x}$	3.15	.00	1.05	20.34	.49	4.14
	L.S.D. (.05)	8.86	.00	2.95	57.23	1.37	11.65
	C.V. %	6.91	.00	3.67	57.09	72.70	29.01

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

Table 10. Summary of agronomic data from the Western Regional White Winter Wheat Nursery grown at the Northwestern Agricultural Research Center and Stillwater in 1976.

C.I. or State No.	Variety	Yield Bu/A 1/	Test Wt Lbs/Bu 1/	Heading Date 2/	Plant Height 1/	Lodging % 1/	Lodging Sev. 1/	% Dwarf Smut 3/
CI 14565	McDermid	72.58	56.35	165.25	30.63	63.63	0.88	11.50
WA 6099	WA4877/VB66336	67.82	59.40	165.25	30.88	0.00	0.00	9.00
OR 68007	Yamhill/Hyslop	69.29	56.90	169.50a	32.75	0.00	0.00	16.25
OR 67237	CD/101//55-1744/3/DC	67.50	57.50	167.00	31.50	49.50	0.50	25.00
WA 6156	71R26a/Aline CI13438	64.27	58.55	163.50b	32.88	87.88	1.25	25.00
ID 755312	WA4765//Burt/PI 178383	67.35	57.00	165.50	32.38	50.75	0.88	3.00b
CI 14564	Hyslop	67.45	57.75	166.00	29.25	37.13	0.38	16.25
ID 755314	WA4765//Burt/PI178383	67.53	59.10	168.25a	38.25	40.88	1.38	1.75b
WA 6241	VH 66354/WA 5827	66.41	55.30	168.75a	28.63	62.50	1.00	13.75
OR 739401	Oregon Sel. R73-9401	66.35	56.35	166.50	30.25	12.38	0.13	16.25
WA 6242	Luke//Itana/CI13431	63.37	58.00	166.25	30.00	61.88	0.63	2.75b
OR 65116	Nord Desprez/Sel. 101	64.71	57.15	164.25b	30.63	24.75	0.25	17.50
CI 13968	Nugaines 4/	60.26	59.25	166.50	29.25	28.50	1.00	18.75
CI 15376	Sprague	65.90	56.50	166.00	32.38	54.75	5.13	0.50b
WA 6240	VD68245/Luke	68.46	57.00	170.50a	29.63	26.63	0.63	1.75b
CI 17294	Rew	55.53	59.05	168.25a	35.88	41.50	1.75	27.50
WA 6238	CI 13749/Omar//Delos	59.10	57.20	165.25	32.13	16.13	2.13	27.50
OR 7141	CI13748/Moro, Sel. 38	60.85	57.05	164.25b	31.63	19.25	2.13	5.25b
OR 7138	OM/CI13749, Sel. 3862	63.83	58.85	167.00	32.38	27.25	1.00	23.75
CI 14485	Paha	59.03	57.25	166.75	33.50	39.63	1.38	22.50
OR 7388	27-15//R-R/3/EG/4/13748	61.37	58.15	168.75a	33.13	14.88	0.88	15.00
OR 7147	CI13748/Moro, 905	60.04	56.05	165.75	30.50	6.25	2.00	4.00b
OR 7142	CI13748/Moro, 142	62.31	57.85	165.75	31.88	19.88	2.13	10.25
OR 67205	Cap. Desp./Sel101//DRV	57.96	55.10	170.00a	26.88	0.00	0.00	15.00
CI 13740	Moro	60.02	57.00	167.50	37.38	36.00	3.50	1.25b
WA 6155	13431/7805/13447/3*Omar	57.33	56.05	168.75a	30.13	29.75	1.38	20.00
CI 11755	Elgin	51.52	58.45	168.25a	37.50	16.13	1.63	31.25a
CI 1442	Kharkof	50.10	60.05	164.50b	40.75	33.75	3.50	17.50

1/ $\bar{x}$ for Northwestern Agricultural Research Center and Stillwater
2/ $\bar{x}$ for Northwestern Agricultural Research Center only
3/ $\bar{x}$ for Stillwater only
4/ Check variety
a/ Value significantly greater than check (.05)
b/ Value significantly less than check (.05)

YEAR: 1976

TITLE: Investigation of cropping sequence on 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 effect of a 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 for all operations.

Fertilizer application rates were based on soil analysis and experience over the past 10 years in these fields.

Protein data was obtained using the Udy method of analysis.

An economic evaluation is made of this study for a period of five years. Three of the sequences have gone a full cycle. In this evaluation we have subtracted only the cost of fertilizers from the gross income. The value of crops is based on; actual sales of hay, and price of 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 DISCUSSION:

Moisture for the crop year of 1975-76 was 19.97 inches, which was .96 of an inch higher than the long term mean at the research center. Precipitation during the months, April, May, June and July was very near the long term mean. August precipitation was 3.42 inches, which was 1.79 inches above the 27 year mean. Spring barley yields are much higher than the 1975 yields. This I attribute to the additional rainfall this season and a higher yielding variety of barley.

Sequence in R-2: Winter wheat yields are very good, higher than any year during the study. Barley yields are 51.1 bushel above last years yield. This is due in part, to the variety and the more favorable rainfall pattern. It should be noted as you compare Sequences R-2 with R-4, for the first time in five years, R-2 is slightly higher in yield of wheat and barley. The only difference between these sequences is the green manure plowed down in R-2. The nitrogen rate on wheat was a little higher in R-2 than in R-4 this season. The nitrogen rate on barley in R-4 was 5 lbs/A higher than in R-2.

Sequence R-3: The human element caused a grave error in this sequence. The alfalfa stand which was to be plowed in the spring of 1977 was plowed in the spring of 1976. To compensate for this error, alfalfa yields were estimated at 3 T/A. This may be somewhat high, however yields in a lighter soil in Field R-7a were 2.5 T/A and in 1975 yields from this field (R-3) were 3.3 T/A. Winter wheat yields are low. This can be attributed to a high population of downy bromegrass (Cheat) throughout the field. This stand of downy bromegrass developed because of

the method of tillage. R-3c was fallowed with a disk and vibra shank cultivator. Normally all fields are plowed with a mowboard plow. This usually results in excellent control of downy bromegrass in these soils.

Sequence R-4: This has been discussed in part, under Sequence R-2. I should add that wild oats were not a problem in either sequence R-2 or R-4 this season as they were last season. Triallate (Fargo) at 1.25 lbs/A was applied following seeding, which accounts in part, for good control of wild oats.

Sequence R-5: Hard red winter wheat yields are below last years yields and considerably below the yields of winter wheat in Sequence R-2 and R-4. In periods of normal or above normal rainfall the variety Crest will not yield with the soft white varieties. Monetary returns are lower this season because of the new seeding of alfalfa. Alfalfa yields are quite good for seeding year under these conditions.

Sequence R-7: Small grains this season were highest in yield than ever before secured from this sequence. Alfalfa yields were a little higher than last year, 1975, but lower than the 1974 yields. The return per acre in this sequence was the highest in the entire study in 1976. Quackgrass is becoming a problem in this sequence. We are able to control wild oats and the broadleadleaf weeds however, quackgrass is difficult to control without a fallow period. The seedings made in the fall of 1976 have a very high population of quackgrass. A modification of this sequence may be necessary to bring about control of this grassy weed. Table 1.

Five Year Economic Evaluation: In this five year summary we have only subtracted fertilizer cost when making this analysis. No doubt we should include other costs of production, such as chemicals, seed, tillage and etc. This will be considered in another season. We have sufficient records that most of the cost could be calculated.

In sequence R-3a (fifteen years, five legume, winter wheat, fallow, alternating) is the most productive in the study at $93.90/A. It should be noted that all cropping sequences were down in value from the four year average except the continuous cropping, which was up about $5.00/A. Most of the loss is related to the price of the commodity. Average produced yields were found to be improved in R-2, for both wheat and barley when compared to the four year average. Wheat yields were down in R-3 and R-5 and slightly increased in R-4 and R-7. Other comparisons and checks can be made in Tables 2, 3,4,5 and 6.

Table 1. Annual data from cropping sequence study, Northwestern Agricultural Research Center, Kalispell, MT, 1976.

Field Number	Crop	Variety	Pounds/Acre N	P_2O_5	S	% Protein	Test Wt Lbs/Bu	Yield/ Acre	Price Unit Dollars	Gross[1] Dollars	Fertilizer Cost	Net per Sequence	Dollars/ Acre
			Crop Sequence - 3 years: fallow, winter wheat, spring grain seed legume with spring grain and plow down as green manure										
R-2a	Fallow												
R-2b	W. Wheat	Luke	104	37	26		56.0	77.0bu	2.08/bu	160.16	33.91		
R-2c	S. Barley	Freja	52	27	0		50.0	83.4bu	3.75/cwt	150.12	16.59		
						Total				310.28	50.50	259.78	86.59
			Crop Sequence - 15 years: five years legume, winter grain, fallow alternating										
R-3a	Alfalfa	Ladak	65[1]					3.0T	50.00/T	150.00	-		
R-3b	Fallow												
R-3c	W. Wheat	Luke	90	37	26		54.5	53.4bu	2.08/bu	111.07	30.45		
						Total				261.07	30.45	230.62	76.87
			Crop Sequence - 3 years: fallow, winter wheat, spring grain										
R-4a	Fallow												
R-4b	W. Wheat	Luke	92	40	28		56.0	67.7bu	2.08/bu	140.82	30.45		
R-4c	S. Barley	Freja	57	29	0		48.2	76.8bu	3.75/cwt	138.24	17.97		
						Total				279.06	48.42	230.64	76.88
			Crop Sequence - 9 years: three years legumes, winter grain, fallow alternating										
R-5a	W. Wheat	Crest	37	46	32	13.1	58.0	48.1bu	2.36/bu	113.52	20.61		
R-5b	Fallow												
R-5c	Alfalfa	Thor	0	96	0			0.7T	50.00/T	35.00	18.93		
						Total				148.52	40.54	107.98	35.99
			Crop Sequence - continuous cropping including a legume										
R-7a	Alfalfa	Thor						2.5T	50.00/T	125.00	-		
R-7b	W. Wheat	Crest	91	38	27		57.0	43.7bu	2.36/bu	103.13	31.08		
R-7c	S. Barley	Freja	50	26	0		48.0	63.0bu	3.75/cwt	113.40	16.00		
						Total				341.53	47.08	294.45	98.15

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, Montana, 1972-76.

	1972	1973	1974	1975	1976	$\bar{x}$	5 Yr. Ave/A
			BARLEY				
Yield/Acre	46.9 bu	47.8 bu	43.8 bu	32.3 bu	83.4 bu	50.8	
Fertilizer Cost	8.72	17.29	14.92	25.76	16.59	16.66	
Price of Commodity	2.50/cwt	4.50/cwt	6.40/cwt	4.10/cwt	3.75/cwt	4.25	
Gross $	56.30	103.25	134.55	63.57	150.12	101.56	
Net/Acre	47.58	85.96	119.63	37.81	133.53	84.90	
			WHEAT				
Yield/Acre	53.9 bu	48.7 bu	62.1 bu	65.8 bu	77.0 bu	61.5	
Fertilizer Cost	6.53	13.60	26.30	30.31	33.91	22.13	
Price of Commodity	1.95/bu	4.20/bu	4.36/bu	3.11/bu	2.08/bu	3.14	
Gross $	105.11	204.54	270.76	204.63	160.16	189.04	
Net/Acre	98.58	190.94	244.46	174.32	126.25	166.91	83.94

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, Montana, 1972-76.

	1972	1973	1974	1975	1976	$\bar{x}$	5 Yr. Ave/A
			ALFALFA				
Yield/Acre	.6 T	2.7 T	4.2 T	3.3 T	3.0 T	2.8	
Fertilizer Cost	7.60					1.52	
Price of Commodity	25.00/T	45.00/T	40.00/T	45.00/T	50.00/T	41.00	
Gross $	15.00	121.50	168.00	148.50	150.00	120.60	
Net/Acre	7.40	121.50	168.00	148.50	150.00	119.08	
			WHEAT				
Yield/Acre	56.3 bu	58.1 bu	60.7 bu	64.0 bu	53.4 bu	58.5	
Fertilizer Cost	13.24	26.46	26.96	30.31	30.45	25.48	
Price of Commodity	2.11/bu	4.25/bu	4.36/bu	3.11/bu	2.08/bu	3.18	
Gross $	118.79	246.93	264.65	199.04	111.07	188.10	
Net/Acre	105.55	220.47	237.69	168.73	80.62	162.61	93.90

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, Montana, 1972-76

	1972	1973	1974	1975	1976	$\bar{x}$	5 Yr. Ave/A
			BARLEY				
Yield/Acre	60.4 bu	42.3 bu	42.3 bu	35.0 bu	76.8 bu	51.4	
Fertilizer Cost	8.71	17.29	17.26	24.47	17.97	17.14	
Price of Commodity	2.50/cwt	4.50/cwt	6.40/cwt	4.15/cwt	3.75/cwt	4.26	
Gross $	72.47	88.51	129.95	69.72	138.24	99.78	
Net/Acre	63.76	71.22	112.69	45.25	120.27	82.64	
			WHEAT				
Yield/Acre	71.5 bu	48.6 bu	65.2 bu	66.7 bu	67.7 bu	63.9	
Fertilizer Cost	13.24	26.46	25.64	30.31	30.45	25.22	
Price of Commodity	2.11/bu	4.25/bu	4.36/bu	3.11/bu	2.08/bu	3.18	
Gross $	150.87	206.55	284.27	207.44	140.82	197.99	
Net/Acre	137.63	180.09	258.63	177.13	110.37	172.77	85.14

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, Montana, 1972-76.

	1972	1973	1974	1975	1976	$\bar{x}$	5 Yr. Ave/A
			ALFALFA				
Yield/Acre	3.2 T	.2 T	4.2 T	3.4 T	.7 T	2.3	
Fertilizer Cost		14.58			18.93	16.76	
Price of Commodity	25.00/T	45.00/T	40.00/T	45.00/T	50.00/T	41.00	
Gross $	80.00	9.00	168.00	153.00	35.00	89.00	
Net/Acre	80.00	- 5.58	168.00	153.00	16.07	82.30	
			WHEAT				
Yield/Acre	62.0 bu	41.9 bu	39.5 bu	56.6 bu	48.1 bu	49.6	
Fertilizer Cost	6.53	13.60	14.42	13.20	20.61	13.67	
Price of Commodity	2.11/bu	4.20/bu	4.46/bu	3.43/bu	2.36/bu	3.31	
Gross $	130.82	175.98	176.17	194.14	113.51	158.12	
Net/Acre	124.29	162.38	161.75	180.94	92.90	144.45	75.58

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, 1972-76

	1972	1973	1974	1975	1976	$\bar{x}$	5 Yrs. Ave/A
			ALFALFA				
Yield/Acre	.7 T	.15 T	2.9 T	2.2 T	2.5 T	1.7	
Fertilizer Cost		14.76				2.95	
Price of Commodity	25.00/T	45.00/T	40.00/T	45.00/T	50.00/T	41.00	
Gross $	17.50	6.75	116.00	99.00	125.00	72.85	
Net/Acre	17.50	- 8.01	116.00	99.00	125.00	69.90	
			SPRING GRAIN				
	Wheat	Barley					
Yield/Acre	27.6 bu	36.5 bu	45.6 bu	31.5 bu	63.0 bu	40.8	
Fertilizer Cost	10.47	16.07	16.80	24.98	16.00	16.86	
Price of Commodity	1.92/bu	4.50/cwt	6.40/cwt	4.10/cwt	3.75/cwt		
Gross $	52.99	78.84	140.08	61.99	113.40	89.46	
Net/Acre	42.52	62.77	123.28	37.01	97.40	72.60	
			WINTER WHEAT				
Yield/Acre	26.5 bu	30.8 bu	40.6 bu	29.7 bu	43.7 bu	34.3	
Fertilizer Cost	6.53	13.60	27.18	30.31	31.08	21.74	
Price of Commodity	1.90/bu	4.20/bu	4.46/bu	3.55/bu	2.36/bu	3.29	
Gross $	50.35	129.36	181.08	105.44	103.13	113.87	
Net/Acre	43.82	115.76	153.90	75.13	72.05	92.13	78.21