

WEST RIVER AGRICULTURAL RESEARCH AND EXTENSION CENTER
CROPS AND SOILS RESEARCH

Rapid City, South Dakota

INTRODUCTION

This is an annual progress report of the West River Crops and Soils Research Project, South Dakota Agricultural Experiment Station. The equipment storage and processing facilities are located approximately 1 mile west of the village of Box Elder. The office facilities are located on the Central States Fairgrounds at 801 San Francisco Street, Rapid City. Telephone 394-2236.

The Research Project serves the western part of the state. It is unique in that all experimental plots are cooperatively located with farmers, ranchers, crop improvement associations, and county agents.

The research conducted is not restricted to a specific area, crop, or soil, but by necessity of workload investigates only those problems which are pertinent to general areas. This report contains results of selected research. It does not include results of incomplete work nor work conducted by projects headquartered from the campus at Brookings.

FIELD PLOT COOPERATORS

<u>Name</u>	<u>Address</u>	<u>County</u>
County Crop Impr. Ass'n	Martin 57551	Bennett
David Winkler	Newell 57760	Butte
Pat Halstead	Spearfish 57783	Lawrence
Keith Keffler	Sturgis 57785	Meade
Charles Hawks	Plainview 57771	Meade
Robert Grubl	Sturgis 57785	Meade
Lavon Shearer	Wall 57790	Pennington
Joe Wunder	Bison 57620	Perkins
County Crop Impr. Ass'n	Winner 57580	Tripp

This is an annual report and results published herein are therefore neither complete nor conclusive. 1000 copies printed at an estimated cost of 45¢ each.

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Weather Summary

The weather summaries presented in tables 1 and 2 were obtained from the National Oceanic and Atmospheric Administration publication, Climatological Data-South Dakota.

Some of the information which is identified by footnotes, was obtained from private cooperators, and The South Dakota Department of Natural Resources because data from the primary source was missing.

The effects of weather had a major influence on yields of all crops in 1980. Data reported during the summer and fall of 1979 indicated above normal temperature and below normal precipitation. That combination resulted in a high evaporation rate and created additional moisture stress.

Extreme drought in the northwest part of the state prevented germination of spring grains. Hail damage at several sites either severely reduced yields or completely destroyed the plots.

Table 1. Weather Data - Average Temperatures and Total Precipitation by Months, with Departures from Normals.

Month & Year	Average Temperature*	Departure from Normal**	Total Precipitation*	Departure from Normal**
<u>Martin</u> (Bennett County Reporting Station)				
Aug. 1979	69.9	-2.4	1.00	-1.08
Sept. 1979	68.0	6.5	0.39	-1.03
Oct. 1979	51.9	1.2	1.22	0.18
Nov. 1979	31.7	-3.9	0.22	-0.13
Dec. 1979	33.9	7.2	0.01	-0.28
Jan. 1980	21.8	-0.7	0.20	-0.09
Feb. 1980	27.3	0.6	0.20	-0.21
Mar. 1980	32.6	0.5	0.89	0.22
Apr. 1980	48.6	2.8	1.06	-0.59
May 1980	58.3	2.2	1.36	-1.59
June 1980	69.5	4.3	3.22	-0.66
July 1980	77.9	4.6	1.00	-1.46
Aug. 1980	71.9	-0.4	2.35	0.27
Sept. 1980	64.1	2.6	0.16	1.26
<u>Newell</u> (Butte County Reporting Station)				
Aug. 1979	69.2	-1.8	0.73	-0.52
Sept. 1979	64.8	5.6	0.16	-1.10
Oct. 1979	50.2	2.1	0.34	-0.44
Nov. 1979	31.7	-0.9	0.08	-0.49
Dec. 1979	27.8	5.1	0.04	-0.25
Jan. 1980	15.2	-2.3	0.23	-0.17
Feb. 1980	23.1	1.2	0.32	-0.05
Mar. 1980	29.7	0.9	0.61	-0.03
Apr. 1980	49.9	6.0	0.69	-0.94
May 1980	59.9	5.4	0.96	-1.73
June 1980	67.6	4.2	3.58	0.06
July 1980	75.2	3.3	0.94	-0.91
<u>Spearfish</u> (Lawrence County Reporting Station)				
Aug. 1979	67.9	-2.4	4.54	2.94
Sept. 1979	64.0	4.4	0.65	-1.26
Oct. 1979	50.6	0.6	1.26	0.05
Nov. 1979	32.2	-3.8	0.21	-1.11
Dec. 1979	32.9	4.0	0.26	-0.51
Jan. 1980	18.5	-6.0	0.54	-0.19
Feb. 1980	27.9	0.1	0.23	-0.54
Mar. 1980	31.4	-0.4	1.49	0.03
Apr. 1980	47.5	2.9	1.71	-0.86
May 1980	56.5	2.1	2.77	-0.87
June 1980	65.9	3.2	3.03	-1.57
July 1980	75.1	4.1	0.75	-0.94

* Average temperatures and precipitation obtained from NOAA Climatological Data from reporting station nearest the experimental sites. Temperatures are reported in degrees Fahrenheit and precipitation in inches.

**Departures from normal are based on records for the period 1941-1970.

Table 1 continued.

Month & Year	Average Temperature*	Departure from Normal**	Total Precipitation*	Departure from Normal**
<u>Alkali</u> (Meade County Reporting Station)***				
Aug. 1979	--	--	2.48	--
Sept. 1979	--	--	.19	--
Oct. 1979	--	--	--	--
Nov. 1979	--	--	--	--
Dec. 1979	--	--	--	--
Jan. 1980	--	--	--	--
Feb. 1980	--	--	--	--
Mar. 1980	--	--	--	--
Apr. 1980	--	--	1.45	--
May 1980	--	--	.81	--
June 1980	--	--	2.95	--
July 1980	--	--	1.36	--
<u>Plainview</u> (Meade County Reporting Station)***				
Aug. 1979	76.6	--	1.03	--
Sept. 1979	--	--	0.30	--
Oct. 1979	--	--	--	--
Nov. 1979	--	--	--	--
Dec. 1979	--	--	--	--
Jan. 1980	--	--	--	--
Feb. 1980	--	--	--	--
Mar. 1980	--	--	--	--
Apr. 1980	--	--	1.01	--
May 1980	--	--	1.07	--
June 1980	--	--	2.20	--
July 1980	--	--	1.68	--
<u>Cottonwood</u> (Pennington County Reporting Station)				
Aug. 1979	69.7	-3.8	2.03	0.65
Sept. 1979	65.7	3.8	.03	-1.21
Oct. 1979	50.0	-0.3	1.64	0.73
Nov. 1979	31.6	-3.1	0.07	-0.33
Dec. 1979	29.3	5.2	tr	-0.35
Jan. 1980	17.5	-1.9	0.08	-0.37
Feb. 1980	23.2	-1.3	0.30	-0.15
Mar. 1980	28.7	-2.7	0.94	0.15
Apr. 1980	48.1	1.7	1.02	-0.77
May 1980	59.6	2.7	0.49	-2.48
June 1980	69.5	3.4	2.90	-0.72
July 1980	77.7	3.4	2.00	0.29
Aug. 1980	71.3	-2.2	1.68	0.30
Sept. 1980	62.1	0.2	0.60	-0.64

* Average temperatures and precipitation obtained from NOAA climatological data from reporting station nearest the experimental sites. Temperatures are reported in degrees fahrenheit and precipitation in inches.

**Departures from normal are based on records for the period 1941-1970.

***Data obtained from alternate sources.

Table 1 continued.

Month & Year	Average Temperature*	Departure from Normal**	Total Precipitation	Departure from Normal**
<u>Bison</u> (Perkins County Reporting Station)				
Aug. 1979	68.2	--	1.63	-0.18
Sept. 1979	64.0	--	0.10	-1.20
Oct. 1979	50.3	--	0.39	-0.44
Nov. 1979	30.1	--	0.20	-0.34
Dec. 1979	29.4	--	0.08	-0.19
Jan. 1980	14.1	--	0.10	-0.36
Feb. 1980	21.5	--	0.88	0.47
Mar. 1980	28.3	--	0.63	-0.10
Apr. 1980	49.7	--	0.74	-0.86
May 1980	59.8	--	0.25	-2.28
June 1980	67.2	--	1.74	-2.21
July 1980	74.6	--	0.96	-1.09
<u>Winner</u> (Tripp County Reporting Station)				
Aug. 1979	70.4	-4.2	2.35	-0.38
Sept. 1979	68.0	4.2	1.64	-0.18
Oct. 1979	53.6	0.9	3.50	2.28
Nov. 1979	34.2	-3.0	0.30	-0.43
Dec. 1979	34.7	8.6	0.12	-0.36
Jan. 1980	22.3	0.8	0.29	-0.16
Feb. 1980	26.9	0.4	0.42	-0.16
Mar. 1980	34.2	1.2	1.29	0.17
Apr. 1980	52.6	4.1	0.57	-1.79
May 1980	62.9	3.6	1.78	-1.23
June 1980	73.5	5.0	3.65	-0.59
July 1980	81.1	5.2	2.07	-0.49
Aug. 1980	75.2	0.6	4.77	2.04
Sept. 1980	67.5	3.7	0.87	-0.95

* Average temperatures and precipitation obtained from NOAA climatological data from reporting station nearest the experimental sites. Temperatures are reported in degrees fahrenheit and precipitation in inches.

**Departures from normal are based on records for the period 1941-1970.

Table 2. Weather Data - Date of Critical Temperatures and Total Usable Precipitation in Counties with Experimental Plots, 1979-80.

Location	Date of Temperature*		Total Usable Moisture**	
	Fall-First	Spring-Last	Aug 79-July 80	April 80-July 80
Bennett County (Martin)	Oct 31	May 8	8.07	5.14
Butte County (Newell)	Oct 13	April 9	4.73	4.48
Lawrence County (Spearfish)	Oct 22	May 7	13.61	7.25
Meade County (Alkali) (Plainview)	Oct 13	May 8	--	3.48
	Oct 13	May 8	--	--
Pennington County (Cottonwood)	Oct 4	May 9	9.15	5.35
Perkins County (Bison)	Oct 13	May 8	5.10	2.65
Tripp County (Winner)	Oct 13	May 8	15.18	7.21

* First 28° temperature in Fall or last 28° temperature in Spring.

**Sum of all precipitation where amounts were greater than 0.25 inch or totaled 0.25 in two contiguous days.

SMALL GRAIN VARIETY TRIALS

Objective: To observe and compare standard small grain varieties and experimental varieties for winterhardness, grain yield, grain quality, disease resistance, insect resistance, and other characteristics for area adaptability.

Hard Red Winter Wheat

Trials were located in Bennett, Lawrence, Meade - (2 locations), Pennington, and Perkins counties. All plots were seeded in non-fertilized fallow with a deep furrow drill. The seeding rate averaged 60 pounds per acre.

Of the six locations, one winterkilled due to lack of moisture and an infestation of greenbugs, and one was lost because of a severe hailstorm at heading. The four surviving locations suffered from moisture stress during the entire growing season.

The plots were harvested with a HEGE Model 125B self-propelled plot combine. Machine harvested plots contained a minimum of 100 square feet but generally contained 300 square feet per sample.

Table 3. Hard Red Winter Wheat Variety Trial - Bennett County (Martin), (1979-80).

Variety	Height (Inches)	Percent Stand*	Percent Protein**	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
					1980	(3 yr av)
Newton	28	89	13.1	60.5	37.2	--
Larned	30	91	12.9	60.9	36.8	28.1
Rocky***	30	86	12.5	61.3	35.2	--
Gent	31	89	13.6	60.9	35.2	24.7
Vona	25	86	13.2	60.4	34.2	20.4
Buckskin	33	86	13.5	60.8	33.9	29.0
Wings***	27	88	13.3	61.9	32.8	--
Scout 66	32	91	13.7	61.1	32.7	25.8
Gage	32	89	14.3	61.1	32.7	23.8
Sentinel	28	89	14.4	59.9	32.6	25.5
Parker 76***	30	89	15.1	61.8	32.3	--
Rall	30	90	13.0	61.5	32.0	25.5
Scoutland	30	92	16.6	60.5	32.0	23.7
Lindon	28	83	13.6	61.5	31.8	23.4
Agate	32	85	13.9	60.2	31.7	29.1
Roughrider	33	94	14.1	60.8	31.6	28.3
Lancota	31	86	14.8	60.0	31.5	22.3
Centurk	29	86	13.4	60.9	31.1	25.0
Lancer	32	89	13.2	61.1	30.9	27.0
Winoka	33	94	13.2	61.8	30.8	28.7
Centurk 78	29	84	12.8	61.1	30.1	--
Eagle	29	89	14.6	61.1	29.9	22.9
Bronze	31	90	15.2	59.8	28.5	23.6
Homestead	26	88	14.0	60.5	28.0	21.1
Baca	33	76	13.5	60.6	27.8	20.9
YT0-117	37	92	14.6	58.6	27.3	29.7
Sage	30	83	14.3	60.8	26.8	20.7
Bennett	27	91	13.4	60.2	26.4	--
Hiplains	30	76	13.8	59.1	25.6	19.3
Cream	34	15****	14.6	59.0	7.0	--
LSD(05) - 4.6 Bu/A		C.V. - 10.8%		Mean - 30.6		

Note: Yield data presented within the table are averages of four replications. Plot size was 6' x 25' with 12 inch spaced rows. Seeded on September 19, 1979 and harvested on July 18, 1980. Seeding rate was 60 pounds per acre.

* Stand information was taken and recorded in mid-April 1980.

** Protein content was calculated from Kjeldahl nitrogen analysis and is reported on an oven dry basis.

*** Private release, data inconclusive at this time.

****Seed supply had very low germination.

Table 4. Hard Red Winter Wheat Variety Trial - Lawrence County (Spearfish), (1979-80).

Variety	Height (Inches)	Winter Hardiness	Percent Protein*	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
					1980	(2 yr av)
Roughrider	26	Excellent	16.2	60.5	44.6	41.9
Rocky**	27	Good	14.6	61.0	43.7	--
Centurk 78	25	Good	14.7	60.7	43.4	41.0
Centurk	23	Good	15.1	60.5	43.2	39.4
Winoka	28	Excellent	15.2	60.8	42.1	39.4
Buckskin	27	Good	15.6	60.3	41.8	38.7
Lancer	26	Good	15.7	61.2	40.9	--
Gent	25	Good	16.3	61.2	38.1	35.0
Rall	25	Fair	16.0	61.0	37.2	34.4
Wings**	21	Fair	14.7	61.7	36.9	--
Scout 66	27	Fair	16.1	61.3	36.9	34.6
Bennett	23	Fair	15.8	60.7	36.9	33.2
Vona	21	Fair	14.3	60.8	35.8	28.4
Bronze	27	Excellent	16.6	60.5	35.5	33.2
Sage	27	Good	16.0	60.5	35.3	34.1
Eagle	25	Fair	16.5	63.3	34.6	30.0
Agate	25	Good	15.4	58.5	32.5	32.8
LSD(05) - 4.6 Bu/A		C.V. - 7.1%		Mean - 38.8		

Note: Yield data presented within the table are an average of 4 replications. Plot size was 5' x 25' with 12 inch spaced rows. Seeded on September 20, 1979 and harvested on July 21, 1980. Seeding rate was 60 pounds per acre. Soil moisture was adequate for germination and emergence.

* Protein content was calculated from Kjeldahl nitrogen analysis and is reported on an oven dry basis.

**Private release, data inconclusive at this time.

Bennett County

The winter wheat plots in Bennett county were under moisture stress during the entire growing season. Rainfall was below normal prior to seeding but there was sufficient moisture for germination and emergence. Winter survival, grain yield, and grain quality were all good. The average yield for the trial was equivalent to the 1974-75 county average yield. The results are shown in table 3.

Lawrence County

The winter wheat trial in Lawrence county had excellent winter survival. Rainfall was limited, but timely. Grain quality was excellent with good test weights and high protein content. The average for the 1980 test (38.8 Bu/A) was mid-way between the high yields of 1978 and the low yields of 1979. Test results are given in table 4.

Table 5. Hard Red Winter Wheat Variety Trial - Meade County (Plainview), 1980.

Variety	Height	Winter	Percent	Test Weight	Grain Yield-Bu/Acre	
	(Inches)	Hardiness	Protein*	(Lbs/Bu)	1980	(Av 1977-78)
YTO-117	27	Excellent	15.3	58.8	25.9	--
Centurk	20	Good	14.5	60.2	25.6	25.6
Lancer	23	Good	14.6	60.3	25.0	--
Vona	19	Fair	14.0	60.7	24.4	--
Buckskin	22	Good	14.7	58.8	24.4	32.7
Sage	19	Good	15.0	59.2	23.0	32.2
Rocky**	21	Fair	14.4	60.5	22.4	--
Rall	21	Fair	15.1	60.0	21.5	24.6
Roughrider	22	Excellent	15.3	59.0	21.5	--
Centurk 78	20	Good	14.1	60.7	21.2	--
Bennett	18	Fair	14.9	59.0	21.2	--
Bronze	22	Excellent	15.2	57.2	20.7	30.5
Agate	22	Good	15.9	57.8	20.6	--
Eagle	20	Fair	15.8	59.2	19.8	--
Wings**	18	Fair	14.9	59.7	19.5	--
Winoka	24	Excellent	14.7	59.7	18.9	36.5
Gent	20	Good	15.0	58.7	16.3	22.9
Scout 66	21	Fair	14.5	58.7	14.0	38.9

LSD(05) - 6.5 Bu/A

C.V. - 14.5%

Mean - 21.1

Note: Plots were seeded on September 24, 1979 using a deep furrow drill with 12 inch row space. Harvesting was completed on July 22, 1980. Soil moisture was adequate for germination and emergence.

* Protein content was calculated from Kjeldahl nitrogen analysis and is reported on an oven dry basis.

**Private release, data inconclusive at this time.

Meade County (Plainview)

Grain yields in the trial were very low because of the limited precipitation. Winter survival was good and grain quality fair. Test weights were slightly below normal, while protein content was normal. Results are given in table 5.

Pennington County

The trial had good germination and emergence in the fall of 1979. In the spring the plots averaged 90% survival. The plants, even though under severe moisture stress, were vigorous and were shooting heads in late May. At that time they were completely destroyed by hail.

Table 6. Hard Red Winter Wheat Variety Trial - Perkins County (Bison), 1980.

Variety	Winter Hardiness	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(4 yr av)
Buckskin	Good	62.0	8.4	26.5
SD 75314	--	61.0	6.5	--
Gent	Good	62.5	6.4	26.6
Winoka	Excellent	62.5	6.4	25.2
SD 73177	--	60.0	5.8	--
Rocky*	Fair	60.5	5.7	--
Lancer	Good	61.0	5.6	23.5
Centurk	Good	60.5	4.6	25.3
Nebred	Good	60.5	4.6	22.4
Agate	Good	61.0	4.5	27.1
Centurk 78	Good	61.0	2.8	17.0
Scout 66	Fair	61.5	4.4	22.6
Rall	Fair	60.0	4.1	24.3
Rita	Fair	59.0	3.9	--
Eagle	Fair	61.0	3.9	21.6
Sage	Good	60.5	3.8	23.7
SD 76850	Good	60.0	3.5	--
SD 76598	--	59.5	3.3	--
Roughrider	Excellent	59.0	3.3	21.2**
SD 74224	--	59.0	3.3	--
SD 7279	--	61.0	3.2	--
SD 75269	--	60.0	2.6	--
SD 75284	--	60.0	2.5	--
Dawn	Fair	60.5	2.4	--
SD 74221	--	59.5	2.4	--
Bennett	Fair	59.5	2.4	18.3**
Newton	Poor	--	2.2	--
SD 75375	--	59.0	2.2	--
SD 73176	--	--	2.2	--
Vona	Fair	--	1.9	21.5

LSD(05) - 4.2 Bu/A

Mean - 4.0

Note: Yield data presented within the table are an average of 3 replications. Plot size was 5' x 25' with 10 inch spaced rows. Seeded on September 20, 1979 and harvested on July 16, 1980. Seeding rate was 60 pounds per acre, and soil moisture adequate for germination and emergence.

* Private release, data inconclusive at this time.

**Average yield for 1979 and 1980 only.

--Data not available at this time.

Perkins County

The trial, when seeded in September 1979, had sufficient soil moisture available to initiate germination and emergence. Further useable precipitation was extremely limited. The plants had few tillers, were stunted, and produced very little grain. The results are shown in table 6.

Hard Red and Durum Spring Wheat

Plots were seeded at 6 locations in 1980. All trials were seeded on fallow with the exception of Butte county. The Butte county site had been in small grain the previous year. All sites were seeded with a 6 row plot seeder having an 8 inch row spacing.

Seeding rate was controlled by prepackaging all seed. Fertilizer requirements were predetermined by soil test and only phosphorus was applied with the seed. Nitrogen was surface broadcast on the irrigated trial.

Harvesting was accomplished with a self-propelled plot combine. Grain yields and other agronomic data are reported in tables 7 through 16.

Table 7. Hard Red Spring Wheat Variety Trial - Bennett County (Martin), (1979-80).

Variety	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
		1980	(2 yr av)
Semidwarfs			
James	53.7	18.6	22.3
Solar	50.2	18.6	20.7
Probran 711	56.0	17.9	--
Protor	55.5	17.9	21.6
Len	50.8	17.9	21.8
Marberg	53.0	17.4	--
Era	50.2	16.0	19.8
Angus	53.3	15.5	19.0
Olaf	52.3	15.2	20.3
Wared	52.2	14.8	--
WS 1809	53.5	13.6	17.8
Aim	54.2	12.6	--
Pondera	51.3	12.6	--
Prodax	48.7	10.2	19.0
Standard Height			
Waldron	52.8	18.9	21.9
Eureka	52.3	18.9	19.5
Ellar	52.8	16.7	20.5
Coteau	52.2	16.5	19.0
Butte	54.8	15.7	20.0
Fortuna	54.2	14.3	19.3
Lew	53.5	12.6	--
Experimental Selections			
MN 70170R	50.2	20.3	--
SD 2868	54.7	17.9	--
SD 2835	54.5	17.7	--
NAPB 74-183	54.0	17.4	--
906-R	54.2	17.2	--
SD 2870	56.3	16.2	--
SD 2700	54.8	14.3	--

LSD(05) - 3.8 Bu/A

C.V. - 14.4%

Mean - 16.2

Note: Plots were seeded on April 21 at 60 pounds per acre, and harvested on July 24. Drill row space was 8 inches.

The plots in Bennett county were seeded in fallow soil and had sufficient soil moisture for germination and emergence. Rainfall after seeding was below normal and temperatures above normal. The combination resulted in short plants, few tillers, small heads, poor quality grain, and low test weights. Harvesting was completed on July 24 when all plots were mature. Both Hard red spring wheat (table 7) and Durum wheat (table 13) were tested at this site.

Table 8. Hard Red Spring Wheat Variety Trial - Butte County (Newell), 1978-80.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre 1980	(3 yr av)
Semidwarfs				
Solar	32	57.0	59.3	69.6
Marberg	31	59.7	58.8	--
Probran 711	31	59.7	58.1	--
Pondera	32	59.8	57.8	--
Era	31	57.8	56.6	64.5
James	34	58.8	53.2	68.7
Prodax	30	56.0	53.0	70.1
Bounty 309	30	58.3	52.0	--
Len	33	57.0	51.8	--
Aim	31	59.5	49.9	--
Olaf	33	57.0	46.9	63.0
Protor	29	59.8	43.8	63.7
Angus	33	57.7	39.9	56.8
WS 1809	29	57.2	38.2	60.4
Standard Height				
Chris	32	55.5	54.5	--
Butte	35	59.8	49.9	64.4
Lew	40	60.2	48.4	--
Waldron	35	58.3	47.2	59.7
Fortuna	37	58.7	46.5	58.4
Eureka	34	59.3	45.3	58.5
Coteau	37	57.3	41.1	54.3
Ellar	37	58.7	40.7	53.4
Nowesta	36	57.8	39.4	55.6
Experimental Selections				
NAPB 74-183	31	59.2	50.6	--
SD 2868	36	60.0	45.0	--
WPB 906-R	30	58.7	39.0	--
SD 2870	36	59.7	37.5	--
SD 2835	34	60.0	36.3	--
SD 2700	32	58.7	27.6	--
LSD(05) - 6.6 Bu/A		C.V. - 8.5%	Mean - 47.2	

Note: Plots were seeded on April 15 at 120 pounds per acre, and harvested on August 6. Drill row space was 8 inches. The wheat was flood irrigated 3 times during the growing season. Nitrogen was broadcast at 100 lbs per acre on May 9.

Table 9. Hard Red Spring Wheat Breeding Lines - Butte County (Newell), 1980.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield (Bushel/Acre)
SD 2016	31	59.5	52.8
SD 2329	32	59.2	49.9
SD 2526	30	58.8	47.7
SD 2536	28	58.3	37.8
SD 2829	34	58.5	35.6
Pavon 76	32	58.8	34.4
Pavon "Sib"	30	58.8	33.9
SD 2700	30	58.8	25.2

LSD(05) - 6.9 Bu/A C.V. - 10.0% Mean - 39.7

Note: Plots were seeded on April 15 at 60 pounds per acre, and harvested on August 6. Row spacing was 8 inches. The wheat was flood irrigated 3 times during the growing season. The plots were topdressed with nitrogen at 100 pounds per acre on May 9.

The trial in Butte county was seeded in soil which had been in spring wheat the previous year. The soil was extremely dry because of the lack of late summer and fall rains, winter snow, and spring rain.

In early May, it was necessary to apply water so that the seed would germinate. Lack of precipitation during the late spring and early summer required additional applications of water. Due to above normal temperatures in May few tillers were formed. The plots were harvested on July 24. The results are shown in tables 8 and 9.

Table 10. Hard Red Spring Wheat Variety Trial - Meade County (Alkali), 1980.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield (Bushels/Acre)
James	25	56.3	21.8
Lew	23	56.0	19.6
Coteau	22	53.8	19.2
Fortuna	22	54.0	18.2
Era	21	53.5	18.2
Olaf	20	55.5	16.7
Eureka	24	54.0	16.7
WS 1809	22	55.5	16.0
Len	23	55.5	15.2
Butte	22	55.0	12.3

Mean - 17.4

Note: Plots were seeded on April 18 at 60 pounds per acre, and harvested on August 5. Drill row space was 8 inches.

The trial at Alkali was seeded in fallow soil. Soil moisture was adequate for germination and emergence only. Rainfall during May was very limited. Above normal temperatures were not favorable for tillering. The plants were short with few tillers. A severe hail storm with heavy rain after heading caused a large reduction in yield.

Table 11. Hard Red Spring Wheat Variety Trial - Meade County (Plainview), (1979-1980).

Variety	Height	Test Weight	Grain Yield-Bu/Acre	
	(Inches)	(Lbs/Bu)	1980	(3 yr av)
Semidwarfs				
Len	25	50.0	24.2	--
Pondera	26	51.7	19.1	--
Era	23	50.0	18.6	22.7
Olaf	22	53.0	17.2	18.2
James	26	53.8	16.7	18.0
Protor	20	55.2	15.7	19.8
WS 1809	21	52.7	15.2	15.9
Profit 75	20	55.8	10.2	17.4
Standard Height				
Coteau	28	50.3	25.9	19.4
Ellar	29	51.3	24.7	24.4*
Fortuna	30	54.7	21.5	17.8
Butte	26	56.5	16.2	17.0
Eureka	26	49.3	15.2	15.4*
Lew	26	52.5	10.2	--

Mean - 17.9

Note: Plots were seeded on April 23 at 60 pounds per acre, and harvested on July 22. Drill row space was 8 inches. Plot size was 4' x 25'.

*Two year grain yield average.

The trial at Plainview was seeded in fallow soil. Soil moisture was adequate for germination and emergence. Rainfall during the growing season was very limited. The plants were short with few tillers. Grain quality was poor because of drought stress. Total precipitation from seeding to harvest was approximately 6 inches as compared to the normal rainfall of 8.5 inches. The greatest factor influencing the yield level was the lack of fall rain and winter snow cover.

Table 12. Hard Red Spring Wheat Variety Trial - Pennington County (Quinn), (1979-1980).

Variety	Height	Test Weight	Grain Yield-Bu/Acre	
	(Inches)	(Lbs Bu)	1980	(2 yr av)
Semidwarfs				
Era	21	57.6	27.4	36.2
Wared	22	57.8	26.7	--
Len	21	58.0	25.6	33.6
Protor	19	57.0	25.6	32.3
Pondera	23	57.9	25.4	--
Walera	21	59.3	25.2	--
Solar	22	56.8	24.9	34.5
Olaf	21	57.9	24.3	31.4
Prodax	21	55.1	24.1	34.6
James	21	57.0	23.8	28.6
Angus	21	58.6	23.4	32.8
Aim	19	58.9	23.1	--
WPB 906-R	20	57.3	22.3	--
Marberg	22	56.5	22.3	--
Probran 711	20	56.0	20.5	--
WS 1809	18	56.9	18.7	24.9
Standard Height				
Coteau	23	56.3	27.0	36.4
Waldron	21	54.9	24.5	29.8
Lew	25	59.3	24.0	--
Eureka	23	55.5	23.8	29.8
Fortuna	23	57.0	23.1	26.3
Butte	21	57.8	21.8	26.7
Chris	22	56.8	20.9	--
Ellar	23	56.1	13.6	26.1
Experimental Selections				
SD 2835	22	59.4	27.0	--
SD 2870	22	59.4	25.8	--
MN 7017R	20	57.9	25.2	--
SX X8-8	22	56.4	24.9	--
SD 2868	24	59.6	24.0	--
NAPB 74-183	20	57.1	23.4	--
SD 2700	19	58.6	21.8	--

LSD(05) - 3.7 Bu/A

C.V. - 11.1%

Mean - 23.7

Note: Plots were seeded on April 18 at 60 pounds per acre and harvested on July 24. Drill row space was 8 inches. Plots received severe hail damage in late May just prior to boot stage.

The spring wheat trial at Quinn was seeded in fallow. Soil moisture conditions were good with rapid germination and emergence. However, above normal temperatures and below normal precipitation during April, May, and June reduced tillering and plant vigor in general. In late May when the plants were in the boot stage, they received heavy hail damage. The results are shown in table 12.

Table 13. Durum Wheat Variety Trial - Bennett County (Martin), 1979-80.

Variety	Test Weight (Lbs/ Bu)	Grain Yield-Bu/Acre	
		1980	(2 yr av)
Semidwarfs			
Calvin	53.3	17.9	24.5
Sexauer X4-5	53.2	15.2	--
Cando	49.7	12.1	17.9
Standard Height			
Rugby	55.0	19.1	23.0
Vic	50.0	19.1	--
Edmore	49.8	19.1	24.2
Crosby	51.8	17.9	22.0
Rolette	56.2	16.5	24.7
Ward	53.5	14.0	24.4
Botno	55.2	13.1	20.9

Mean - 16.4

Note: Plots were seeded on April 21 at 60 pounds per acre, and harvested on July 24. Drill row space was 8 inches.

The durum wheat plots in Bennett county were seeded in fallow soil and had sufficient soil moisture for germination and emergence. Rainfall after seeding was below normal and temperatures above normal. The combination resulted in low yields and poor quality grain. Results are shown in table 13.

Table 14. Durum Wheat Variety Trial - Butte County (Newell), 1978-1980.
(Irrigated)

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(3 yr av)
Semidwarfs				
Calvin	26	54.8	54.7	76.6
Cando	27	50.8	52.3	79.6
Sexauer X4-5	28	54.2	35.1	--
Standard Height				
Rugby	32	55.5	61.0	72.4
Crosby	33	54.7	53.5	70.4
Ward	34	54.3	50.8	74.3
Vic	34	53.5	49.9	--
Rolette	33	55.8	49.1	64.4
Edmore	33	54.3	44.5	68.5
Sheba	39	51.3	33.4	--
Botno	34	55.3	32.9	60.4

Mean - 47.0

Note: Plots were seeded on April 15 at 120 pounds per acre, and harvested on August 6. Row spacing was 8 inches. The wheat was flood irrigated 3 times during the growing season. The plots received 100 pounds of broadcast nitrogen on May 9.

The irrigated durum wheat trial in Butte county was seeded in dry soil and required an application of water before the seed would germinate. The lack of normal rainfall required 2 additional irrigation treatments during the growing season. Above normal temperatures and the lack of normal moisture resulted in average yields which were lower than those of previous years. Results are listed in table 14.

Table 15. Durum Wheat Variety Trial - Meade County (Alkali), 1980.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield (Bu/Acre)
Semidwarfs			
Cando	20	55.3	21.8
Calvin	18	54.0	20.3
Standard Height			
Ward	24	53.8	24.0
Vic	22	50.5	23.6
Rugby	22	54.4	22.5
Edmore	20	53.0	22.5
Crosby	24	50.8	21.4
Mean - 22.3			

Note: Plots were seeded on April 18 at 60 pounds per acre, and harvested on August 5. Drill row space was 8 inches.

The trial at Alkali (table 15) was seeded in fallow soil. Soil moisture was adequate for germination and emergence only. Rainfall in May was very limited and above normal temperatures were not favorable for tillering. The plants were short with few tillers. A destructive hail storm with heavy rain after heading caused a severe reduction in yield.

Table 16. Durum Wheat Variety Trial - Pennington County (Quinn), 1979-80.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(2 yr av)
Semidwarfs				
Calvin	21	59.6	26.9	37.1
Cando	21	59.0	25.4	36.3
Standard Height				
Vic	25	59.9	25.2	37.1
Crosby	26	58.3	24.0	33.6
Rolette	24	60.9	23.4	32.0
Ward	25	58.8	23.1	36.4
Rugby	26	58.9	22.0	36.6
Edmore	27	59.3	21.4	35.2
Botno	23	59.5	21.2	31.7
Sheba	28	56.9	15.8	--

LSD(05) - 3.5 Bu/A C.V. - 10.4% Mean - 22.8

Note: Plots were seeded on April 18 at 60 pounds per acre, and harvested on July 31. Drill row space was 8 inches.

Seeded in fallow soil, the durum test at Quinn had rapid germination and emergence. Above normal temperatures provided good early growing conditions for the seedlings. However, below normal precipitation during the late spring reduced vigor and tillering. While in the boot stage at the end of May there was a destructive hail storm which reduced the grain yields. Results are listed in table 16.

Oat Variety Trials

Oat variety trials were conducted on a cooperative basis at five locations in 1980. Seeding dates ranged from April 15 to April 23. Soil moisture was adequate for germination and emergence at all sites but Newell. Further growth was limited by subnormal precipitation during the remainder of the growing season. Two sites received hail, Alkali was badly damaged, while Quinn was only lightly damaged because the hail came before the plants had headed.

Table 17. Oat Variety Trial - Bennett County (Martin), 1978-1980.

Variety	Height	Test Weight	Grain Yield-Bu/Acre	
	(Inches)	(Lbs/Bu)	1980	(4 yr av)
Early Maturing				
Bates	28	33.8	47.2	46.5
Lang (Resel)	27	31.5	43.1	--
Nodaway 70	32	34.5	42.2	41.1
Lang	27	32.2	39.0	46.7
Otee	30	32.8	38.1	50.3
Stout	28	32.0	36.3	43.7
Medium Maturing				
Spear	30	33.7	35.4	46.1
Lancer	30	32.5	32.2	49.7*
Noble	28	31.5	30.9	48.5
Chief	31	34.0	28.6	40.1
Diana	30	29.8	27.2	39.9
Burnett	31	31.3	23.6	41.2
Late Maturing				
Otana	33	28.3	49.5	--
Moore	32	27.2	43.6	--
Wright	33	31.0	41.3	47.3
Benson	33	31.2	34.0	47.9*
Marathon	36	25.8	31.8	47.5*
Lyon	34	29.2	29.5	44.5
Dal	31	27.3	25.9	38.7
Froker	33	29.7	20.0	35.9
Experimental Selections				
Ogle	25	30.5	44.5	--
Larry	28	31.3	44.0	--
SD 74-3199	33	29.3	37.7	--
SD 74-3358	31	30.5	37.2	--
SD 77-0542	31	31.8	34.9	--
SD 77-0051	31	35.7	29.9	--
SD 75-1187	30	34.5	29.5	--
SD 77-0064	32	31.5	26.8	--

LSD(05) - 8.6 Bu/A

C.V. - 15.0%

Mean - 35.1

Note: Plots were seeded on April 21 at 64 pounds per acre, and harvested on July 18. Drill row spacing was 8 inches.

*Three year grain yield average (1978-79-80).

The plots in Bennett county were seeded in fallow soil and had sufficient soil moisture for germination and emergence. Rainfall after seeding was below normal and temperatures above normal. The combination resulted in short plants, few tillers, small panicles, poor quality grain, and low test weights. Harvesting was completed on July 24 when all plots were mature.

Table 18. Oat Variety Trial (Irrigated) - Butte County (Newell), 1978-1980.

Variety	Height	Test Weight	Grain Yield-Bu/Acre	
	(inches)	(Lbs/Bu)	1980	(3 yr av)
Early Maturing				
Ogle	34	39	113.7	--
Otee	36	42	104.9	100.8
Lang (Resel)	35	40	98.1	112.7
Lang	35	38	97.3	112.4
Larry	35	39	95.3	--
Bates	35	41	86.5	109.0
Nodaway 70	36	39	78.3	99.7
Stout	35	40	76.3	103.6
Medium Maturing				
Lancer	35	39	83.8	104.6
Burnett	37	38	78.3	95.5
Noble	34	40	66.1	99.9
Diana	36	40	65.4	85.2
Spear	37	41	65.3	85.6
Chief	36	39	61.3	81.4
Late Maturing				
Otana	36	38	101.7	--
Moore	40	41	89.9	105.6
Lyon	39	40	85.1	104.6
Marathon	43	37	84.4	99.8
Wright	39	38	80.4	104.8
Froker	38	39	72.9	99.0
Dal	38	39	72.9	97.0
Benson	38	40	71.5	93.5
Experimental Selections				
SD 77-0542	36	41	89.9	--
SD 74-3358	39	42	85.1	--
SD 77-0064	37	38	81.7	--
SD 74-3199	40	40	80.3	--
SD 77-0051	36	40	70.1	--
SD 75-1187	37	40	68.1	--

LSD(05) - 25.2 Bu/A

C.V. - 15.0%

Mean - 81.7

Note: Plots were seeded on April 15 at 80 pounds per acre, and harvested on August 6. Row spacing was 8 inches. The oats were flood irrigated 3 times during the growing season. The plots received 50 pounds of broadcast nitrogen on May 9.

The trial in Butte county was an irrigated study. It was seeded in soil which had been in small grain the previous year. Due to drought conditions it was necessary to irrigate the soil before germination would begin. For that reason the plants were late in starting and with the normal temperatures formed few tillers. The height of the plants was also reduced from previous years. Test weights and grain yields were below the levels of previous years.

A trial was conducted to compare seven oat varieties for forage production under irrigation. Six varieties were selected on the basis of leafiness, straw strength, and protein content. They were compared to Burnett which was used as a standard variety. The plots were fertilized and watered for maximum yield. The plots were seeded at the normal seeding rate and double the normal seeding rate to see if increasing plant populations would increase forage yields.

Table 19. Irrigated Oat Forage Yield Trial - Butte County (Newell), 1980.

Variety	Seeding Rates (Bushel/Acre)	Protein Content		Forage Yield-12% Moisture	
		Percent	Lbs/Acre	Tons/Acre	Pounds/Acre
Haylander	4	9.5	864	5.17	10,346
Rodney	2	9.9	808	5.03	10,065
Rodney	4	9.1	826	4.77	9,534
Marathon	4	9.0	748	4.72	9,432
Diana	4	10.4	842	4.64	9,287
Mammoth	4	9.4	715	4.57	9,134
Marathon	2	9.1	789	4.44	8,883
Moore	4	10.0	757	4.29	8,570
Burnett	4	10.0	749	4.28	8,554
		C.V. - 9.9%	Mean - 4.66	9,312	

Note: Plots were seeded on April 15, and harvested in late July. Row spacing was 8 inches. The plots received 50 pounds of broadcast nitrogen on May 9, and were irrigated 3 times during the growing season.

Oats grown for grain has been a poor crop. Therefore, most producers who raise oats feed them to livestock. The question was raised should these producers harvest the oats for forage or grain. The experiment was conducted along side of the oat variety grain yield test plots.

The average grain yield of the seven varieties tested was 77 bushels per acre. Based on \$1.75 per bushel it was calculated that the 12% moisture hay produced would have cost about \$30 per ton. The growing season during 1980 was very dry and hay was selling for up to \$100 per ton. The producer would have been much better off to cut the oats for forage rather than take it as a grain crop.

There were no significant differences in yield or protein content in this experiment.

Table 20. Oat Variety Trial - Meade County (Alkali), 1980

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield (Bu/Acre)
Lancer	22	30.3	22.5
Benson	24	27.0	21.2
Froker	25	29.3	19.7
Chief	23	28.8	17.0
Wright	23	29.5	16.3
Noble	23	27.5	16.3
Lyon	24	26.5	15.7
Nodaway 70	23	27.5	15.0
Burnett	24	28.5	14.3
Moore	26	29.0	12.3

Mean - 17.0

Note: Plots were seeded on April 18 at 64 pounds per acre, and harvested on August 5. Drill row spacing was 8 inches.

The oat variety trial at Alkali was seeded in mid-April on fallow soil. Germination and emergence were normal, but lack of rainfall and above normal temperatures restricted growth. The trial was severely damaged by large hail at heading time. The test data are listed in table 20.

Table 21. Oat Variety Trial - Meade County (Plainview), 1978-1980.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre 1980	(3 yr av)
Early Maturing				
Nodaway 70	28	36.3	50.8	46.2
Lang	26	32.3	47.2	49.8
Bates	26	34.0	42.7	46.7
Stout	24	34.5	41.7	47.6
Medium Maturing				
Burnett	27	32.3	51.3	47.5
Noble	25	33.0	49.9	52.6
Lancer	27	33.2	48.5	48.5
Spear	26	33.5	44.9	46.8
Chief	24	34.2	42.7	41.4
Late Maturing				
Wright	30	33.2	60.3	59.7
Moore	25	32.2	56.7	52.6
Marathon	26	26.8	51.7	58.5
Otana	26	32.3	48.5	--
Lyon	29	32.3	47.6	54.1
Benson	29	32.8	41.7	48.0

LSD(05) - 9.1 Bu/A

C.V. - 4.5%

Mean - 48.4

Note: Plots were seeded on April 23 at 64 pounds per acre, and harvested on July 22. Drill row spacing was 8 inches.

The oat trial at Plainview was seeded in late April on fallow soil. Abnormally warm weather and subnormal rainfall restricted growth. However, 1980 yields were near the three year average of the test site.

Table 22. Oat Variety Trial - Pennington County (Quinn), 1978-1980.

	Height	Test Weight	Grain Yield-Bu/Acre	
Variety	(Inches)	(lbs/Bu)	1980	(3 yr av)
Early Maturing				
Bates	20	35.3	52.4	59.2
Ogle	20	30.9	49.0	--
Lang	21	34.5	45.6	53.3*
Lang (Resel)	20	33.3	44.9	59.8
Otee	19	37.3	43.6	40.7
Larry	20	32.9	42.2	--
Nodaway 70	24	37.6	39.5	50.6
Stout	20	33.8	37.4	52.3
Medium Maturing				
Burnett	22	36.8	47.0	54.1
Lancer	22	37.0	47.0	51.5
Diana	24	36.5	45.6	52.5
Noble	21	34.5	42.9	50.5
Chief	23	35.3	39.5	51.7
Spear	24	35.5	37.4	48.9
Late Maturing				
Froker	21	37.4	49.0	54.6
Wright	23	35.3	44.9	56.1
Marathon	24	33.0	44.3	58.1
Moore	23	33.6	43.6	55.2
Dal	20	37.5	42.2	53.0
Otana	20	34.4	40.2	--
Lyon	22	33.9	36.8	55.7
Benson	20	31.0	34.7	51.6
Experimental Selections				
SD 74-3358	22	36.1	47.6	--
SD 77-0064	22	35.8	44.2	--
SD 74-3199	27	40.4	43.6	--
SD 77-0542	22	38.6	41.5	--
SD 77-0051	24	37.6	41.5	--
SD 75-1187	21	35.5	34.7	--

LSD(05) - 9.1 Bu/A

C.V. - 10.3%

Mean - 43.0

Note; Plots were seeded on April 18 at 64 pounds per acre, and harvested on July 30. Drill row spacing was 8 inches.

* 2 year grain yield average.

The oat variety trial at Quinn was seeded in mid-April in fallow. Soil moisture was adequate to start growth but was limited from then on. Air temperatures were above normal preventing the plants from tillering. Yields (table 22) were only slightly lower than in previous years even though there were few tillers and conditions were droughty. The trial also received hail damage in mid-June.

Spring Barley

Spring barley varieties were compared at five locations in 1980. All plots were seeded between April 15 and April 23. Soil moisture was adequate for germination at all sites except Newell. Seasonal moisture was short and air temperatures were above normal. The overall production from the trials averaged about 80% of the 1978 yields and only about 45% of the 1979 yields. The data are shown in tables 23 through 27.

Table 23. Spring Barley Variety Trial - Bennett County (Martin), 1978-1980.

Variety	Height (Inches)	Test Weight (lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(3 yr av)
Steptoe	25	36.8	56.3	59.6*
Glenn	28	36.4	42.7	41.8
Primus II	24	38.3	39.6	37.7
Morex	28	37.4	39.3	39.8
Larker	28	37.7	38.4	44.2
SD 71-672	26	43.5	37.5	49.2*
Hector	25	39.2	36.9	57.0*
Beacon	28	34.8	36.0	37.1
Prilar	29	37.5	35.1	43.3
Firlbeck's III	26	40.3	33.9	--
Park	28	37.5	33.3	42.5
SD 77-137	28	37.7	33.0	--
SD 77-163	27	37.7	32.4	--
Klages	24	40.3	30.3	--
LSD(05) - 6.1 Bu/A			C.V. - 9.6%	
			Mean - 37.5	

Note: Plots were seeded on April 21 at 72 pounds per acre and harvested on July 18. Drill row spacing was 8 inches.

* 2 year grain yield average.

The barley variety trial in Bennett county was seeded in late April on fallow. Germination and emergence was good but due to above normal temperatures there was limited tillering. Limited rainfall in May and June prevented normal growth and resulted in short plants, small heads, and poor quality grain. The yields listed in table 23 were comparable to those of the two previous years.

The barley trial at Newell was grown under flood irrigation. However, due to the lack of fall rain, winter snow, and early spring rains, it was necessary to apply water before germination would begin. The irrigation water first became available on May 10. At that time air temperatures were above normal and tillering did not occur. Two additional water applications were necessary before harvest. Yields were about half of those in previous years, and are shown in table 24.

Table 24. Spring Barley Variety Trial (Irrigated) - Butte County (Newell), (1978-1980).

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(3 yr av)
Firlbeck's III	30	52.5	59.0	--
Steptoe	28	46.7	55.4	88.8*
Hector	29	51.5	51.3	75.0*
Glenn	29	50.7	49.9	87.3
Morex	30	51.7	47.7	71.0
Klages	28	51.0	42.7	--
Park	30	50.0	39.9	77.4
Prilar	32	50.5	38.6	65.3
Larker	30	52.0	37.7	71.7
Primus II	29	50.5	36.3	70.8
Beacon	31	48.7	35.4	64.9
SD 71-672	30	51.7	51.7	67.9
SD 77-163	31	50.3	39.5	--
SD 77-137	32	50.0	34.9	--

LSD(05) - 10.3 Bu/A

C.V. - 10.8%

Mean - 44.3

Note: Plots were seeded on April 15 at 72 pounds per acre, and harvested on August 6. Row spacing was 8 inches. The barley was flood irrigated 3 times during the growing season. The plots received 50 pounds of broadcast nitrogen on May 9.

Table 25. Spring Barley Variety Trial - Meade County (Alkali), 1980.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield (Bu/Acre)
Prilar	20	42.3	18.6
Primus II	19	42.0	17.7
Morex	20	40.5	16.8
Glenn	19	40.5	14.5
Larker	19	43.0	14.1

Mean - 16.3

Note: Plots were seeded on April 18 at 72 pounds per acre, and harvested on August 5. Drill row spacing was 8 inches.

The trial at Alkali was seeded in fallow and had good germinating conditions. Growth was normal although rainfall was below normal. The plots received heavy hail damage on June 14. Rain which accompanied the hail helped the plants to recover and finish filling. The yield data is listed in table 25.

The barley trial at Plainview was seeded in late April on fallow soil. Abnormally warm weather and subnormal rainfall restricted growth. However, 1980 average yield was slightly above the three year average of the test site. Test weights were below normal because of drought and because they had a high moisture content when test weights were taken.

Table 26. Spring Barley Variety Trial - Meade County (Plainview), 1978-80.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(3 yr av)
Morex	25	43.3	33.0	32.1
Larker	24	42.5	30.3	31.0
Steptoe	21	40.0	30.3	--
Park	24	42.7	29.3	31.0
Glenn	24	41.0	29.0	30.7
Prilar	24	43.2	28.7	30.4
Firlbeck's III	25	44.5	27.2	--
Hector	25	46.2	26.9	--
Primus II	23	46.3	26.0	24.1
Klages	23	42.5	22.1	--

Mean - 28.3

Note: Plots were seeded on April 23 at 72 pounds per acre, and harvested on July 22. Drill row spacing was 8 inches.

Table 27. Spring Barley Variety Trial - Pennington County (Quinn), 1979-80.

Variety	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield-Bu/Acre	
			1980	(2 yr av)
Larker	25	46.1	38.7	61.0
Park	26	45.5	38.4	64.7
Glenn	23	44.9	37.8	65.0
Prilar	25	45.3	37.2	61.6
Hector	22	48.3	36.0	70.2
Morex	24	45.4	36.0	61.4
Steptoe	19	42.8	35.7	62.5
Menuet	21	47.6	35.1	--
Firlbeck's III	22	49.0	34.8	--
Primus II	24	46.6	31.2	54.9
Klages	19	48.8	29.4	--
Beacon	23	44.1	26.9	51.6
SD 79-355	22	43.6	39.3	--
SD 71-672	21	49.6	31.8	51.6
SD 77-137	25	46.3	31.2	--
SD 77-163	21	47.0	26.3	--

LSD(05) - 5.9 Bu/A

C.V. - 10.4%

Mean - 34.1

Note: Plots were seeded on April 18 at 72 pounds per acre, and harvested on July 31. Drill row spacing was 8 inches.

The barley variety trial at Quinn was seeded in mid-April in fallow. Soil moisture was adequate to start growth but was limited thereafter because of the lack of rainfall. Air temperatures were above normal during April and May which induced the plants to reproduce, or initiate jointing, rather than tillering. Yields were much lower than in previous years because of fewer tillers and droughty conditions. The trial also received hail damage in mid-June. Results are listed in table 27.

SUNFLOWER VARIETY TESTING

Objective: To compare the various brands and hybrids or varieties as to adaptability based on seed yield, seed quality, insect and disease resistance, and other agronomic characteristics.

Table 28. National Sunflower Variety Trial - Bennett County (Martin), 1980.

Brand & Hybrid	Height (Inches)	Percent Oil	Test Weight (Lbs/Bu)	Seed Yield (Lbs/Acre)
Texas-Triumph 490	61	35.5	29.3	1313
Sheyenne-Sundance	62	38.1	30.3	1294
RBA-300G	60	38.9	29.3	1290
4 Winds-900	61	35.0	29.5	1287
Cal/West-8905	61	38.7	30.0	1246
Growers Seed-GS 378	60	40.9	27.8	1176
Dakota Seed-Arrowhead 8907	64	37.7	31.5	1153
Barzen-Rancher	57	40.6	31.0	1075
Kraig-Hybrid 903	65	38.2	31.0	1052
Keltgen-DO 844	68	40.2	30.5	1048
Minn. Farm Bur.-Hysun 101	64	37.7	30.5	1016
Sigco-449	60	34.4	31.5	991
TNT-444	57	39.0	31.3	983
Cargill-205	54	39.0	33.5	968
Sokota 4000	58	35.6	30.5	962
Cal/West-Hybrid 894	58	35.8	33.3	948
Dahlgren-DO 704 X1	60	41.0	32.3	932
Payco-Sungold 85	63	39.1	28.0	919
Northrup King-Sunbred 254	63	38.0	32.0	863
PAG-SF 101	53	38.2	33.5	862
Master Farmer-MF 707	56	34.2	28.5	859
Interstate-IS 3100	54	41.2	28.8	853
POI-S315	66	35.0	31.5	843
Funk's-G6625	58	41.5	32.5	839
Cenex-907	61	40.3	29.0	839
Jacques-501	57	36.3	30.5	815
Golden Harvest-10	62	33.8	30.0	690
Phizer-P620	64	36.7	30.5	648

LSD(05) - 231 lbs/acre

C.V. - 30.2%

Mean = 994

Note: Plots were seeded on May 27 and harvested on September 30. Row space was 36 inches with 11 inches between plants for a population of 15,800 plants per acre. Treflan was applied at 1 lb/acre and incorporated with a tandem disc prior to seeding. The trial was heavily infested with cutworms at time of emergence. Toxaphene was applied at the rate of 1 oz/acre as soon as cutworm damage was noted. Insects causing damage to stems, heads, or seeds were not a serious problem in 1980. The trial was under severe moisture stress during the entire growing season.

Table 29. National Sunflower Variety Trial - Meade County (Alkali), 1980.

Brand & Variety	Height (Inches)	Percent Oil	Test Weight (Lbs/Bu)	Seed Yield (Lbs/Acre)
Payco-Sungold 85	37	40.1	34.0	677
Funk's-G6625	33	40.8	31.5	642
Minn. Farm Bur.-Hysun 101	40	41.5	32.0	589
Sigco-449	43	41.4	31.5	589
Sokota-4000	41	38.9	32.5	584
4 Winds-900	38	39.6	32.5	565
Growers Seed-GS 378	32	41.3	31.5	565
Golden Harvest-10	38	40.6	32.5	562
Dahlgren-DO 704 X1	41	39.3	32.5	546
RBA-300G	39	41.9	31.5	544
Barzen-Rancher 994	36	40.2	33.0	541
Master Farmer-707	39	42.1	30.5	536
Dakota Seed-Arrowhead 8907	41	40.8	32.5	522
Cargill-205	33	42.3	32.5	512
Sheyenne-Sundance	41	42.9	31.5	509
Phizer-P620	39	42.5	32.0	504
Texas-Triumph 490	39	42.2	31.5	504
Kraig-Hybrid 903	37	41.3	31.0	498
PAG-SF 101	34	36.3	33.0	496
Northrup King-Sunbred 254	34	41.1	33.5	490
Cenex-907	40	42.3	29.0	490
Cal/West-Hybrid 894	36	41.0	32.0	477
Keltgen-Do 844	41	40.8	32.0	461
Jacques-501	35	40.4	31.5	458
Interstate-IS 3100	32	41.1	31.5	458
Cal/West-8905	38	41.0	33.0	456
POI-S315	37	41.4	30.5	429
TNT-444	37	44.8	32.5	389

LSD(05) - NS

C.V. - 21.7%

Mean - 521

Note: Plots were seeded on May 28 and harvested on October 1. Row space was 36 inches with 11 inches between plants for a population of 15,800 plants per acre. Treflan was applied at the rate of 1 lb/acre prior to seeding. Toxaphene was applied to the seedlings after emergence to control cutworms which were destroying the seedlings. Insects on the heads were not a serious problem in 1980. The plants were badly damaged by hail (June 14) prior to budding. The trial was under moisture stress during the entire growing season.

SORGHUM VARIETY TESTING

Grain Sorghum

Objective: To compare the performance of grain sorghum hybrids and varieties for yield and other agronomic characteristics.

Grain sorghum variety trials were seeded in Meade, Pennington, and Stanley counties in 1980. Included were commercial varieties which varied in maturity from short season, or very early, to medium, or mid-season.

The stands varied from excellent to very poor. Moisture shortage was evident in all trials by the number of varieties that failed to produce heads, or produced heads but did not pollinate and produce seed. Heading and pollination for most varieties was not initiated until mid-September. None of the trials were harvested because of drought, hail damage, and wildlife destruction.

Sorghum Forage Trials

Objective: To compare the various forage sorghums, sorghum-sudangrass crosses, and sudangrasses as to their adaptability, their forage production, and their forage quality.

Replicated single row plots of forage sorghum, sorghum-sudangrass, and sudangrasses were seeded in Meade, Pennington, and Stanley counties. The trial in Meade county was seeded into soil which had been in an oat crop in 1979, the trial in Pennington county had been in wheat and barley the previous cropping year, while the trial in Stanley county had been in sunflowers. The seedbeds were excellent, but soil moisture was limited. Forage yields are reported in tables 30 through 35.

Footnotes for tables 30 through 35.

* Legend for Plant Type:

Score	Description
1	Tall-Extra Leafy-No Grain
2	Tall-Leafy-Some Grain
3	Tall-Leafy-Grain (50-50)
4	Tall-Few Leaves-Some Grain
5	Tall-Few Leaves-No Grain
6	Short-Extra Leafy-No Grain
7	Short-Leafy-Some Grain
8	Short-Leafy-Grain (50-50)
9	Short-Few Leaves-Some Grain
10	Short-Few Leaves-No Grain

** Legend for Maturity:

1-Mature Grain; 2-Hard Dough Stage; 3-Milk Stage; 4-Pollination Stage; 5-Not Headed.

*** Protein content was calculated from Kjeldahl nitrogen analysis and is reported on an oven-dry basis.

**** Forage yields are reported on a 12% moisture basis.

Table 30. Forage Sorghum Variety Trial - Meade County (Alkali), 1980.

Brand & Variety	Plant Type*	Stem Dia. (mm)	Maturity (1-5)**	Height (Inches)	% Sugar in Sap	Percent Protein***	Yield Ton/A****
Pioneer 931	2	18	5	62	11.8	10.19	3.8
Sokota 320F	7	18	5	48	10.8	9.38	3.6
Funk's 102F	8	20	4	46	14.2	11.56	3.3
Northrup King 326	8	16	4	48	9.6	10.00	3.0
Cenex Sweet Suso	8	19	5	47	11.9	12.44	3.0
Cenex 700T	2	20	4	60	12.3	13.44	2.9
Pioneer 956	3	19	4	54	12.1	13.32	2.6
Western WS-60	2	19	5	52	11.1	9.88	2.5
Northrup King 367	2	20	5	55	9.9	12.82	2.4
Disco 213R	7	16	4	48	10.1	11.13	2.3
DeKalb FS-25a+	2	19	5	51	13.2	13.25	2.1
DeKalb FS-4	2	18	4	51	10.5	11.25	1.8
Rancher	4	10	1	55	13.1	7.63	1.4
GSA 1586F	6	20	5	45	10.6	14.31	1.4
Waconia	9	18	5	44	15.9	6.82	1.3
Dual	4	12	3	51	14.3	12.31	0.8

LSD(05) - 0.8 Tons/Acre

Mean - 2.4

Note: Footnotes are described on page 29.

Table 31. Forage Sorghum Variety Yield Trial - Stanley County (Hayes), 1980.

Brand & Variety	Plant Type*	Stem Dia. (mm)	Maturity (1-5)**	Height (Inches)	% Sugar in Sap	Percent Protein***	Yield Ton/A****
Waconia	3	17	3	72	16.5	6.75	7.7
Sokota 320F	3	20	4	65	15.0	7.44	6.8
DeKalb FS-4	3	22	4	73	17.0	7.00	6.4
DeKalb FS-25a+	7	22	5	56	17.2	9.50	6.4
Disco 213R	8	22	4	58	13.9	7.63	6.0
Cenex Sweet Suso	3	23	3	73	14.2	7.13	5.7
Funk's 102F	8	16	4	58	18.2	7.07	5.3
Northrup King 326	3	20	3	64	16.6	6.32	5.3
GSA 1586F	2	21	5	67	16.6	7.25	5.2
Pioneer 956	3	18	3	67	17.1	8.25	5.2
Pioneer 931	2	19	5	78	14.8	8.38	5.2
Northrup King 367	2	20	5	84	16.2	8.82	5.0
Western WS-60	3	24	4	65	14.6	9.00	4.5
Cenex 700T	9	23	4	50	17.7	9.00	4.0
Rancher	4	11	1	59	14.2	5.69	3.1
Dual	9	21	1	49	10.9	4.50	1.5

LSD(05) - 1.3 Tons/Acre

Mean - 5.2

Note: Footnotes are described on page 29.

Table 32. Sorghum-Sudangrass Variety Yield Trial - Meade County (Alkali), 1980.

Brand & Variety	Plant Type*	Stem Dia. (mm)	Maturity (1-5)**	Height (Inches)	% Sugar in Sap	Percent Protein***	Yield Ton/A****
Sokota 315F	3	13	4	65	11.1	12.88	3.7
Sokota 310F	3	12	4	65	11.8	9.00	3.4
Pioneer 988	3	11	4	61	12.4	11.57	3.4
Western WS-15	2	14	4	63	11.8	7.88	3.2
Frontier HiDan 37R	3	13	4	63	11.8	8.19	3.1
Mustang Graze	3	11	4	67	11.4	10.25	3.1
DeKalb ST-6+	2	14	5	67	10.3	11.25	3.1
NK Sordan 77	3	11	4	61	13.7	11.44	3.0
Cenex							
Highland Sweet	3	13	4	65	10.6	11.44	2.8
Funk's 88F	3	12	4	68	12.2	12.57	2.8
GSA 1757	2	12	4	61	10.1	9.63	2.6
Sokota 300F	3	11	4	68	11.7	11.25	2.6
Mustang Sor-Sudan	3	12	5	60	11.5	11.50	2.5
Frontier HiDan 35	3	11	4	64	12.5	13.82	2.5
Cenex							
Highland Green	3	15	4	62	9.6	7.82	2.4
Western WS-20	3	12	4	65	11.3	10.19	1.5

Note: Footnotes are described on page 29.

Mean - 2.9

Table 33. Sorghum-Sudangrass Variety Yield Trial - Stanley County (Hayes), 1980.

Brand & Variety	Plant Type*	Stem Dia. (mm)	Maturity (1-5)**	Height (Inches)	% Sugar in Sap	Percent Protein***	Yield Ton/A****
Sokota 300F	3	15	4	76	13.4	5.07	5.2
Western WS-20	3	14	2	76	14.9	5.82	5.0
Western WS-15	3	15	4	79	15.0	6.44	5.0
Mustang Sor-Sudan	3	13	4	74	15.3	7.32	4.9
DeKalb ST-6+	3	14	5	77	17.8	5.00	4.8
Funk's G88F	3	14	3	79	15.2	5.75	4.5
Frontier HiDan 35	3	12	3	75	11.6	5.07	4.5
NK Sordan 77	3	12	1	78	15.7	6.07	4.4
Sokota 310F	3	15	3	80	15.2	6.57	4.3
Pioneer 988	3	16	3	73	18.1	7.13	4.2
Cargill SS-100	3	13	4	74	16.5	5.75	4.1
GSA 1757	3	14	4	73	16.6	7.57	4.1
Cenex							
Highland Green	2	14	5	73	15.6	5.75	4.1
Cenex							
Highland Sweet	3	13	4	77	18.7	6.63	4.0
Frontier HiDan 37R	3	15	4	78	15.1	5.75	3.9
Sokota 315F	3	15	4	77	15.8	5.88	3.9
Mustang Graze	3	13	4	72	14.1	4.75	3.9

Note: Footnotes are described on page 29.

Mean - 4.4

Table 34. Sudangrass Variety Yield Trial - Meade County (Alkali), 1980.

Brand & Variety	Plant Type*	Stem Dia. (mm)	Maturity (1-5)**	Height (Inches)	% Sugar in Sap	Percent Protein***	Yield Ton/A****
NK Trudan 6	3	12	4	66	11.3	10.32	4.1
NK Trudan 8	3	9	4	70	10.6	8.82	3.7
NK Trudan 7	4	11	2	67	11.7	8.07	3.2
Disco 3030	3	15	4	67	11.0	10.75	2.9
GSA FFR 74A	3	11	4	60	8.9	9.00	2.6
Piper	3	9	4	65	9.6	7.19	2.4

Note: Footnotes are described on page 29.

Mean - 3.2

Table 35. Sudangrass Variety Yield Trial - Stanley County (Hayes), 1980.

Brand & Variety	Plant Type*	Stem Dia. (mm)	Maturity (1-5)**	Height (Inches)	% Sugar in Sap	Percent Protein***	Yield Ton/A****
Disco 3030	3	14	4	71	15.1	8.19	5.8
GSA FFR 74A	3	10	3	76	10.5	5.94	5.2
NK Trudan 8	4	11	2	77	13.3	5.82	4.9
NK Trudan 7	4	12	1	75	12.3	5.82	4.7
Piper	3	10	4	72	15.0	9.44	4.0
NK Trudan 6	3	14	2	74	13.8	6.19	3.7

Note: Footnotes are described on page 29.

Mean - 4.7

Meade County

Sorghum trials of grain and forage types were seeded on June 23 in soil previously cropped with oats. The soil was extremely dry from lack of rain. Germination and emergence was not uniform with most of the plants not emerging until late July. Only the shortest season grain sorghums were able to mature seed before first frost in mid-October. Sorghum forages were harvested on October 2. At that date most of the varieties were beginning to shoot heads and pollinate. Forage yields are reported in tables 30, 32, and 34.

Pennington County

Sorghum trials of grain and forage in Pennington county were seeded in soil previously cropped to winter wheat and spring barley. Germination and emergence were slow because of the lack of rain. The plants went into a dormant condition soon after emergence, and remained so until September. For that reason they were not harvested.

Stanley County

Sorghum trials of grain and forage were seeded on June 4. Immediately after seeding the area received heavy hail and rain. The soil formed a thick crust which affected emergence and resulted in uneven stands.

During the remainder of the season the area was subjected to two more hail

storms. The trial received 4 inches of supplemental water by a sprinkler irrigation system. However, because of the hail destruction, the initial shoots were destroyed and only the tillers grew. The grain sorghum produced heads but were not able to set seed. Forage yields are reported in tables 31, 33, and 35.

MANAGEMENT, TILLAGE, AND CULTURAL PRACTICES

Seed Mixtures of Wheat Classes and Seeding Rates

Objective: To observe and compare winter survival, growth characteristics, seed quality, and seed production of winter wheat when mixed with spring wheat in different ratios in order to obtain a uniform seeding rate; and, to study the same factors of winter wheat when seeded at progressive rates from 1/4 bushel per acre up to 1 bushel per acre.

Two varieties of hard red winter wheat were seeded in replicated plots at progressive rates of 1/4 bushel per acre up to one bushel per acre. The wheat was scored for percent stand based on ground cover and plant height. Grain quality was compared by measuring protein content and weight per bushel. Grain yield was the final measurement. The data are reported in table 36.

Table 36. Hard Red Winter Wheat Seed Mixture and Rate of Seeding Study - Bennett County (Martin), 1980.

<u>Mixture of Classes</u>		<u>Percent</u>	<u>Height</u>	<u>Percent</u>	<u>Test Weight</u>	<u>Grain Yield</u>
<u>HRW</u>	<u>HRS</u>	<u>Stand</u>	<u>(Inches)</u>	<u>Protein*</u>	<u>(lbs/Bu)</u>	<u>(Bu/Acre)</u>
RATE OF SEEDING						
<u>Winoka</u>	<u>Protor</u>					
1 Bu/A	0 Bu/A	94	34	12.6	64.1	37.7
3/4 Bu/A	0 Bu/A	89	34	12.9	64.1	36.2
1/2 Bu/A	0 Bu/A	76	34	13.7	63.5	32.7
1/4 Bu/A	0 Bu/A	53	35	13.6	62.4	26.1
<u>Centurk</u>	<u>Protor</u>					
1 Bu/A	0 Bu/A	91	30	12.5	62.6	40.2
3/4 Bu/A	0 Bu/A	88	29	12.9	62.5	38.8
1/2 Bu/A	0 Bu/A	75	29	13.4	62.4	33.4
1/4 Bu/A	0 Bu/A	43	29	13.6	60.1	21.3
SEED MIXTURE						
<u>Winoka</u>	<u>Protor</u>					
1 Bu/A	0 Bu/A	94	34	13.1	63.5	32.8
3/4 Bu/A	1/4 Bu/A	88	33	13.1	63.4	32.4
1/2 Bu/A	1/2 Bu/A	71	35	13.3	62.3	27.4
1/4 Bu/A	3/4 Bu/A	45	36	13.7	61.1	23.5
<u>Centurk</u>	<u>Protor</u>					
1 Bu/A	0 Bu/A	91	31	12.8	63.0	37.5
3/4 Bu/A	1/4 Bu/A	78	30	12.8	62.6	33.7
1/2 Bu/A	1/2 Bu/A	71	30	12.7	62.1	31.4
1/4 Bu/A	3/4 Bu/A	43	29	13.1	60.3	21.9
LSD(05) - 4.4 Bu/A		C.V. - 8.6%		Mean - 31.7		

*Protein content was calculated from Kjeldahl nitrogen analysis and is reported on an oven dry basis.

Discussion:

Rate of Seeding

The percent stand was slightly higher for the variety Winoka, which is more winter hardy than Centurk, even though kernel size of Centurk is smaller and consequently, should have had more plants per unit area. The relative percent stand was the same for both varieties. Plant height did not vary from one seeding rate to another.

Grain quality indicated several differences. Protein quantity in most cases was higher where seeding rate was lower. Weight per bushel was higher where the seeding rate was higher. Yield is correlated with stand and decreased as plant population decreased. Real differences in yield occurred when the seeding rate dropped to 1/2 bushel per acre or less.

Seed Mixture

When different wheat classes were mixed (winter vs spring), the percent stand for the various seeding rates was similar to those where pure winter wheat was seeded. This would indicate there was no effect on winter survival due to the added ground cover of the spring wheat. Plant heights exhibited an inverse relationship between varieties. In the case of Centurk, the thinner the stand the shorter the plants, while the Winoka was taller with fewer plants.

Seed quality, as with the rate of seeding, differed by having an inverse relationship between protein content and test weight, but a direct relationship between protein content and yield. As seeding rates were decreased protein content increased but test weights decreased. This was true for both of the winter wheat varieties. Grain yield and test weights were directly related because as seeding rate decreased test weights and yields also decreased.

Seed Mixture vs Seeding Rate

When comparing the two studies, it would appear in a majority of comparisons with Winoka that protein content was higher where spring wheat was used at seeding time, while in the case of Centurk the protein content was higher when spring wheat was not used. The test weights for Winoka were higher than for Centurk. However, they were higher for both varieties when spring wheat was not used.

Grain yields were higher for Centurk than for Winoka. However, there was a decrease in nearly all instances when spring wheat was planted. The decrease was undoubtedly due to the competition for moisture in the fall.

Seed Treatment of Spring Wheat

Objective: To study the effects of Oxamyl seed treatment on the control of nematodes on spring wheat grown under irrigated conditions.

Seed of a semidwarf hard red spring wheat (var.-James) were treated with a nematicide prior to seeding. The seeds were soaked in a 25,000PPM (a.i.) solution of Oxamyl for 24 hours. The seed was then dried and packaged. It

was seeded in a replicated split plot experiment in conjunction with the variety trials. The data are shown in table 37.

Table 37. The Influence of Oxamyl Seed Treatment on the Agronomic Characteristics of Hard Red Spring Wheat, var.-James, Grown Under Irrigation - Butte County (Newell), 1980.

Seed Treatment	Height (Inches)	Test Weight (Lbs/Bu)	Grain Yield (Bu/Acre)
Treated*	34.6	53.7	49.4
Untreated	31.8	53.0	43.1

LSD(05) - 15.4 Bu/A

C.V. - 19.0%

Mean - 46.2

*Seed soaked in 25,000 PPM (a.i.) Oxamyl for 24 hours.

Note: Plots were seeded on April 15 at 120 pounds per acre, and harvested on August 6. Drill row spacing was 8 inches. The wheat was flood irrigated 3 times during the growing season. Nitrogen fertilizer was applied at 100 pounds per acre.

Discussion:

The seed treatment study was conducted under irrigated conditions in Butte county. The plots did not receive any treatment different than the Hard Red Spring Wheat Variety Trial. The results of the study indicate a beneficial effect was obtained by the treatment. There was an increase in plant height, a small increase in test weight, and an increase in yield. However, the yield increase was not statistically significant. Other trials have indicated a possible phytotoxiceffect from the treatment. However, none were seen in this study.

Alternate Cropping Sequences

Objective: To compare a series of six crop rotations and determine the relative operational costs and economic returns, as well as monitor changes in weed populations, pathogens, and soil moisture.

The series of rotations used in this study are shown in table 38, and includes a continuous cropping, an alternating crop-fallow system, as well as monoculture, biculture, and triculture systems.

Table 38. Rotation Study - Pennington County (Quinn), 1980.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Rot 1	HRW*	HRW	HRW	HRW	HRW	HRW
Rot 2	Barley	HRW	Safflower	Barley	HRW	Safflower
Rot 3	HRS**	HRW	Fallow	HRS	HRW	Fallow
Rot 4	Fallow	HRW	Fallow	HRW	Fallow	HRW
Rot 5	HRS	HRW	Proso	HRS	HRW	Proso
Rot 6	HRW	HRW	Fallow	HRW	HRW	Fallow

* Hard Red Winter Wheat.

**Hard Red Spring Wheat

Table 39. Economic Returns from Six Cropping Sequences - Pennington County (Quinn), 1980.

Rotation	Year 1	2	3	4	Gross* Return	Cycle Return	Annual Return
1							
Crop	HRW	HRW	HRW	HRW			
Test Wt	56.5	59.0	57.5	57.5			
Yield-Bu/A	1.9	3.1	2.3	2.9			
Return/Acre	\$ 7.13	\$11.63	\$ 8.63	\$10.88	\$ 38.27	\$ 9.57	\$ 9.57
2							
Crop	BAR	HRW**	SAF***	BAR			
Test Wt	44.5	56.0	35.9	46.8			
Yield-Bu/A	6.7	2.7	1118#	12.7			
Return/Acre	\$19.30	\$10.13	\$84.96	\$36.58	\$150.97	\$123.03	\$41.01
3							
Crop	HRS	HRW	FAL	HRS			
Test Wt	58.0	57.0	--	59.9			
Yield-Bu/A	5.2	2.0	--	18.3			
Return/Acre	\$19.50	\$ 7.50	--	\$68.63	\$ 95.63	\$ 51.56	\$17.19
4							
Crop	FAL	HRW**	FAL	HRW**			
Test Wt	--	54.1	--	56.6			
Yield-Bu/A	--	8.6	--	12.0			
Return/Acre	--	\$32.25	--	\$45.00	\$77.25	\$ 38.62	\$19.31
5							
Crop	HRS	HRW	PROSO	HRS			
Test Wt	56.0	56.0	56.9	58.5			
Yield-Bu/A	5.2	2.2	12.5	14.1			
Return/Acre	\$19.50	\$ 8.25	\$56.34	\$52.88	\$136.97	\$100.78	\$33.59
6							
Crop	HRW	HRW	FAL	HRW**			
Test Wt	57.5	56.5	--	57.5			
Yield-Bu/A	3.0	3.0	--	15.4			
Return/Acre	\$11.25	\$11.25	--	\$57.75	\$ 80.25	\$ 45.75	\$15.25

* Gross return is calculated on market price on January 1: HRW-\$3.75/Bu, HRS-\$3.75/Bu, BAR-\$2.88/Bu, SAF-7.6¢/lb less discount.

** Overseeded to HRS in May 1980.

***Estimated yield based on 1979 data.

Note: HRW-Hard red winter wheat, HRS-Hard red spring wheat, BAR-Spring barley, SAF-Safflower, PROSO-Pros0 millet.

DISCUSSION:

The yield of grain from all rotations was severely reduced by hail in mid-June. At that date the winter wheat was fully headed and promised a fair yield. After the hail only late tillers produced grain. The spring wheat and barley were also badly damaged and suffered from drought. Pros0 millet showed drought stress and some plants failed to head. The safflower was seeded twice but a stand was not obtained.

After the hail damaged the wheat, weeds became a serious problem in most of the rotations. However, some of the rotations favor the increase of annual grasses and kochia. Both weed species are controllable by using a selective herbicide. A discussion of each rotation follows:

Rotation 1 is continuous cropping with winter wheat. It requires careful management in order to control the grassy winter annual weeds. Soil moisture necessary for the establishment of the wheat in the fall is limited and may be the most serious problem. Seedbed preparation must be accomplished with the minimum loss of soil moisture.

Rotation 2 is a 3 year winter wheat-safflower-spring barley rotation. The barley stand was good and weeds were not a serious problem. The winter wheat was seeded into the barley stubble and emerged in the fall. It did not survive the winter and was overseeded with spring wheat in order to maintain a cover on the soil, and prepare it for the safflower in the following year. The safflower was seeded twice but did not emerge. Soil moisture was extremely short, but in sufficient quantity for the safflower seed to germinate. The seedlings were not able to emerge and continue growth.

Rotation 3 is also a 3 year rotation utilizing spring wheat-winter wheat, and fallow. The spring wheat seeded into the fallow had an excellent stand and was nearly weed free. However, the winter wheat had only a poor stand due to winterkill. Kochia without competition from the wheat took over and required chemical control.

Rotation 4 is a 2 year winter wheat-fallow system and required overseeding with spring wheat because of winterkill. A good stand of winter wheat was obtained the previous fall but the plants were weak due to drought and did not survive.

Rotation 5 is a 3 year rotation of spring wheat, winter wheat, and proso millet. The spring wheat seeded into the millet stubble had a good stand and only a few weeds, whereas the winter wheat had poor winter survival with a heavy stand of kochia and downy brome grass. The millet had a good stand but exhibited drought stress throughout the summer.

Rotation 6 is a 3 year rotation having 2 years of wheat and 1 year of fallow. Both the wheat after fallow, and wheat after wheat had poor stands because of the lack of fall rain. All plots had heavy stands of weeds which required chemical control.

The yields obtained in 1980 and converted to gross returns per acre are reported in table 39. The extremely low yields were due to the extensive hail damage and lack of early season moisture.

Fallow Alternatives and Seeding Methods

Objectives: (1) To compare the three fallow alternatives of zerotill, sub-surface or mulch tillage, and black fallow, by measuring grain yield and quality. Soil changes are to be monitored by soil sampling.

(2) To compare the long term effects of nitrogen and phosphorus fertilizer when applied in combinations with fallow alternatives.

(3) To compare the effects of fallow technics on soil tilth, organic accumulation, plant pathogens, nematodes, and weed populations.

Procedure:

An experiment was established in which a winter wheat-fallow system was utilized to study the residue management of 3 fallow procedures. The systems consisted of (1) a black fallow, (2) a stubble mulch fallow, and (3) a zerotill or chemical fallow.

The fallowed areas were subdivided and a fertility factor in which nitrogen, phosphorus, and the combination of nitrogen plus phosphorus were incorporated. The plots were seeded to hard red winter wheat (var. Bronze) in September 1979. However, due to droughty conditions, the seedlings lacked vigor and much of the stand was lost.

The area was overseeded in the spring of 1980 with hard red spring wheat (var. Protor). A uniform stand was obtained, but at heading time in mid-June received heavy hail damage. Harvesting was completed in mid-August. The results are shown in tables 40 and 41.

Results:

Table 40. Estimated Percent Winter Survival of Hard Red Winter Wheat Seeded With a Combination of Drill Openers and Press Wheels in Soil Fallowed by Three Different Technics - Pennington County(Quinn), 1980.

Drill Opener	Type of Press Wheel	Methods of Fallow			Mean
		Black	Subsurface	Chemical	
Spear Point	Steel "V"	5.4	17.5	4.0	9.0
Double Disc	2" Rubber	19.2	17.1	21.1	19.1
HZ (Slot)	Steel "V"	5.8	21.9	9.7	12.5
Shoe 4"	2" Rubber	11.0	19.1	16.5	15.5
Double Disc	Steel "V"	27.4	12.8	27.2	22.5
Mean		13.8	17.7	15.7	15.7

Discussion:

A review of the winter wheat stand estimates (table 40) indicated better stands were obtained where the double disc openers were used. The type of press wheel behind the openers had only a minimal effect, with the steel "V" more favorable than the 2 inch rubber press wheel. The next most desirable opener was the 4 inch shoe with rubber press wheel, it was followed by the HZ or slot opener, and the least desirable was the spear point with steel "V" press wheel.

The tillage method had very little effect on stand with the mulch or subsurface being best, followed by the chemical fallow, and the least desirable was the black fallow system.

The area was overseeded to spring wheat in late April after the remaining winter wheat was chemically killed. The spring wheat germinated but due to warm temperatures and limited soil moisture did not produce tillers and lacked vigor. In mid-June the area received heavy damage from hail.

Table 41. Influence of Fallow Methods and Fertilizer Variables on Grain Yield of Spring Wheat (var. Protor) - Pennington County (Quinn), 1980.

Fallow Method	Fertilizer Treatment*	Test Weight (Lbs/Bu)	Grain Yield (Bu/Acre)
Mulch	Check	52.9	10.7
	30 lbs Nitrogen	53.1	10.3
	40 lbs Phosphorus	53.8	12.1
	30 lbs Nitro + 40 lbs Phos	53.8	12.2
Black	Check	53.7	9.9
	30 lbs Nitrogen	53.0	9.3
	40 lbs Phosphorus	53.6	10.4
	30 lbs Nitro + 40 lbs Phos	53.0	9.3
Chemical	Check	52.4	7.0
	30 lbs Nitrogen	53.9	8.1
	40 lbs Phosphorus	54.2	8.3
	30 lbs Nitro + 40 lbs Phos	53.5	7.7

LSD(05) - 1.4 Bu/A

Mean - 9.6

*Fertilizer used was Ammonium Nitrate (34-0-0) applied at 88 pounds per acre, and Treble Superphosphate (0-46-0) applied at 87 pounds per acre.

The yield data in table 41 indicates a real difference existed between the yields obtained from plots which had received different tillage, and in some instances a yield increase due to the added fertilizer. The primary response seems to be that of residual soil moisture retained under the mulch procedure.

Effect of Methods of Fallow on Soil Nitrates

Presented in table 42 are the results of two years of a research study conducted near Quinn in Pennington County. The experiment was started in the fall of 1978. Three different tillage methods used for fallowing are being evaluated for their effect on the accumulation of soil nitrates. The 3 methods are:

Surfac Tillage - disc or one-way

Subsurface Tillage - blade or sweeps

Chemical Fallow - Residual & Non-residual herbicides

Tillage and chemicals were used as much as necessary to control weeds. Two years of results show a significant reduction in Nitrate Nitrogen ($\text{NO}_3\text{-N}$) release under chemical fallow compared to subsurface and surface fallowing methods. This is a continuing study and will be evaluated yearly to determine

if different amounts of nitrate release continue at current levels or if eventually the three fallowing methods will release equal amounts of nitrate-nitrogen. The soil is sampled in the fall of each year and nitrates are reported to a depth of two feet. No additional nitrogen fertilizer was applied to the plots being evaluated.

Table 42. Nitrate-Nitrogen ($\text{NO}_3\text{-N}$) Levels After 14 Months of Fallow Due to Mineralization of Organic Matter Under 3 Different Fallow Methods.

Fallowing Method	Pounds of Nitrate-Nitrogen	
	1979	1980
Surface Tillage	82.25	207.25
Subsurface Tillage	87.50	157.25
Chemical Fallow	41.25	135.75
Mean	70.33	166.75
Least Significant Difference at 5%	31.31	48.79
Coefficient of Variability	25.7%	16.9%

Ecofallow Investigations

Objective: To compare the effects of tillage methods on a wheat-row crop-fallow rotation.

Ecofallow is a term used to describe a cropping rotation of small grain-row crops-summer fallow. This rotation has some or all of the mechanical tillage replaced by herbicides. This concept was tested this past growing season in research plots at Winner, South Dakota. Two different crop rotation experiments were designed;

1. Winter Wheat-Sorghum-Fallow
2. Winter Wheat-Sunflower-Fallow

The experimental site was a winter wheat field harvested in August of 1979. Three different combinations of tillage and herbicide treatments were applied to experimental plots 25 feet wide and 75 feet long. The tillage and chemicals used were as follows:

Conventional tillage plots were disked in the fall and again in the spring to control weeds and to establish a uniform seedbed. After planting the row crop with a buffalo till planter, the plots were sprayed with preemergence herbicide to control annual weeds. The plots were cultivated once during the early part of the season.

Minimum tillage plots were sprayed with Paraquat and Atrazine in the winter wheat stubble after harvest of the 1979 crop. The plots were undercut by a blade in the spring of 1980 prior to planting the row crop with a buffalo till planter. After planting, the plots were sprayed with a preemergence herbicide to control annual weeds. The plots were cultivated once during the early part of the growing season.

No tillage plots were sprayed with Paraquat and Atrazine in the stubble after harvest of the 1979 winter wheat crop. There was no tillage prior to the planting of the row crop with a buffalo till planter. The plots were not cul-

tivated during the growing season and much of the wheat stubble remained standing between the rows.

Sorghum

The plant populations and weed control in all plots were excellent during the growing season. The yield differences were significant at the 95 percent level of confidence. The experiment was very uniform and variations within treatments were small. The yield differences expressed here for this past growing season are real. The experiment will be repeated to determine if the results can be duplicated. Table 43 contains yield, nitrate, and moisture data from the sorghum experiment.

Table 43. Sorghum Ecofallow Experiment - Tripp County (Winner), 1979-80.

Treatment	Sorghum Yield		Winter Wheat Yield	Nitrates 0-36"	Moisture 0-36"
	(Bu/A)	(Lbs/A)	(Bu/A)	(Lbs/A)	Inches Water
Cropped-1980					
No Tillage	71	3977 a	22.8 a	79.5 a	6.34
Minimum Tillage	84	4729 b	24.5 a	70.5 a	6.38
Conventional Tillage	63	3524 c	18.3 b	38.8 b	4.97
Fallowed-1980					
No Tillage	--	--	--	98.5	8.75
Minimum Tillage	--	--	--	103.3	8.87
Conventional Tillage	--	--	--	104.5	8.82
Mean	73	4077	21.8	82.5	
LSD(05)	7.0	374	4.7	31.4	(NS)
C.V. (%)	5.3	5.3	11.7	25.2	

Sunflowers

The plant populations were very erratic in all plots and weed control was generally poor. Insect damage to the sunflowers was severe and heads were only partially filled. The largest C.V. (35.4%) indicates a high degree of error in the experiment which is most likely due to erratic plant populations and a severe insect infestation. Table 44 contains yield, soil nitrate, and moisture data from the sunflower experiment.

Table 44. Sunflower Ecofallow Experiment - Tripp County (Winner), 1979-80.

Treatment	Sunflower Yield (Lbs/A)	Winter Wheat Yield (Bu/A)	Nitrates 0-36" (Lbs/A)	Moisture 0-36" Inches Water
Cropped - 1980				
No Tillage	140	16.3 b	35.3	6.38
Minimum Tillage	159	26.0 a	59.3	6.43
Conventional Tillage	227	14.3 b	27.8	5.64
Fallowed - 1980				
No Tillage	--	--	86.3	9.20
Minimum Tillage	--	--	105.3	9.15
Conventional Tillage	--	--	92.0	8.83
Mean	175	18.8	67.6	
LSD(05)	--	4.8	37.7	(NS)
C.V. (%)	35.4	14.6	37.0	

Chemical Aid Fallow

Objective: To compare the effects of tillage methods on a wheat-fallow rotation.

Chemical Aid Fallow is a term used to describe a winter wheat-fallow rotation in which some or all of the tillage in the fallow and seedbed preparation has been replaced by herbicides. The winter wheat-fallow experiment was initiated in the fall of 1979 at Winner, South Dakota on a site that had been previously cropped to winter wheat. Three different fallowing and cropping methods are being evaluated, they are: No tillage, Minimum tillage, and Conventional tillage.

No Tillage Fallow

Winter wheat stubble was sprayed with Paraquat and Atrazine/Bladex. The plots were also sprayed with Roundup in the early summer of 1980.

Minimum Tillage Fallow

Winter wheat stubble was sprayed with Paraquat and Atrazine/Bladex. Two tillage operations were performed during the spring and summer of 1980 to control volunteer wheat and weeds.

Conventional Tillage Fallow

Winter wheat stubble was undercut with a sweep implement in the fall of 1979. Tillage during the spring and summer of 1980 was performed when local field conditions dictated the need for it.

Discussion:

The bushels per acre of wheat shown in table 45 were a result of the first year of experimentation and are therefore recropped wheat yields. The pounds per

acre of nitrate-nitrogen ($\text{NO}_3\text{-N}$) and inches of moisture per acre are the results of accumulations during the 1980 fallow period. Due to variations in the experiment there were no significant differences in the yields, moisture, or nitrate levels in these plots.

Table 45. Winter Wheat-Fallow Rotation - Tripp County(Winner), 1979-80.

Fallow Method	Winter Wheat	Nitrates	Moisture
	Yield (Bu/A)	0-36" (Lbs/A)	0-36" Inches Water
No Tillage	21.3	84.0	8.26
Minimum Tillage	25.8	49.3	8.19
Conventional Tillage	21.8	102.0	7.76
Mean	23.0	78.4	8.07

Recropping of Winter Wheat

Objective: To compare the effects of tillage methods on recropped winter wheat.

One of the major problems with recropping of winter wheat stubble with another winter wheat crop is establishing an adequate stand in the fall. In years when moisture is adequate after harvest, tillage operations are necessary to kill weeds but it also dries out the top soil. If the winter wheat seed is planted into a dry top soil the wheat will not germinate in the fall and produce growth for a winter cover. Fields that have been ~~summer~~ fallowed offer less risk in establishment of the winter wheat crop in the fall. A season of fallow generally only stores about 2 plus acre inches of moisture in the soil. This 2 plus acre inches of moisture will result in 5 to 10 bushel yield advantage for the fallow if adequate stands are obtained on both the fallow and the recropped fields.

Currently, some research is aimed at developing reduced tillage systems which would conserve moisture and reduce the risk of stand establishment on recropped winter wheat. Hopefully, this would provide the grower an opportunity to produce an additional crop when conditions are right. Three different combinations of tillage and herbicide treatments were applied to experimental plots 25 feet wide and 75 feet long. The tillage and chemicals used were as follows:

Conventional Tillage generally involves disking after harvest to kill weeds and reduce crop residues. The disk does an excellent job of killing existing weeds and planting weeds and volunteer wheat seeds. As the weeds and volunteer wheat begins to grow, they must be controlled by additional tillage to keep the field weed free until planting. The experimental plots were disked twice after harvest before seeding and because of the dry soil condition, a poor stand was obtained.

Minimum Tillage as used in experimental plots consisted of spraying the stubble after harvest with Paraquat and blading the plots once just prior to seeding. This method of tillage retained slightly more moisture in the top soil and an adequate stand of winter wheat was obtained on these plots.

No Tillage plots were sprayed after harvest with Paraquat and had no tillage prior to seeding of the winter wheat in the fall. An adequate stand of winter wheat was obtained in these plots in the fall of 1979.

Table 46. Recropping of Winter Wheat - Tripp County (Winner), 1979-80.

Treatment	Winter Wheat	Nitrates	Moisture
	Yield (Bu/A)	0-36" (Lbs/A)	0-36" Inches Water
No Tillage	22.5	67.3	6.60
Minimum Tillage	27.8	64.0	5.62
Conventional Tillage	19.3	38.0	5.55
Mean	23.2	56.4	5.92

Discussion:

The plots with better stands of wheat in the fall had fewer broadleaved weed problems during the next growing season. The plots were sprayed but a poor weed kill was obtained. The yield differences which are significant at the 95% level of confidence were due to poor stand and weed competition. This experiment was continued in the fall of 1980 and again poor stands were obtained in the conventional tillage plots. Table 46 shows winter wheat yields, nitrate levels, and inches of water present in the top 3 feet of soil. Yield data is from the 1980 crop. Nitrate and moisture data was taken the fall of 1980.