Plant Science Pamphlet #27 December 1976

ANNUAL PROGRESS REPORT

CENTRAL CROPS AND SOILS RESEARCH STATION

HIGHMORE, SOUTH DAKOTA

Introduction

The 1976 crop season started out with a shortage of subsoil moisture and continued to become drier as the season progressed. Moisture in the top 6 inches of soil at planting time was so low that germination was slow and erratic. A frost in early May further stunted the plants. All crops on the farm were affected by the adverse conditions, but samples were taken to obtain yield and soil moisture data. By the end of the season, plants had reached a stage where moisture extraction was critical and they were drying up.

Fall plantings of winter grains were those of variety demonstration nature. No attempt was made to plant winter wheat in the experiments. Soil moisture was so low at planting time that germination would have been poor and subsequent removal would follow in the spring.

Work on the Kleppin farm, west of Wessington Springs, was completed this fall. Soil samples were taken to compare differences between the starting condition of the soil and the final condition. A tour of the small grain varieties and the weed control work was conducted in July.

A tour of the Central Research Station was conducted in early June, prior to the Field Day date of July 9. The purpose of the tour was to determine if a Field Day should be conducted. It was the general opinion of the Station Advisory Group to cancel plans for the Field Day. A tour of the vegetable plantings was conducted by the Horticulture Department personnel in July. Emphasis was placed on watering, fertilizing and mulching of vegetables, berry crops and fruit trees.

NOTE: This is a progress report and therefore the results presented are not necessarily complete nor conclusive. Any interpretation given is strictly tentative because additional data from continuation of these experiments may produce conclusions different than those of any one year. These data accurately reflect the 1976 growing season but because of extreme drought are of dubious value.

750 copies printed at an estimated cost of 1¢ per page

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1976 CROP SEASON

Total Rainfall for Growing Season by Months with their Departure from Long-time Average at Central Research Station, Highmore, S.D.

Rainfall	Inches	Departure*	Greatest day	Date
April	1.72	-0.15	0.65	16th
May	0.62	-1.93	0.45	21st
June	1.08	-2.89	0.61	23rd
July	0.48	-2.06	0.38	25th
August	0.22	-2.13	0.10	16th
September	0.75	-0.86	0.40	7th

Number of days during month with temperatures 90° or above
June - 17; July - 23; August - 23; September - 8.
Last frost - Spring (May 7)
First frost - Fall (September 23)
*Departure from longtime rainfall average for 82 years on the Central Research Station.

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Keith and Myron Kleppin Farm
Jerauld County, 11 miles West and
2½ miles South of Wessington Springs

Rainfall data provided by Mrs. Myron Kleppin

TITLE: Weed Control for Corn and Sorghum Forage Production

OBJECTIVES OF EXPERIMENT:

1. Effects of weed control chemicals on succeeding crops.
2. Effect of these cropping sequences on soil moisture.
3. Effect of cropping sequences on the succeeding small grain crop.
4. Silage yields of corn and forage sorghum.

CROPPING SEQUENCE:

1. Corn-atrazine 74, Corn 75, Wheat 76
2. Forage Sorghum-atrazine 74, Forage Sorghum 75, Wheat 76
3. Corn-Ramrod 74, Corn-Ramrod 75, Wheat 76
4. Corn-atrazine 74, Forage Sorghum 75, Wheat 76

CROP YEAR HISTORY: Spring Wheat, 1976

Planted: April 1	Harvested: July 16
Variety: WS 1809, 1 Bu/A	Fertilizer: 60-40-0 Broadcast
Replications: 4	Soil Preparation: Chisel plow
	Plot Size: 12 feet x 114 feet

Rainfall: April, 2.10; May, 1.39; June, 1.39; to July 16, 0.15.
Total 5.03 inches.

RESULTS:

Table 1. Wheat yields following Corn and Forage Sorghum. Moisture use and bushels produced per inch of water used.

Treatment Cropping Sequence Yields following*	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used**	Bushels per Inch of Water Used	Test Weight
1. Atrazine 74***					
Corn 75	21.66	5.32	10.57	0.50	54.7
Wheat 75	21.66	7.02	10.30	0.68	54.3
2. Atrazine 74					
Forage Sorghum 75	21.95	4.01	11.08	0.37	53.9
Wheat 75	22.23	4.59	10.30	0.45	54.5
3. Ramrod 74 and 75					
Corn 75	21.95	5.02	10.77	0.47	54.9
Wheat 75	21.66	6.13	10.30	0.60	54.8
4. Atrazine 74					
Forage Sorghum 75	21.09	4.35	11.68	0.37	53.0
Corn 75	21.09	4.54	10.57	0.43	54.5
Wheat 75	21.09	4.19	10.30	0.41	54.3

* Atrazine 74: Atrazine was applied once in 1974 at 3#/A broadcast and Ramrod at 6#/A in a 7" band in 1974 and 75.

** Inches Used: Includes 5.03 inches of rain from April 1 to July 16.

*** Cropping Sequence: The 1975 crop is listed to show which crop preceded the 1976 wheat crop.

DISCUSSION:

The seedbed condition at spring planting time was mellow and had adequate moisture for rapid germination. As the season progressed and the environmental stresses increased, weeds became a problem from the lack of competition by the spring wheat.

No adverse effect of the atrazine applied in 1974 was evident in 1976. Weed growth on these areas treated with atrazine was less and the wheat showed no herbicide damage.

Soil moisture usage of corn and forage sorghum in 1975 was about equal. The moisture usage of wheat following these crops in 1976 was slightly higher than where wheat followed wheat as indicated in Table 1. When the difference in moisture usage is spread through the 3 foot profile, it would amount to 0.4" of moisture in Rotation 4, 0.27" in Rotation 2, 0.10" in Rotation 1, and 0.17" in Rotation 3. Under these conditions, any of the cropping sequences referred to on page 3 should be satisfactory.

Yields of wheat are consistent where forage sorghum was used and slightly higher where corn was the preceding crop in 1975.

In summary, the moisture loss from the profile plus precipitation would indicate there was more moisture left from row crop than from wheat in 1975.

CENTRAL RESEARCH STATION

HIGHMORE, SOUTH DAKOTA

TILLAGE AND FERTILITY EXPERIMENTS

Q. Kingsley and M. Volek

TITLE: Tillage Methods and Cropping Sequences

OBJECTIVES OF EXPERIMENTS (eight in number):

1. Soil moisture change with tillage method or crop sequence.
2. Effect of fertility on yield of grain or silage.
3. Comparison of tillage tools used for weed control.
4. Effect if cropping sequences on yields.

TILLAGE TREATMENTS:

1. Chisel plow, narrow sweeps, disk once or when needed.
2. Mulch, 32" wide sweeps, disk once or when needed.
3. Stubble, no tille, or possibly chemical.
4. Fallow, black, narrow or wide sweeps + disk or duckfood until black.
5. Fallow, some residue, narrow or wide sweeps + fisk or duckfood until nearly black.

CROP SEQUENCE: (Numbers on side refer to tillage treatments)

	Spring Grain		Winter Grain
1-2	wheat	1-2	wheat
1-2	wheat-oats	1-2	wheat-oats
1-2	wheat-row crop (grain)	1-2	wheat-row crop (silage)
3-4-5	wheat-fallow	3-4-5	wheat-fallow

FERTILITY:

0- 0-0	
0-30-0	Phosphorus applied with grain (P_2O_5)
45- 0-0	Nitrogen broadcast on surface
45-30-0	

PLANTING SPACE:

Small grain, 7 inch
Row crop, 36 inches

PLOT SIZE:

20 ft. x 40 ft.

STARTING SOIL SAMPLES:

Every plot 0-6", 6-12", 12-18", 18-24"

REPLICATIONS: 4

CROP YEAR HISTORY:

Planted:	wheat, March 31	Harvested:	wheat, July 14
	corn, May 17		corn, Oct. 6
	oats, March 31		oats, July 14

Herbicide: Ramrod, 6#/A
7" band, corn

Insecticide: Thimet, 1# active/A on corn

Row Space: wheat 7"
corn 36"

Fertilizer: 45-30-0
45- 0-0 Broadcast application
0-30-0 Applied with the grain drill

Cultivation: Corn, twice

Tillage: Chisel plow or with 32" sweeps to depths of about 4 to 6 inches

Replications: 4

Corn - Silage Planted May 17 Harvested August 30

Wheat - WS 1809

Oats - Spear

Winter Wheat - Sage Planted Sept. 5, 1975 Harvested July 5, 1976

RESULTS:

Table 2. Influence of Tillage and Fertility on Wheat Yields in a Spring Wheat - Corn Rotation. Experiment 1.

Fertility Treatment Lb/A $N-P_2O_5K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
		Tillage: Mulch with 32 Inch Sweeps			
45-30-0	18.24	2.42	12.26	0.20	57.0
45- 0-0	18.81	2.46	11.42	0.22	56.5
0-30-0	18.24	2.48	10.97	0.23	56.0
0- 0-0	18.24	2.37	11.89	0.20	55.0
		Tillage: Chisel Plow			
45-30-0	18.24	2.61	10.04	0.26	59.0
45- 0-0	18.81	4.30	10.06	0.43	57.0
0-30-0	18.24	3.58	10.26	0.35	57.8
0- 0-0	18.81	2.40	10.05	0.24	55.8

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 14 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

The yields produced on mulch tillage with 32 inch sweeps were similar for all fertilizer treatments. Fertilizer had no appreciable effect on percent protein or bushels produced per inch of water used. Mulch tillage was performed with 32 inch sweeps at a depth of 4-6 inches with a mulch cover of corn stalks.

Chisel plow preparation of the corn stalk ground for spring wheat left a rough condition due to the loosening of whole chunks of corn stalk roots. This increased soil moisture loss and may be a factor in the lower moisture usage for wheat grown on chisel plowed ground. Fertility had little effect on the percent protein in the grain. Chisel plowing was performed to a depth of 8-12 inches with a small amount of debris on top.

In summary, fertility had very little effect on yields produced under mulch tillage but under chisel plowing yields were 1.9 bushels per acre higher on plots fertilized with 45-0-0 and 1.2 bushels higher on plots fertilized with 0-30-0 than for the 0-0-0 treatment (table 2).

RESULTS:

Table 3. Influence of Tillage and Fertility on Corn Grain Yields in a Spring Wheat - Corn Rotation. Experiment 1.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Corn Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**
		Tillage: Mulch with 32 Inch Sweeps		
45-30-0	13.75	1.96	8.06	0.24
45- 0-0	11.88	4.61	6.01	0.77
0-30-0	13.13	4.09	5.32	0.77
0- 0-0	12.50	1.80	6.55	0.27
		Tillage: Chisel Plow		
45-30-0	13.75	0.95	6.96	0.14
45- 0-0	13.75	2.33	6.42	0.36
0-30-0	14.38	1.11	6.38	0.17
0- 0-0	13.75	1.96	7.30	0.27

* Inches Used: Includes soil water loss in the 3-foot section of soil from May 17 to Oct. 6 when soil was near the wilting point plus 3.17 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

The soil moisture following the 1975 spring wheat crop was lower, Table 3, than following the 1975 corn crop, Table 2. This drying of the subsoil plus any variations in surface soil depths had a decided effect on the bushels of grain produced by the corn crop.

Some bird damage was experienced but poor set may be attributed primarily to extreme heat and wind at pollinating time.

In summary, the depletion of the subsoil moisture was so extensive that fertilizer was ineffective.

RESULTS:

Table 4. Effect of Tillage and Fertility on Winter Wheat Yields in a Winter Wheat - Corn Silage Rotation. Experiment 2.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
Tillage: Mulch with 32 Inch Sweeps					
45-30-0	17.10	5.86	11.44	0.51	57.0
45- 0-0	17.10	5.18	10.99	0.47	57.5
0-30-0	17.10	6.39	11.41	0.56	57.0
0- 0-0	15.96	8.67	11.74	0.74	57.5
Tillage: Chisel Plow					
45-30-0	18.13	8.66	11.14	0.77	57.3
45- 0-0	17.10	9.49	11.23	0.85	57.3
0-30-0	17.10	6.09	11.72	0.52	57.3
0- 0-0	15.96	8.00	11.91	0.67	57.3

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 5 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

The deeper tillage resulting from the use of the chisel plow seemed to enhance the moisture usage of the winter wheat plants. A slight increase in yield may be noted, Table 4, for the bushels produced per inch of water used.

In summary, fertilizer usage under mulch tillage was nonresponsive and chisel plowing aided in better extraction of soil moisture in some cases.

RESULTS:

Table 5. Effect of Tillage and Fertility on Corn Silage Yields in a Winter Wheat - Corn Silage Rotation. Experiment 2.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	Corn Silage Yield Tons/A Wet	Corn Silage Yield Tons/A 12% H_2O	Moisture Loss From Profile plus Precipitation Inches Used*	Tons per Inch of Water Used**
		Tillage: Mulch with 32 Inch Sweeps		
45-30-0	3.38	1.24	8.71	0.14
45- 0-0	3.28	1.18	8.87	0.13
0-30-0	3.25	1.10	8.70	0.13
0- 0-0	2.70	0.94	9.71	0.10
		Tillage: Chisel Plow		
45-30-0	3.62	1.25	8.61	0.15
45- 0-0	3.01	1.07	6.51	0.16
0-30-0	2.37	1.08	7.50	0.14
0- 0-0	2.72	1.00	7.83	0.13

* Inches Used: Includes soil water loss in the 3-foot section of soil from May 17 to August 30 when soil was near the wilting point plus 3.17 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

The corn silage yield is reported in tons per acre wet and at 12% moisture. The 12% figure is used to put the corn silage on equal basis with air dried hay.

The corn crop follows winter wheat and is planted in the spring of the following year. A draw down of subsoil moisture may be noted when comparing Table 4 to Table 5. Without fall and spring moisture, the yield potential of the crop was reduced resulting in short plants with very little ear development.

In summary, there seems to be a little response to fertility, but the bushels per acre produced are not of a magnitude to be economically important.

RESULTS:

Table 6. Continuous Winter Wheat. Experiment 3.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
		Tillage: Mulch with 32 Inch Sweeps			
45-30-0	19.38	19.99	11.92	1.68	56.2
45- 0-0	19.38	16.11	12.05	1.34	56.0
0-30-0	18.81	16.87	12.36	1.36	56.8
0- 0-0	18.24	20.88	12.04	1.73	57.0
		Tillage: Chisel Plow			
45-30-0	19.38	18.64	10.92	1.71	56.4
45- 0-0	19.38	15.10	11.17	1.35	56.2
0-30-0	17.67	18.14	11.15	1.63	56.8
0- 0-0	18.81	21.35	10.68	2.00	56.6

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 5 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

This continuous winter wheat study lies on a lower area with a deep surface soil horizon. The mulch was heavier than for other experiments on the station and the shading effect aided in moisture conservation and reduced heat buildup.

Yields produced on mulch tillage or chisel plowing are nearly the same. No benefit may be attributed to fertilizer applications when compared to the 0-0-0 treatment. Percent protein is higher where nitrogen has been added to the soil.

In summary, even though the mulch was heavier and the surface soil horizon deeper, the quantity of moisture was so limited there was no response to added fertilizer.

RESULTS:

Table 7. Continuous Spring Wheat. Experiment 4.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
		Tillage: Mulch with 32 Inch Sweeps			
45-30-0	19.95	1.87	11.65	0.16	53.5
45- 0-0	19.95	1.61	11.66	0.14	53.0
0-30-0	18.84	2.15	11.38	0.19	55.0
0- 0-0	18.81	3.18	11.51	0.28	55.2
		Tillage: Chisel Plow			
45-30-0	19.95	2.00	11.95	0.17	56.0
45- 0-0	17.10	2.42	11.16	0.22	55.7
0-30-0	19.38	2.05	11.72	0.17	54.0
0- 0-0	19.38	2.83	11.39	0.25	53.8

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 14 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

Tillage methods or fertility had little effect on the grain yields. The 45-30-0 fertilizer treatment did increase the percent of protein in wheat when compared to the 0-0-0 treatment.

RESULTS:

Table 8. Degree of Fallow Tillage for Spring Wheat. Experiment 5.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
			Tillage: No Till***		
45-30-0	17.67	4.45	10.30	0.43	59.8
45- 0-0	17.67	6.45	10.69	0.60	58.8
0-30-0	17.67	3.50	10.85	0.32	58.0
0- 0-0	17.67	6.08	10.67	0.57	60.5
			Tillage: Some Till***		
45-30-0	18.24	14.68	11.25	1.30	58.8
45- 0-0	18.24	17.00	10.34	1.64	59.3
0-30-0	17.67	14.11	10.78	1.31	59.0
0- 0-0	17.67	16.21	11.06	1.47	59.0
			Tillage: Most Till***		
45-30-0	18.24	12.29	10.65	1.15	58.5
45- 0-0	18.24	16.88	10.64	1.59	58.3
0-30-0	18.81	16.32	10.31	1.58	59.0
0- 0-0	18.24	17.43	10.58	1.65	59.0

* Inches Used: Includes 3.42 inches of rain from April 1 to July 14.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

*** Tillage: No till -- Weed control with chemicals
Some till -- Chisel plow twice but maintain organic matter
Most till -- Weed free using a chisel plow

DISCUSSION:

In this fallow tillage study, the three fallow practices performed during 1976 will be planted to spring wheat in 1977. The fallow treatments are explained on the bottom of Table 8.

The degree of tillage for this spring wheat study produced varying effects, notably "no-till" versus "some till" and "most till." Grain produced by the "no till" method, with its undisturbed soil, was 10 or more bushels lower than for the other two methods. Under these conditions, there is no decided yield advantage of "most till" over "some till." The percent protein is higher in the 0-30-0 and 0-0-0 of "most till" than "some till" and higher in all cases than "no till." Bushels per inch of water used was higher for the "some" and "most till" methods when compared to the "no till" and the amounts of water used from the profile.

In summary, in a dry year "no till" tillage does not produce as desirable a seedbed as the other two treatments. Soil moisture use is about the same as for the other treatments and protein and yield are lower.

RESULTS:

Table 9. Degree of Allow Tillage for Winter Wheat. Experiment 6.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used	Test Weight
			Tillage: No Till**		
45-30-0	19.38	16.05	10.37	1.55	56.8
45- 0-0	18.81	17.46	10.41	1.68	57.3
0-30-0	19.38	11.46	9.10	1.26	57.0
0- 0-0	19.38	18.54	10.26	1.81	58.0
			Tillage: Some Till**		
45-30-0	19.38	21.94	11.38	1.93	57.5
45- 0-0	19.95	24.12	10.94	2.20	57.0
0-30-0	18.81	11.74	11.28	1.04	56.0
0- 0-0	19.95	18.29	11.21	1.63	57.3
			Tillage: Most Till**		
45-30-0	18.81	21.20	11.58	1.83	57.0
45- 0-0	19.38	18.04	11.32	1.59	57.3
0-30-0	19.38	17.86	10.71	1.67	56.3
0- 0-0	19.38	20.51	11.32	1.78	56.5

* Inches Used: Includes 3.42 inches of rain from April 1 to July 5
** Tillage: No Till -- Weed control with chemicals
Some Till -- Chisel plow twice but maintain organic matter
Most Till -- Weed free using a chisel plow

DISCUSSION:

The fallow tillage for this study was performed in 1975 stubble. The fallow treatments are explained at the bottom of Table 9.

Winter wheat yields are much higher on the "no till" treatments, Table 9, than for spring wheat using the same method, Table 8. The main reason for this difference is the fall moisture received in 1975. The seed germinated and the plant stooled well in the fall and was growing through the dry soil that spring wheat was being planted in during the spring season. Soil moisture usage was lower for "no till" but yields produced per inch of water used varied with fertilizer treatments.

The extra moisture under "some till" and "most till" helped increase yields for some fertility treatments, but the response was not consistent, Table 9.

In summary, the planting of winter wheat into "no till" soil in the fall, when moisture is present, may be a practical approach to wheat production.

RESULTS:

Table 10. Tillage Methods, Fertility and Yield of Spring Wheat in a Wheat - Oats Rotation. Experiment 7.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
Tillage: Mulch with 32 Inch Sweeps					
45-30-0	18.24	3.62	10.61	0.34	57.0
45- 0-0	18.24	1.91	11.09	0.17	56.0
0-30-0	17.10	4.29	10.31	0.42	57.0
0- 0-0	17.67	3.12	10.82	0.29	57.0
Tillage: Chisel Plow					
45-30-0	18.24	4.43	9.32	0.48	57.0
45- 0-0	18.81	4.36	9.00	0.44	57.3
0-30-0	17.10	5.90	9.54	0.62	58.0
0- 0-0	18.24	3.69	10.12	0.36	57.0

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 14 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

RESULTS:

Table 11. Tillage Methods, Fertility and Yield of Oats in a Spring Wheat - Oats Rotation. Experiment 7.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Oats Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
		Tillage: Mulch with 32 Inch Sweeps			
45-30-0	18.75	3.58	13.24	0.27	35.0
45- 0-0	18.75	3.39	13.14	0.26	34.0
0-30-0	18.75	7.04	13.59	0.52	32.3
0- 0-0	18.75	4.58	13.28	0.34	36.0
		Tillage: Chisel Plow			
45-30-0	18.75	2.47	12.85	0.19	34.3
45- 0-0	18.13	3.68	13.58	0.27	33.5
0-30-0	18.75	7.04	13.27	0.53	37.0
0- 0-0	17.50	2.97	13.17	0.23	31.7

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 14 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

This experiment is a spring wheat-oats rotation.

The moisture usage of wheat and oats, Tables 10 and 11, indicate which has the higher water requirements to produce grain. The quantity of available moisture was higher following wheat than following oats. The phosphorus is applied with the seed at planting time and did not affect the yields of either the wheat or oats, Tables 10 and 11.

Fertility and tillage had minimal effect on the yields of either oats or wheat as illustrated in Tables 10 and 11.

RESULTS:

Table 12. Influence of Tillage Methods and Fertility on Winter Wheat Yields in a Winter Wheat - Oats Rotation. Experiment 8.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Wheat Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
		Tillage: Mulch with 32 Inch Sweeps			
45-30-0	18.81	3.67	10.28	0.36	57.0
45- 0-0	18.81	2.53	9.52	0.27	56.0
0-30-0	18.24	3.17	9.35	0.34	57.7
0- 0-0	17.67	1.83	9.65	0.19	56.3
		Tillage: Chisel Plow			
45-30-0	16.81	2.72	8.87	0.31	55.7
45- 0-0	17.67	2.81	8.09	0.34	56.8
0-30-0	19.38	3.15	9.57	0.33	57.0
0- 0-0	18.24	2.33	9.43	0.25	57.0

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 5 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

This is a winter wheat-oats rotation. The effect of fertilizer was very small under either stubble mulching with 32 inch sweeps or chisel plowing. Subsoil moisture was low and total moisture available was on an average less than 10 inches for the growing season.

In summary, tillage methods and fertility had little effect on the yielding ability of the wheat. The residual moisture left from oats was not enough to sustain good plant growth.

RESULTS:

Table 13. Influence of Tillage Methods and Fertility on Oats Yields in a Winter Wheat - Oats Rotation. Experiment 8.

Fertility Treatment Lb/A $N-P_2O_5-K_2O$	% Protein	Oats Yield Bu/A	Moisture Loss From Profile plus Precipitation Inches Used*	Bushels per Inch of Water Used**	Test Weight
		Tillage: Mulch with 32 Inch Sweeps			
45-30-0	21.25	22.76	13.57	1.68	33.8
45- 0-0	20.00	23.42	13.30	1.76	35.3
0-30-0	21.25	22.46	13.00	1.73	35.3
0- 0-0	20.00	21.81	13.78	1.58	34.8
		Tillage: Chisel Plow			
45-30-0	20.00	21.61	11.65	1.85	35.8
45- 0-0	21.25	26.57	12.63	2.10	35.8
0-30-0	21.25	30.95	11.92	2.60	36.0
0- 0-0	20.00	22.52	12.02	1.87	35.8

* Inches Used: Includes soil water loss in the 3-foot section of soil from April 1 to July 14 when soil was near the wilting point plus 3.42 inches of precipitation received during this period. Even though some is lost, all figure into the total used.

** Calculated by $\frac{\text{Bu. of grain produced}}{\text{Loss + precipitation}}$ = bushels of grain produced per inch of water used.

DISCUSSION:

The effect of fertility for oats or wheat in a low rainfall year is not very pronounced and the anticipated yield increases are down from the yielding capacity of the plant. Subsoil moisture was higher under the oats phase, Table 13, than that available for the wheat, Table 12. The yields of oats following spring wheat, Table 11, are lower than those where oats follows winter wheat, Table 13.

1976 WEED CONTROL DEMONSTRATION
Winter Wheat
Sully County

Newell Ludwig, Cooperator
Harold Wood, County Extension Agent
Leon Wrage, Extension Weed Specialist

Table 14

Treat No. (2 - reps)	Treatment	Rate lb/A act.	% Wild Buckwheat Control 5/8	% Wild Buckwheat Control 5/22	% Kochia Control 7/7	Yield Bu/A
1.	Check	--	0	0	0	28.0
2.	2,4-D amine	1/2	80	13	38	27.4
3.	2,4-D amine	3/4	80	55	50	27.8
4.	2,4-D ester	1/2	88	75	75	27.2
5.	2,4-D ester	3/4	85	88	83	27.0
6.	dicamba	1/8	85	90	83	28.0
7.	dicamba + 2,4-D amine	1/8+1/4	83	93	90	29.7
8.	Check	--	0	0	0	28.7
9.	bromoxynil	3/8	98	93	93	28.5
10.	bromoxynil + 2,4-D ester	3/8+3/8	98	97	93	28.5
11.	picloram + 2,4-D amine	1/48+3/8	77	85	57	29.4
12.	picloram + 2,4-D ester	1/48+3/8	80	88	27	30.9
13.	picloram + 2,4-D amine	1/64+1/4	80	75	23	31.1

Field Size: 260 x 90 Ft. Plot Size: 10 x 90 Ft. Variety: Sage

Applied: April 29, 1976
Wheat--fully tillered - jointing, 4-6 inches tall.
Wild buckwheat--1-2 true leaves. Kochia - under 1 inch. Weed density light.

Frost: May 1, 2, 4, 6 & 7. Severe freeze May 3 (18-20°F). Frost damage evident on May 8.

Data: August 2 reps. - 2 ratings/plot

Purpose: To evaluate herbicide treatments for wild buckwheat and Kochia weed control in winter wheat. Poor control has been reported by growers. Evaluation of labeled herbicide is not being done in other research programs.

Methods: Herbicides were applied to established Sage winter wheat on April 29, 1976. All treatments were applied with bicycle plot sprayer, using 20 GPA water and 25 PSI. Each plot size was 10 x 90 feet, with two replications.

The crop was fully tillered to the jointing stage (4-6 in) at time of treatment. Weed infestations were moderate to light. Wild buckwheat had 1-2 true leaves and Kochia was less than 1 inch tall. Frost occurred on May 1, 2, 4, 6 and 7, with a severe freeze May 3 (18° to 20° F).

Evaluation: Visual weed ratings were recorded on dates shown. Each plot was evaluated in two areas; thus each rating represents an average of four observations. Yields were obtained by harvesting the entire plot with a plot combine. Visual evaluation of crop damage on May 8 indicated foliage burn on bromoxynil plots.

Results: Treatments including dicamba or bromoxynil provided excellent wild buckwheat and Kochia control. Picloram and the 2,4-D ester treatments at the high rate provided a high degree of wild buckwheat control. Kochia control with 2,4-D amine and picloram was not satisfactory. Trends from yield data are not definite. The relatively light weed infestation and late season drought reduced the value of weed control. The foliage burn apparently did not reduce the yield. This may be associated with (frost) conditions. No single herbicide treatment appeared to show a trend suggesting reduced yield or improved yields.

WEED CONTROL OBSERVATIONS ON THE CENTRAL RESEARCH STATION, 1976

Gene Arnold

There were two experiments conducted on the Highmore Station in 1976. Both experiments were initiated in the fall of 1975. One involved the evaluation of herbicides for fallow wheatland. The herbicides were applied in the spring of 1975; winter wheat was planted over these plots in the fall of 1975. Because of the poor rainfall conditions, both in 1975 and 1976, the herbicides were not activated to give sufficient control of weeds in the fallow. Because of the dry weather in 1976 yields from these winter wheat trials were not significantly different from the weedy check.

The other experiment was to evaluate the effects of a potential herbicide for the control of downy bromegrass. Sixteen varieties of winter wheat were planted in the fall of 1975 and were treated with the experimental compound in November. The compound appeared to increase winter kill of some wheat varieties; however, because of the extreme dry weather in 1976, those plots receiving substantial winter kill yielded as much as the plots with little or no winter kill. The experiments on chemical fallow will continue in an effort to determine satisfactory herbicides for fallow in semi-arid wheatland production. The experiments for control of downy brome in winter wheat will be continued, but dry weather has reduced the downy brome infestations. These experiments will be discontinued until more normal weather produces larger downy brome infestations.

WINTER BARLEY

P. B. Price

Winter barley testing was continued at the Central Substation during 1975-76. The objective of this testing and selection is to develop a winter barley variety with higher level of winterhardiness. A winter barley which is superior to the varieties Kearney and Dicktoo would appear to have potential for stable production of this feed grain in the southwest quarter of South Dakota.

Twenty winter barley composites, developed at the South Dakota Experiment Station, and the check variety Kearney were seeded in September 1975. Fall growth and over-winter survival were good, but plant height and grain yields were severely reduced by the drought.

A large number of head selections were made. They will be used in crosses and increased to permit further field testing.

EFFECT OF UREA PLACED WITH THE SEED

E. Adams and P. Carson

This study was established to evaluate the effect of applying urea fertilizer with small grain seed at planting. Urea rates with the spring wheat seed varied from 0 to 60 lbs actual N. This experiment was planted April 26 in very dry soil. Germination and emergence occurred very unevenly but did not appear to be related to fertilizer applied with the seed. Continued severe drought prevented normal germination and plant growth. The study was abandoned at this point. Existing plants failed to develop and the grain did not fill during the remainder of the growing season.

COMPARING UREA AND AMMONIUM NITRATE SOURCES OF NITROGEN FOR TOPDRESSING SMALL GRAIN

E. Adams and P. Carson

The objective of this study was to compare the effectiveness of urea and ammonium nitrate as the nitrogen source for top dressing small grains. They were applied at rates from 0 to 60 lbs actual nitrogen per acre. It was seeded, and top dressed with nitrogen on April 26. Extremely dry soil at planting and very low precipitation caused uneven stands. Continued severe moisture and temperature stress prevented normal head development. The study was abandoned when it was certain the plants were dead and no grain formation would occur.

HIGHMORE GRASS TESTS, 1976

J. G. Ross and G. L. Holborn

Grass tests to determine forage and seed production of new selections and varieties were seeded on August 25, 1975. These tests were irrigated using lawn sprinklers to get the grass seed germinated. Creeping foxtail did not become established because it needed more moisture than was available. It is suited to low areas that flood in the spring. There were, however, nine replicates of varieties of smooth bromegrass, intermediate wheatgrass and crested wheatgrass established. These came through the winter and in spite of the very low rainfall produced some forage and seed in the summer of 1976. They were harvested with a plot combine on July 13. No significant differences in forage or seed production were found among the varieties of bromegrass and crested wheatgrass. SD 5 yielded more forage and seed than the other varieties but differences were not significant. Likewise, Nordan crested wheatgrass yielded more forage and seed than the other varieties but the differences were not significant. In the intermediate wheatgrass test, Oahe yielded significantly more forage but Slate yielded significantly more seed than the other varieties.

The bromegrass and intermediate wheatgrass varieties had higher forage yield than the crested wheatgrass.

It seems likely that the dry weather effects covered up any real differences between varieties. Such differences will likely be evident in future years.

Table 15. Bromegrass

	Forage T/A	Seed lbs/A
SD 5	1.10 a	254 a
SD 6	1.06 a	238 a
Lincoln	.91 a	229 a

Table 16. Intermediate Wheatgrass

	Forage T/A	Seed lbs/A
Oahe	1.15 a	50 b
Slate	.98 b	158 a
SD 52	.97 b	98 b
SD 51	.92 b	42 b

Table 17. Crested Wheat-grass

	Forage T/A	Seed lbs/A
Nordan	.89 a	317 a
Ruff	.84 a	307 a
SD 711	.79 a	231 a

Figures followed by the same letter are not significantly different from each other.

1976 SMALL GRAIN VARIETY TRIALS

J. J. Bonnemann

Six small grains were seeded for 1976 performance evaluation at the Central Research Station. Winter wheat and rye were seeded on September 6, 1975. The remaining spring grains were seeded on April 8, 1976. Harvest of all the small grain was finished on July 21, 1976.

Adequate moisture was available for germination of all crops but was limited the remainder of the year. The effects of the severe drouth are shown in the low yields reported in the accompanying tables. The test weight and quality of the grain was good, considering the growing season.

Table 18. 1976 Standard Variety Spring Wheat Trial Yields and Available Averages, Highmore

	Bushels per acre				Test weight, lb/bu			
Variety	1974	1975	1976	3 yr	1974	1975	1976	3 yr
Thatcher	9.5	13.2	12.8	11.8	47	53	56	52
Fortuna	14.9	13.8	12.8	13.8	49	52	57	53
Chris	10.7	10.1	11.6	10.8	49	54	57	53
Waldron	12.7	16.3	15.2	14.7	45	49	57	50
Tioga	16.1	15.7	10.9	14.2	49	55	57	54
Ellar	14.0	14.0	14.1	14.0	46	52	56	51
Nowesta	9.8	13.9	12.2	12.0	46	52	57	52
Era	10.5	5.0	13.4	9.6	46	52	58	52
Bonanza	13.2	12.8	10.2	12.1	46	52	57	52
WS 1809	16.3	10.4	9.7	12.1	45	53	56	51
Bounty	23.9		11.1		48		58	
Olaf	14.4	14.7	13.7	14.3	46	54	60	53
W-433R	20.6	14.3	12.7	15.9	50	56	58	55
Kitt	9.2	8.0	11.7	9.6	47	51	57	52
Bounty 309	16.9	11.3	12.9	13.7	47	51	59	52
Profit 75		9.5	14.6			52	58	
Protor	16.3	10.5	10.9	12.6	51	50	58	53
Prodax	12.5	9.9	9.2	10.5	45	52	57	51
WS 25			10.2				60	
Leeds	12.9	11.0	11.5	11.8	54	60	61	58
Rolette	15.1	13.3	11.2	13.2	52	60	60	57
Ward	17.2	10.8	12.4	13.5	51	59	59	56
Crosby	15.0	11.5	13.9	13.5	46	59	60	55
Rugby	14.6	13.7	13.0	13.8	50	58	59	56
Botno	14.3	11.1	14.7	13.4	51	58	60	56
Cando (semi)			10.4				54	
Mean, B/A			12.3					
CV - %			17.3					
LSD (.05)			3.4					

Table 19. 1976 Standard Variety Triticale Trial Yields and Available Averages, Highmore

Variety	Lb/A 1975	Lb/A 1976	Lb/A Av.	T.W. 1976
Triticale 203	716	397	556	46
Triticale 204		266		43
Triticale 418		285		45
Triticale 419		250		51
Mean, Lb/A		300		
CV - %		48.5		
LSD (.05)		N.S.		

Table 20. 1976 Standard Variety Oat Trial Yields and Available Averages, Highmore

Variety	Bushels per acre 1974	1975	1976	3 yr	Test weight, lb/bu 1974	1975	1976	3 yr
Burnett	23.5	46.1	20.5	30.0	31	34	38	34
Trio	23.4	53.5	20.5	32.5	30	38	36	35
Diana	28.6	47.0	19.1	31.6	29	37	36	34
Holden	29.4	43.8	17.1	30.1	30	33	38	34
Portal	20.5	45.2	11.1	25.6	30	34	34	33
Nodaway 70	24.2	49.3	13.9	29.1	33	38	40	37
Froker	22.6	37.1	20.2	26.6	30	34	38	34
Chief	25.5	40.4	14.6	26.8	31	32	36	33
Otee	24.2	43.8	15.3	27.8	32	36	36	35
Dal	23.7	29.7	10.8	21.4	30	29	33	31
Astro	17.7	34.5	13.2	21.8	28	28	34	30
Noble	34.1	42.5	14.8	30.5	30	32	36	33
Stout	34.0	47.5	12.4	31.3	32	35	36	34
Spear	30.4	45.9	19.4	32.1	32	30	35	32
MN 71101	24.8	50.5	11.9	29.1	26	32	33	30
Wright	31.3	42.3	20.7	31.4	31	34	38	34
M-73	16.5	45.9	12.4	24.9	31	34	35	33
E-76			14.6				36	
Lang		49.4	18.1			33	36	
E-77			10.6				33	
Mean, B/A			16.4					
CV - %			14.6					
LSD (.05)			3.4					

Table 21. 1976 Standard Variety Rye Trial Yields and Available Averages, Highmore

Variety	Bushels per acre 1973	1974	1976	3 yr	Test weight, lb/bu 1973	1974	1976	3 yr
Cougar	37.8	57.3	12.8	35.9	54	53	47	51
Puma		49.9	9.8			54	49	
Rymin		59.4	19.4			55	51	
SD Sel 75			15.2				51	
Mean, B/A			14.3					
CV - %			40.4					
LSD (.05)			N.S.					

Table 22. 1976 Standard Variety Winter Wheat Trial Yields and Available Averages, Highmore

Variety	Bushels per acre 1973	1974	1976	3 yr	Test weight, lb/bu 1973	1974	1976	3 yr
Nebred	35.9	27.9	22.6	28.8	59	57	58	58
Lancer	28.3	22.6	23.5	24.8	59	52	59	57
Scout 66	34.8	31.2	25.3	30.4	61	55	58	58
Winoka	31.4	19.4	24.6	25.1	60	54	58	57
Bronze	35.7	24.1	18.4	26.1	60	56	57	58
Eagle	37.1	40.6	23.3	33.7	62	57	59	59
Centurk	32.9	39.8	21.6	31.4	60	57	57	58
Baca			27.4				59	
HiPlains	37.4	28.3	17.6	27.8	60	56	58	58
Buckskin	32.5	34.9	20.3	29.2	60	55	56	57
Homestead	33.9	34.7	24.1	30.9	59	54	57	57
Sentinel	39.5	38.6	24.8	34.3	60	57	57	58
Cloud	35.2	28.3	24.6	29.4	60	56	59	58
Kirwin			19.3				59	
Sage	34.6	44.4	26.6	35.2	61	59	59	60
Gent	30.2	37.3	23.5	30.3	61	57	58	58
Lancota			18.7				58	
Rall (OK)		34.6	25.3				59	
Agate (NE)			19.2				58	
Lindon (CO)			19.1				59	
Mean, B/A			21.6					
CV - %			15.3					
LSD (.05)			5.3					

1975 lost to poor germination and winterkill.

Table 23. 1976 Standard Variety Barley Trial Yields and Available Averages, Highmore

Variety	Bushels per acre				Test weight, lb/bu			
	1974	1975	1976	3 yr	1974	1975	1976	3 yr
Liberty	23.5	29.8	7.8	20.4	42	39	47	43
Firlbecks III	21.6	23.3	11.3	18.7	40	39	48	42
Larker	25.3	27.6	8.2	20.4	41	41	48	43
Cree	19.9	24.9	10.3	18.4	37	37	48	41
Conquest	24.4	30.4	7.2	20.7	39	38	47	41
Primus II	32.7	23.4	9.2	21.8	41	39	48	43
Bonanza	21.3	24.2	8.5	18.0	38	37	45	40
Prilar	28.9	27.3	7.4	21.2	41	43	47	44
Beacon	25.1	23.8	8.5	19.1	41	39	47	42
Manker	22.6	28.7	5.0	18.8	38	41	46	42
SD 71-672			12.8				48	
SD 74-118		28.4	9.0			43	49	
SD 74-602		28.3	10.2			41	48	
SD 74-604		21.8	5.7			40	45	
Mean, B/A			8.6					
CV - %			22.5					
LSD (.05)			2.8					