Southeast South Dakota Experiment Farm

16th Annual Progress Report 1976

Experimental Solar-heat corn drying facility is shown "buttoned up" for winter on SE Farm. See Report p. 28.

Agricultural Experiment Station
South Dakota State University
Brookings

This sixteenth annual report of the research program at the Southeast South Dakota Experiment Farm has special significance for those engaged in agriculture and the agriculturally related businesses in the nine county area of southeast South Dakota. The results shown are not necessarily complete or conclusive. Interpretations given are tentative because additional data resulting from continuation of these experiments may result in conclusions different from those based on any one year. Trade names are used in this publication merely to provide specific information. A trade name quoted here does not consititute a guarantee or warranty and does not signify that the product is approved to the exclusion of other comparable products.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION
BROOKINGS, SOUTH DAKOTA 57006

Published in accordance with an Act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agricultural College and with the Act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University

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SIXTEENTH ANNUAL PROGRESS REPORT
SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

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INTRODUCTION . . . . Fred E. Shubeck
Research Manager

1976 was the second continuous year of droughty conditions. Many requests for research information were received regarding crops and soils management from farmers concerned about another possible dry year and no reserves of subsoil moisture. This brings up questions on how much research effort should be directed toward problems of drought and how much toward problems normally encountered in years of average rainfall. To give some guidance on areas of research that need to be emphasized, a meeting of the Experiment Station Farm Board of Directors, County Extension Agents and representatives for each southeast South Dakota county was held on December 14, 1976. Problems needing research were presented and discussed. Several of these suggestions will be incorporated into research investigations in the upcoming growing season.

The evening crop tour in June and the annual Field Day in September were well attended. Several additional tours were conducted for technical school classes, biology students and various company representatives. A total of 39 meetings were held at the Farm by extension, educational and local groups using the facilities of the Office-Lab building.

A new steel building was erected with funds provided by the Southeast Farm Corporation. The electric drying oven now housed in the Office-Lab building will be moved to the steel building in a fireproof enclosure. Drying ovens of this type have proved to be a fire hazard at Brookings. Beginning next year, all grain, silage, stover and soils samples will be processed in the new building. Feed additives for livestock will also be weighed and stored in the new building as well as fertilizer and small equipment.

An experimental solar drying bin was erected at the Farm. We were fortunate to obtain high moisture corn to dry in the new facility. The solar bin was a cooperative project with each of the following organizations making an important contribution: The Southeast South Dakota Experiment Farm Corporation, South Dakota Office of Energy Policy, Federal Energy Administration, South Dakota Cooperative Extension Service, Sukup Manufacturing Company, Sioux Steel Company, Clay-Union Electric Cooperative and East River Electric Power Cooperative.

Cattle handling and sorting pens were rebuilt. The original structures were decayed and in need of repair.

Three rooms in the residence at the Experiment Farm were insulated. The outside double plastered walls were removed and fiberglass insulation installed. Also, ceilings in two downstairs rooms were lowered and insulated.

Plans were drawn by Louis Lubinus, Extension Ag Engineer at Brookings, to change the manure handling system in the hog house. Funds were allocated by the Southeast Farm Corporation for this improvement. We plan to begin work on this project when approval is received from the State Engineer.

Tables 1 and 2 show a summary of temperatures and precipitation data for 1976. Daily readings are taken and the data compiled by research personnel. The extreme droughty conditions warrants careful attention when analyzing agronomic data to make management decisions.

Table 1. Temperatures at the Southeast Experiment Farm

Month	1976 Av. Temperature (F)[1] Maximum	Minimum	24 Year Average Maximum	Minimum	Departure from 24 Year Average Maximum	Minimum
January	24.6	5.7	26.4	5.4	-1.80	+0.3
February	34.9	18.7	33.1	11.6	+1.80	+7.1
March	44.4	23.9	43.6	22.2	+0.8	+1.7
April	64.0	38.6	61.4	35.3	+2.6	+3.3
May	71.2	42.4	73.7	47.4	-2.5	-5.0
June	85.3	55.3	83.1	57.6	+2.2	-2.3
July	89.6	61.2	88.1	62.4	+1.5	-1.2
August	88.2	58.8	86.5	60.1	+1.7	-1.3
September	77.3	46.7	75.7	49.0	+1.6	-2.3
October	59.1	28.9	66.2	41.6	-7.1	-12.7
November	43.6	14.6	46.8	24.6	-3.2	-10.0
December	31.1	3.6	31.8	11.5	-0.7	-7.9

[1] Computed from daily observations.

Table 2. Precipitation at the Southeast Experiment Farm

Month	Precipitation 1976 (inches)	24-Year Average (inches)	Departure From 24-Yr. Av. (inches)
January	0.63	0.50	+0.13
February	0.91	1.20	-0.29
March	0.93	1.33	-0.40
April	2.27	2.39	-0.12
May	1.96	3.24	-1.28
June	1.31	4.16	-2.85
July	1.79	3.00	-1.21
August	1.05	2.79	-1.74
September	1.14	2.72	-1.58
October	0.57	1.56	-0.99
November	0.05	1.02	-0.97
December	0.21	0.72	-0.51
Total	12.82	24.63	-11.81

RATES OF NITROGEN AND DATES OF PLANTING CORN

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Will planting dates influence response to fertilizer?
2. What is the optimum rate of nitrogen fertilizer for a soil with a medium amount of organic matter?
3. Will optimum rate of nitrogen application be influenced very much by drought?
4. Will high nitrogen rates influence disease or insect damage?
5. Will soil temperatures serve as a dependable guide to determine optimum date to plant corn?

Methods and Procedures Used in Rate of Nitrogen Study

Nov. 5, 1975 - Chopped stalks and plowed area.
April 14, 1976 - Sprayed with Aatrex 4L at 2.8 lbs of active ingredient per acre and disked in immediately.
April 27, 1976 - Broadcasted high and low rates of nitrogen, also phosphorus and potash for first planting date, then tandem disked and spike tooth harrowed.
April 28 - First planting date
Variety - Pioneer 3571
Insecticide - Counter 15G
Herbicide - Lasso II banded in row
May 5 - Second planting date. Fertilizer spread, disked, harrowed and planted.
May 12 - Third planting date. Fertilizer spread, disked, harrowed and planted.
May 19 - Fourth planting date. Fertilizer spread, disked, harrowed and planted.
May 26 - Rotary hoed first and second plantings.
June 4 - Cultivated first and second plantings.
June 10 - Cultivated third and fourth plantings.
June 16 - Cultivated first and second plantings (second time).
June 28 - Cultivated third and fourth plantings and sprayed with Sevin 80W for corn borer control.
Sept. 21 - Took silage samples.
Sept. 29 - Harvested all plots
Nov. 5 - Rotary chopped all stalks
Nov. 8 - Finished plowing plot area.

Table 3. Effect of Fertilizer and Planting Dates on Yield of Corn (high nitrogen rates)

Broadcast Treatment	Planting Dates				
N + P + K	April 28	May 5	May 12	May 19	Average
0 + 0 + 0	30	27	31	37	31.3
0 + 25 + 70*	16	23	35	37	27.8
80 + 25 + 70*	13	16	25	32	21.5
160 + 25 + 70*	12	16	32	42	25.5
240 + 25 + 70*	13	17	29	35	23.5
Average	16.8	19.8	30.4	36.6	

*Received 4 lbs N, 7 lbs P and 7 lbs K per acre as a starter sideband in addition to the broadcast treatment.

Discussion and Interpretation of Table 3

Overall yields of this study were low. As planting was delayed, yields were increased. This trend is similar to that in 1975. This is due in part to a deficiency and an abnormal distribution of rainfall.

There were no yield increases from increasing nitrogen fertilizer rates.

Table 4. Effect of Fertilizer and Planting Dates on Yield of Corn (low rates of N)

Broadcast Treatment	Planting Dates				
N + P + K	April 28	May 5	May 12	May 19	Average
0 + 0 + 0	26	33	38	37	33.5
20 + 25 + 70*	21	32	37	40	32.5
40 + 25 + 70*	20	34	36	53	35.8
60 + 25 + 70*	28	27	36	35	31.5
80 + 25 + 70*	25	31	40	40	34.0
Average	24.0	31.4	37.4	41.0	

*Received 4 lbs N, 7 lbs P and 7 lbs K per acre as a starter sideband in addition to the broadcast treatment.

Discussion and Interpretation of Table 4

Yields increased as planting dates were delayed. There were no yield increases due to increasing nitrogen fertilizer rates.

Table 5. Effect of Fertilizer on Yield of Silage (May 5 planting date)

Low Rates of N		High Rates of N	
Broadcast N + P + K	Tons per acre	Broadcast N + P + K	Tons per acre
0 + 0 + 0	6.1	0 + 0 + 0	6.3
20 + 25 + 70*	7.3	0 + 25 + 70*	6.2
40 + 25 + 70*	7.5	80 + 25 + 70*	6.4
60 + 25 + 70*	6.8	160 + 25 + 70*	6.2
80 + 25 + 70*	8.1	240 + 25 + 70*	6.7

*Received 4 lbs N, 7 lbs P and 7 lbs K per acre as a starter sideband in addition to the broadcast treatment.

Discussion and Interpretation of Table 5

The south half of each of four blocks received the high rates of nitrogen for nine years. The north half of each block received the low rates for three years. Silage yields were increased by nitrogen applications in the low nitrogen rate area.

EFFECTS OF RATES OF NITROGEN ADDITION ON THE CONCENTRATION OF NITRATE-NITROGEN IN THE SOIL PROFILE

Ron Gelderman, Robert Nettleton, Fred Shubeck,
Burt Lawrensen and Paul Carson

The "Date of Planting and Rates of Nitrogen for Corn" study being carried on by Fred Shubeck and Burt Lawrensen reported elsewhere in this publication provides an opportunity to study the accumulation and movement of NO_3-N in the soil profile.

Objectives

1. Study and record the effects of rates of nitrogen addition on the accumulation and movement of NO_3-N in the soil profile.
2. Determine the effect of large amounts of nitrogen fertilizer on the pH of the soil.

Methods and Materials

1. Soil samples have been taken to a depth of 6 feet each year since 1969 in the heavy rate of application experiment. They are only being taken to a depth of 4 feet in the low rate experiment.
2. The samples were dried as soon as possible in a forced air oven at a temperature not to exceed 115° F.
3. Nitrate-nitrogen was determined by the n-phenol-di-sulphonic acid method until 1973. Since then the nitrate electrode methods have been used.

4. Two experiments are involved in this study. The experiments are adjacent and related. They were started at different times. The treatments for each experiment are listed under the year of establishment.

1974 Rate of Nitrogen Applied, lbs/A	1969 Rate of Nitrogen Applied, lbs/A
0 + 0 + 0	0 + 0 + 0
20 + 0 + 0	80 + 0 + 0
40 + 0 + 0	160 + 0 + 0
60 + 0 + 0	240 + 0 + 0
80 + 0 + 0	

5. The longer duration experiment with high rates of nitrogen is in its seventh year. This means that the plots receiving 160 lbs of nitrogen per acre have had 1280 lbs per acre of nitrogen added during this time. The nitrogen fertilizer used has been ammonium nitrate. Even though this experiment is in the eighth year, the samples were taken after seven years of fertilization and cropping. The additions of P_2O_5 and K_2O remained constant on both experiments.

Results and Discussion

The effects of nitrogen fertilizer additions on the nitrate-nitrogen (NO_3-N) content of the soils are reported in Table 6 (two years after application, low rates, 0-80 lbs/A) and Table 7 (after 7 years of annual fertilization, high rates, 0-240 lbs/A). The data in Table 6 shows that rates below 40 lbs of nitrogen per acre had little or no effect on the amount of NO_3-N found in the soil profile at the end of the second growing season. It should be noted that the yields in 1975 were very low. Consequently, very little demand was made for available nitrogen by the crop. Increases in NO_3-N are noted at the 18-24 inch zone for the 40, 60 and 80 lb/A application rates. Rainfall in 1975 was very near average but it was erratic and did not supply sufficient moisture at the times needed for high yields of corn.

The experiment that was conducted over a seven year period (Table 7) shows the accumulation of NO_3-N in the soil profile. The amount of this accumulation increases as the rate of nitrogen application increases. Most of the NO_3-N is found above the 48 inch level but there is some evidence that NO_3-N has moved to depths below this level. Note especially the 48-60 inch depths for the 160 and 240 lb application rates.

The high rates (0-240 lbs/A) of nitrogen addition were sampled in May of 1976 at the time of the second planting (approximately May 10). These samples were taken to a depth of 4 feet. The results are found in Table 7 so a comparison of the May 1976 and November 3-4, 1975 samples could be easily made. Some variability exists in the total amount of nitrogen found in the top 4 feet of the profile between the fall and spring sampling. This variability is small enough that it should be considered within the sampling and analytical errors. In general, there appears to be both a movement down and up within the profile from November to May. This is probably easiest to observe by comparing averages for each 6 inch depth from the fall and spring sampling.

The year by year accumulation of the NO_3-N in the soil profiles under the different treatments is shown in Figure 1. The results from the longer duration-higher rates of application plots are the only values shown. The NO_3-N contents of the soils have been increasing. The decreases noted in values for the years 1972 and 1974 are associated with higher yields. This is illustrated by placing the yields from 160 lb/A application rate for each year near the point on the graph. These yield values have a line drawn under them. Note that the NO_3-N contents found in the profile after the higher yields (1972 and 1974) were lower.

The rainfall received in 1975 was very erratic and did not supply needed moisture during the time of greatest need. As a result, the yields were adversely affected by all nitrogen rates.

Exploratory work was started in 1976 to determine the effect of the fertilizer treatments on the NO_3-N content of the ground water. Six foot wells were established in the 0+0+0 and the 240+0+0 plots. These wells penetrated the water table. The wells were pumped on three different dates. The results are reported in Table 8. A large difference in NO_3-N in the well water is noted between treatments. It should also be noted that the NO_3-N decreased as the season progressed. This decrease would correspond with the increasing demand for additional nitrogen by the crop.

Table 6. The Effects of Added Nitrogen Fertilizer on the Amount of Nitrate-Nitrogen Present in the Soil Profile After Two Cropping Seasons, Southeast Experiment Farm, 1976[1]

Depth in Inches	Nitrogen Added Each Year, lbs/A[2]				
	0+0+0	20+0+0	40+0+0	60+0+0	80+0+0
0 - 6	10.2	9.2	15.4	13.8	32.2
6 - 12	4.5	5.2	10.3	13.7	31.4
12 - 18	4.5	4.5	7.2	10.0	26.1
18 - 24	4.5	4.5	5.5	7.1	14.5
24 - 30	4.5	4.5	4.5	4.5	4.8
30 - 36	4.5	4.5	4.5	4.5	4.5
36 - 42	4.5	4.5	4.5	4.5	4.5
42 - 48	4.5	4.5	4.5	4.5	4.5
Total	41.7	41.4	56.4	65.6	122.5
Corn Yields, 1975 (Bu/A)	23	18	13	10	11

[1]These samples were taken in the fall of 1975 after 2 years of fertilizing and cropping.
[2]Each plot received a uniform amount of P_2O_5 and K_2O.

Table 7. The Effect of Adding Nitrogen Fertilizer Over a Seven Year Period on the Amount of Nitrate-Nitrogen Present in the Soil Profile at the End of the Growing Season and the Following Spring, Southeast Experiment Farm, 1976[1]

Depth in Inches	Nitrogen Added Each Year, lbs/A[2]									
	0 + 0 + 0		80 + 0 + 0		160 + 0 + 0		240 + 0 + 0		Average	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
0 - 6	14.1	23.9	39.5	91.5	72.3	197.0	105.2	226.3	57.8	134.7
6 - 12	8.5	13.9	44.1	36.1	118.2	63.1	160.9	83.3	82.9	49.1
12 - 18	5.5	5.7	51.7	33.4	163.7	47.8	135.2	107.9	89.0	48.7
18 - 24	5.9	4.7	41.1	30.7	172.7	67.7	193.8	141.1	103.4	61.1
24 - 30	6.6	3.4	27.3	27.1	103.2	88.8	185.9	175.4	80.8	73.7
30 - 36	8.7	3.2	17.3	21.2	48.3	113.2	102.4	165.9	44.2	75.9
36 - 42	9.0	3.4	12.7	23.4	27.8	73.0	63.3	113.0	28.2	53.2
42 - 48	9.6	3.4	11.9	16.2	21.5	44.9	44.5	177.3	21.9	60.5
Subtotal	67.9	61.6	245.6	279.6	727.7	695.5	991.2	1090.2	508.5	556.9
48 - 54	11.0		11.8		19.4		30.2			
54 - 60	11.5		10.3		15.6		21.6			
60 - 66	12.3		10.9		14.4		16.0			
66 - 72	13.1		10.4		12.4		14.4			
Total	115.8		289.0		789.5		1073.4			
Yield of Corn, 1975 (Bu/A)	21		9		17		17			

[1] Samples were taken in November of 1975 and May of 1976.

[2] Treatments have been repeated on the same plots for the past 7 years. During this time plots receiving 80 lbs of nitrogen each year have received 560 lbs of nitrogen per acre. All plots received a uniform amount of P_2O_5 and K_2O.

Figure 1. The Effect of Rates of Added Nitrogen on the Amount of Nitrate-Nitrogen in the 6-foot Profile at the End of the Seven Year Period, Southeast Experimental Farm, 1976

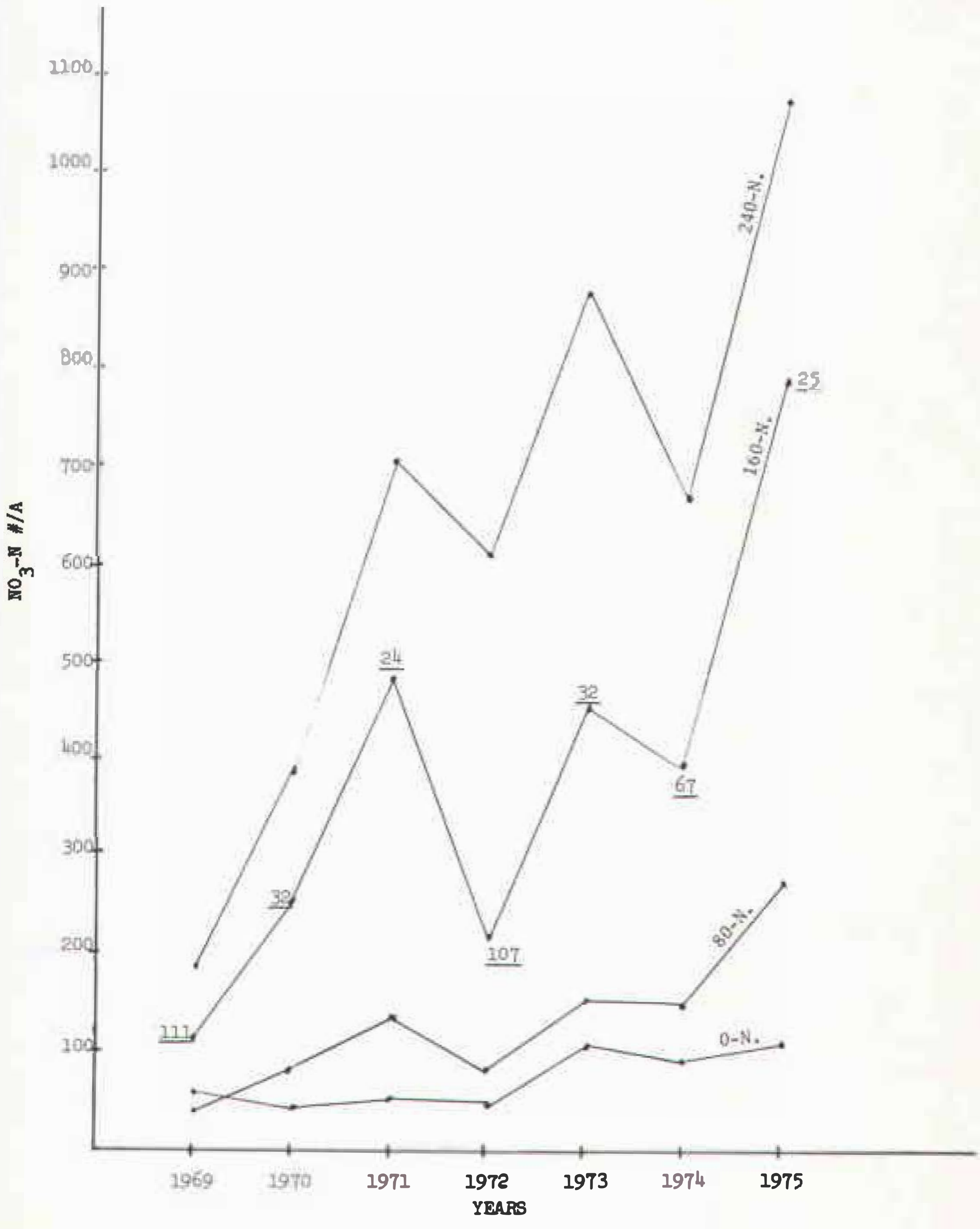


Table 8. The Effect of Rate of Fertilization and Time of Sampling on the Nitrate-Nitrogen Content of Well Water, Southeast Experiment Farm, 1976

Nitrogen Added Each Year lbs/A	Date of Sampling July 1	July 15	July 30
		ppm NO_3-N	
0	18	8	11
240	37	28	17

FOLIAR FERTILIZATION DURING SOYBEAN SEED-FILL

Jay Goos, Paul Carson, Paul Fixen and Ron Gelderman

Introduction

Foliar feeding of crops has interested farmers and research workers for several years. Results generally have been successful with foliar feeding of minor elements and with problem soils. However, results with the three major elements (N, P, K) have not been conclusive.

In 1975, researchers at Iowa State University reported remarkable yield responses in one experiment, to an application of nitrogen, phosphorus, potassium, and sulfur in a 10:1:3:.5 ratio, respectively. This success came when four applications of these fertilizer elements were applied during the seed-filling stage of soybeans. With these startling results from Iowa, it seemed justifiable to attempt a similar experiment under South Dakota conditions and to learn more about leaf absorption of nutrients.

Objectives

Under both dryland and irrigated conditions:

1. To test this technique and fertilizer ratio under South Dakota conditions, and attempt to stimulate positive yield responses.
2. To adapt hand sprayed small plot results to large field custom applicator methods using a self-propelled high clearance field sprayer.

Location

The dryland site was at the Southeast Experiment Farm, on an Egan silt loam. Egan soils are deep, friable, well drained, silty clay loams developed in a silty cap over glacial till. The irrigated site was on the Don Hunter farm, five miles south of Centerville, on a Dempster loam. Dempster soils occur along major streams on nearly level, gravelly terraces that are over-lain by various depths of sediments. These soils are well drained to somewhat excessively drained.

Methods

1. Irrigated site was irrigated twice by hand-move sprinkler irrigation. Water was applied once in mid-July and once in mid-August.
2. Varieties used were: NK-1474 on dryland and Corsoy on the irrigated site.
3. The foliar spray was made of water, urea, potassium polyphosphate, and sulfate of potash. This mixture, as sprayed, contained 10% nitrogen, 2.4% P_2O_5, 4% K_2O and .6% sulfur.
4. On August 13, 20, 24 and 31, applications of 20 gallons per acre (or approximately 20 lbs of N, 5 lbs of P_2O_5, 8 lbs of K_2O, and 1.2 lbs of sulfur) were applied.
5. Some plots were sprayed at every application date, some at only a given application date, and some at various combinations of application dates. The check received no foliar fertilizer. The treatments were as follows:

Treatment	Gallons per acre of 10-2.4-4-.6 applied on			
No.	Aug. 13	Aug. 20	Aug. 24	Aug. 31
1	0	0	0	0
2	20	0	0	0
3	0	20	0	0
4	0	0	20	0
5	0	0	0	20
6	20	20	0	0
7	20	0	20	0
8	20	0	0	20
9	0	20	20	0
10	0	0	20	20
11	0	20	0	20
12	20	20	20	0
13	20	20	0	20
14	20	0	20	20
15	0	20	20	20
16	20	20	20	20

6. Soybeans were harvested with a plot combine and yields were estimated.
7. Randomized complete block design with four replications was employed at each site.

Results

The effects of the foliar applied fertilizer are shown in Tables 9 and 10. Table 9 shows the results under dryland conditions and Table 10 shows those from the irrigated plots. All the yields produced on the treated plots from the dryland site were lower than the non-treated plot. Only one of these yields was low enough to be considered significant. This was from treatment 12 which received the foliar treatment on the first three dates.

The yields from the plots on the irrigated experiment were quite variable. No consistent trends could be established. The yield differences from the plot receiving no fertilizer were not large enough to be considered significant. Lodging was a problem at this site and caused the results to be quite variable.

Both irrigated and non-irrigated sites suffered heat and moisture stress. Each application produced some leaf "burn". From less than 5% to 25% of the leaf area was "burned" by a single application. The amount of "burn" depended on the amount of stress that the plant was under when application was made. In general, leaf damage was minimized when evening and night applications were made.

The effect of the date of application at the irrigation site was studied by comparing single applications against the check (no fertilizer). These results are shown in Table 11. The time of application had very little effect on yield except for the second application (Aug. 20). The plants were under severe moisture stress at that time. The application caused severe leaf burn (figure 2). The leaf burn was estimated at 25% of the leaf surface.

The use of foliar applied fertilizer may have a place in South Dakota agriculture. Its profitable use may be limited to special situations. At the present time, much more needs to be learned about the time, method and rate of application.

Table 9. Effect of Foliar Fertilization on Dryland Soybeans, Southeast Experiment Farm, 1976

Treatment No.	Gallons per acre of 10-2.4-4-.6 applied on Aug. 13	Aug. 20	Aug. 24	Aug. 31	Average Yield (bu/acre)
1	0	0	0	0	21
2	20	0	0	0	17
3	0	20	0	0	18
4	0	0	20	0	18
5	0	0	0	20	18
6	20	20	0	0	18
7	20	0	20	0	18
8	20	0	0	20	18
9	0	20	20	0	18
10	0	0	20	20	18
11	0	20	0	20	19
12	20	20	20	0	15*
13	20	20	0	20	17
14	20	0	20	20	18
15	0	20	20	20	18
16	20	20	20	20	18

*This treatment is statistically lower than the check at the .05 level. There is no significant differences between any other treatments.

Table 10. Effect of Foliar Fertilization on Irrigated Soybeans, Don Hunter Farm, 1976

Treatment No.	Gallons per acre of 10-2.4-4-.6 applied on				Average Yield* (bu/acre)
	Aug. 13	Aug. 20	Aug. 24	Aug. 31	
1	0	0	0	0	17
2	20	0	0	0	22
3	0	20	0	0	19
4	0	0	20	0	24
5	0	0	0	20	19
6	20	20	0	0	15
7	20	0	20	0	20
8	20	0	0	20	23
9	0	20	20	0	18
10	0	0	20	20	24
11	0	20	0	20	16
12	20	20	20	0	12
13	20	20	0	20	18
14	20	0	20	20	21
15	0	20	20	20	14
16	20	20	20	20	15

*There were no significant (.05 level) increases or decreases in these yields due to fertilizer treatment.

Table 11. Effect of Application Time and Rate of Foliar Fertilizer on Irrigated Soybeans, Don Hunter Farm, 1976

Rate in Gallons/acre	Date of Application			
	Aug. 13	Aug. 20	Aug. 24	Aug. 31
0	19	21	19	19
20	18	16*	18	18

*There was a significant yield depression associated with foliar application at this date. This is the period when the crop was subjected to the most severe moisture stress, just prior to the second irrigation.

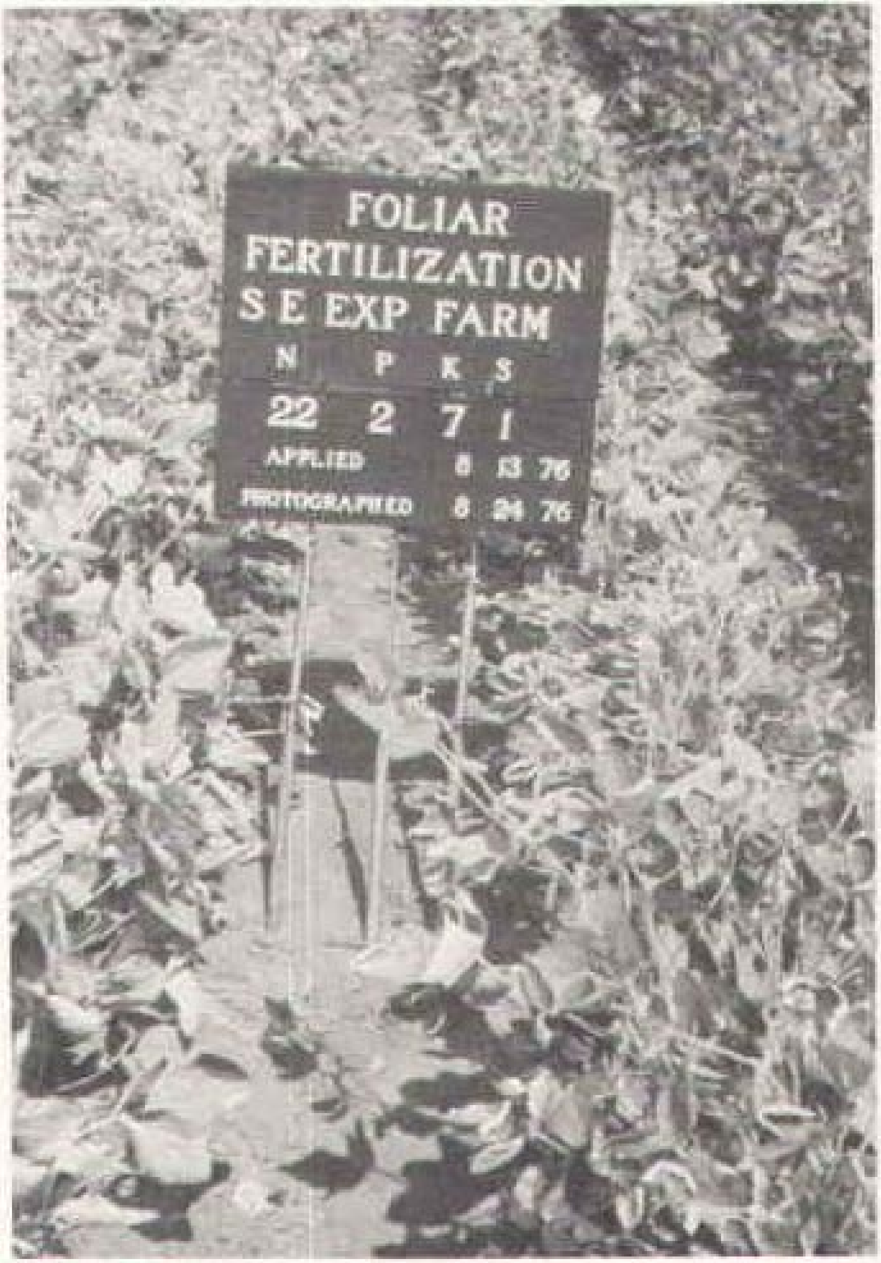


Figure 1. Leaf burn caused by foliar fertilizer.

STARTER FERTILIZER FOR CORN ON FALLOW

Ron Gelderman, Burt Lawrensen, Fred Shubeck, Jay Goos,
Paul Fixen, Robert Nettleton and Paul Carson

It has been observed many times that planting corn on fallow slowed the early growth of corn. It has also been observed that the early growth of the corn can be improved by the applications of phosphorus with a planter equipped with a fertilizer attachment. The amount of phosphorus needed to correct the poor early growth is not known.

Objectives

1. To determine how much phosphorus is needed to improve the early growth of the corn grown on fallowed land.
2. To determine the cause of the poor early growth of the corn.

Methods

1. The experiment was located on an Egan silty clay loam south of the office building at the Southeast Experiment Farm. Egan soils are deep, friable, well drained, silty clay loams developed in a silty cap over glacial till. Soil tests on samples taken at planting time are as follows:

Nitrate-nitrogen	289 lbs/A
Phosphorus	26 lbs/A
Potassium	530 lbs/A
pH	6.1
Soluble salts	.70 mmhos/cm

   The nitrates found in the top six inches were 90 lbs per acre and in the 6-24" depth 199 lbs/A.
2. The land was fallowed in 1975 and disked just prior to planting.
3. The fertilizer treatments were applied with a corn planter that places the fertilizer beside and below the seed. Approximately 1½ to 2 inches of soil separated the seed and fertilizer. The fertilizer treatments used are listed below:

Fertilizer Applied $N + P_2O_5 + K_2O$ lbs/A
0 + 0 + 0
10 + 0 + 0
10 + 10 + 0
10 + 20 + 0
10 + 30 + 0
10 + 40 + 0
40 + 40 + 0

Additional nitrogen (approx. 80 lbs/A) was applied by broadcasting on the surface before planting to make sure nitrogen was not a limiting factor.

4. The experimental design used was a randomized block.
5. Weed control.
   (a) Aatrex broadcast on surface before planting.
   (b) Lasso II applied in a band at planting time.
   (c) Cultivation. Two cultivations.

   Weed control was only fair in that the Lasso II did not control weeds in the row because of dry weather. The weeds in the row were removed by hand.
6. Soil insects were controlled by use of Counter 15G applied at planting time in a band.
7. Variety used was Pioneer 3571.
8. Corn was planted April 29 with John Deere tool-bar planters. Row width was 30 inches and approximately 17,000 seeds per acre were planted.
9. Corn was harvested by hand on September 15. Fifty feet of row was harvested for grain and 50 feet was harvested for silage from each plot.
10. The weather was dry during the latter part of the growing season.
11. Leaf samples were taken early in the season and at silking time. Soil samples were taken weekly during the early part of the growing season. Nitrates and ammonium were determined on these samples.

Results

The yield in bushels per acre of 15% moisture corn, the percent moisture in the ears at harvest time, the yield of silage (70% moisture) and the moisture in the silage at harvest time are reported in Table 12.

The grain yields were variable and to some extent inconsistent. The yield of silage was more consistent. In the case of silage, any treatment used increased the yield. The lower rates of starter fertilizer appear to have increased the yield of grain a small amount. The higher rates of application decreased the yield. These yield differences may not be statistically significant.

Growth early in the season was excellent. Growth increases due to phosphorus added with the planter attachment were noted in June (see Figure 3). These early growth differences are not reflected in increased yield.

Plant samples were taken when the plants were 10 inches high for analysis and at silking time. The values found for N, P and K in the early samples are shown in Table 13.

Table 12. The Effects of Added Phosphorus on the Yields of Grain and Silage and the Moisture Contents of the Ears and Silage at Harvest of Corn Grown on Fallow at the Southeast Experiment Farm, 1976

Treatment No.	Fertilizer $N + P_2O_5 + K_2O$	Yield[1] bu/A	Ear Corn Moisture[2]	Silage Yields 70% Moisture Tons/A	Silage Moisture at Harvest %
1	0 + 0 + 0	34	33	5.3	63
2	10 + 0 + 0	40	32	8.5	53
3	10 + 10 + 0	37	30	7.9	49
4	10 + 20 + 0	40	28	7.3	51
5	10 + 30 + 0	27	31	8.6	51
6	10 + 40 + 0	27	30	7.7	51
7	40 + 40 + 0	26	33	8.4	54

[1] Calculated at 15% moisture.
[2] Moisture sample was taken by cutting a section out of the center of 8 ears of corn. This includes a section of the cob.

Table 13. The Effect of Added Fertilizer on the N, P and K Content of Corn Plants Sampled in Early June, Southeast Experiment Farm, 1976

$N + P_2O_5 + K_2O$ lbs/A	% Content N	P	K
0 + 0 + 0	3.32	.149	3.75
10 + 0 + 0	3.34	.203	3.50
10 + 20 + 0	3.57	.245	3.50
10 + 30 + 0	3.54	.271	3.63
10 + 40 + 0	3.41	.290	3.50

The phosphorus content of the plant tissue increases as the amount of phosphorus fertilizer applied is increased. The potassium and nitrogen contents tend to vary some but are relatively constant. The amounts of phosphorus found in the plant tissue from the 0+0+0, the 10+0+0 and the 10+20+0 treatments are below that considered to be sufficient (.270%).

The analysis on the samples taken at silking time remain to be completed.

Soil samples were taken each week for nine weeks starting May 19. The samples were taken from the top six inches of soil. Nitrate, nitrite and ammonium were determined on these samples in an attempt to isolate the cause of the poor early growth of the corn. The values found varied some but did not show any consistent trends.

Figure 3. Effect of added phosphorus on the early growth of corn.

NITRIFICATION INHIBITION

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Determine effectiveness of nitrification inhibitors (N-Serve) in South Dakota soils.
2. What are effects of nitrification inhibitors on corn yield, stalk rot, moisture in ears at harvest and nitrogen content of leaf tissue?
3. Determine effect of nitrification inhibitor on loss of soil nitrogen through denitrification.

Methods and Procedures

Oct. 27, 1975 - Tandem disked soybean stubble. Applied fall application of aqua ammonia.
Nov. 4, 1975 - Took soil samples in furrows where ammonia had been applied.
Dec. 23, 1975 - Took soil samples again in the furrows.
May 18, 1976 - Broadcast 80 lbs/acre of 0-46-0, then disked and harrowed. Applied spring ammonia. Planted all plots.
Variety - Pioneer 3709
Insecticide - Lorsban
Weedicide - Lasso II banded
May 25 - Soil sampled (7 days after spring nitrogen application)
June 25 - Soil sampled (30 days after initial sampling)
June 28 - Sprayed for corn borer with Sevin-80W at 2 lbs active ingredient per acre
July 26 - Soil sampled (30 days after previous sampling)
Sept. 21 - Took silage samples
Oct. 21 - Harvested all plots

Table 14. Effect of Nitrogen Applications and Nitrogen Inhibitors on Yield of Corn, Percent Ear Moisture and Yield of Silage

Rate of Nitrogen Application lbs/acre	Time of Application	Nitrification Inhibitor	Bu/acre #2 corn	% ear Moisture	Tons/acre of 65% Moisture Silage
100	fall	none	54	11.4	8.6
100	fall	+N-Serve	62	10.8	9.6
60	fall	none	60	10.2	8.2
60	fall	+N-Serve	56	10.1	8.2
40	fall	none	55	11.1	8.1
40	fall	+N-Serve	55	10.9	7.8
none	--	none	56	11.2	8.0
100	spring	none	61	10.2	9.3
100	spring	+N-Serve	63	10.3	9.2
60	spring	none	59	10.7	8.5
60	spring	+N-Serve	51	10.3	7.9
40	spring	none	63	10.6	9.1
40	spring	+N-Serve	70	10.6	10.0
none	--	none	61	11.1	9.0

Discussion and Interpretation of Table 14

Corn yields in this experiment were some of the highest at the Research Farm in 1976. Some possible reasons for these high yields are: soybean stubble was disked without plowing for seedbed preparation, more snow cover, more subsoil moisture, variety, no barren stalks and very little smut, excellent weed, rootworm and corn borer control, and date of planting.

N-Serve slows down or inhibits the normal transformation of ammonia nitrogen in the soil to nitrate nitrogen. Under restricted aeration conditions due to soil compaction or excessive water, considerable nitrogen is lost due to microbial transformations of nitrogen to gaseous forms. This experiment was an attempt to see how valuable N-Serve would be to reduce nitrogen losses in an imperfectly drained soil. However not enough rainfall was received to bring soil moisture to field capacity. Consequently, there were little or no ear corn yield responses to nitrogen fertilizer and no consistent increases due to N-Serve.

Silage yields were increased by most fertilizer treatments.

LIME EXPERIMENT

Paul Carson, Burt Lawrensen, Fred Shubeck,
Ron Gelderman and Robert Nettleton

The use of lime on soils having pH's greater than 6.2 is considered uneconomical in most states. However, interest in its use remains high in some areas of South Dakota. Past experiments have not shown yield increases large enough to justify its use (see SDSU Experiment Station Bulletin 643). Because the interest in the use of lime has remained high, an experiment was established in 1974.

Objectives

1. Determine the effect of added lime on the yield of corn.
2. Determine the effect of added lime on the pH of the soil.

Methods

1. Lime in the form of Niobrara chalk was applied in the spring of 1974 to an Egan silty clay loam east of the office building at the Southeast Experiment Farm. Egan soils are deep, friable, well drained, silty clay loams developed in a silty cap over glacial till. To obtain a well drained site, the ends of two ranges were used. One half of the experiment being in each range. The tests on the soil samples taken in 1974 from each of these halves are shown in Table 15. A considerable difference in the fertility exists between the soils from these two ranges. This can be noted in the tests for available phosphorus, and for exchangeable potassium.
2. The fertilizer treatments used in the experiment are as follows:

Fertilizer Applied N + P + K, lb/A	Lime Applied Tons/A
0 + 0 + 0	-
0 + 0 + 0	2
0 + 0 + 0	4
0 + 30 + 0	-
0 + 120 + 0	-
0 + 30 + 0	2
0 + 30 + 0	4
0 + 120 + 0	2
0 + 120 + 0	4

The fertilizer and lime were broadcast on the surface and plowed under just before planting in 1974. The lime application will not be repeated for the duration of the experiment, but the phosphorus application will be repeated each year. Nitrogen was applied at the rate of 80 lbs. per acre before planting.

3. Experimental design used was a randomized block.
4. Weeds were controlled with Lasso II 15G at 17 lbs. per acre applied in a band at planting time; Aatrex 4L was applied before planting. There were two cultivations.
5. Soil insects were controlled with Counter 15G in a band at 1 lb/A of active material at planting time.
6. Variety was Pioneer 3571.
7. The seedbed was prepared in the conventional manner, that is, plowing in the fall, disking, and dragging in the spring.
8. Corn was planted April 29 with John Deere tool-bar planters. The row width was 30 inches, plant population 17,000 at planting time.
9. Corn was harvested by hand September 15. Sixty feet of row was harvested from each plot for grain and another 60 feet of row was harvested for silage.
10. The weather was dry during the last part of the growing season. During this portion of the season these plots showed severe moisture stress.
11. Leaf samples were taken for analysis at silking time. Yield samples and ear moisture samples were taken at harvest time.

Results

The yield in bushels per acre of 15% moisture corn, the percent moisture in the ear at harvest, the yield of silage (70% moisture), and the moisture content of the silage at harvest time are reported in Table 16.

Yield differences are small and probably cannot be attributed to treatments. The grain yields are erratic and for the most part the yields from plots receiving treatments were less than the plots receiving no lime or fertilizer. Plots number 8 and 9 produced no grain yield in one replication. Variability exists in the silage yields but they appear more uniform. Again no yield increase can be attributed to added treatments. The corn in mid-June was growing rapidly and was ahead of schedule. Differences in growth were noted at that time. The growth on plots receiving added phosphorus was greater at that time.

Table 15. Soil Tests on Samples Taken from the Experiment Site at Seeding Time in 1974, Southeast Experiment Farm

Depth of Sample inches	NO_3-N ppm	N/A lbs.	O.M. %	Phos- phorous lbs/A	Potas- sium lbs/A	pH 1:1	Salts mmhos/cm	Tex- ture
				East 1/2 of Experiment				
0 - 6	24.6	44	3.7	56	1000+	6.3	0.52	sicl
6 - 12	36.0	65	3.4	22	600	6.3	0.50	sicl
12 - 18	30.0	54	2.4	7	470	6.8	0.50	sic
18 - 24	24.6	44	1.9	4	580	6.9	0.44	sic
24 - 30	24.6	44	1.3	4	540	7.6	0.60	sic
30 - 36	31.0	56	0.9	1	410	8.0	0.65	c
36 - 42	27.0	49	0.7	1	400	8.0	1.20	c
42 - 48	41.0	74	0.6	1	460	7.9	1.30	sic
				West 1/2 of Experiment				
0 - 6	21.0	38	3.7	16	740	6.5	0.80	sicl
6 - 12	12.4	22	3.1	14	620	6.4	0.52	sicl
12 - 18	5.8	11	2.1	9	480	6.7	0.40	sic
18 - 24	4.8	9	1.6	9	570	7.2	0.56	sic
24 - 30	4.4	8	1.2	6	590	7.4	0.56	sic
30 - 36	5.2	9	0.9	5	490	7.7	0.58	sic
36 - 42	7.6	14	0.6	4	410	8.0	0.50	scl
42 - 48	4.4	8	0.4	3	340	8.3	0.42	sl

Table 16. The Effects of Added Lime and Phosphorus on the Yields of Grain and Silage and the Moisture Content of the Ears and Silage at Harvest for Corn Grown at the Southeast Experiment Farm, 1976

Treatment No.	Fertilizer $N + P_2O_5 + K_2O$ lbs/A	Lime Tons/A	Yields[1] bu/A	Ear Corn Moisture[2] %	Silage Yield 70% Moisture Tons/A	Silage Moisture at Harvest %
1	0 + 0 + 0	-	18	33.0	6.2	63.4
2	0 + 0 + 0	2	13	35.1	5.6	66.0
3	0 + 0 + 0	4	19	32.8	6.3	64.6
4	0 + 30 + 0	-	17	34.0	5.8	66.0
5	0 + 120 + 0	-	11	31.5	5.9	67.0
6	0 + 30 + 0	2	17	34.0	6.5	63.4
7	0 + 30 + 0	4	13	35.3	6.3	65.7
8	0 + 120 + 0	2	12	30.0	5.8	67.8
9	0 + 120 + 0	4	12	33.0	5.3	69.9

[1]Yields calculated at 15% moisture.
[2]Moisture sample was taken by cutting a section out of the center of 8 ears of corn. This includes a section of the cob.

SILAGE REMOVAL AND SOIL DEPLETION

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. By removing all crop residues from the soil but fertilizing adequately, how long can we continue raising corn without an appreciable yield decrease?
2. Can we maintain yields by returning an amount of manure equal to that generated by the feed produced?

Methods and Procedures

Nov. 17, 1975 - Fall plowed plot area
May 11, 1976 - Applied manure and commercial fertilizer on designated plots
May 14 - Planted all plots
  Variety - Pioneer 3571
  Insecticide - Dyfonate 20G
  Herbicide - Lasso II banded
June 4 - Cultivated all plots
June 28 - Cultivated second time (lay-by)
Sept. 22 - Took forage sample for silage determination
Oct. 21 - Harvested all plots

Table 17. Effect of Commercial Fertilizer and Manure Applications on Corn Yield with Intensive Soil Depletion Management

Removed from Plot	Fertilizer Treatment $N + P_2O_5 + K_2O$	Tons Silage per acre	Bushels of Corn per acre
Ear corn removed	0 + 0 + 0	---	48
Ear corn removed	5 tons manure/acre	---	46
Ear corn removed	0 + 0 + 0	---	44
Ear corn removed	100 + 40 + 40	---	43
Silage removed	0 + 0 + 0	7.7	--
Silage removed	5 tons manure/acre	7.9	--
Silage removed	0 + 0 + 0	8.3	--
Silage removed	100 + 40 + 40	7.9	--

Discussion and Interpretation of Table 17

Approximately one-half of our soil organic matter was lost in 100 years of farming. Consequently, many farmers are concerned about yield reductions if both grain and stover are continually removed from the fields and fed to livestock. With skyrocketing feed coats the practice of feeding all crop residues will continue.

This experiment is an attempt to evaluate the seriousness of removing all crop residues as we begin to use the last half of our soil organic matter reserves.

The first two years results of this experiment were not very spectacular. Droughts and poor rainfall distribution suppressed yields and reduced rate of fertility removal by crops. In 1976, there was enough fertility remaining in the soil for the amount of rainfall received because no increases of grain or silage were obtained from application of either manure or commercial fertilizer.

CORN BREEDING

D. B. Shank and J. R. Jenison

Six yield trials of experimental corn hybrids and inbreds were located on the Southeast Experiment Farm in 1976. They were as follows:

1. Ten late maturing inbred lines were crossed in all possible combinations to study the single crosses themselves and to predict the performance of all possible three and four way hybrids that could be made from the same ten inbreds.

2. Three way hybrids involving new inbreds being tested for the first time.

3. A repeat test containing experimental hybrids which had performed well in prior years.

4. Twelve early inbred lines crossed in all possible combinations with the same objectives as listed under #1 above.

5. Advanced generation inbred recoveries of the released line SDP309, in which better seed and stalk qualities are being sought.

6. Material being tested in several states to evaluate new lines developed by several North Central experiment stations.

Good stands were obtained but because of the severe drought no corn was produced on any of the plots.

CORN PERFORMANCE TRIALS

J. J. Bonnemann

The corn performance trials at the Southeast Experiment Farm in 1976 had 81 entries, proprietary and SD experimental, entered for testing.

Seeding was on May 13, 1976 in 30-inch row spacings. The trial was over-seeded and thinned to achieve populations of 16,000 and 20,000 plants per acre. Fertilizer had been broadcast on the field at the rate of 100-40-0 lbs/A prior

to fall plowing. Granular Lasso II and Furadan were applied at seeding for weed and insect control.

The trials were virtually "burned-up" by late August. Few ears were found with kernels throughout most of the plot. Some replications were harvested for yield and moisture determination but the variability was so great that the results had little validity and were not included in this report.

SOLAR CORN DRYING

William H. Peterson
Extension Agricultural Engineer

Objectives

1. Demonstrate the feasibility of using a solar-heat low-temperature drying bin to dry corn in southeastern South Dakota.
2. Assist manufacturer in designing and manufacturing an improved solar collector.
3. Compare costs and energy conservation of solar drying to other methods of drying corn.

Methods and Procedures

A 23.5 foot diameter metal drying bin was constructed with a capacity of 5000 bushels. A black-coated bare metal solar collector was mounted on the southern two-thirds of the drying bin wall. Air was drawn from between the solar collector and the wall of the bin into a "fan house" from where it was blown under a perforated floor in the bin and up through the shelled corn. The solar collector is a factory-built design and features a black, co-polymer plastic coating which is expected to be both cheaper and longer lasting than conventional black paint.

Thermocouples with a strip chart recorder were installed to measure differences in temperature. Electric meters were placed in the "fan house" to record amount of electricity used.

Results and Discussion

With nearly half of the petroleum used in this country coming from imports and with the possibility of supplies being cut off or raised in price, it is important to explore alternate ways of drying corn.

It was difficult to find wet corn last fall, but some was located and dried in the new solar drying bin. With five days of continuous fan operation (from November 17 to November 22) and no heat other than that supplied by the solar collector, 1300 bushels of shelled corn was dried down from 20.4 percent to 14.25 percent moisture, using 1170 kilowatt hours of energy. Figuring energy cost at 1.75 cents per KWH, this comes out to just about 1.5 cents per bushel for six "points" of moisture removal. This is less than half the expected cost for fuel alone for a typical high-speed drying operation.

PERFORMANCE OF HERBICIDES IN CORN AND SOYBEANS

W. E. Arnold and L. J. Wrage

Herbicide demonstration plots are the final step in the herbicide testing program. These plots include those treatments that have been labeled and are available to producers. Rates and application methods for each treatment are based on results obtained in previous years' screening tests.

Methods

Preplant and preemergence herbicides were applied on the corn and soybean plots on May 18. All treatments were made with a plot sprayer using 20 gpa water. Preplant treatments were incorporated immediately with two tandem diskings set to cut 5-6 inches deep (except Cobex--3-4 in.) and harrowed. Plots were planted in 30-inch rows on May 18. There was approximately 1 1/3 inch of rain within 7 days after planting. Post-emergence herbicides were applied when annual grasses were 1-1½ inch and broadleaves 1-2 inches tall.

Weed pressure was moderately light. Annual grasses included green and yellow foxtail. Annual broadleaves most common were rough and prostrate pigweed and lambsquarters. The plots were not cultivated.

Results

The performance of several corn and soybean herbicide treatments in 1976 is presented in the following tables. A 3-year (1974, 1975, 1976) average is included as a comparison. Plots were evaluated June 28. Visual ratings reported for each treatment are shown as percent control compared to an untreated plot.

All herbicide treatments performed satisfactorily on susceptible species. A high degree of grass and broadleaved weed control was obtained with treatments intended for grass and broadleaved weeds, respectively. Combination or overlay treatments provided very good control of all weeds present. Differences in broadleaved weed control would be greater if some of the more troublesome broadleaves such as velvetleaf or cocklebur would have been present.

Table 18. Corn Herbicide Demonstration Plots, 1976

Treatment	lb/A a.i.	Percent Weed Control 6/28/76 Gr	Percent Weed Control 6/28/76 Bdlf	3-Yr. Avg. Gr	3-Yr. Avg. Bdlf
PREPLANT INCORPORATED					
Check	--	0	0	0	0
Eradicane	3	98	88	96	87
Eradicane	4	98	95	96	93
AAtrex/Atrazine	2½	90	99	86	99
Sutan+	4	93	80	91	80
Sutan+ + Atrazine	3+1	95	96	90	97
Sutan+ + Bladex	3+1½	96	94	92	95
PREEMERGENCE					
AAtrex/Atrazine	2½	75	90	63	94
Bladex	3	85	80	81	89
Cycle	3	80	82	--	--
Prowl	2	88	78	81	88
Ramrod/Bexton	5	97	88	97	84
Lasso	3	98	88	96	89
Dual	3	97	92	--	--
Lasso + Atrazine	2+1	99	99	95	99
Lasso + Bladex	2+1½	97	99	95	99
Lasso + Banvel	2+½	96	99	95	99
Ramrod + Atrazine	3+1	96	98	95	99
Ramrod + Bladex	3+1½	96	96	--	--
POST-EMERGENCE					
AAtrex/Atrazine + oil	1½+1 gal.	80	95	78	97
Bladex	1½	65	90	83	93
Cycle	1½	70	88	--	--
PREEMERGENCE & POST					
Ramrod & 2,4-D amine	5+½	85	85	--	--
Ramrod & Banvel	5+¼	96	95	--	--

Gr = annual grasses
Bdlf = annual broadleaved weeds

Table 19. Soybean Herbicide Demonstration Plots, 1976

Treatment	lb/A a.i.	Percent Weed Control 6/28/76 Gr	Bdlf	3-Yr. Avg. Gr	Bdlf
PREPLANT INCORPORATED					
Check	--	0	0	0	0
Treflan	3/4	98	86	97	91
Cobex	½	97	85	97	91
Tolban	1	98	82	94	88
Basalin	1	94	75	--	--
Vernam	2½	92	80	90	82
Treflan + Sencor/Lexone	3/4+3/8	97	88	--	--
PREPLANT INC. AND PRE					
Treflan & Sencor/Lexone	3/4&3/8	98	97	98	97
Treflan & Lorox	3/4&1	98	92	98	96
Treflan & Modown	3/4&2	98	98	--	--
PREPLANT INC. & POST					
Treflan & Basagran	3/4&1	97	94	97	93
PREEMERGENCE					
Amiben	3	96	84	95	86
Lasso	3	96	80	96	80
Lasso + Sencor/Lexone	2+3/8	94	88	96	92
Lasso + Maloran	2+1½	94	84	--	--
Lasso + Lorox	2+1	94	75	96	85
Lasso + Modown	2+2	94	85	--	--
Lasso + Premerge	2+3	94	70	--	--
Lasso + CIPC	2+3	94	84	--	--
Lasso + Dynap	2+4½	94	95	--	--
Modown	2½	50	85	--	--
Sencor/Lexone	½	80	94	86	93
PREEMERGENCE & POST					
Lasso & Basagran	2+1	94	95	--	--

Gr = annual grasses
Bdlf = annual broadleaved weeds

HERBICIDE CARRYOVER

L. J. Wrage and W. E. Arnold

The residual activity (carryover) of herbicides is important when planting crop rotations or when selecting the herbicide treatment for a specific rotation. Treatments are evaluated for carryover potential as part of the herbicide screening and demonstration program each year. Residual activity is evaluated by planting a sensitive crop such as oats over the previous year's row-crop herbicide plots. The carryover effect is evaluated by visual rating or grain yield. Herbicide carryover is an important consideration for the 1976-77 season.

CROPPING SEQUENCE SUGGESTIONS
Drought Conditions - 1976-77

Unusually dry conditions may result in carryover from herbicide treatments that normally would not cause problems. Also, effects may be greater than usual from treatments which normally result in some carryover.

Dry conditions have resulted in changes in intended crop rotations. Fall or spring grain may be planted instead of the usual row crops. Carryover from 1976 herbicides is an important consideration. Some extreme conditions (1-4 inchea total rainfall since application) have been reported.

Late fall or early spring moisture is less effective for herbicide degradation due to low temperatures. Herbicide rate, soil texture, soil pH and tillage are also important factors. Moldboard plowing prior to planting 1977 crops reduces the potential for crop injury from most herbicides having carryover potential under dry conditions.

These guidelines are based on information available from other states, industry data and experience in South Dakota. Some suggestions are speculative and conservative and are offered with the intent that, where alternatives exist, carryover risk can be eliminated or reduced. Data based on unusually dry conditions are not available for some treatments. These suggestions pertain only to situations in South Dakota for the 1976-77 season.

HERBICIDE IN 1976	SUGGESTIONS
atrazine (AAtrex, Atrazine)	Do not plant small grain, grass or alfalfa in the fall of 1976. Crop choices for 1977 without risking plant injury are limited to corn, sorghum and millet. Some injury from 1975 applications may be observed on sensitive crops planted in 1977, particularly where high rates, spraying overlap, clay knolls or high pH are associated.
cyprazine (Fox-4, Outfox)	Do not plant small grain, grasses or alfalfa in fall of 1976. Crop choices for 1977 without risking plant injury are limited to corn, sorghum and millet.
chlorbromuron (Maloran, Bromex)	Little risk of injury on fall-seeded wheat or rye. Injury may occur on fall-seeded grasses or small-seeded legumes. No injury expected on spring-planted crops.

linuron (Lorox)	Little risk of injury on fall-seeded wheat or rye. Injury may occur on fall-seeded grasses or small-seeded legumes. No injury expected on spring-planted crops.
cyanazine (Bladex)	Little risk of injury to fall-seeded wheat or rye. Injury may occur on fall-planted small-seeded legumes and grasses. No injury expected on spring-planted crops.
picloram (Tordon) (on small grain)	Do not plant alfalfa in fall of 1976. Do not plant soybeans, sunflowers, dry beans or alfalfa in 1977.
metribuzin (Sencor, Lexone)	Some injury potential for fall-seeded small grain grasses or legumes. Injury from carryover has been observed on oats and may occur in 1977 in extreme situations. Problems can be expected on high pH soils or overlapping application. Some injury may occur on small grain planted in potato fields treated in 1976.
trifluralin (Treflan)	Do not plant small grain or grasses the fall of 1976. Based on label restrictions and residue tests on soil samples taken in adjacent states this fall, the following suggestions are offered: Do not plant oats or sorghum in 1977. If 3/4 lb/A was used and there was less than 7 inches of rain or if 1 lb/A was used with less than 11 inches of rain during the season, don't plant crops other than soybeans, sunflowers or dry beans unless the field is deep (moldboard) plowed. If the field is plowed, problems on corn planted in 1977 are not anticipated. Corn injury has been reported in some states where fields were chisel plowed, disked or field cultivated without moldboard plowing.
dinitramine (Cobex) profluralin (Tolban) fluchloralin (Basalin) penoxalin (Prowl)	Do not plant small grain or grasses in the fall of 1976. There are no label restrictions for crops to plant in 1977, suggesting that crop injury from carryover is not anticipated based on current label data. However, the same 1977 crop suggestions as for trifluralin are offered as a precautionary measure for extremely dry conditions.
propazine (Milogard)	Do not plant small grain, grasses or legumes in fall of 1976. Sorghum may be planted in 1977 without risk of injury.
alachlor (Lasso) propachlor (Ramrod, Bexton) chloramben (Amiben)	No injury anticipated for fall-planted wheat or rye. Granules may persist longer than spray formulations. Suggest tillage across the bands prior to fall-planted crops unless most extreme drought conditions. No injury expected on spring-planted crops.
butylate (Sutan$^+$) EPTC (Eradicane) vernolate (Vernam)	No injury anticipated for fall-planted wheat or rye. However, the Sutan$^+$ label states soil residues will be dissipated by time of crop harvest under normal growing conditions. No injury anticipated for spring-planted crops.
2,4-D dicamba (Banvel)	No injury for fall or spring crops from rates applied in crops during 1976.

(TO BE REVISED WHEN ADDITIONAL DATA BECOME AVAILABLE) 9/76, Revised 12/76.

CHISEL PLOW SOYBEANS AND CORN

F. Shubeck and B. Lawrensen

Objectives

1. How much tillage is necessary for optimum yields?
2. Will fall tillage increase moisture storage?
3. Can yields be maintained with chisel plowing comparable to moldboard plowing?
4. Which is the best type of chisel points to use, sweeps, twists or straight narrow points?

Procedure (Soybeans)

Nov. 5-8, 1975 - Completed all fall tillage treatments. Cornstalks were rotary chopped.
May 21, 1976 - All spring tillage completed. Stalks rotary chopped.
Planted all soybean plots.
Sideband application of 100#/A of 8-32-16
Variety - Corsoy
Herbicide - Lasso II-15G banded in row
June 7 - Cultivated all soybean plots
June 16 - Cultivated all soybean plots the second time
Oct. 13 - Combined soybean plots

Procedure (Corn)

Nov. 5-8, 1975 - All fall tillage completed.
May 10, 1976 - Spring tillage completed.
May 17 - Planted all corn plots
Sideband starter at 100#/A of 8-32-16
Variety - Curry's TC 343
Insecticide - Counter 15G
Herbicide - Lasso II banded in row
June 3 - Rotary hoed corn plots
June 7 - Cultivated all corn plots
June 26 - Cultivated all corn plots
July 1 - Sidedressed corn with 100# nitrogen per acre
Oct. 20 - Harvested corn

Table 20. Effect of Tillage Treatments on Yield of Soybeans

	Tillage Treatment		Soybeans
	In Fall	In Spring	Bu/A
1	---	Disk-disk-drag	27
2	---	Chop-sweeps-disk-drag	25
3	---	Disk-moldboard plow-disk-drag	26
4	Disk-moldboard plow	Disk-drag	29
5	Disk-twists	Disk-drag	24
6	Chop-twists	Disk-drag	28
7	Chop-twists	Sweeps-drag	25
8	Chop-sweeps	Sweeps-drag	24
9	Disk	Disk-drag	25
10	Chop-twists*	Sweeps-drag	24

*Treatment 10 was unfertilized. All other plots received 100 lbs of 8-32-16 (oxide) as a sideband starter.

Discussion and Interpretation of Table 20

Soybean yields in the experiment were quite good for a year of severe drought. There was no definite yield advantage for any one tillage system or for time of performing the tillage.

Table 21. Effect of Tillage Treatments on Yield of Corn

	Tillage Treatment		Corn
	In Fall	In Spring	Bu/A
1	---	Disk-disk-drag	23
2	---	Chop-sweeps-disk-drag	21
3	---	Disk-plow (moldboard)-disk-drag	20
4	Plow (moldboard)	Disk-drag	21
5	Disk-twists	Disk-drag	17
6	Chop-twists	Disk-drag	14
7	Chop-twists	Sweeps-drag	16
8	Chop-sweeps	Sweeps-drag	21
9	Disk	Disk-drag	23
10	Chop-twists*	Sweeps-drag	24

*Treatment 10 was unfertilized. All other corn plots received 100 lbs of 8-32-16 (oxide) as a sideband starter. In addition, 100 lbs of nitrogen per acre were applied as a sidedressing when corn was about 18 inches high.

Discussion and Interpretation of Table 21

Corn yields were very low in 1976. It was interesting to see that on a bushel per acre basis in this tillage experiment, corn yields were less than soybeans. The critical blossoming period for locally grown soybean varieties

extends over a longer period than that for single cross corn. When a severe drought occurs at this critical period as in 1976, soybean yields are injured less than corn.

There appeared to be no corn yield advantages in favor of fall tillage. One of the objectives for chisel plowing in the fall is to loosen the soil to promote rapid infiltration of rainfall. The fall rains were so limited that no fall tillage was needed to promote infiltration. In treatments 5, 6 and 7 where fertilizer was applied in the spring and twist points used in the fall, yields appeared to be a little less than plots with no fall tillage.

SOYBEAN ROW SPACING (30" vs. 7")

B. Lawrensen and F. Shubeck

Objectives of Experiment

1. Is there a yield advantage in narrowing rows from 30 inches to 7 inches?
2. Will planting soybeans with a grain drill (7" spacings) without cultivating be a desirable practice?

Methods and Procedures

May 25, 1976 - Sprayed 1.5 pints of Treflan per acre, tandem disked immediately.
May 26 - Spike tooth harrowed. Planted beans.
Variety - Corsoy
June 11 - Cultivated 30 inch rows
July 6 - Cultivated 30 inch rows
Oct. 4 - Combined all plots

Table 22. Comparison of 30" Rows and 7" Rows for Soybeans

Row Spacing	Bu/A
30 inch rows (planted with tool bar planter)	17.6
7 inch rows (planted with press drill)	17.9

Discussion and Interpretation of Table 22

Seven inch row spacings yielded about the same as the 30 inch spacings. When yields were over 30 bushels per acre, 7 inch rows usually yielded more than 30 inch row spacings (one exception in eight years).

DATE OF PLANTING SOYBEANS

F. Shubeck and B. Lawrensen

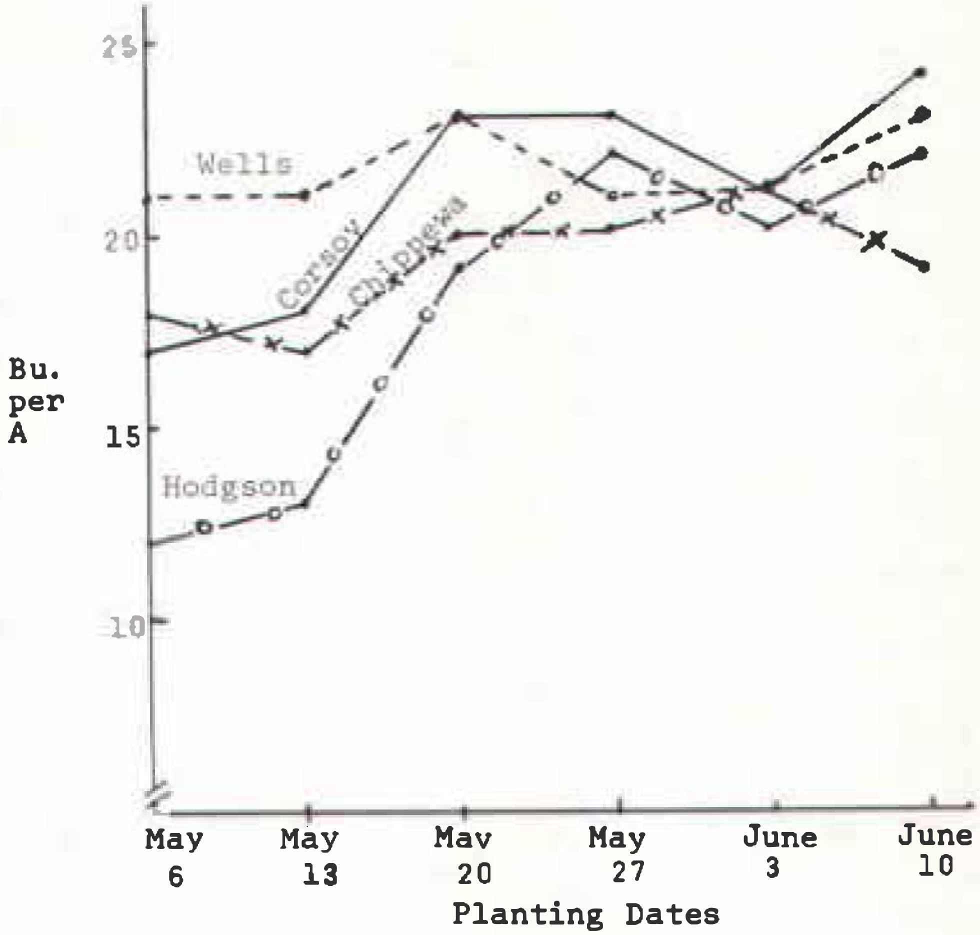
Objectives of Experiment

1. Will early planting dates decrease yields of early maturing soybean varieties?
2. Does day length and time of planting seriously affect soybean yield?
3. Can a planting date be selected for early maturing varieties that will prevent improper day length from triggering premature flowering?

Methods and Procedures

Nov. 3, 1975 - Moldboard plowed
April 14, 1976 - Tandem disked plot area
April 21 - Sprayed Treflan at 1.5 pints per acre, disked to incorporate
April 29 - Broadcast 100 lbs/acre of 8-32-16, disked
May 6 - First planting date
  Varieties - Corsoy, Wells, Hodgson, Chippewa 64
  Herbicide - Lasso II banded
  Soil temperature at 2 inches - 51° F
  Emergence date - May 15
May 13 - Second planting date
  Soil temperature - 55° F
  Emergence date - May 21
May 20 - Third planting date
  Soil temperature - 60° F
  Emergence date - May 25
May 27 - Fourth planting date
  Soil temperature - 64° F
  Emergence date - June 6
June 3 - Fifth planting date
  Soil temperature - 77° F
  Emergence date - June 14
June 9 - Cultivated first, second and third planting dates (first time)
June 10 - Sixth planting date
  Soil so dry that emergence date is not applicable
June 18 - Cultivated fourth and fifth planting dates (first time)
Sept. 27 - Combined all plots

Figure 4. Effect of Planting Dates on Yield of Soybeans



Discussion and Interpretation of Figure 4

There were wide variations in yield from different varieties with the early planting dates but differences narrowed considerably as planting dates were delayed. The early variety, Hodgson, had low yields when planted early but yielded almost as well as Corsoy and Wells when planted later. The other early variety, Chippewa, was similar to Hodgson in yield response to date of planting but results were not quite so striking.

SOYBEAN INOCULATION STUDY FOR 1976

R. M. Pengra

Objective

To evaluate the nitrogen fixing ability of soybeans inoculated with each of four commercial soybean inoculants.

Methods

Sixty test plots were planted with soybeans. Fifty-four of the plots were planted with Corsoy variety soybeans and the remaining six with Northrup King S1474. Northrup King "Noculized" soybeans are all inoculated by the company itself using only their own varieties. No lot of variety S1474 uninoculated soybeans was available, therefore no negative or uninoculated controls could be run.

The inoculant method was that of the company marketing the inoculant.

The treatments or experimental groups were: no nitrogen no inoculum, 80 lbs of ammonium nitrate nitrogen per acre, regular peat-base inoculant, granular inoculant, "Noculized", and a second "regular" peat base inoculant.

Plants in all of the sixty plots including the uninoculated controls had nodules at all three dates of observation during the growing season.

The average yield for all sixty plots was only 14.66 bu of seed per acre.

The presence of nodules on the uninoculated controls indicates that there are root nodule bacteria in the field although they may not be good nitrogen fixers.

The lack of moisture, not nitrogen, limited growth in this dry season and therefore, nodulation and hence nitrogen fixation, had no effect on growth and yield of these soybeans.

Under these conditions we are unable to evaluate these inoculants.

EFFECT OF DICAMBA ON EMERGENCE OF SEED FROM INJURED SOYBEANS

G. Arnold and D. Auch

Objectivea of Experiment

1. To determine effect of dicamba on emergence of seed from injured soybeans.
2. To determine effect of dicamba on vigor of progeny from injured soybeans.

Methods

1. In 1975 dicamba was applied at .001, .010, and .050 lb/A to Corsoy soybeans in the early bloom and early pod stages.
2. The seed from these treatments was planted on June 27, 1976 with a hand planter under normal field conditions.
3. Experimental design - randomized complete block. Plot size was 30 inches by 20 feet.
4. Emergence counts were taken 9 and 15 days after planting.
5. Plant dry weight measurements were taken 41 and 75 days after planting.
6. Data were analyzed using Duncan's multiple range test. Means followed by different letters indicate a significant difference at the 95% confidence level.

Table 23. Effect of Dicamba on Soybean Progeny Emergence (1975)

		% Emergence Days After Planting	
Stage	Rate	9	15
Early bloom	.000	63.5 a-c	71.2 ab
	.001	62.8 a-c	64.8 a-c
	.010	54.8 c-e	64.5 a-c
	.050	53.8 c-e	65.2 a-c
Early pod	.000	66.2 a-c	74.0 ab
	.001	63.2 a-c	74.2 a
	.010	44.8 ef	59.8 b-d
	.050	37.2 f	47.2 ef

Results

There was no significant reduction in emergence at either counting dates with seed from plants injured in the early bloom stage.

Emergence nine days after planting was significantly reduced at the two high rates applied at the early pod stage. Fifteen days after planting emergence was significantly reduced at only the highest rate. The significant difference between the counting dates at the .01 rate indicates a delay in emergence.

There was no significant difference in progeny vigor 41 days after planting.

DICAMBA INJURY ON SOYBEANS

G. Arnold and D. Auch

Objectives of Experiment

1. To determine soybean growth stages most sensitive to dicamba.
2. To determine the effect of dicamba on seed from injured soybeans.

Method

1. Experimental design - randomized complete block. Plot size was 8 x 50 feet.
2. Corsoy soybeans were planted on June 25.
3. Dicamba was applied at four rates: .000, .010, .025, .050 lb/A.
4. Applications were made on July 7 (early bloom), July 14 (mid-bloom), July 26 (early pod), and August 2 (late pod).
5. Soybeans were harvested on October 15.
6. Data were analyzed using Duncan's multiple range test. Means followed by different letters indicate significant difference at the 95% confidence level.

Table 24. Average Yield of Soybeans Treated With Dicamba at Four Growth Stages, 1976

Stage	Yield kg/ha	Yield bu/A
Control	818.5 a	12.2
Early bloom	358.2 c	5.3
Mid bloom	521.5 b	7.8
Early pod	520.1 b	7.8
Late pod	767.4 a	11.4

Table 25. Effect of Dicamba on Soybean Germination (1976)

	% Germination			
	Stage			
Rate	Early bloom	Mid bloom	Early pod	Late pod
.000	67.9 ab	68.6 ab	70.0 a	71.2 a
.010	72.2 a	72.5 a	56.2 cd	50.2 d
.025	68.5 ab	61.1 bc	53.1 d	23.2 e
.050	70.9 a	66.0 ab	52.5 d	27.1 e

Results

The greatest yield reduction occurred when injury occurred at the early bloom stage. Yield was not significantly reduced when injury occurred at the late pod stage.

When dicamba injury occurred at the early and late pod stages germination was significantly reduced at all three rates. The greatest reduction in germination occurred when the most pods were present.

SOYBEAN PERFORMANCE TESTING

J. J. Bonnemann and G. W. Erion

Changes in staff responsibilities at the Agricultural Experiment Station level eliminated all breeding efforts with soybeans effective July 1, 1976. The testing work was placed under the supervision of the Crop Performance Testing project. The testing of proprietary soybeans was changed to a fee program, partially off-setting trial costs. Two trial sites were located in southeast South Dakota for testing of Group II and Group III Northern Uniform and Northern Uniform Preliminary Tests as well as standard varieties and proprietary entries.

Trials at both locations were seeded on May 21. Harvest was on October 14 at Centerville and October 21 at Elk Point. Both trials were seeded in 30-inch row spacings.

The summer drouth caused serious yield reduction at Centerville. The yields were not depressed as badly at Elk Point. The drouth induced stress caused serious shattering losses to many entries at Centerville and to the early entries at Elk Point. The quality varied and green seeds were frequently noted. Of the standard varieties, Corsoy has the best long-time yield record at Centerville. Several of the commercial lines have done equally well. The later varieties performed best at Elk Point in 1976. Among the standard varieties the Group III have the higher yield averages for the 1973-76 period at Elk Point. The later maturity proprietary entries also produced the higher yields at Elk Point in 1976.

The yield results of the trials are shown in Tables 26 and 27 for Centerville and Elk Point, respectively. Results of these and all soybeans trials are available in Plant Science Pamphlet #29, 1976 Soybean Performance Trials.

Table 26. Soybean Performance Trial, Southeast Experiment Farm, Beresford, SD, 1976

Identification of Entries[1]			1976 Field Data			Average Yield in Bu/acre					
Standard Varieties: Entry	Maturity Group[2]	Days to Mature[3]	Maturity Date (mo.-day)	Plant Height (inches)	Potential Shatter Loss[4]	1973	1974	1975	1976	1973-76	75-76
Hodgson	I	+ 5	9-20	17	4	28.0	22.5	32.7	9.7	23.2	21.2
Corsoy	II	+12	9-22	20	5	37.6	26.9	33.4	10.4	29.5	21.9
Hark	I	+13	9-22	20	5	31.9	23.9	28.8	11.6	24.0	20.2
Harcor	II	+14	9-23	22	4	36.5	25.3	33.9	13.1	27.2	23.5
Rampage	I	+11	9-23	19	2	30.4	23.5	30.6	18.4	25.7	24.5
Coles	I	+11	9-23	22	4				16.0		
Provar	II	+13	9-24	22	2	37.3	22.1	31.7	16.9	27.0	24.3
Amsoy 71	II	+15	9-24	23	3	39.3	25.2	32.5	14.4	27.8	23.4
Wells	II	+14	9-25	21	2	37.0	25.2	32.3	17.9	28.1	25.1
Beeson	II	+17	9-26	21	2	41.3	21.9	32.2	13.9	27.3	23.0
Wayne	III	+24	9-30	25	2	42.3	26.4	30.3	21.1	30.0	25.7
Woodworth	III	+25	10-1	21	1	49.2	21.9	32.4	12.5	29.0	22.4
Proprietary Entries:											
Brand	Entry										
Peterson-Pioneer	85		9-16	14	4			31.4	9.6		20.5
Peterson-Pioneer	118-11		9-20	19	4				11.4		
Peterson-Pioneer	105P		9-21	20	4			36.5	13.4		24.9
Land O'Lakes	GO-44		9-21	22	4				15.3		
Land O'Lakes	LL 4301		9-21	21	3				13.2		
FFR	223		9-22	21	4				11.4		
SRF	200		9-22	21	3	39.8	27.8	35.3	17.4	30.1	26.3
Land O'Lakes	LLA 43		9-22	20	4				16.6		
Peterson-Pioneer	P61-22		9-23	20	4				11.4		
Land O'Lakes	GO-42		9-23	20	4	39.9	24.4	35.1	10.8	27.5	22.9
Peterson-Pioneer	3100		9-23	21	3			36.9	13.7		25.3
Pride	B216		9-23	19	4			34.8	9.5		22.1

Table 26 (cont). Beresford, SD

FFR	111	9-24	22	4			12.1	
Northrup King	S 1492	9-24	20	4			10.0	
Northrup King	Multi 51	9-25	21	3		37.0	15.5	26.2
Northrup King	S 1474 Ex	9-26	22	2	25.3	34.5	17.8	26.1
SRF	307P	9-29	24	1		32.3	18.9	25.6
Sexauer	SX 28 Ex	9-29	19	3			13.8	
					Mean, B/A		13.9	
					CV - %		27.4	
					LSD (.05)		6.2	

1 - Listed in order of 1976 maturity.
2 - Maturity Group from USDA classification: I=early, II=midseason, III=late at Beresford.
3 - Expected relative maturity at this site compared to Swift when not exposed to a killing frost.
4 - Shattering potential: 1=no loss, 2=up to 5%, 3=5-10%, 4=10-20%, 5=20% or more.

Table 27. Soybean Performance Trial, Ed Curry, Cooperator, Elk Point, SD, 1976

Identification of Entries[1]			1976 Field Data			Average Yield in Bu/acre					
			Maturity Date (mo.-day)	Plant Height (inches)	Potential Shatter Loss[4]	1973	1974	1975	1976	1973-76	75-76
Standard Varieties:											
Entry	Maturity Group[2]	Days to Mature[3]									
Hark	I	+13	9-22	29	5	39.8	35.6	37.0	22.3	33.7	29.6
Corsoy	II	+12	9-23	28	3	41.6	39.7	43.1	31.4	38.9	37.2
Coles	I	+11	9-23	32	5				23.3		
Amsoy 71	II	+15	9-23	31	3	44.9	35.3	36.3	33.1	37.4	34.7
Harcor	II	+14	9-25	34	2			45.0	38.2		41.6
Wells	II	+14	9-27	34	2	40.8	35.8	39.7	36.3	38.1	38.0
Beeson	II	+17	9-29	29	2	46.2	35.9	38.9	30.9	37.9	34.9
Wayne	III	+24	10-3	38	2	44.8	36.9	31.0	43.7	39.1	37.3
Woodworth	III	+25	10-4	34	1	45.4	37.4	35.5	40.4	39.7	37.9
L-21	III	+28	10-6	37	1				37.8		
Calland	III	+26	10-7	36	1	49.4	36.3	31.5	39.5	39.2	35.5
Williams	III	+27	10-8	35	1	40.0	38.2	29.7	37.5	36.3	33.6
Proprietary Entries:											
Brand	Entry										
Peterson-Pioneer	118-11		9-18	26	2				28.5		
Pfizer-Clemens	CX 114		9-22	32	2				31.3		
Peterson-Pioneer	P61-22		9-22	34	2				39.1		
Land O'Lakes	GO-42		9-23	30	2	46.2	36.5	45.0	35.7	40.8	40.3
FFR	223		9-23	34	4				23.5		
FFR	111		9-23	31	4				22.1		
Land O'Lakes	LL 4301		9-23	30	3				30.7		
Peterson-Pioneer	105P		9-23	33	2			39.0	35.6		37.3
Asgrow	A 2440		9-24	33	2				38.8		
Pfizer-Clemens	2ER-75		9-25	30	3				29.0		
Land O'Lakes	LLA-43		9-25	31	3				30.0		
Peterson-Pioneer	P83-14		9-25	32	3				28.8		
Peterson-Pioneer	3100		9-25	32	2			39.1	38.5		38.8
McCurdy	102		9-25	29	3				27.8		
SRF	200		9-25	29	2	43.9	37.1	37.0	32.4	37.6	34.7

Table 27 (cont). Elk Point, SD

McCurdy	101+	9-26	32	3				33.7		
Northrup King	S 1492	9-26	29	3				26.4		
Northrup King	Multi 51	9-26	33	2			38.9	38.8		38.8
Asgrow	A 2656	9-27	32	2			40.6	38.4		39.5
Asgrow	A 2770	9-27	34	2			35.1	35.9		35.5
Pfizer-Clemens	2L-76	9-28	30	2				32.5		
Land O'Lakes	Dixon	9-28	30	2	42.9	39.8	42.8	39.9	41.3	41.3
Northrup King	S1474 Ex	9-28	34	2		34.3	45.4	43.5		44.4
Pfizer-Clemens	2L-75	9-29	32	2				34.0		
Peterson-Pioneer	3105	9-29	39	1				43.4		
Midwest	50938	9-29	33	2				32.0		
Pfizer-Clemens	CX 290	10-1	33	1				35.8		
Sexauer	SX 28Ex	10-1	29	2				34.6		
SRF	307P	10-3	37	1			28.6	39.3		33.9
SRF	350	10-5	38	1				42.7		
Sexauer	SX 32Ex	10-6	34	1				42.9		
					Mean, B/A			34.4		
					CV - %			12.9		
					LSD (.05)			7.1		

1 - Listed in order of 1976 maturity.
2 - Maturity Group from USDA classification: I & II=early to midseason, III=full season to late at Elk Point.
3 - Expected relative maturity at this site compared to Swift when not exposed to a killing frost.
4 - Shattering potential: 1=no loss, 2=up to 5%, 3=5-10%, 4=10-20%, 5=20% or more.

CONTINUOUS SOYBEANS

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. What are the possibilities of growing continuous soybeans for increasing soil nitrogen and at the same time producing an excellent cash crop? Indications are that for every bushel of beans raised, approximately one pound of nitrogen is returned to the soil.
2. Will disease and insects gradually build up in the soil and reduce yields?
3. Soybeans do not respond like corn to large quantities of commercial nitrogen. Could we raise continuous beans, and in this way cut down on the need for nitrogen fertilizer yet increase the nitrogen reserves from symbiotic soybean nitrogen?

Methods and Procedures

Nov. 17, 1975 - Fall plowed plot area
May 3, 1976 - Fertilized beans and corn
    Beans - 75 lbs/acre of 8-32-16 (oxide)
    Corn - 80 lbs N, 30 lbs P_2O_5 and 20 lbs of K_2O broadcast per acre
    Tandem disked and spike tooth harrowed, then planted corn.
    Variety - Pioneer 3571
    Insecticide - Counter 15G
    Herbicide - Lasso II banded
May 20 - Planted soybeans
    Variety - Corsoy
    Herbicide - Lasso II banded
June 2 - Cultivated corn plots
June 7 - Cultivated continuous bean plots
June 15 - Cultivated rotation bean plots
June 16 - Cultivated corn plots (second time)
June 28 - Sprayed all corn plots with Sevin 80W at 2 lbs active ingredient per acre for corn borer control
Sept. 29 - Combined all soybean plots
Oct. 21 - Harvested all corn plots

Table 28. Effect of Cropping Sequence on Soybean Yield

Cropping Sequence	Fertilizer $N + P_2O_5 + K_2O$	Bushels of corn per acre	Bushels of beans per acre
Continuous beans	0 + 0 + 0	--	29
Continuous beans	8 + 32 + 16	--	29
Rotation beans*	0 + 0 + 0	--	32
Rotation beans*	8 + 32 + 16	--	32
Rotation corn*	0 + 0 + 0	19	--
Rotation corn*	80 + 30 + 20	20	--

*This rotation consisted of two crops, corn and beans.

Discussion and Interpretation of Table 28

In the second year of this experiment, soybeans in a two-year rotation of corn and beans consistently yielded more than continuous beans. It will be interesting to observe this trend in future years and attempt to discover why this occurred.

There were no yield responses due to commercial fertilizer in 1976.

1976 CHEMICAL CONTROL TESTS FOR ALFALFA WEEVIL

R. J. Walstrom

Table 29. 1976 Chemical Control Tests for Alfalfa Weevil, Gale Erickson Farm, Gayville, South Dakota

	Rate		Insects per 100 net sweeps				
	per	Method	ALFALFA WEEVIL		PEA	LADYBIRD BEETLE	
Chemical	Acre	Applied	Larvae	Adults	APHID	Larvae	Adults
Furadan	0.5 lbs	Ground	0	6	15,625	9	9
Sevin	1.5 lbs	Ground	28	7	43,375	3	10
Imidan	1.0 lbs	Ground	18	2	30,000	0	4
Supracide	0.5 lbs	Ground	26	8	3,833	3	4
Alfa-Tox	3.0 qts	Ground	94	14	8,375	0	4
Methyl Parathion	0.5 lbs	Air	336	13	233	7	3
Check	---	---	1701	35	23,500	154	24

Ground applications at 15 gallons per acre were applied 5-24-76.
Air application at 2 gallons per acre was applied 5-26-76.

Table 30. Alfalfa Test, Southeast South Dakota Experiment Farm, M. Rumbaugh

Location:	Centerville, SD	Plot Size:	4' x 20'
Design:	Triple Lattice	Planting Date:	May 2, 1974
Method of Seeding:	V-Belt Drill	Replications:	3
Soil Type:	Egan Silt Loam	Years:	1976

Source	Entry	Percent Stand 1976	Oven Dry Tons per Acre 1975 1 cut
Acco	235	99	1.00
Acco	436	99	.87
Asgrow	Aztec	99	.98
Asgrow	Kodiak	99	1.02
Barzan	Flandria	98	.89
Barzan	Norseman	98	1.16
Cal/West	Bonus	99	.96
Cal/West	Vista	99	.85
DeKalb	131	97	.95
DeKalb	123	96	1.02
DeKalb	153	99	.91
FFR	Tempo	99	.95
FFR	Weevelchek	99	1.11
Farm Seed Research	A-9	99	.89
Farm Seed Research	A-37	99	.99
Farm Seed Research	A-40	99	.96
Jacques	J-60	98	1.03
Jacques	J-70	99	.84
Jacques	JX-80	99	.98
Land O'Lakes-Felco	Valor	99	1.09
Land O'Lakes-Felco	Pacer	97	1.06
Northrup, King	Glacier	99	.82
Northrup, King	Thor	99	1.04
Northrup, King	Warrior	97	.93
J. C. Robinson	Gold n' Pure	99	.91
North American PB	Anchor	98	.87
North American PB	Nugget	99	1.08
North American PB	Titan	99	1.21
Sexauer	A-7	97	.93
Sexauer	A-10	99	1.08
Sexauer	BH-22	99	1.14
Security	Langmeiller	97	.87
Teweles	Klondike	97	1.02
Teweles	Superatan	97	.86
Teweles	Americana	99	.86

Table 30 continued.

Source	Entry	Percent Stand 1976	Oven Dry Tons per Acre 1975 1 cut
Waterman-Loomis	215	99	1.06
Waterman-Loomis	216	99	1.08
Waterman-Loomis	318	99	.97
Waterman-Loomis	305	98	1.09
Waterman-Loomis	307	99	.99
FFR	Scout	97	1.11
Funk's	G-777	98	.83
Agate		97	1.01
Dawson		97	1.02
Iroquois		97	1.03
Kanza		97	.96
Ladak 65		98	1.10
Saranac		99	.96
Vernal		97	1.14
Mean		98	.99
LSD (.05)		N.S.	.14
CV (%)		2	9

CORN OR SOYBEANS AFTER ALFALFA IN A DRY YEAR

B. Lawrensen and F. Shubeck

Objective of Experiment

1. After a dry year, which crop (soybean or corn) is best to plant after plowing up a five year alfalfa sod?

Methods and Procedures

Nov. 1975 - Fall plowed alfalfa
June 2, 1976 - Tandem disked and spike tooth harrowed plot area. Corn and beans planted.
Varieties: Corn - Curry's TC 343
Soybeans - NK 1474
Lasso II banded for both corn and beans
June 11 - Cultivated corn and beans
July 6 - Cultivated corn and beans
Oct. 4 - Combined soybeans
Oct 21 - Harvested corn

Table 31. Returns for Corn and Soybeans Planted in Alfalfa Sod in a Dry Year

Crop	Bu/acre	Price/bu Dec. 22, 1976	Return per acre
Corn	31	2.10	$ 65.10
Soybeans	16	6.50	104.00

Discussion and Interpretation of Table 31

This test was conducted in a year with far below average rainfall. Five continuous years of alfalfa preceeded the test crops, corn and beans.

Under the conditions of 1976 and prices of Dec. 22, it was more profitable to raise soybeans than corn.

MOST PROFITABLE ROTATION

B. Lawrensen and F. Shubeck

Objectives of Experiment

1. How much will commercial fertilizer increase net profits?
2. Is it more profitable to add nitrogen from a commercial source or grow a legume in a rotation?
3. Which cropping sequence will bring the greatest net cash return?
4. Will the previous crop affect the available moisture during the cropping season?

Methods and Procedures

Nov. 18, 1975 - Fall moldboard plowed all ranges. Until this time, all plowing had been performed in the spring.
April 2, 1976 - Tandem disked all ranges
April 8,9 - Seeded oats plots with John Deere press drill.
Variety - Spear
April 21 - Chisel plowed with sweeps all fall plowed alfalfa plots to control vegetative growth.
May 17 - Tandem disked all corn, soybean and grain sorghum plots
May 19 - Planted all corn plots
Variety - Curry's TC 343
Insecticide - Counter 15G
Herbicide - Lasso II banded
May 20 - Planted soybean plots
Variety - Corsoy
Herbicide - Lasso II banded
May 21 - Planted grain sorghum
Variety - NK 233 (greenbug resistant)
Insecticide - Furadan 10G for greenbug control
Herbicide - Ramrod 20G banded

June 3 - Rotary hoed all plots
June 7 - Cultivated all corn plots
June 9 - Cultivated grain sorghum plots
July 2 - Sidedressed ammonium nitrate on all corn and sorghum plots
July 13 - Combined oats plots
Oct 5 - Combined soybean plots
Oct 6 - Combined sorghum plots
Oct. 21 - Harvested all corn plots

Discussion and Interpretation of Table 32

With corn yields in the 30 to 40 bushel per acre range, there was little or no response to commercial fertilizer. The lowest corn yields were in rotations that included alfalfa.

There were some small yield increases with oats due to fertilizer in this dry year.

Fertilizer did not increase the yield of soybeans.

Note that favorable yield of grain sorghum compared to that of corn. This illustrates the advantage of raising sorghum in a dry year.

Spring frosts and dry weather severely reduced yields of alfalfa.

Table 32. Effect of Cropping Sequence and Fertilizer on Crop Yield, 1976

Cropping Sequence	Crop Receiving Fertilizer	Fertilizer lbs/A N + P + K	N Side Dress lbs/A	Oats Bu/A	1st Year Corn Bu/A	2nd Year Corn Bu/A	Soy-beans Bu/A	Sor-ghum Bu/A	Hay Tons/A
1 Continuous corn	—	0 + 0 + 0			39.0				
1 Continuous corn	Corn	6 + 11 + 10	70		30.0				
2 Corn-oats	—	0 + 0 + 0		26.0	40.0				
2 Corn-oats	Corn	6 + 11 + 10	70		34.0				
	Oats	30 + 7 + 0		34.0					
3 Corn-oats-oats+alf-alf hay	—	0 + 0 + 0		39.0	28.0	19.0			0.54
3 Corn-corn-oats+alf-alf hay	Corn	6 + 11 + 10			30.0				
	Corn	6 + 11 + 10	70			16.0			
	Oats	15 + 26 + 0		40.0					
	Alf residual	0 + 0 + 0							0.53
4 Oats+sweet clover-corn	—	0 + 0 + 0		28.0	38.0				
4 Oats+sweet clover-corn	Oats	30 + 7 + 0		36.0					
	Corn	6 + 11 + 10			33.0				
5 Corn-soybean-oats	—	0 + 0 + 0		39.0	35.0		20.0		
5 Corn-soybean-oats	Corn	6 + 11 + 10	70		37.0				
	Soybeans	6 + 11 + 10					18.0		
	Oats	30 + 7 + 0		40.0					
6 Corn-oats-soybeans	—	0 + 0 + 0		34.0	38.0		21.0		
6 Corn-oats-soybeans	Corn	6 + 11 + 10	55		41.0				
	Oats	20 + 7 + 0		47.0					
	Soybeans	6 + 11 + 10					19.0		
7 Continuous grain sorghum	—	0 + 0 + 0						61.0	
7 Continuous grain sorghum	Sorghum	6 + 11 + 10	70					69.0	

GRAIN SORGHUM TRIALS

J. J. Bonnemann and G. W. Erion

The grain sorghum program in the state underwent some changes at the Agricultural Experiment Station level effective July 1, 1976. All breeding work was terminated with grain sorghum. The work with Regional Testing and evaluation of some lines of male sterile SD 106 was included in the Crop Performance Testing project together with the testing of released Station and proprietary hybrids.

All trials were seeded on May 21 in 36-inch rows to achieve a final stand of 3-4 plants per foot of row. Harvesting was done on October 1. The field had received a broadcast fertilizer application of 60-30-0 lbs/A prior to fall plowing. Ramrod and Furadan were banded at time of seeding for grassy weed and insect control, respectively. The yields were quite variable, the later entries generally yielding much better than the earlier varieties. The mean yield for the trial was 2860 pounds per acre. Test weights were good to excellent for the later maturing types. Bird damage and lodging were nearly non-existant.

The 1976 trial results appear in Table 33. This and additional data will appear in an upcoming circular, 1976 Grain Sorghum Performance Trials.

STANDARD VARIETY SMALL GRAIN TRIALS

J. J. Bonnemann

The standard variety trials at the Southeast Experiment Farm included three spring small grains--barley, oats and spring wheat.

The trials were seeded on April 2, 1976. The mean yields for all three crops were at least 5 B/A higher in 1976 than in 1975 and quality was generally better. A major advantage was the early date of seeding that permitted the crops to mature earlier in the summer and escape the mounting effects of the drouth and heat.

The data included for this report are the 1976 and three-year averages for yield and test weight. The results are found in Tables 34, 35 and 36. Results of these and all small grain trials are available in Plant Science Pamphlet #28, 1976 Standard Variety Small Grain Trials.

Table 33. 1976 Grain Sorghum Performance Trial, Area E, Southeast Experiment Farm, Centerville, Clay County, SD

Brand & Variety	Yield, lb/A	Test Wt., lb/B	Height, inches	Percent Moisture, 9/16/76	Date Headed
Funks G-404	4155	54	30	30.0	8/1
DeKalb B-35	3800	59	34	23.4	7/27
DeKalb C-42A+	3585	58	30	28.8	8/1
Trojan M55	3565	56	33	27.4	8/4
Warner W-561	3560	57	31	27.4	7/31
Northrup-King X3171	3505	59	29	19.5	7/27
Trojan M54	3450	59	34	24.5	7/29
ACCO R1019	3435	58	30	23.7	8/4
Funks G-520GBR	3295	59	31	30.9	8/3
SDAES RS 506	3255	58	38	18.3	7/21
Trojan M56	3155	58	29	35.+	8/12
Funks G-393	3135	59	31	22.3	7/28
Northrup-King NK 180	3060	58	32	21.1	7/27
ACCO R1029A	2955	58	29	28.1	8/4
SDAES RS 610	2920	57	29	26.9	7/31
Northrup-King NK 129	2850	59	30	18.7	7/24
Funks G-251	2785	59	29	18.1	7/21
Warner W-601	2770	59	30	18.8	7/29
ACCO R1014	2745	57	27	23.9	8/4
Warner W-55	2715	58	32	17.3	7/19
DeKalb B-38	2620	59	27	21.6	7/26
Warner W-501	2410	57	34	17.8	7/19
SDAES Exptl.	2320	56	34	18.5	7/19
SDAES SD 75005	2275	55	28	17.3	7/18
SDAES SD 75006	2255	55	30	18.4	7/18
SDAES SD 75002	2100	53	30	17.5	7/19
SDAES SD 75001	2040	53	33	16.5	7/16
SDAES SD 75003	1885	55	30	17.9	7/16
SDAES SD 75004	1715	53	33	17.6	7/16
SDAES SD 106	1420	50	27	17.7	7/16
Mean	2860				

LSD (Least Significant Difference) - .05 1045

C.V. (Coefficient of Variation) 22.5%

Table 34. 1976 Standard Variety Oat Trial Yields, Beresford

Variety	Bushels/acre 1974	1975	1976	3 yr	Test wt. 1976	3 yr
Burnett	69.4	48.9	51.6	56.6	36	33
Trio	68.4	44.9	60.1	57.8	34	33
Diana	89.4	57.1	67.7	71.4	35	33
Holden	82.4	51.6	55.1	63.0	36	33
Portal	72.7	52.4	34.6	53.2	38	35
Nodaway 70	80.0	50.2	64.6	64.9	37	35
Froker	72.9	49.0	40.9	54.3	39	34
Chief	81.1	48.6	55.6	61.8	34	32
Otee	84.7	51.3	64.7	66.9	35	34
Dal	68.2	48.4	42.4	53.0	39	33
Astro	75.2	48.4	36.6	53.4	35	31
Noble	88.2	46.9	73.4	69.5	35	32
Stout	89.2	44.9	62.0	65.3	34	33
Spear	87.5	51.2	60.7	66.5	35	32
MN 71101	70.4	51.6	40.5	54.2	37	33
Wright	67.6	51.2	51.2	56.7	38	35
M-73	64.2	43.8	50.9	50.0	35	33
E-76			47.2		34	
Lang		50.4	69.1		33	
E-77			54.9		34	
Mean, B/A			54.2			
CV - %			12.0			
LSD (.05)			9.2			

Table 35. 1976 Standard Variety Barley Yields, Beresford

Variety	Bushels/acre 1974	1975	1976	3 yr	Test wt. 1976	3 yr
Liberty	50.1	29.5	48.1	45.2	45	43
Firlbecks III	42.4	31.1	43.5	39.0	44	43
Larker	68.9	31.3	41.4	47.2	44	45
Cree	51.7	33.8	27.6	37.7	38	41
Conquest	63.7	34.5	45.4	47.9	44	44
Primus II	63.7	35.6	41.7	47.0	46	46
Bonanza	52.5	37.1	32.2	40.6	39	41
Prilar	62.0	30.5	41.1	44.5	44	44
Beacon	53.0	32.3	39.8	41.9	41	42
Manker	56.5	33.5	30.4	40.1	41	44
Mean, B/A			40.7			
CV - %			16.4			
LSD (.05)			9.5			

Table 36. 1976 Standard Variety Spring Wheat Trial Yields, Beresford

Variety	Bushels/acre				Test wt.	
	1974	1975	1976	3 yr	1976	3 yr
Standard						
Thatcher	22.0	13.9	22.8	19.6	54	53
Fortuna	32.7	14.0	26.7	24.5	58	56
Chris	34.1	14.7	20.9	23.2	56	55
Waldron	36.2	16.6	25.0	25.9	54	54
Tioga	28.0	14.5	24.4	22.3	57	55
Ellar	34.4	15.2	25.1	24.9	55	54
Nowesta	34.2	14.0	21.9	23.4	55	54
Semi-dwarf						
Era	36.3	17.8	25.1	26.4	56	54
Bonanza	39.9	15.0	23.9	26.3	55	56
WS 1809	45.0	17.0	27.7	29.9	56	57
Bounty 208	38.5		23.8			
Olaf	39.6	15.1	28.0	27.6	56	56
W-433R	39.1	12.1	28.0	26.4	57	57
Kitt	35.5	15.2	22.7	24.5	56	53
Bounty 309	34.5	17.1	24.7	25.4	56	54
Profit 75		13.1	23.4		55	
Protor	40.2	14.8	23.1	26.0	57	56
Prodax	32.8	17.3	21.6	23.9	54	52
WS 25			22.5		55	
Durums						
Leeds	40.2	14.8	22.8	25.9	62	60
Rolette	35.3	14.4	23.1	24.3	58	58
Ward	40.3	17.4	22.0	26.6	59	57
Crosby	32.2	20.0	22.5	24.9	58	57
Rugby	37.0	18.9	28.2	28.0	60	58
Botno	45.6	19.2	23.4	29.4	59	58
Cando (semi)			22.2		59	
Mean, B/A			24.1			
CV - %			14.2			
LSD (.05)			N.S.			

WINTER WHEAT - FERTILIZER AND TILLAGE

Paul Carson, Jay Goos, Paul Fixen, Ron Gelderman,
Burt Lawrensen, Fred Shubeck and Robert Nettleton

The growth of winter wheat as a part of the cropping program on the Upland soils of Southeastern South Dakota is a fairly recent undertaking. This experiment is exploratory in nature to determine the effect of variety, fertilizer and tillage on yield.

Objectives

1. To compare some of the varieties grown elsewhere in South Dakota for winter hardiness and yield in this area.

2. To determine the effect of a starter fertilizer on the winter survival and yield.
3. To compare two methods of land preparation with and without fertilizer on yield.

Methods

1. Small grain stubble land was prepared by two methods of tillage for the seeding of winter wheat.
   (a) Chisel plowed
   (b) Chisel plowed and disked
2. Fourteen varieties of winter wheat were planted with a semi-deep furrow type drill set at 10 inches between rows. The drill units were not staggered and trash caused some problems in drilling. In some cases, these problems caused poor stands. The wheat was planted September 15, 1975.
3. The fertilizer used was 18-46-0 at the rate of 60 lbs per acre. This means that the plots receiving fertilizer received it at the rate of 11 lbs of nitrogen and 28 lbs of P_2O_5 per acre.
4. No evidence of winter injury could be detected in the spring of 1976.
5. The wheat received a severe frost during the last week of May. It had little or no effect on the seed set.
6. The wheat was harvested with a small plot combine on July 1.

Results

The yields in bushels per acre as affected by fertilizer and tillage are reported in Table 37. On the average, disking in addition to chisel plowing increased the yield 6 bushels when the crop was fertilized and only 1 bushel when the crop was not fertilized. The fertilized yields were approximately 6 bushels greater than the non-fertilized.

The top five varieties (fertilized) averaged 44 bu/A whereas the poorest five varieties fertilized produced 8 fewer bushels per acre. Disking in addition to chisel plowing increased the yield of these five varieties 5 bushels per acre, which is approximately the same increase caused by disking for the fourteen varieties.

The effects of tillage, variety and fertilizer treatments on test weights are shown in Table 38. The effects of treatments, either fertilizer or tillage, on the test weights were small.

Table 37. The Effect of Tillage and Fertilizer on the Yield of 14 Varieties of Winter Wheat, Southeast Experiment Farm, 1976

	FERTILIZED[1]			NON-FERTILIZED		
Varieties	Chiseled[2]	Chiseled and Disked[2]	Average	Chiseled[2]	Chiseled and Disked[2]	Average
		Bu/Acre			Bu/Acre	
1. Baca	37.6	45.4	41.5	33.5	35.4	34.5
2. Bronze	36.8	40.8	38.8	29.3	25.3	27.3
3. Centurk	46.9	47.7	47.3	34.0	39.1	36.6
4. Eagle	32.8	37.6	35.2	34.8	34.6	34.7
5. Gent	39.0	41.3	40.2	42.5	35.4	39.0
6. Homestead	37.4	38.0	37.7	35.4	36.8	36.1
7. Lancer	40.5	48.5	44.5	32.8	41.2	37.0
8. Lancota	29.3	48.9	39.1	34.3	37.3	35.8
9. Sage	41.7	41.4	41.6	39.8	42.1	41.0
10. Scoutland	32.2	33.9	33.1	31.8	33.7	32.8
11. Scout 66	39.9	49.6	44.8	32.5	33.4	33.0
12. Tamioi	30.4	43.2	36.8	21.9	25.0	23.5
13. Winoka	36.3	40.8	38.6	24.9	37.1	31.0
14. Agate	40.1	49.6	44.9	42.9	37.3	40.1
Average	37.2	43.3	40.3	33.6	35.3	34.5

[1] 60 lbs of 18-46-0 per acre
[2] Average of 2 replications

Table 38. The Effect of Tillage and Fertilizer on the Test Weight of 14 Varieties of Winter Wheat, Southeast Experiment Farm, 1976

	FERTILIZED[1]			NON-FERTILIZED		
Varieties	Chiseled[2]	Chiseled and Disked[2]	Average	Chiseled[2]	Chiseled and Disked[2]	Average
		(lbs/bu)			(lbs/bu)	
1. Baca	60.5	60.5	60.5	60.0	61.0	60.5
2. Bronze	59.0	60.0	59.5	58.0	60.5	59.3
3. Centurk	60.5	60.5	60.5	59.5	61.5	60.5
4. Eagle	61.0	61.0	61.0	60.5	61.5	60.0
5. Gent	60.5	61.5	61.0	61.0	61.0	61.0
6. Homestead	59.0	60.5	59.8	59.0	60.5	59.8
7. Lancer	60.5	60.5	60.5	60.5	61.0	60.8
8. Lancota	59.0	59.5	59.3	59.0	59.5	59.8
9. Sage	61.0	61.5	61.3	61.0	61.5	61.3
10. Scoutland	61.5	61.5	61.5	61.5	62.0	61.8
11. Scout 66	61.0	62.0	61.5	61.0	62.0	61.5
12. Tamioi	57.0	58.5	57.8	56.5	59.0	57.8
13. Winoka	59.5	61.5	60.5	59.5	61.5	60.5
14. Agate	60.5	60.5	60.5	60.5	60.5	60.5
Average	60.0	60.8		59.8	60.9	

[1] 60 lbs of 18-46-0 per acre
[2] Average of 2 replications

BIOLOGICAL CONTROL IN RELATION TO WHEAT YIELD

J. D. Otta, W. S. Gardner and V. H. Lengkeek

Biological control can be defined as the "reduction of inoculum density or disease-producing activities of a pathogen or parasite in its active or dormant state, by one or more organisms, accomplished naturally or through manipulation of the environment, host, or antagonist, or by mass introduction of one or more antagonists." Fungi and bacteria are two groups of microorganisms that are potential biological control organisms. Of the bacteria, several members of the genus Bacillus show capabilities of becoming successful bio-control organisms. These soil inhabiting bacteria are capable of producing antibiotics which, when produced, have potential of reducing fungal pathogens which cause wheat disease.

The Bacillus must grow in the soil before it will produce its antibiotics, and the antibiotic production determines the success of the Bacillus. If the antibiotic is formed, the pathogenic fungi may be reduced and the bio-control organism is successful as measured in increased grain yield. Studies have shown that soil temperature may be a very important factor in the success of the Bacillus microorganism as a biological control entity, since soil temperature can be correlated with Bacillus growth. Generally, a higher temperature from 20-30°C (68-85°F) is preferred by the organism for optimum growth and antibiotic production.

Field studies were initiated in 1976 to study the soil temperature and its relation to the Bacillus success as a bio-control organism. Protor spring wheat was planted at three locations, the Southeast Experiment Farm at Centerville, the Agronomy Farm at Brookings and the North Sioux Valley Crops and Soils Research Station at Watertown, with two dates of planting at each location, April 15 and May 6. The experimental design was a randomized complete block using hill plots.

Five Bacillus species were used as seed treatments, Bacillus uniflagellatus, B. subtilis, B. subtilis var globigii, B. thurengiensis var sotto and B. polymyxa. Wheat was inoculated with one of the five treatments and 15 seeds were planted per hill plot. Each hill plot was then inoculated with a particular wheat pathogen. Soil temperatures were recorded at each location to determine if differences in soil temperature between the three locations and two planting dates could be correlated with Bacillus response as determined by wheat yield.

Yield response per Bacillus treatment at the Southeast Experiment Farm is shown in Table 39. There were no significant differences in yield among the seed treatments at the first planting, nor were there any differences among the seed treatments at the second planting. There was a significant decrease in yield in the later planted wheat as compared to the earlier planted wheat for all treatments. Average soil temperature from planting to emergence for both planting dates showed no difference and temperatures at either date were not high enough to initiate a Bacillus response.

Table 39. Yield of the Bacillus Treated Wheat Planted April 15 and May 6 at the Southeast Experiment Farm

Treatment	Planting Date: April 15	Planting Date: May 6
B. uniflagellatus	27.2[1] a	8.0 b
B. subtilis	26.7 a	10.1 b
B. subtilis var globigii	25.7 a	8.0 b
B. thurengiensis var sotto	26.9 a	10.8 b
B. polymyxa	25.7 a	8.4 b
H_2O	25.4 a	8.0 b

[1]Yield is average of 10 replications in grams per hill plot.

a, b Yields with corresponding letters show no significant differences.

SOD WEBWORMS AFFECTING RANGE AND PASTURE GRASSES IN SOUTH DAKOTA

B. McDaniel and Tom Johnson

Objectives

To identify economically important species of sod webworms in South Dakota range and pasture grasses. Relate laboratory and field biology to possible cultural and chemical control practices.

Approach

We are using light traps, other suitable equipment, and on-site field inspection to determine the most reliable survey methods for adult and immature sod webworms. We will observe and record larval and adult movement, fecundity, preferred ovipositional sites, number and duration of larval stadia, pupation sites, number of generations per year, over-wintering stage and site in the field. We will also observe host specificity, plant damage and feeding behavior in field and laboratory. We shall then attempt control practices that appear economically feasible.

Results

The following field study objectives were accomplished at the Southeast South Dakota Experiment Farm at Centerville. A light trap was set up for collecting sod webworm adults on August 17, 1976. Extraction efficiency has now been established and sorting of the light trap material is in progress.

SEED PRODUCTION AND TESTING OF WARM SEASON GRASSES

James G. Ross and Burt Lawrensen

Breeder seed of summer switchgrass has been produced successfully at the Southeast South Dakota Experiment Farm for a number of years. The invasion of cool-season grasses as well as annual weeds has been controlled by burning in early May followed by application of 1.5 lb. of actual atrazine per acre. Nitrogen in the form of 210 lbs. of ammonium nitrate was applied in the last week of May. Canadian thistles were controlled by spraying with 2,4-D. Because of the extreme drought seed did not set though abundant forage was produced.

From approximately one-four acre of SD43 big bluestem, seed was harvested in mid-October. This grass had been seeded in rows in June 1974 and cultivated during the summers of 1975 and 1976. This seed will be used for increase and testing. An additional seeding in 1976 was unsuccessful because of the drought.

In early June a test of warm-season grasses alone and in mixture with alfalfa and birdsfoot trefoil was sown to determine the best grass-legume mixture. Because of the drought only alfalfa was established as a partial stand. The experiment was abandoned.

CORN SILAGE AND GRAIN FEEDING SYSTEMS FOR FINISHING YEARLING STEERS

W. W. Schneider, F. E. Shubeck,
C. W. Carlson and L. B. Embry

Corn silage and corn grain are major dietary ingredients in rations for growing and finishing cattle in the midwest. Animal performance and the production potential from the corn crop is subject to considerable variation by the ways in which corn is fed as grain and silage. These variations are obtained by the proportions of grain and silage in the ration and by varying time periods of feeding high silage and high grain rations. The main concerns of the farmer-feeder are the production potentials from the corn crop and in the feedlot under various systems of use and supplements needed with various types of rations.

Under investigation in the experiments reported here was the comparative performance and feed requirements of feedlot cattle fed high silage and high grain rations for varying periods of time. The research was planned to use yearling steers following summer grazing for a winter-spring experiment and following a winter backgrounding program for a spring-fall experiment. One experiment has been completed under each time period.

Procedures

Experiment 1 - Winter-Spring

Sixty-four Hereford steers were purchased from a feeder cattle auction market for the experiment initiated on November 14, 1975. They were allotted into 8 pens of 8 each for four experimental treatments as follows:

Treatment 1 (T_1) - High-grain ration throughout the experiment (85% corn grain and supplement, 15% corn silage, dry basis).

Treatment 2 (T_2) - Corn silage and supplement to about 850 lb then same as T_1 to market.

Treatment 3 (T_3) - Corn silage and supplement to about 1000 lb then same as T_1 to market.

Treatment 4 (T_4) - Corn silage and supplement throughout the experiment.

The corn silage was from drought-stricken corn with an estimated grain yield averaging about 5 to 6 bushels/acre and a silage yield of about 3 to 4 tons/acre. Average dry matter content of the silage was about 40% with an average protein content of about 11.5%, dry basis. The corn grain was purchased locally in quantities of about 250 bushels as needed.

Soybean meal (44% protein) was fed at about 1 lb per head daily with the high-grain and 2 lb per head daily with the corn silage ration. In addition, all steers received about 1 oz. trace mineral salt and were supplemented with vitamins A, D and E and chlortetracycline. An organic iodine product was fed at periodic intervals as a preventative treatment against lumpjaw. Steers were implanted with Synovex-S at the beginning of the experiment.

All cattle were started on the experiment at about a full feed of corn silage. The silage was reduced with a gradual increase in grain for those to be fed the high-grain rations throughout the experiment. The increase to a full feed of the high-grain ration was accomplished over a period of about 2 weeks. Groups changed to the high grain ration at 850 or 1000 lb were increased to a full feed of this ration in a similar manner after the appropriate weight.

Upon termination of the experiment for each treatment group, the cattle were marketed through a packing plant and carcass data were obtained.

Experiment 2 - Summer-Fall

Sixty-four steers of mixed breeding were purchased from a feeder cattle auction market for the second experiment initiated on July 15, 1976. They were allotted into 8 pens of 8 each for the same four experimental treatments as in experiment 1.

Corn silage was from the 1975 crop as in experiment 1. Rations, feeding procedures, supplements and implant treatments were essentially the same for the two experiments except the organic iodine compound was not fed in the second experiment.

The experiment was terminated by treatment groups as each group approximated the planned market weight. The steers were sold through a commission company at the Sioux Falls Stockyards.

Results

Experiment 1 - Winter-Spring

Results for experiment 1 are presented in table 40. Average final weights following an overnight stand without feed and water were 1097, 1143, and 1088 lb, respectively, for T_1, T_2 and T_3 groups. Steers from these treatment groups were marketed at the same time after 150 days on the experiment. Those fed corn silage without additional grain (T_4) were fed for 173 days and had an average shrunk weight of 1097 pounds. Experimental plans were to market when the filled feedlot weight for each treatment averaged about 1150 pounds. The T_2 group would have been slightly in excess of this weight and the others would have been slightly less. However, when expressed on an average daily basis, these variations in market weight are not believed to result in any important influence on treatment comparisons.

Some losses occurred during the experiment. Data are presented for the cattle completing the experiment. Feed intake was adjusted on basis of an average intake during the period the animal was on the experiment. Final weight, average daily gain and feed efficiency presented in the table are adjusted to an average yield of 62%.

Steers fed the high-concentrate ration throughout the experiment gained 2.84 lb daily. Corn silage averaged about 22% of the ration dry matter rather than the 15% stated in procedures. This resulted largely from the higher level of corn silage fed during the time when adjusting the cattle to the high-concentrate ration. Total dry feed of 847 lb per 100 lb of gain for this group represents rather typical performance with this type of ration.

Steers fed corn silage and supplement to about 850 lb (T_2) and then the high-concentrate ration (same as T_1) to market gained at a faster rate over the entire experiment. The higher carcass yield (63.2%) favored this group when weight gains were adjusted to the constant carcass yield. For the first 2 months of the experiment, their rate of gain was about equal to those fed the high-concentrate ration. When changed to the high-concentrate ration at about 850 lb, they gained at a slightly faster rate.

Ration dry matter for the T_2 treatment was roughly equal parts of corn silage and corn grain supplement. Total dry feed per 100 lb of gain was reduced slightly by this feeding system. In comparison to the T_1 cattle, T_2 cattle required 173 lb more corn silage but 281 lb less corn and supplement per 100 lb of gain. The T_2 program in comparison to T_1 resulted in a high value of the additional corn silage since each 100 lb of corn silage dry matter resulted in a saving of 162 lb of corn grain and supplement on basis of feed efficiency.

When corn silage and supplement were fed to an average weight of about 1000 lb (T_3), weight gains were at a lower rate than for those fed corn silage to 850 lb (T_2). This resulted from a lower weight gain during an additional period of 49 days of feeding corn silage. However, there was some compensation when put on the high-concentrate ration. The overall rate of gain was only slightly less than for steers fed the high-concentrate ration throughout the experiment (T_1).

Ration dry matter for T_3 cattle was approximately 72% corn silage. In comparison to T_1 group, they required 454 lb more corn silage dry matter but 417 lb less corn grain and supplement. In this instance, 100 lb of the additional corn silage dry matter saved 92 lb of corn grain and supplement. This is a relatively high value for corn silage but somewhat less than for the T_2 treatment.

Steers fed corn silage and supplement through the experiment (T_4), showed pronounced reductions in rate of gain after about 2 months. In comparison to T_1 cattle, they required 749 lb more corn silage dry matter per 100 lb of gain but 575 lb less concentrates. In this comparison, 100 lb of the additional corn silage saved about 77 lb of concentrates. The additional 23 days in the feedlot would also increase nonfeed costs.

Carcasses graded from average to high Good. There was a slight advantage in grade for the steers fed the high-concentrate (T_1) and the high-silage (T_4) rations. However, the differences are small but do indicate a slightly lower yield for cattle fed high silage rations through finishing.

Experiment 2 - Summer-Fall

Results for experiment 2 conducted during the summer and fall are presented in table 41. Average shrunk weights varied from 1128 to 1138 lb for the various treatment groups. These final weights are slightly higher in most instances than for experiment 1. Days on experiment were 124, 138, 145 and 152, respectively, with increasing time of feeding corn silage and supplement. Average percents of corn silage in the dry rations were 20, 42 and 63, respectively, for T_1, T_2 and T_3. These values compare with 22, 48 and 72% corn silage dry matter in the average rations for experiment 1.

Results from this experiment differ from experiment 1 primarily in difference in performance between steers fed the high-grain ration throughout the experiment (T_1) and those fed corn silage and supplement to about 850 lb then the high-grain ration to market (T_2). Steers fed the high-grain ration gained at the fastest rate during the early part of the experiment when the other treatment groups were fed corn silage and supplement. There was no later compensation in weight gain for the steers fed the high-silage rations for varying periods before changing to the high-grain ration.

There was a rather uniform reduction in average daily gain with increasing lengths of feeding corn silage and supplement. This along with the rather uniform increasing amounts of corn silage dry matter in the rations (22, 48, 72 and 92%, respectively, for T_1, T_2, T_3 and T_4) resulted in the corn silage having similar grain and supplement replacement values with increasing lengths of feeding in comparison to the high-grain ration throughout the experiment. Each additional 100 lb of corn silage dry matter fed to T_2, T_3 and T_4 groups resulted in a saving of 65, 62 and 69 lb of corn grain and supplement in comparison to the high-grain ration throughout the experiment.

The cattle were sold through a commission company at the Sioux Falls Stockyards. Therefore, carcass data were not obtained. Market quotations on days of marketing are presented in the table along with the average selling price for each treatment group. There was some variation in the market and prices received during the time over which marketed. Each group had an average market price

approximately that quoted for the low range of the Choice grade. It would appear that treatments had only small effect on market price of the live cattle.

Summary

Results of the two experiments conducted during winter-spring and during summer-fall show good performance from corn silage fed to yearling steers (about 680 and 740 lb intitially) up to weights of about 850, 1000 and market weight of 1100 or 1130 pounds. The corn silage appeared to have a higher value in grain saved on basis of feed requirements in the winter-spring (experiment 1) largely because of an apparent lower performance of steers fed the high-grain ration throughout the experiment.

In the summer-fall experiment, increasing time of feeding corn silage resulted in rather uniform decreases in average daily gain and similar savings in grain and supplement for increasing amounts of corn silage fed. Each additional 100 lb of corn silage dry matter in the higher-silage rations reduced grain and supplement requirements from 62 to 69 pounds. The increase in feeding periods ranged from 2 to 4 weeks for the higher silage rations.

Results indicate only small differences in carcass grade or market value of live animals when marketed at similar weights.

The average value of corn silage dry matter at about 65% that of corn grain obtained in the summer-fall experiment (higher in the winter-spring experiment as discussed) shows a good potential for corn silage for finishing yearling steers. Two groups of steers averaging about 700 lb could be finished in the same lots each year under feeding programs used.

These results were obtained with corn silage having small amounts of grain. Additional experiments are planned for further comparisons between the two seasons of feeding and hopefully with corn silage which contains more typical amounts of grain in relation to forage.

Table 40. Corn Silage and Grain Feeding Systems for Finishing Yearling Steers (Experiment 1 -- November 14, 1975 to May 5, 1976)

	85% corn grain + suppl, DM 15% corn silage, DM to mkt. (T1)	Corn silage to 850 lb then T1 (T2)	Corn silage to 1000 lb then T1 (T3)	Corn silage to market (T4)
No. animals	14	16	16	16
Days fed	150	150	150	173
Init. shrunk wt., lb.	672	691	676	681
Final shrunk wt., lb.	1097	1143	1088	1092
Avg. daily gain, lb.	2.84	3.02	2.75	2.37
Avg. daily ration, dry basis, lb.				
Corn silage	5.27	10.82	17.61	22.19
Corn grain	17.87	10.25	4.46	---
Suppl.	0.89	1.21	2.27	2.05
Total	24.03	22.28	24.34	24.24
Feed/100 lb. gain, dry basis, lb.				
Corn silage	186	359	640	935
Corn grain	630	340	162	---
Suppl.	31	40	82	86
Total	847	739	884	1021
Dressing percent	62.68	63.19	62.21	61.04
Carcass grade[a]	18.0	17.4	17.4	18.0

[a]17 = average Good; 18 = high Good.

Table 41. Corn Silage and Grain Feeding Systems for Finishing Yearling Steers (Experiment 2 -- July 15 to December 14, 1976)

	85% corn grain + suppl, DM 15% corn silage, DM to mkt. (T1)	Corn silage to 850 lb then T1 (T2)	Corn silage to 1000 lb then T1 (T3)	Corn silage to market (T4)
No. animals	15	16	16	16
Days fed	124	138	145	152
Init. shrunk wt., lb.	740	731	737	742
Final shrunk wt., lb.	1129	1138	1135	1128
Avg. daily gain, lb.	3.13	2.94	2.75	2.54
Avg. daily ration, dry basis, lb.				
Corn silage	4.95	10.55	16.40	23.82
Corn grain	18.47	13.23	8.08	---
Suppl.	0.86	1.13	1.50	1.95
Total	24.24	24.91	25.98	25.77
Feed/100 lb. gain, dry basis, lb.				
Corn silage	158	358	596	938
Corn grain	589	449	294	---
Suppl.	27	38	55	77
Total	774	845	945	1015
Market quotations day sold (steers), cwt, $				
Date	Nov. 17	Dec. 1	Dec. 8	Dec. 15
Ch 2-4	38.00-39.00	39.50-40.50	40.00-41.25	38.50-39.00
Mix G + Ch 2-3	37.00-38.00	38.50-39.50	39.25-40.25	37.50-38.50
G 2-3	34.50-37.00	35.50-38.50	36.00-39.25	35.00-37.50
Avg. selling price, cwt, $	38.25	39.50	40.00	38.25

SOIL AND SALT ASPECTS OF ANIMAL WASTE DISPOSAL

M. L. Horton, R. Schnabel and R. Beyer

The animal waste management experiment which began at the Southeast South Dakota Experiment Farm during the fall of 1973 was continued through 1976.

Prior to the 1974 and 1975 growing season beef steer manure was applied to field plots at rates up to 80 tons per acre annually on a dry weight basis at two salt levels based on a ration of approximately 0.13 and 0.63% sodium chloride on a dry weight basis. No applications were made prior to the 1976 growing season with this period serving as a recovery period for the soil.

The field plota were planted to Funks G-4252 corn at a population of approximately 17,000 plants/acre on May 6, 1976. A corn borer damage survey was conducted on July 21, 1976 and a portion of each plot was harvested for silage yield on September 9, 1976 and a portion harvested on September 23, 1976 for ear corn yield.

Soil samples were taken by power probe from each plot in May and September. Chemical analyses were performed by the Soil Testing Lab and the Water Quality Lab on the SDSU campus. Water infiltration tests were performed on half of the plots during the first two weeks of June, 1976. Double ring infiltrometers were used for the tests.

Partial results are reported below under the following headings:

I. Soil Salts
II. Water Infiltration
III. Silage and Grain Yields
IV. Corn Borer Damage

I. Soil Salts

All but a very small amount of the salts present in the ration of beef animals is excreted in the manure (liquid and solid). Therefore, when manure is applied to cropland, potentially harmful salts in addition to fertilizer elements are added to the soil. Excess salts in the soil may limit yield by reducing the amount of available moisture for crop growth. One measure of total salts present in the soil is the electrical conductivity (EC) of the saturation extract. An EC of 4000 μmhos/cm is a level commonly set to separate non-saline and saline soils and a level at which a 10% reduction in yield of most common feed grains can be expected.

The EC of the surface one foot of soil in the waste disposal plots is shown in Table 42. The fall 1975 data were collected after two yearly applications. Sufficient salts had been added to make the surface soils of all but the check plots saline or nearly so. The spring 1976 data were taken after one year without manure applications and all of the surface soils now fall into the non-saline category. It should be remembered that the salts that were present in 1975 have not been removed but rather moved down into the soil by rains where they remain to limit water removal by plant roots at lower depths.

II. Water Infiltration

A possible problem with the addition of salts to the soil is that sodium (Na) on the soil complex may cause a breakdown of soil structure and severely limit the soils ability to transport water and gases, as well as make tillage more difficult (slick spots). Figure 5 gives a graphic representation of water infiltration with time for two of the treatments employed. In 1975 the 80 ton/acre/year application rate for two consecutive years had caused the soil to admit very little water and to become sealed after a short period of time while the 20 ton/acre/year application rate allowed water to infiltrate for the duration of the test. In 1976, after one year without manure applications, much of the difference in the two treatments ability to infiltrate water was eliminated.

An exchangeable sodium percentage (ESP) of 15 has been set as a value at which soil structure problems can be expected. The ESP values determined for these plots were never greater than 3. It would appear that excess Na cannot be the sole cause of the reduction in water transport capabilities of this soil. It is more likely a combination of things, some swelling of the soils by sodium and potassium and a blocking of the soil pores by large organic matter particles that were more slowly decomposed due to the drier than usual summers.

III. Silage and Grain Yields

Silage and corn yield results are given in Table 43. It is with a great deal of reluctance that these results are presented because they might easily be misinterpreted. Disease and insect damage has made the yield data of the last two years difficult to interpret. The 1975 silage yield is the most straightforward. There is a significant difference in silage yield among waste rates at the .05 level, which indicates that repeated large applications in excess of 20 tons/acre/year may reduce yields under dryland conditions. The 1975 grain yields were affected by a corn smut problem, with smut most pronounced in plots receiving low application rates. The 1975 yields suffer as a result of a corn borer problem.

IV. Corn Borer Damage

Although all plots were treated to prevent corn borer damage, the treatment was not effective.

A corn borer damage survey was conducted on July 21, 1976. The results of the survey are presented in Table 44. Looking at the column labelled "burrows," it is evident that the number of burrows made by the European corn borer decreased as the manure applications of the previous two years increased. In the column labelled "good stalks" we see that the number of stalks without borer damage increased as the application rate increased. No attempt to explain these results will be made at this time. They are presented in an effort to help explain the yield results of 1976.

Summary

1. The saline condition of the surface soil created by applying beef manure has been improved within one year after waste application was discontinued.

2. Water infiltration rates on plots receiving more than 40 tons of waste per year have drastically improved after discontinuing manure application for one season.

3. Corn yields on waste disposal plots in 1976 were extremely low due to a combination of drought, insect damage and disease. Corn borer damage was most severe on plots receiving no waste or the low rates.

Table 42. Average Electrical Conductivities of Saturation Extracts for the Surface 12 Inches of Plot Soils

Proposed Treatments Tons/acre/year	Fall 1973	Fall 1975	Spring 1976
	µmhos/cm		
Check	630	1304	1530
20-Low	682	4521	2247
20-High	460	3728	1826
40-Low	724	5389	2952
40-High	713	5960	3296
60-Low	683	7804	3953
60-High	745	7139	3890
80-Low	923	7227	3923
80-High	830	8857	3895

Table 43. Average Silage and Ear Corn Yields

Proposed Treatments	Silage Yield		Ear Corn Yield	
	1975	1976	1975	1976
Tons/acre/year	tons/acre 0.00% H_2O		bu/acre 15.5% H_2O	
Check	3.55	1.26	22.29	2.50
20-Low	3.57	1.37	36.01	2.41
20-High	3.60	1.24	36.31	4.18
40-Low	3.11	1.37	42.70	3.73
40-High	2.28	1.57	38.94	5.83
60-Low	3.32	1.50	24.97	9.92
60-High	1.61	1.67	26.92	10.04
80-Low	2.52	1.63	31.41	6.38
80-High	1.72	1.58	12.62	8.19

Average Infiltration

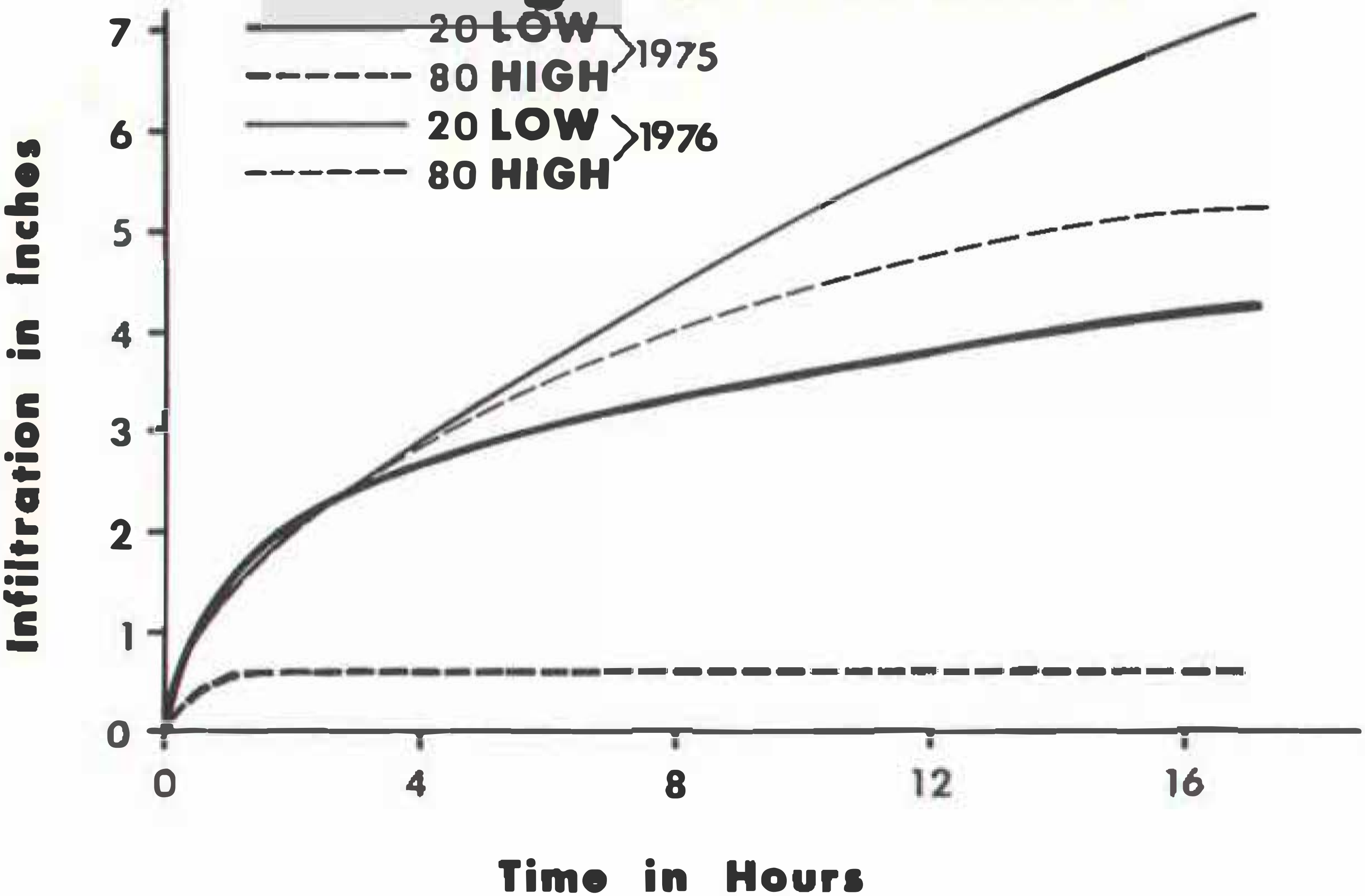


Table 44. Corn Borer Damage Survey

Proposed Treatments	Burrows	Good Stalks
Tons/acre/year	------Number/16 stalks------	
Check	32	3
20-Low	33	2
20-High	25	2
40-Low	23	2
40-High	14	7
60-Low	11	8
60-High	9	10
80-Low	11	8
80-High	6	12

CORN ROOTWORM - INSECTICIDE INTERACTION RESEARCH PROJECT

D. D. Walgenbach

Objectives

To provide the basis for South Dakota State University soil insecticide recommendations. Experiments and evaluations were conducted at five locations in addition to the Southeast Experiment Station.

To obtain information on insecticide performance associated with planting date sequences, placement and cultivation applications of rootworm insecticides.

To evaluate experimental insecticides for improved rootworm control.

To monitor corn rootworm insecticidal resistance through topical applications of technical insecticides to field collected and laboratory reared larvae.

To determine correlations between LD_{50} values and field performance of registered and experimental insecticides.

Methods and Procedures

At-Planting Evaluations. Insecticides were applied at planting in single-row plots 100 ft. in length with four replications. Granular treatments were applied with modified Noble metering units mounted on a specially adapted John Deere 4-row Flexi-planter. The metering units were ground driven. The granules were applied in a 7 inch band in front of the press wheel. Covering knives were utilized for incorporation. Insecticides placed in the seed furrow were metered through plastic tubing directly behind the double disk seed furrow openers. Liquid formulations were applied in a 7 inch spray over the seed furrow in 10 gpa insecticidal solution.

Five roots were dug from each replication, washed under pressure and rated for rootworm feeding damage. The 1-6 rating system adopted for use in the North

Central States was utilized as the measure of insecticidal effectiveness. The damage rating criteria are as follows:

Damage Rating*	Description of Root System
1	No noticeable feeding damage
2	Feeding scars, no root pruning
3	At least one root pruned but less than an entire node of roots pruned
4	One node of roots destroyed
5	Two nodes of roots destroyed
6	Three or more nodes of roots destroyed

*ISU damage scale

To qualify as a pruned root, the root must be eaten to within 1.5 inches of the plant. It is not necessary for all pruned roots to originate from the same node to qualify as a root system with a full node pruned. The number of roots pruned must be equivalent to that of a full node.

The cultivation treatments were applied with a specially adapted 2-row John Deere rear mounted cultivator, equipped with Noble metering units driven by 12 volt electric motors.

Percent Root Protection (% R.P.). The percent root protection was calculated as follows:

$$\% \text{ R.P.} = \frac{100-(\text{root rating of treatment}-1)}{\text{root rating of UTC}}$$

These calculations, although somewhat skewed at the low performance range, allow comparison of treatments between plots.

Results and Discussion

Registered Insecticides, 1974, 1975, 1976. The effectiveness of corn rootworm insecticides declined about 10% in 1976 compared to previous years. This decrease in performance was associated with the drought conditions. Comparative performance of the insecticides remained constant over the 3 year period (Tables 45-49).

The general rootworm infestation pattern in continuous corn began at moderate to high levels. Considerable larval mortality was associated with the extremely dry soil conditions. Plants showed moisture stress during much of the growing season. Corn rootworm larval survival appeared related to the larvae tunnelling in the larger roots. Per plant larval counts were more erratic within plots than in preceding years. Counts at the Southeast Experiment Station ranged from 10 to 90 larvae per plant during late June; subsequent counts showed sharp declines in larval numbers.

Western corn rootworm adults were first observed through the use of sex pheromone traps on June 28. Adult numbers began levelling during mid-July. Western corn rootworm adults comprised 95% of the emerged population in all plots. We assumed a comparable larval species mix. Few southern adults were observed.

Corn rootworm damage and reported field insecticidal performance complaints were considerably fewer in 1976 compared to previous years. The large acreage of drought affected corn cut for silage and rapid maturity of dryland corn contributed to beetle migration to irrigated corn. Few small grain stubble fields had sufficient volunteer grain and weed growth to attract corn rootworm beetles. The incidence of first year corn damage in 1977 is expected to be minimal. Erratic populations are expected in continuous corn fields.

Date of Planting - Insecticide Application At-Planting 7" Band. The better performing soil insecticides (Table 50) showed somewhat of a different pattern in performance in 1976 compared to previous years. The variations in performance appeared to be related to both incidence of precipitation and residual activity of the insecticides. In general, the performance of Category C insecticides showed slightly better control when applied later in the season.

Experimental Insecticides. CGA 12223 and SRA 12869 continue as promising materials for rootworm control. Rho-Dotan at 1.5 lbs A/A also has shown good rootworm control.

Off-Station Plots - Insecticide History.

Table 45. Tofte Farm, Brookings. 1970-73 Thimet; 1974 Dyfonate; 1975 Furadan; 1976 Furadan.

	Percent Root Protection		
	1974	1975	1976
Furadan 10G	69.6 (8)	82 (5)	56.3 (3)
Thimet 15G	47.1 (8)	50 (2)	57.0 (2)
Dyfonate 20G	53.5 (2)	60 (2)	41.0 (1)
Counter 15G	70.3 (3)	67 (5)	60.0 (4)
Mocap 10G	48.0 (2)	56 (1)	42.6 (3)
Lorsban 15G		36 (2)	46.0 (4)

Number of tests indicated in parenthesis.

Table 46. Krog Farm, Lake Benton. 1970-73 Furadan; 1975 Dyfonate; 1976 crop rotation.

	Percent Root Protection		
	1974	1975	1976
Furaden 10G		62 (1)	74 (2)
Thimet 15G		61 (1)	40 (2)
Dyfonate 20G		55 (1)	44 (2)
Counter 15G		63 (1)	49 (2)
Mocap 10G		32 (1)	42 (2)
Lorsban 15G		49 (1)	45 (2)

Number of teats indicated in parenthesis.

Table 47. Gubbrud Farm, Beresford. 1970-74 Furadan; 1975 Dyfonate; 1976 Dyfonate.

	Percent Root Protection		
	1974	1975	1976
Furadan 10G		45 (1)	79 (1)
Thimet 15G		51 (1)	66 (1)
Dyfonate 20G		47 (1)	72 (1)
Counter 15G		42 (1)	79 (1)
Mocap 10G		41 (1)	58 (1)
Lorsban 15G		35 (1)	57 (1)

Number of teats indicated in parenthesis.

Table 48. Hodgson Farm, Alcester. 1970-72 Thimet; 1973-74 Dasanit; 1975 Dyfonate; 1976 Thimet.

	Percent Root Protection		
	1974	1975	1976
Furadan 10G		81 (1)	54 (1)
Thimet 15G		53 (1)	51 (1)
Dyfonate 20G		74 (1)	53 (1)
Counter 15G		77 (1)	50 (1)
Mocap 10G		52 (1)	46 (1)
Loraban 15G		48 (1)	51 (1)

Number of tests indicated in parenthesis.

Table 49. Southeast South Dakota Experiment Farm.

	Percent Root Protection		
	1974	1975	1976
Furadan 10G	76 (13)	71 (13)	58 (11)
Thimet 15G	58 (13)	49 (9)	46 (9)
Dyfonate 20G	57 (7)	62 (8)	50 (8)
Counter 15G	69 (7)	67 (14)	52 (11)
Mocap 10G	59 (7)	51 (8)	44 (10)
Lorsban 15G		43 (8)	42 (11)

Number of tests indicated in parenthesis.

Table 50. Rootworm Soil Insecticide Performance in South Dakota Research Experiments During 1974 Through 1976.

Treatment & Formulation	% Root Protection			
	1976	1975	1974	3 yr. avg.
Furadan 10G	(18) 60	(20) 73	(32) 76	(70) 70
Counter 15G	(21) 55	(25) 65	(14) 71	(60) 64
Dyfonate 20G	(10) 51	(13) 60	(14) 60	(37) 57
Dasanit 15G	(15) 48	(15) 52	(14) 56	(44) 52
Thimet 15G	(17) 49	(12) 49	(32) 56	(61) 51
Mocap 10G	(19) 44	(13) 48	(14) 58	(46) 50
Lorsban 15G	(21) 44	(13) 42	(3) 62	(37) 49
Bux 10G	(15) 53	(11) 38	(14) 49	(40) 46

All insecticides tested at recommended rate of 1 lb. actual per acre at planting time in 7 inch band.
Number of tests indicated in parenthesis.

Table 51. Anderson Farm, Canton. Furadan 1972-75.

Treatment	Rate, lb. A/A, 7" Band	Root Rating*	Percent Root Protection
CGA 12223 20G	1.0	1.70a	80
Counter 15G	1.0	1.90ab	75
BUX 10G	2.0	2.05abc	71
GCP 6361 9G	1.0	2.10abcd	70
BUX 10G	1.0	2.15abcde	68
Dotan 15G	1.5	2.20abcde	67
Dyfonate 20G	1.0	2.45abcdef	60
RMC 35001 EC	1.0	2.50abcdef	59
Mocap 10GXL	1.0	2.55abcdef	58
Dowco 275 15G	1.0	2.55abcdef	58
Furadan 10G	2.0	2.60abcdaf	56
Mocap 15G	1.0	2.65abcdef	55
SRA 12869 15G	1.0	2.65abcdef	55
Loraban 15G	1.0	2.70 bcdefg	53
Thimet 15G	1.0	2.75 bcdefg	52
Furadan 10G	1.0	2.85 bcdefg	49
Dasanit 15G	1.0	2.95 cdefg	47
A47171 10G	2.0	3.00 cdefg	45
GCP 9646 10G	1.0	3.05 defg	44
Mocap 10GU	1.0	3.10 defg	42
FMC 27289 EC	1.0	3.15 efg	41
Mocap 10GR	1.0	3.15 efg	41
A47171 10G	1.0	3.25 fg	38
UTC	--	3.65 g	--

*Averages followed by same letter are not significantly different.

Table 52. Suing Farm. Thimet 1975.

Treatment	Rate, lb. A/A, 7" Band	Root Rating	Percent Root Protection
Thimet 15G	1.0	2.20a	66
Dotan 15G	1.5	2.20a	66
Dotan 15G	2.0	2.20a	66
Dyfonate 20G	1.0	2.25a	65
SRA 12869 15G	1.0	2.25a	65
Counter 15G	1.0	2.35ab	62
BUX 10G	1.0	2.45ab	59
BUX 10G	2.0	2.45ab	59
Furadan 10G	1.0	2.45ab	59
Dowco 275 15G	1.0	2.70abc	52
GCP 9646 10G	1.0	2.70abc	52
Loraban 15G	1.0	2.70abc	52
CGA 12223 20G	1.0	2.70abc	52
Dasanit 15G	1.0	2.75abc	51
FMC 35001 EC	1.0	2.80abc	49
FMC 27289 EC	1.0	2.80abc	49
GCP 6361 9G	1.0	2.80abc	49
Mocap 10GXL	1.0	2.80abc	49
Mocap 10GR	1.0	2.80abc	49
Mocap 15G	1.0	2.90abcd	46
Mocap 10GU	1.0	3.20 bcde	38
A47171 10G	2.0	3.40 cde	32
UTC	--	3.55 cde	28
A47171 10G	1.0	3.70 e	--

Resistance Monitoring. The larval topical LD_{50} and LD_{90} values showed that rootworm larvae were resistant to Furadan in selected fields. The higher larval values were from areas with continued Furadan use.

Table 53. Corn Rootworm Larval Susceptibility Ranges

	LD_{50}	LD_{90}
Furadan		
Field collected 1975	6.8 - 25.4	29.0 - 778
1976	6.3 - 18.5	13.4 - 101.4
F_1 larvae 1976	2.6 - 23.8	15.0 - 206
Counter		
Field collected 1975	0.53 - 0.70	1.1 - 1.5
1976	0.40 - 0.60	0.7 - 0.9
F_1 larvae 1976	0.40 - 0.80	0.6 - 1.7
Thimet		
Field collected 1975	1.6 - 2.6	3.7 - 4.8
1976	1.2 - 1.4	1.9 - 2.1
F_1 larvae 1976	0.9 - 1.9	2.1 - 3.6
Dyfonate		
Field collected 1975	2.8 - 2.9	9.0 - 9.5
1976	2.8 - 6.7	7.9 -12.2
F_1 larvae 1976	2.0 - 6.3	4.2 -17.0
Mocap		
Field collected 1975	3.9	18.7
1976	3.6 - 4.2	8.4 - 8.9
F_1 larvae 1976	2.2 - 6.6	5.7 - 9.9
Lorsban		
Field collected 1975	1.2	2.1
F_1 larvae 1976	0.6 - 2.0	1.1 - 4.4
Dasanit		
Field collected 1975	1.0 - 1.2	3.9 - 1.4
F_1 larvae 1976	0.2 - 1.7	1.2 - 5.2
CGA 12223		
Field collected 1975	0.1 - 0.5	0.8 - 1.4
1976	0.2 - 0.3	0.4 - 0.6
F_1 larvae 1976	0.1 - 0.4	0.3 - 1.3
SRA 12869		
F_1 larvae 1976	0.6 - 1.4	1.0 - 3.9
BUX		
Field collected 1975	3.5 - 4.2	15.7 - 198
1976	0.2 - 3.2	1.3 - 16.4
F_1 larvae 1976	0.8 - 7.5	7.8 - 118

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2 200 copies printed at an estimated cost of 92 cents each—2-77—7511