Southeast South Dakota Experiment Farm

15th Annual Progress Report 1975

Agricultural Experiment Station
South Dakota State University
Brookings

This fifteenth 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 constitute 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

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FIFTEENTH ANNUAL PROGRESS REPORT
SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

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INTRODUCTION . . . . Fred E. Shubeck

A prolonged drought from the third week in June until the first of August reduced crop yields considerably, especially row crops that were planted early. A drought this severe interferes with or masks the effects of many treatment variables. Results from this one year should not be considered typical.

Even though growing conditions were severe, much can be learned by studying results of individual experiments and utilizing this information in making management decisions.

Soil temperatures were recorded and related to optimum planting dates for corn.

The evening crop tour was held in June as usual but because of the drought, the fall field day was cancelled.

The State Bicentennial Commission visited the Experiment Farm Sept. 8, 1975. They were conducted on a tour of the research plots and Bicentennial corn plot.

There were 22 meetings held in the office building by extension, educational and local groups.

Several tours of the Experiment Farm were conducted for individuals and groups. These included representatives from insecticide, weedicide, seed corn, and fertilizer companies. Also biology students, technical school classes, real estate salesmen and local farmers.

The 4-H Livestock Judging School for the southeast area counties was again held at the Experiment Farm. This is a popular event well attended by 4-H members and their parents.

A change was made in the memorandum of understanding with South Dakota State University. From now on, all crops and crop residues not used for livestock feed or research purposes are to be sold and the funds given to the Southeast Experiment Farm Corporation who in turn use these funds to develop the farm facilities and to aid research.

All of the corn grown for livestock feed on the north quarter of the Experiment Farm was cut for silage and stored in our three silos.

The application of the first coat of white paint on the farm buildings was nearly completed before the onset of cold weather. Additional insulation was blown into the attic of the residence at the farm.

A grant in aid from Dow Chemical Co. was given to the Research Farm for work on nitrification inhibitors.

Tables 1 and 2 show a summary of temperatures and precipitation data for 1975. Daily readings are taken and the data compiled by research personnel who are the official volunteer weather observers for this area. The extreme effect of rainfall distribution on this year's research results warrants careful attention when analyzing agronomic data and utilizing research information.

Table 1. Temperatures at the Southeast Experiment Farm

Month	1975 Av. Temperature (F)[1] Maximum	Minimum	23 Year Average Maximum	Minimum	Departure from 23 Year Average Maximum	Minimum
January	27.4	4.9	26.5	5.3	+0.9	-0.4
February	25.3	5.1	33.0	11.3	-7.7	-6.2
March	35.1	12.5	43.5	22.2	-8.4	-9.7
April	49.6	30.4	61.3	35.2	-11.7	-4.8
May	74.6	46.5	73.8	47.6	+0.8	-1.1
June	77.9	55.2	83.0	57.7	-5.1	-2.5
July	91.4	61.7	88.0	62.4	+3.4	-0.7
August	83.2	59.2	86.5	60.1	-3.3	-0.9
September	71.4	42.7	75.6	49.1	-4.2	-6.4
October	67.3	38.2	66.5	42.1	+0.8	-3.9
November	45.3	22.6	46.9	25.0	-1.6	-2.4
December	26.5	11.8	31.8	11.8	-5.3	0.0

[1] Computed from daily observations.

Table 2. Precipitation at the Southeast Experiment Farm

Month	Precipitation 1975 (inches)	23-Year Average (inches)	Departure From 23-Yr. Av. (inches)
January	1.61	0.49	+1.12
February	0.15	1.22	-1.07
March	1.62	1.35	+0.27
April	2.55	2.39	+0.16
May	2.30	3.30	-1.00
June	4.70	4.28	+0.42
July	0.31	3.06	-2.75
August	6.70	2.86	+3.84
September	2.71	2.79	-0.08
October	0.28	1.60	-1.32
November	2.74	1.06	+1.68
December	0.07	0.74	-0.67
Total	25.74	25.14	+0.60

RATES OF NITROGEN AND DATES OF PLANTING CORN

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Will planting dates influence responses to fertilizer?
2. What should the rate of nitrogen fertilizer be for a soil containing a medium amount of organic matter?
3. With the present shortages and high prices for fertilizer, will rates lower than those previously recommended be the most profitable?
4. Will very high nitrogen rates influence insect or disease damage?
5. Will soil temperatures serve as a dependable guide to determine the optimum time to plant corn?

Methods and Procedures in Rate of Nitrogen Study

Nov. 18, 1974 - Stalks chopped and fall moldboard plowed.
Nov. 27, 1974 - Chisel plowed area with twists to reduce soil compaction (bulk density was over 1.4).
April 29, 1975 - Sprayed Aatrex 4L at 3.0 pounds per acre and tandem disked.
April 30, 1975 - Fertilized low and high rates of N for first planting date. Disced to incorporate and harrowed.
May 1, 1975 - First planting date
Variety - Curry's SC 150
Insecticide - Mocap 10G
Herbicide - Lasso 15G, in the row
Soil temperature - at farm 44°F at 2 inch depth
Emergence date - May 9
May 8, 1975 - Fertilized low and high rates of N and tandem disked.
May 9, 1975 - Spike tooth harrowed and planted second planting date. Same insecticide, weedicide, etc.
Soil temperature at noon was 56°F.
Emergence - May 18
May 15, 1975 - Spread low and high N rates for 3rd planting date, disked harrowed and planted.
Soil temperature 56°F
Emergence - May 23
May 20, 1975 - Rotary hoed first planting.
May 21, 1975 - Spread low and high N rates for fourth planting date, disked and harrowed.
May 22, 1975 - Planted fourth planting date. Soil temperature at noon 66°F.
Emergence - May 29
June 2, 1975 - Cultivated first planting
June 3, 1975 - Cultivated second planting
June 12, 1975 - Cultivated third and fourth plantings
Oct. 29, 1975 - Hand picked all plots.

Table 3. Effect of Fertilizer and Planting Dates on Yield of #2 Corn (high rates of N)

Broadcast Treatment N + P + K	Planting Dates May 1	May 9	May 15	May 22	Average
0 + 0 + 0	14	31	38	49	33.0
0 + 11 + 58*	9	21	41	44	29.0
80 + 11 + 58*	3	9	37	44	23.0
160 + 11 + 58*	4	17	34	45	25.0
240 + 11 + 58*	6	17	44	45	28.0
Average	7	19	39	45	

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

Discussion and Interpretation of Table 3

Yields from early planted corn were very low. As planting was delayed, corn yields increased. The early planted corn dried out and burned during the long dry period in July. Late planted corn was able to recover after 2.95 inches of rain fell in the first two days of August breaking the long drought. In other years, the moderately early planting date (first week in May) usually produced the most corn.

Table 4. Effect of Fertilizer and Planting Dates on Yield of #2 Corn (low rates of N)

Broadcast Treatment N + P + K	Planting Dates May 1	May 9	May 15	May 22	Average
0 + 0 + 0	16	23	41	51	33.0
20 + 11 + 58*	15	18	33	51	29.0
40 + 11 + 58*	4	13	37	53	27.0
60 + 11 + 58*	9	10	33	44	24.0
80 + 11 + 58*	7	11	38	48	26.0
Average	10	15	36	50	

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

Discussion and Interpretation of Table 4

A new feature was added to this experiment in 1974. The north half of each block was fertilized with the lower rates of nitrogen listed above. No fertilizer had been applied to these plots for 8 years prior to 1974 so no large backlog of residual nitrogen could be expected to influence yields in the 1975 crop.

Note the increase in yield as planting dates were delayed. Nitrogen fertilizer did not increase corn yields in this 1975 experiment. In other years with higher rainfall, nitrogen increased yields substantially, especially with the earlier planting dates.

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

Paul Carson, Ray Ward, Fred Shubeck, Ron Gelderman
and Burt Lawrensen

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 aoil profile.
2. Determine the effect of large amounts of nitrogen fertilizer on the pH of the soil.

Methods and Materials

1. Soil samples. Samples have been taken to a depth of 6 feet each year since 1969.
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 has been used.
4. Enough additional land waa available adjacent to the original plots (continued for 7 years) to add 5 nitrogen treatments in 1974 involving rates lower than those in the original experiment. The treatments added are as follows:

Lbs/acre $N + P_2O_5 + K_2O$
0 + 0 + 0
20 + 0 + 0
40 + 0 + 0
60 + 0 + 0
80 + 0 + 0

   Constant amounts of P_2O_5 and K_2O equal to those used in the experiment with higher nitrogen rates were used in this experiment. The samples from these plots were taken in the spring after the 1st years cropping, but before fertilizing and planting the 1975 crop.
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 had 1120 lbs. per acre of nitrogen added during this time. The nitrogen fertilizer used has been ammonium nitrate. Even though this experiment is in the 7th year, the samples were taken after 6 years of fertilization and cropping. The addition of P_2O_5 and K_2O have remained constant.

Results and Discussion

The effects of nitrogen fertilizer additions on the nitrate-nitrogen content of the soils are reported in Table 5 (one year after application, low rates 0-80 lbs/A) and Table 6 (after 6 years of annual fertilization, high rates 0-240 lbs/A). The data in Table 5 show that rates below 60 lbs. of nitrogen per acre had little or no effect on the amount of nitrate-nitrogen found in the soil profile and that very little nitrate-nitrogen was found at depths below 12 inches regardless of rate of application. Yields were increased from 39 to 58 bushels per acre with 40 lbs. of nitrogen per acre. Rates above this level did not increase the yields and it is at these rates that a small increase in nitrates is noted.

The experiment that has been conducted over a six year period (Table 6) shows some accumulation of nitrate-nitrogen in the soil profile. The amount of this accumulation increases as the rate of nitrogen application increases. Most of the nitrate-nitrogen found in the profiles was concentrated in the upper (above 48") part of the soil profile. There is no evidence to indicate that applied nitrogen increased the NO_3-N content of the soil below 48".

The year by year accumulation of nitrate-nitrogen 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. A decrease in the amount of NO_3-N present in the soil for each treatment is noted in the years 1972 and 1974. No explanation is offered for these variations at this time.

The application of 80 lbs. of nitrogen in the longer duration experiment increased the yield 21 bushels per acre. This is essentially the same increase found for the rate of application for the shorter duration experiment. Higher rates of added nitrogen did not increase the yield very much above this level in 1974.

A comparison of the NO_3-N found in check plots (top 48") from the two associated experiments show the amounts present to be nearly equal. A similar comparison between the 80 lbs. per acre treatments shows a greater accumulation of NO_3-N in the soil that has been receiving nitrogen for 6 years than in the recently established plots. This may be an indication of excessive fertilization or that we have had several years of less than optimum corn production.

Table 5. The Effects of Added Nitrogen Fertilizer on the Amount of Nitrate-Nitrogen Present in the Soil Profile After One Cropping Season, Southeast Experiment Farm, 1975[1]

Depth in Inches	Treatments[2]				
	0+0+0	20+0+0	40+0+0	60+0+0	80+0+0
	NO_3-N, lbs/acre				
0 - 6	12.5	7.2	8.1	16.9	20.5
6 - 12	8.5	10.8	13.1	22.6	25.9
12 - 18	4.9	4.9	5.7	10.2	4.5
18 - 24	4.5	4.5	4.5	4.5	4.5
24 - 30	4.5	4.5	4.5	4.5	4.5
30 - 36	4.5	4.5	4.5	4.5	4.5
36 - 42	4.5	4.5	4.6	4.5	4.5
42 - 48	4.5	4.5	4.5	4.5	4.5
	48.4	45.6	49.5	72.2	79.6
Corn Yields, 1974 Bu/Acre	39	48	58	57	57

[1]Samples were taken in the epring of 1974.
[2]These samples were taken after the one year of fertilizing and cropping.

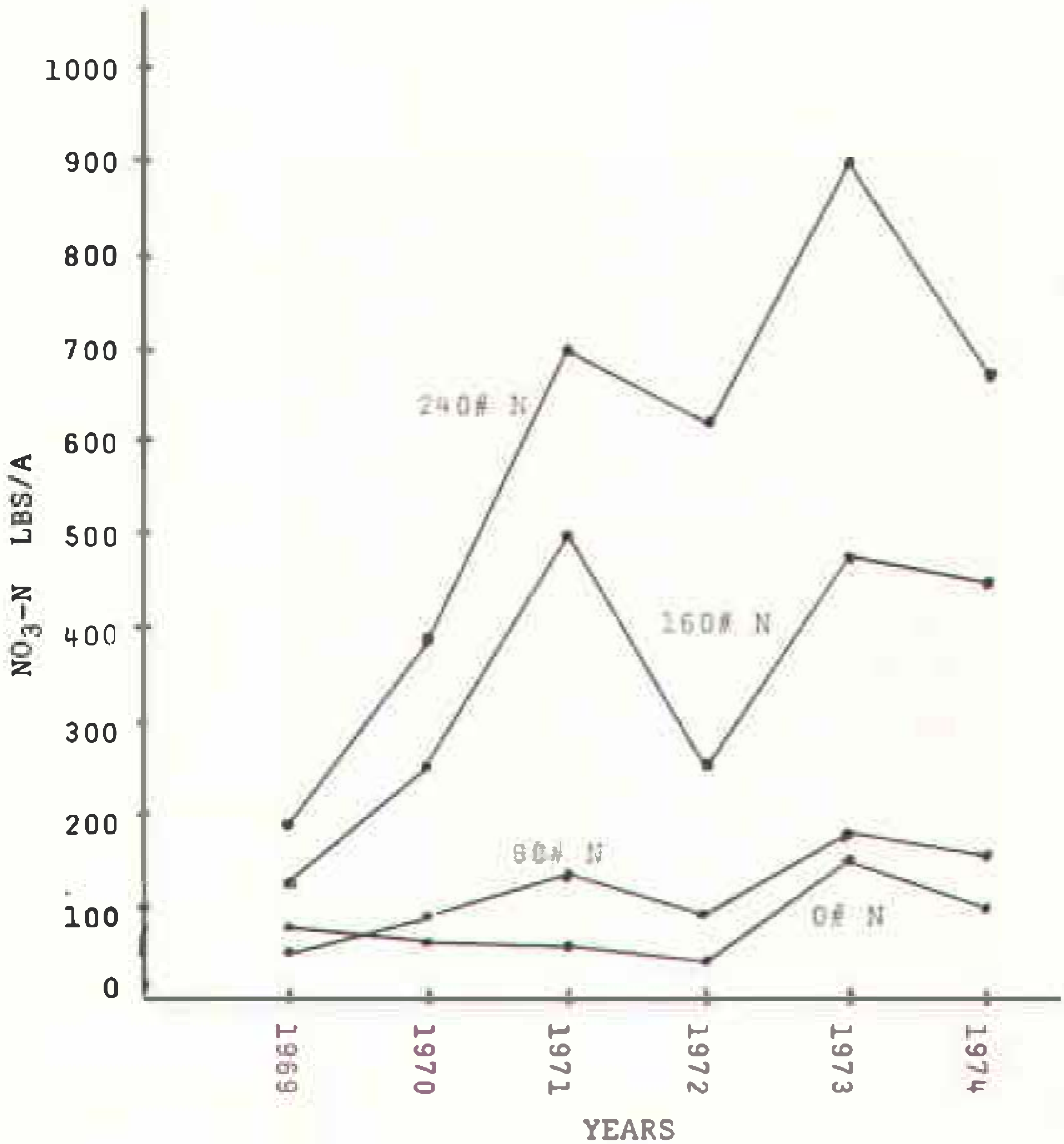
Table 6. The Effect of Adding Nitrogen Fertilizer Over a 6 Year Period on the Amount of NO_3-N Present in the Soil Profile, Southeast Experiment Farm, 1975[1]

Depth in Inches	Treatments[2]			
	0+0+0	80+0+0	160+0+0	240+0+0
	NO_3-N, lbs/acre			
0 - 6	10.8	23.3	70.0	118.9
6 - 12	5.2	21.3	68.4	107.3
12 - 18	4.5	7.8	46.5	63.8
18 - 24	4.7	7.5	61.7	98.9
24 - 30	5.1	11.7	60.1	119.0
30 - 36	5.8	10.7	28.6	73.3
36 - 42	7.9	9.1	13.8	32.4
42 - 48	8.2	9.2	11.6	15.1
Subtotal	52.2	100.6	306.6	628.7
48 - 54	9.8	8.4	9.8	10.5
54 - 60	10.6	8.0	9.5	9.6
60 - 66	11.4	7.6	8.6	9.5
66 - 72	12.2	7.1	8.1	8.9
Total	96.2	131.7	396.7	667.2
Yield of corn bu/acre	37	58	68	62

[1] Samples used were taken in the fall of 1974.

[2] The treatments have been repeated on the same plots for the past 6 years. During that 6 years, the plots receiving 80 lbs. per year have received a total of 480 lbs. of nitrogen per acre.

Figure 1. The Effect of Rates of Added Nitrogen on the Amount of Nitrate-Nitrogen in the 4-foot Profile over a 6-year Period. S. E. Farm 1975



NITROGEN SIDEDRESS STUDY--CORN

E. Adams, F. Shubeck and P. Carson

Objectives

To compare effectiveness of placing sidedress nitrogen fertilizer between each row to that of every other row.

Methods and Procedures

This is the second year of data from this study. Again, as before, the study compares the placement of nitrogen between each row and every other row at both 50 and 100 lbs. of actual nitrogen per acre. The nitrogen was sidedress applied as ammonium nitrate with a belt application device through disc openers. Other pertinent plot data are as follows: planting date, May 14, 1975; corn variety, PAG SX 63; row spacing was 30 inches; soil insecticide was Thimet 15G at 1 lb. active per acre; herbicide weed control was Lasso II 15G banded at 17 lbs. broadcast basis per acre. All plots received a uniform treatment of 46 lbs. of P_2O_5 and 30 lbs. of K_2O per acre applied in a band at planting. It was harvested October 27, 1975.

Results

Data in Table 7 shows the comparable yields from the various treatments. The extremely poor yields were not surprising in view of the very adverse growing conditions. No significance can be attached to the yield differences between treatments. This is also true for the grain moisture values as well as for the plant analysis data.

Table 7. Effects of Nitrogen Sidedress Placement on Corn

N Treatment Lbs N/A	Row Spacing	Yield Bu/A	Moisture, % Grain	N % Leaf	P % Leaf	K % Leaf
0	--	1.8	12.9	1.35	0.23	2.65
50	each	3.0	15.5	1.70	0.23	2.91
50	every other	3.1	16.1	1.80	0.21	3.03
100	each	1.8	14.4	1.93	0.22	3.09
100	every other	3.0	14.6	1.86	0.23	2.75

EFFECT OF FOLIAR APPLIED LIQUID PHOSPHORUS ON CORN

E. Adams, F. Shubeck and P. Carson

Objectives

To evaluate corn response to different forms of foliar applied liquid phosphorus fertilizer.

Methods and Procedures

This is the second year of data from this study. Each of three forms of liquid phosphorus fertilizer (ortho, pyro, poly) were foliar applied on corn at both 5 and 10 lbs. P_2O_5 per acre. The phosphorus soil test level at this site was low (10 lbs. P/A Bray 1). Each plot treatment included a uniform nitrogen application totalling 89 lbs. of actual N/A. Each treatment, with exception of number 1, received foliar and/or soil phosphorus applications totalling 46 lbs. P_2O_5 per acre. A 5 lb. foliar P_2O_5 rate of each source was applied in July 1975 to all treatments to receive foliar application. A second 5 lb. foliar P_2O_5 rate of each source was subsequently applied to those treatments designated to receive a total of 10 lbs. foliar application. The liquid phosphorus fertilizer materials were again applied with a hand boom sprayer, operated in a 30 to 40 psi pressure range. The other pertinent plot data include: planting date, May 12; hybrid variety, Curry's SC 150; soil insecticide was Mocap 1# active in band at planting; herbicide was Lasso II 15G banded at 17 lbs. broadcast basis per acre; planted in 30 inch row spacing and harvested, September 15, 1975.

Results

Data in Table 8 shows the results of the various phosphorus treatments applied. We might point out this corn field was under extreme stress throughout most of the growing season, thus the low overall yields. There were no statistical significant differences in yield, grain moisture level, or plant analysis values between various phosphorus treatments. It is interesting to note that under severe climatic stress the nitrogen and phosphorus plant analysis levels were approaching deficiency even though optimum rates of fertilizer plant food had been applied.

Table 8. Effect of Foliar Phosphorus on Corn Yields, Moisture Level, Grain, Plant Analysis

P_2O_5 Treatment, lbs/A Soil	+	Foliar	Yield Bu/A	% Moisture Grain	N % Leaf	P % Leaf	Zn, ppm Leaf
0	+	0	31	50.1	2.40	0.24	48
46	+	0	24	52.0	2.33	0.23	41
41	+	5 Ortho	36	50.2	2.34	0.22	40
36	+	10 Ortho	33	49.8	2.30	0.21	42
41	+	5 Pyro	43	47.3	2.30	0.21	42
36	+	10 Pyro	37	47.7	2.27	0.22	39
41	+	5 Poly	25	52.7	2.41	0.27	40
36	+	10 Poly	38	50.2	2.32	0.22	41
			NS	NS	NS	NS	NS

STARTER FERTILIZER WITH CORN

P. Carson, F. Shubeck, B. Lawrensen, R. Gelderman
and P. Fixen

Objectives of Experiment

1. To establish the value of starter fertilizer on the growth and yield of corn.
2. To determine what effects, rates of P and/or K applied as a starter have on the yield of corn.

Method

1. The experiment was located on the Gary Anderson farm, 2 miles north and 1 west of the Experiment Farm. The soil was an Egan silty clay loam. Egan soils are deep, friable, well-drained silty clay loams developed in a silty cap over glacial till. Tests on the soil samples taken at planting time are shown in Table 9. These tests show phosphorus to be low, potassium to be high, and nitrogen to be in the high range.
2. Experimental design-completely randomized factorial. Plot size was 10 x 60 feet. Each plot contained four rows of corn.
3. Nitrogen was applied before planting at the rate of 88 lbs. of nitrogen per acre and disked in to incorporate.
4. Variety used was Curry's SC 150.
5. Weeds were controlled with Lasso II 15G at 17#/A applied in a band at planting time and by cultivation.
6. Soil insects were controlled with Mocap 10G in a band at 1 lb/A of active material at planting time.
7. The land was in soybeans in 1974. The seedbed was prepared by disking and spike tooth harrowing at the same time the nitrogen was applied.
8. Corn was planted May 12th with a John Deere tool-bar planter. The planters were equipped with belt fertilizer applicators to apply fertilizer as a starter, beside and below the seed. The rate of planting was intended to be 16,000 plants per acre. The row width was 30 inches.
9. Corn was harvested by hand October 10th. Sixty feet of row was harvested by hand from each plot.
10. Sideband fertilizer treatments were:

Lbs/acre $N + P_2O_5 + K_2O$
12 + 0 + 0
12 + 14 + 0
12 + 27 + 0
12 + 52 + 0
12 + 0 + 11
12 + 14 + 11
12 + 27 + 11
12 + 52 + 11
12 + 0 + 20
12 + 14 + 20
12 + 27 + 20
12 + 52 + 20

11. Weather was dry during the mid and last part of the growing season. The lack of available moisture reduced the growth and yield on these plots.
12. Leaf samples were taken for analysis at silking time. Yield samples and ear moisture samples were taken at harvest time. Lodging and breakage notes were not taken at harvest time because little or no lodging or breakage was noted in the plots.

Results

The yield in bushels per acre of 15% moisture corn, percent moisture in the ear at harvest time, the number of ears per stalk at harvest time, and the final population are reported in Table 10. Some treatments have been listed in this table more than once to make comparisons easier. The yield results range from 16 to 35 bushels per acre. The yield without any added P or K was 35.

The yield without added phosphorus or added postassium was the highest. Thia may be a reflection of the very dry weather encountered at this site. Early in the season (before the corn was 18 inches in height) increases in plant growth due to added phosphorus were observed. However, yield results show small decreases due to added phosphorus. These yield decreases were not large enough to be considered statistically significant at the .05 level of confidence.

Added potassium did not increase the yield. The yields produced by the various potassium treatments were inconsistent.

The added fertilizer had no consistent effect on the moisture content of the grain at harvest time. It should be noted that the moisture content of this grain at harvest time was relatively high (approximately 50%). This is an indication that the grain had not attained physiological maturity. At the time of harvest, the lack of available moisture was causing the leaves to become dry and they were being separated from the plants by the wind. These plots were harvested early so they would not interefere with the farmer if he wanted to make this corn into silage.

Fertilizer treatments had no consistent effects on the percentage of stalks having ears or the final plant population.

This data leads one to conclude that the fertilizer added as a starter (beside and below) at planting time has no positive effect on yield of corn in a year of severe drought.

Table 9. Soil Sample Test Results From the Experimental Site, 1975[1]

Depth in inches	Nitrate-Nitrogen ppm	Nitrate-Nitrogen lbs/A	Organic Matter %	Phosphorus lbs/A	Potassium lbs/A	pH 1:1	Soluble Salts mmhos/cm	Texture
0 - 6	23.3	4.9	3.1	10	680	6.8	1.4	Silty clay loam
6 - 12	15.5	17.8						
12 - 24	4.5	16.0						
24 - 36	2.5	9.0						

[1]The tests are made on a composite of four soil samples except for the 0-6" sample which was a composite of many samples.

Table 10. Effect of Rates of Phosphorus and Potassium in a Starter Fertilizer on Yield, Ear Moisture at Harvest, the Number of Ears per Stalk, and Final Population of Corn Grown on the Gary Anderson Farm, 1975

Treatment Number	Treatment $N + P_2O_5 + K_2O$ lbs/A	Yield[1] bu/A	Moisture[2] %	Having Ears %	Final Population[3]
1	12 + 0 + 0	35	50.9	79	13,500
2	12 + 14 + 0	26	53.7	75	13,500
3	12 + 27 + 0	23	51.3	80	13,000
4	12 + 52 + 0	21	51.0	82	12,600
1	12 + 0 + 0	35	50.9	79	13,500
8	12 + 0 + 11	28	50.6	94	13,000
12	12 + 0 + 20	27	53.5	78	14,400
8	12 + 0 + 11	28		94	13,000
5	12 + 14 + 11	27	52.0	77	13,500
6	12 + 27 + 11	18	54.4	79	12,200
7	12 + 52 + 11	16	52.1	66	13,000
12	12 + 0 + 20	27	53.5	78	14,400
9	12 + 14 + 20	25	52.2	82	12,600
10	12 + 27 + 20	20	51.9	72	13,500
11	12 + 52 + 20	25	52.4	63	13,900
2	12 + 14 + 0	26	53.7	75	13,500
5	12 + 14 + 11	27	52.0	77	13,500
9	12 + 14 + 20	25	52.2	82	12,600
3	12 + 27 + 0	23	51.3	80	13,000
6	12 + 27 + 11	18	54.4	79	12,200
10	12 + 27 + 20	20	51.9	72	13,500
4	12 + 52 + 0	21	51.0	82	12,600
7	12 + 52 + 11	16	52.1	66	13,000
11	12 + 52 + 20	25	52.4	63	13,900

[1] Calculated at 15% moisture.
[2] Moisture sample was taken by cutting a section of the center of 8 ears of corn, this includes a section of the cob.
[3] Approximately 16,000 seeds were planted per acre.

N-P-K STARTER FERTILIZER ON CORN

P. Carson, F. Shubeck, B. Lawrensen, R. Gelderman
and P. Fixen

Objectives of Experiment

1. To determine what effects, rates of N, P and/or K have on the yield of corn.
2. To establish the value of a starter fertilizer on the growth and yield of corn.
3. To relate soil tests to expected response to applied starter fertilizer.

Methods

1. The experiment was located south of the buildings on the Southeast Experiment Farm. The soil was an Egan silty clay loam. Egan soils are deep, friable, well-drained silty clay loams developed in a silty cap over glacial till. Tests on the soil samples taken at planting time are shown in Table 11. These tests show phosphorus to be low, potassium to be high, and nitrogen to be in the high range. The west side of this experiment was fallowed in 1974. There were four plots only on the fallowed ground. The fallow treatment made a considerable difference in the amount of nitrogen and moisture available to plants. A measure of the nitrate-nitrogen present in the fallow and non-fallow areas is reported in Table 11. No measure in the amounts of available moisture present were made.
2. Experimental design used was composite having five rates of nitrogen, five rates of P_2O_5 and five rates of K_2O. Through the use of statistical comparisons the number of fertilizer treatments was reduced to 23 plus one with iron. Plot size was 10 x 60 feet. Each plot contained four rows of corn.
3. Nitrogen was applied before planting at the rate of 100 lbs. of nitrogen per acre.
4. Variety used was Pioneer 3388.
5. Weeds were controlled with Lasso II 15G at 17 lbs. per acre in a band at seeding time and by cultivation.
6. Soil insects were controlled with Mocap 10G applied in a band at planting time at the rate of 1 lb. per acre of active material.
7. Land was in corn in 1974. Seedbed was prepared by the plow, disk, drag method.
8. Corn was planted May 7th with a John Deere tool-bar planter. The planterswere equipped with belt fertilizer applicators to apply fertilizer as a starter, beside and below the seed. The rate of plantingwas 16,000 seeds per acre. Row width was 30 inches.
9. Corn was harvested by hand September 15th. Sixty feet of rowwas harvested for grain and 60 feet of row was harvested for silage.
10. Fertilizer treatments used were:

Treatment No.	Identification	Rate in lbs. applied/A $N + P_2O_5 + K_2O$
1	$N_2P_2K_2$	3 + 7 + 5
2	$N_2P_2K_4$	3 + 7 + 21
3	$N_4P_4K_2$	3 + 27 + 5
4	$N_2P_4K_4$	3 + 27 + 21
5	$N_4P_2K_2$	12 + 7 + 5
6	$N_4P_2K_4$	12 + 7 + 21
7	$N_4P_4K_2$	12 + 27 + 5
8	$N_4P_4K_4$	12 + 27 + 21
9	$N_3P_3K_3$	6 + 14 + 11
10	$N_1P_3K_3$	0 + 14 + 11
11	$N_5P_3K_3$	24 + 14 + 11
12	$N_3P_1K_3$	6 + 0 + 11
13	$N_3P_5K_3$	6 + 54 + 11
14	$N_3P_3K_1$	6 + 14 + 0
15	$N_3P_3K_5$	6 + 14 + 43
16	$N_1P_1K_5$	0 + 0 + 43
17	$N_1P_5K_1$	0 + 54 + 0
18	$N_1P_5K_5$	0 + 54 + 43
19	$N_5P_1K_1$	24 + 0 + 0
20	$N_5P_1K_5$	24 + 0 + 43
21	$N_5P_5K_1$	24 + 54 + 0
22	$N_5P_5K_5$	24 + 54 + 43
23	$N_1P_1K_1$	0 + 0 + 0
24	$N_5P_5K_5$ + Fe	24 + 54 + 43 + Fe

11. Leaf samples were taken for analysis at silking time. Yields for grain and silage were taken before physiological maturity because of the dry weather encountered. Lodging and breakage notes were not taken at harvest time because little or no lodging or breakage was noted on the plots.

Results

The yield in bushels per acre of 15% moisture corn, tons of silage, percent moisture in the grain at harvest, and the height of the corn at harvest time are presented in Table 12. The nature of a composite design makes it difficult to visualize yield differences in a table such as Table 12. Because of this, selected treatments have been organized to make comparisons easier. These are shown in Table 13. The yields from the fallowed plots are not included in the table.

The weather was dry during the middle and latter part of the growing season. Lack of available moisture reduced growth and yield of corn on these plots.

The yield without additional fertilizer (28 bu/A) was very near the highest yield produced. A few treatments produced yields that exceeded this yield, but none more than 3 bushels per acre. The treatments causing yields that equal or exceed the check yield, do not show any consistent pattern. This appears to be true for silage yields as well as grain yields. The early plant growth on the fallowed plots was very poor. The plants were yellow, appeared to be drying up and very slow growing. These are symptoms often seen on fallowed corn. As the season progressed the plants improved in color and began to grow more rapidly. The final yield of these four plots varied from 67 to 84 bushels per acre.

The data available leads to the conclusion that the use of a starter fertilizer in a very dry year does not increase corn yields.

Table 11. Soil Sample Test Results from Experiment Site, 1975[1]

Depth in inches	Nitrate-Nitrogen ppm	Nitrate-Nitrogen lbs/A	Organic Matter %	Phosphorus lbs/A	Potassium lbs/A	pH 1:1	Soluble Salts mmhos/cm	Soil Texture	Fallow Area Nitrate-Nitrogen lbs/A
0 - 6	46.3	83.3	3.1	14	550	6.0	0.90	Silty clay loam	159.7
6 - 12	42.5	76.5							138.2
12 - 18	10.8	19.4							42.3
18 - 24	6.6	11.9							15.8
Subtotal		191.1							355.0
24 - 30	4.9	8.8							
30 - 36	5.0	9.0							
36 - 42	7.8	14.0							
42 - 48	13.0	23.4							
Total		246.3							

[1]Tests are made on a composite of four soil samples except for the 0-6" sample, which was a composite of many samples.

Table 12. The Effect of Starter Fertilizer Rates and Ratios on the Yield of Corn, Silage, Moisture Content of the Grain at Harvest Time, and Plant Height at Maturity, Southeast Experiment Farm, 1975

Treatments			Yield		Moisture[3] Content of Grain at Harvest %	Plant Height at Harvest feet
No.	Designation	Rate lbs/A $N+P_2O_5+K_2O$	Grain[1] Bu/A	Silage[2] Tons/A		
1	$N_2P_2K_2$	3 + 7 + 5	26	2.9	48.1	4.4
2	$N_2P_2K_4$	3 + 7 + 21	29	3.1	54.1	4.1
3	$N_4P_4K_2$	3 + 27 + 5	31	2.7	52.5	4.1
4	$N_2P_4K_4$	3 + 27 + 21	16	2.7	55.5	4.1
5	$N_4P_2K_2$	12 + 7 + 5	26	3.0	51.0	4.2
6	$N_4P_2K_4$	12 + 7 + 21	13	3.0	52.4	4.3
7	$N_4P_4K_2$	12 + 27 + 5	18	3.0	54.2	4.4
8	$N_4P_4K_4$	12 + 27 + 21	29	3.0	51.6	4.5
9	$N_3P_3K_3$	6 + 14 + 11	20	2.7	53.8	4.2
10	$N_1P_3K_3$	0 + 14 + 11	--	--	--	--
11	$N_5P_3K_3$	24 + 14 + 11	15	2.5	54.4	4.0
12	$N_3P_1K_3$	6 + 0 + 11	10	2.7	61.7	4.2
13	$N_3P_5K_3$	6 + 54 + 11	21	3.2	54.0	4.2
14	$N_3P_3K_1$	6 + 14 + 0	9	2.6	60.2	4.3
15	$N_3P_3K_5$	6 + 14 + 43	25	3.1	53.6	4.4
16	$N_1P_1K_5$	0 + 0 + 43	18	2.9	53.5	4.3
17	$N_1P_5K_1$	0 + 54 + 0	18	2.6	57.6	4.0
18	$N_1P_5K_5$	0 + 54 + 43	16	3.0	59.2	4.4
19	$N_5P_1K_1$	24 + 0 + 0	12	2.5	48.2	4.3
20	$N_5P_1K_5$	24 + 0 + 43	28	2.6	52.2	4.3
21	$N_5P_5K_1$	24 + 54 + 0	11	3.7	57.1	4.4
22	$N_5P_5K_5$	24 + 54 + 43	15	2.4	55.8	4.1
23	$N_1P_1K_1$	0 + 0 + 0	28	2.4	54.0	4.2
24	$N_5P_5K_5$+Fe	24 + 54 + 43+Fe	15	2.4	--	3.9

[1]Yields calculated at 15% moisture.
[2]Silage yields are in tons of dry material per acre.
[3]The 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 Selected Starter Fertilizer Rates and Ratios on the Yield of Corn as Grain[1] and Silage[2], Southeast Experiment Farm, 1975

Designation	Rate lbs/A $N + P_2O_5 + K_2O$	Yield Grain bu/A	Yield Silage tons/A
$N_1P_1K_1$	0 + 0 + 0	28	2.4
$N_1P_5K_1$	0 + 54 + 0	18	2.6
$N_1P_1K_5$	0 + 0 + 43	18	2.9
$N_5P_1K_1$	24 + 0 + 0	12	2.5
$N_1P_5K_5$	0 + 54 + 43	16	3.0
$N_5P_1K_5$	24 + 0 + 43	28	2.6
$N_5P_5K_1$	24 + 54 + 0	11	3.7
$N_5P_5K_5$	24 + 54 + 43	15	2.4

[1] Yields of grain calculated at 15% moisture.
[2] Silage yields are in lbs. of dry matter per acre.

NITRIFICATION INHIBITION

F. Shubeck, B. Lawrensen and A. Vogel

Objectives of Experiment

1. Determine effectiveness of nitrification inhibitors in South Dakota soils.
2. Determine effects of nitrification inhibitors on corn yield, stalk rot, moisture content 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

Sept.-Oct., 1974 - Previous corn crop removed as silage. Fall tillage consisted of chisel plowing with sweeps, tandem disking and spike tooth harrowing.
Nov. 20, 1974 - Applied aqua ammonia and N-Serve in specified plots
May 13, 1975 - Completed spring application of aqua ammonia and N-Serve in specified plots

May 14, 1975 - Tandem disked and spike tooth harrowed all plots
Planted - P-A-G SX63
Insecticide - Thimet 15G
Herbicide - Lasso II in band over row
June 5, 1975 - First cultivation
June 12, 1975 - Soil samples taken for analysis
June 24, 1975 - Second cultivation
July 9, 1975 - Soil samples taken for analysis
Aug. 8, 1975 - Soil samples taken for analysis
Aug. 28, 1975 - Corn cut for silage

Table 14. Effect of Nitrogen Applications and Nitrification Inhibitors on Yield of Corn and Percent Ear Moisture at Harvest

Rate of Nitrogen Application lbs/acre	Time of Application	Nitrification Inhibitor	Tons/acre of 65% moisture silage
100	fall	none	3.3
100	fall	+N-Serve	3.3
60	fall	none	3.6
60	fall	+N-Serve	3.6
40	fall	none	4.2
40	fall	+N-Serve	4.1
none	----	none	4.0
100	spring	none	3.8
100	spring	+N-Serve	3.8
60	spring	none	3.9
60	spring	+N Serve	3.7
40	spring	none	3.8
40	spring	+N Serve	4.2
none	----	none	3.7

Discussion and Interpretation of Table 14

Grain yields were influenced by drought, smut and rootworms so severely that no sampling for grain yield was attempted. Silage yields were taken and are shown in Table 14. Increasing the rates of fall applied nitrogen in the form of aqua ammonia failed to increase silage yields in this experiment. Spring applied nitrogen resulted in silage yields about the same as that of the check plots.

One of the more important aspects of this experiment was to determine whether or not a chemical nitrification inhibitor could influence loss of fall applied nitrogen on an imperfectly drained soil. In a different experiment at the Research Farm approximately one-half of the nitrogen that had been applied over the last three years cannot be accounted for. The nitrogen removed in silage added to the amount remaining in the soil amounted to about one-half of the total nitrogen applied. This is a very serious loss, occurring principally at the higher rates of application (160 to 240 lbs. N per acre per year).

This loss of nitrogen probably has been due to microorganisms that live without air, changing the nitrogen to volatile forms that escaped into the atmosphere. The nitrification inhibitor experiment was an attempt to reduce these nitrogen losses by the application of a chemical that influences activity of certain microorganisms.

Before these undesirable soil microorganisms multiply, the oxygen supply in the soil air must be restricted or virtually eliminated. This occurs primarily under water-logged conditions or severe soil compaction or a combination of these two undesirable conditions. A site was selected for the experiment that was imperfectly drained and under normal rainfall conditions would be water-logged for at least part of the growing season. However, rainfall was so limited during the growing season that the soil never approached its holding capacity. Consequently, soil air was never driven out by water, and losses of nitrogen due to activity of these microorganisms that live without air was of little or no consequence.

Table 15. Effect of Nitrogen Fertilizer, Inhibitor and Date of Application on Ammonia Nitrogen in Soil

N-Serve lbs/acre	Date of N Application	Sampling Date in 1975	ppm Ammonia Nitrogen*
0.5	fall	June 10	74.3
0.5	fall	July 9	32.8
none	fall	June 10	58.8
none	fall	July 9	29.0
0.5	spring	June 10	64.3
0.5	spring	July 9	49.0
none	spring	June 10	60.8
none	spring	July 9	41.7

*Analyses by Agrico Service Laboratory, Washington Court House, Ohio.

Discussion and Interpretation of Table 15

Nitrogen fertilizer was applied in the form of aqua ammonia at 100 lbs. N per acre. Soil samples were analyzed for ammonia and expressed as parts per million. Any decrease in ammonia in the soil between sampling dates was attributed to a change over from ammonia to nitrates by microorganisms.

It is interesting to note that when ammonia fertilizer was applied in the fall, the addition of the nitrification inhibitor (N-Serve) resulted in a higher concentration of soil ammonia nitrogen at each sampling date than in plots where N-Serve was omitted. This would indicate that N-Serve slowed down the normal change of ammonia nitrogen to nitrate nitrogen.

LIME EXPERIMENT

Paul Carson, Burt Lawrensen, Fred Shubeck
and Ron Gelderman

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. Because of the interest, 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 16. 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_2 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. 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 100 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 and by cultivation.
5. Soil insects were controlled with Mocap 10G in a band at 1 lb/A of active material at planting time.
6. Variety was Pioneer 3388.

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 May 12 with John Deere tool-bar planters. The row width was 30 inches.
9. Corn was harvested by hand September 10. Sixty feet of row was harvested from each plot. Shelling percents were calculated.
10. The weather was dry during most 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, the moisture content of the silage at harvest time, and the height of the plants at harvest time are reported in Table 17.

The yield differences caused by treatments are relatively small and are not large enough to be considered statistically significant. Early in the season these plots were very uniform and no differences due to treatments could be observed. Neither fertilizer nor lime increased yields of the grain. Treatments had no consistent effects on yield of silage.

The moisture content of the grain and silage at harvest time were relatively consistent irrespective of treatment. It should be noted that the moisture content of the grain was much higher than is usually considered desirable for harvest. These plants had not reached physiological maturity at the time of harvest. However, the leaves were being lost because of the dry weather and to facilitate the silage harvest, grain yields were taken earlier than normal. The moisture content of the silage was higher than estimated at harvest time. The drying of, and loss of leaves gives a false sense of maturity. The shelling percentages were low. This is partially a result of the early harvest and possibly partially due to the low yield caused by the dry weather.

The height of the corn at harvest time was relatively uniform varying from 3.9 to 5.0 feet. Treatments had no consistent effect on the heights under these growing conditions.

Table 16. 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. %	Phosphorous Lbs/A	Potassium Lbs/A	pH 1:1	Salts mmhos/cm	Texture
				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 17. The Effects of Added Lime and Phosphorus on the Yields of Grain and Silage, Shelling Percent of the Ears Harvested, and the Moisture Content of the Ears and Silage at Harvest for Corn Grown at the Southeast Experiment Farm, 1975

Fertilizer $N + P_2O_5 + K_2O$ lbs/A	Lime Tons/A	Yield[1] Bu/A	Ear Corn Moisture[2] %	Shelling Percent	Silage Yield Tons/A	Silage Moisture %	Plant Height at Harvest feet
0 + 0 + 0	-	12	62.1	52	5.4	78.8	3.9
0 + 0 + 0	2	9	63.6	52	5.5	77.4	4.0
0 + 0 + 0	4	7	64.3	50	5.1	79.2	3.9
0 + 30 + 0	-	6	63.9	53	4.8	79.0	4.0
0 + 120 + 0	-	5	63.7	51	4.5	78.3	4.0
0 + 30 + 0	2	6	64.2	49	4.8	78.8	4.1
0 + 30 + 0	4	6	65.2	47	5.5	77.9	4.0
0 + 120 + 0	2	5	68.8	44	4.8	77.2	4.0
0 + 120 + 0	4	3	64.5	49	4.2	78.4	5.0

[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, B. Lawrensen, W. Schneider

Objectives of Experiment

1. By removing all drop 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

April 30, 1975 - Sprayed area with 3.1 pounds per acre of Aatrex 4L on fall plowing
May 1, 1975 - Spike tooth harrowed
May 27, 1975 - Applied commercial fertilizer to specified plots
May 28, 1975 - Applied manure to designated plots. Tandem disked and harrowed all plots.
Planted SX-63
Herbicide - Lasso II in band at planting
Insecticide - Dyphonate 20G
June 16, 1975 - Cultivated all plots
Oct. 2, 1975 - Harvested silage
Oct. 30, 1975 - Picked ear corn

Table 18. Effect of Commercial Fertilizer and Manure Applications on Corn Yield

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	---	37
Ear corn removed	5 tons manure/acre	---	47
Ear corn removed	0 + 0 + 0	---	39
Ear corn removed	100 + 40 + 40	---	45
Silage removed	0 + 0 + 0	6.4	--
Silage removed	5 tons manure/acre	7.5	---
Silage removed	0 + 0 + 0	6.8	---
Silage removed	100 + 40 + 40	6.6	---

Discussion and Interpretation of Table 18

This experiment was initiated in 1975. With skyrocketing feed costs the last two years, great emphasis has been placed on utilizing every pound of roughage raised on the farm for cattle feed. With approximately one-half of our soil organic matter lost in 100 years of cropping, many farmers are concerned

about yield reductions if both the grain and stover are continually removed and fed. Some people have doubts about the ability of commercial fertilizer to maintain yields when the entire corn plant is removed; consequently, a manure treatment was included.

When insufficient midsummer rainfall limits yields to 47 bushels per acre as in 1975, fertility removal by crops would not be greatly accelerated. If drought conditions continue, it may take several years for yield decreases to occur due to removing the entire crop compared to grain alone even though our soil organic matter and fertility levels have approached new lows.

Note the increases in grain yield in Table 18 from applications of manure and commercial fertilizer.

CORN ROOTWORM INSECTICIDE EVALUATIONS

D. D. Walgenbach, Mick Holm*, and Lee Barthelman*

*Research Assistants

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 dates, placement of the insecticide, rate sequences, and cultivation applications of several compounds.

To determine the effects of continued and rotated corn rootworm insecticide use patterns.

To obtain data on rootworm resistance through topical applications of technical insecticides to field collected larvae.

To determine the influence of silage cutting dates on following year rootworm damage.

To determine the effects of fall and spring plowing on rootworm populations and damage.

Methods and Procedures

Field Information

Southeast Experiment Station, Beresford

Location:	6 miles west; 3 miles south, Beresford; Clay County.
Plot History:	
Crops:	Trap Crop (corn) in 1973
Soil Type:	Silty-clay 8% sand 42% silt

Tillage:	Fall plowed 3 spring diskings
Fertilizer:	80-40-20/A
Herbicide:	Atrazine 4L post emergence
Corn Variety:	See data
Row Width:	30 inches
Planter:	John Deere Flexi-Planter, 4 row, equipped with Noble Metering Units
Planting Dates:	See data
Cultivated:	Weed control, June 23
Cultivation Treatments:	See data

Donald Tofte Farm, Brookings

Location:	2 miles west, 2 miles north, Brookings County
Plot History:	Corn, 6 years, 1973 corn Thimet 15G, 6.8 bls/A; Atrazine 80W, 5 lb/A.
Soil Type:	Clay-loam; 30% sand, 28% silt, 42% clay
Tillage:	Spring cheaeled 2 spring diskings
Fertilizer:	80N-20P-10K
Herbicide:	Ramrod, 7 lbs. banded over row
Corn Variety:	See data
Row Width:	38 inches
Planter:	John Deere Flexi-Planter equipped with Noble Metering Units
Cultivated:	Weed control, June 25
Cultivation Treatments:	See data

Grubbrud Farm, Beresford

Location:	Lincoln County
Plot History:	Corn 10 plus years Furadan 5-6 years
Soil Type:	Clay loam
Tillage:	Spring plowed
Fertilizer:	80-40-20
Herbicide:	Ramrod, 7 pounds banded
Corn Variety:	XL 45A
Planter:	John Deere Flexi-Planter equipped with Noble Meteting Units
Row Width:	38 inches

Hodgson Farm, Alcester

Location:	Union County
Plot History:	Corn 5 plus years. Severe rootworm problem 1974. Treated with Dasanit, 1973, 1974.
Soil Type:	Silty clay loam
Fertilizer:	80-40-20

Herbicide:	Sutan & Inc.
Corn Variety:	XL 45A
Tillage:	Spring chiseled
Row Width:	38 inches

Knutson Farm, Volga

Location:	Brookings County
Plot History:	Corn 1974. Severe rootworm problem, untreated in 1974.
Soil Type:	Sandy clay loam
Fertilizer:	80-40-20
Herbicide:	Ramrod banded
Corn Variety:	XL 44A
Tillage:	Spring plowed
Row Width:	40 inches

Krog Farm, Lake Benton

Plot History:	Corn, 1974, Furadan treatment for 5 to 7 years
Soil Type:	Clay loam
Fertilizer:	80-40-20
Herbicide:	Sutan + Inc.
Corn Variety:	XL 44A
Tillage:	Spring plowed
Row Width:	38 inches

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.

Biology. Considerable migration of western corn rootworm beetles from corn fields to small grain stubble and soybean fields were observed during August and September, 1974. Factors contributing to this situation included the increased acreage of drought affected corn harvested for silage and the rapid drying of corn following a September 3rd heavy frost. Insecticidal treatment was recommended for first year corn fields in areas of high beetle populations.

Results and Discussion

Registered Insecticides - Performance At All Locations in 1974 and 1975. The 1974 and 1975 performance averages of registered insecticides are summarized in Table 19. The effectiveness of the insecticides was relatively consistent during the two year period. Comparative performance of the compounds grouped them into four categories ranging from best rootworm control (Category A) to those not included in the recommendations. The susceptibility of larval corn rootworms to specific insecticides vary across the corn production areas depending on previous insecticide use patterns and other extrinsic factors.

Date of Planting - Insecticide Application At Planting, 7" Band. The better performing soil insecticides (Table 20) did not show great variations in percent root protection from the early to late planting dates. The less effective insecticides showed a decline in performance on the June planting date. A similar situation was noted in 1974 except for the May 2 application date. A decrease in rootworm damage in the untreated plots is the major reason for the apparent improvement in insecticidal control when only root ratings are considered.

At-Plating vs. In-Furrow At-Planting Insecticide Applications. The comparison of 7 inch band vs. in-furrow applications for rootworm control again showed a decided rootworm control advantage for the band application (Table 21). The area of insecticidal concentration from the in-furrow treatments was not sufficient to give protection to the brace roots.

Rate Study - Registered Insecticides. The application of registered soil insecticides did not show a significant advantage for application rates in excess of 1 lb. active per acre (Table 22). Application rates of less than 1 lb. active per acre have shown decidedly poorer rootworm control.

Experimental Insecticides. CGA 12223 and SRA 12869 appear as promising materials about equal in performance to Furadan and Counter (Table 23). The use of Furadan seed treatments for rootworm control did not provide the level of protection obtained in 1974. A much higher level of phytotoxicity was evident in the 1975 trials (Table 24).

Off-Station Plots. The registered materials were applied at several rates to fields with known insecticidal histories to provide information on the benefits of changing insecticides on an annual basis.

The Knutson Farm, Volga, (Table 25) had not been treated with soil insecticides the past several years. Rootworm damage in the untreated plots was relatively light and did not place as much stress on the chemicals as at other locations. Performance ranges were only generally indicated at this plot.

The plot at the Hodgson Farm, Alcester, (Table 26) was treated with Dasanit 15G in 1973 and 1974. Poor control was obtained in 1974 with Dasanit and similar results were obtained in the plot in 1975. The remaining recommended insecticides gave expected control. BUX was at the performance level observed in the late 1960's. No clear interactions were evident with the other phosphate materials.

The Grubbrud plot, Beresford, was in an area receiving Furadan treatments for at least the past five years (Table 27). Rootworm damage was light to moderate. Furadan 10G showed a marked decline in performance compared to other plots at all rates tested. The performance of BUX was good, whereas Counter and Thimet were somewhat lower. The lodging counts were associated with severe wind and rain and are meaningless from an insecticide performance basis.

Plots at the Krog Farm, Lake Benton, were also in an area that had up to five years of successive Furadan use (Table 28). The data indicate a somewhat suppressed Furadan performance. Other insecticide relationships were not clear. The rootworm population was unusual in that larval development was 10 to 14 days later than at all other plot locations.

At the Tofte Farm, Brookings, Thimet performed below normal in 1974. In 1975, several of the phosphates gave lower performance than at other locations. BUX performance was poor in both 1974 and 1975 (Table 29).

Resistance Monitoring. Data obtained in 1975 showed that the susceptibility of beetles and larvae to laboratory applied insecticides had no or poor correlations. Carbamate insecticides were considerably more toxic to the adults than to larvae. Collections of larvae showed considerable differences from several locations and do indicate that at least some insecticidal failures are related to tolerance in the larvae. Resistance prediction work is underway in the laboratory in conjunction with USDA, ARS, Northern Grain Insect Laboratory personnel.

The Influence of Corn Removal Date on Oviposition, Resultant Rootworm Populations and Damage. The influence of removing corn plants at weekly intervals on western corn rootworm, *Diabrotica virgifera* Le Conte populations were evaluated at two plot locations. Both plots were in areas of high beetle density; one located within a trap crop area, the other on a former insecticide evaluation site. Fall and spring plowing were imposed on the plots using a

split plot design. Thimet 15G at 1.0 lb. A/A in a 7 inch band was applied at planting to two rows of each corn removal treatment.

In 1975, sufficient root damage was observed from plots with corn removed on August 13, 1974 to warrant insecticidal treatment for rootworm control. No significant differences in larval damage were noted between the fall and spring plowing treatments.

Table 19. Rootworm Soil Insecticide Performance, All Locations, 1974, 1975

Treatment	Rate, lb. A/A	% Root Protection* 1975	1974
Furadan 10G	1.0B	(20)73	(32)76
	2.0B	(7)75	
	3.0B	(4)77	
Counter 15G	1.0B	(25)65	(14)71
	2.0B	(7)69	
	3.0B	(3)76	
Dyfonate 20G	1.0B	(13)60	(14)60
	2.0B	(5)65	
	3.0B	(4)65	
Dasanit 15G	1.0B	(15)52	(14)56
	2.0B	(5)49	
	3.0B	(4)58	
Thimet 15G	1.0B	(12)49	(32)56
	2.0B	(5)57	
	3.0B	(4)64	
Mocap 10G	1.0B	(13)48	(14)58
	2.0B	(7)53	
	3.0B	(4)63	
Lorsban 15G	1.0B	(13)42	(3)62
	2.0B	(4)49	
	3.0B	(4)55	
Diazinon 14G	1.0B	(11)40	
	2.0B	(5)49	
	3.0B	(4)51	
BUX 10G	1.0B	(11)38	(14)49
	2.0B	(5)50	
	3.0B	(4)42	

*Refer to Methods and Procedures for Percent Root Protection calculations.

Number of tests in parenthesis.

Table 20. Date of Planting - Insecticide Application At-Planting, 7" Band

Treatment	Rate lb A/A	Planting and Application Dates May 5	May 12	May 19	June 2	Average all dates
		% Root Protection				
Furadan 10G	1.0	78	67	77	71	73
CGA 12223 15G	1.0	65	73	75	62	69
SRA 12869 15G	1.0	69	66	63	61	68
Counter 15G	1.0	68	67	71	59	66
Dyfonate 20G	1.0	64	64	61	54	61
Mocap 10G	1.0	52	55	61	53	55
Dasanit 15G	1.0	52	61	60	45	55
Thimet 15G	1.0	60	54	69	33	55
Lorsban 15G	1.0	57	54	59	40	53
Diazinon 14G	1.0	44	47	54	32	43
BUX 10G	1.0	40	35	34	0	27

Table 21. Southeast Experiment Station

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
Counter 15G	2.F	2.2a	73.4	7ab	15.5ab
Furadan 10G	2.F	2.4ab	68.9	8ab	16.75ab
Furadan 10G	1.B	2.45ab	67.8	3a	14.75a
Counter 15G	1.B	2.55abc	65.6	8ab	17ab
Furadan 15G	1.B	2.6abc	64.5	5ab	18.5ab
Furadan 15G	0.75B	2.65abc	63.4	9ab	18.75ab
Counter 15G	0.75IF	2.8abcd	60.0	7ab	17.5ab
Furadan 10G	1.0F	2.85abcd	58.9	15ab	16.75ab
Counter 15G	0.75B	2.95bcd	56.7	10.0ab	18.75ab
Furadan 15G	1.0IF	3.0bcd	55.6	15.0ab	18.25ab
Counter 15G	1.0IF	3.20cde	51.0	27.0abc	16.75ab
Furadan 15G	0.75IF	3.35de	47.8	50.0cd	15.75ab
Furadan 10G	0.75IF	3.45de	45.6	19.0ab	16.25ab
Thimet 15G	1.0B	3.7e	40.0	53.0cd	19.5b
UTC	---	4.5f	---	64.5d	19.0ab

Date of Planting: May 13, 1975
Root Rating: July 24, 1975
Cultivation: June 23, 1975
Hybrid: DeKalb XL45A

Table 22. Southeast Experiment Station Rate Study

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
Furadan 10G	1	2.35abcdef	69.4	5.0a	16.75abc
	2	1.70a	84.1	6.0a	16.5abc
	3	1.90ab	79.6	2.0a	15.5abc
Counter 15G	1	2.45abcdefgh	67.1	10.0abc	13.75a
	2	2.20abcde	72.8	2.0a	16.75abc
	3	1.90ab	79.6	3.0a	18.25abc
SRA 12869 15G	1	2.34abcdef	69.4	2.0a	17.25abc
	2	2.45abcdefgh	67.1	7.0a	15.75abc
	3	2.05abc	76.2	8.0a	19.25bc
CGA 12223 15G	1	3.30ijkl	47.8	41.0bcdefg	16.5abc
	2	2.20abcde	72.8	9.0ab	16.0abc
	3	2.15abcd	73.9	17.0abcde	17.5abc
Dyfonate 20G	1	2.50abcdefgh	66.0	5.0a	16.0abc
	2	2.20abcde	72.8	2.0a	18.5bc
	3	2.45abcdefgh	67.1	6.0a	15.75abc
Mocap 10G	1	3.25hijk	48.9	43.0defg	18.5abc
	2	3.55jkl	42.1	44.0defg	18.25abc
	3	3.0efghijk	54.6	27.0abcdefg	18.25abc
Dasanit 15G	1	2.60bcdefghi	64.0	23.0abcdef	19.0bc
	2	2.75cdefghij	60.3	14.0abcd	15.0ab
	3	2.45abcdefgh	67.1	10.0abc	17.0abc
Thimet 15G	1	3.50jkl	43.2	26.0abcdefg	16.25abc
	2	2.75cdefghij	60.3	15.0abcd	16.5abc
	3	2.40abcdefh	68.2	7.0a	17.50abc
Lorsban 15G	1	3.50jkl	43.2	28.0abcdefg	16.0abc
	2	3.15fghijk	51.2	14.0abcd	16.5abc
	3	3.0efghijk	54.6	15.0abcd	18.25abc
BUX 10G	1	4.05lmn	20.5	52.0fg	15.25abc
	2	3.70klmn	38.7	57.0g	19.75c
	3	3.45jkl	44.4	51.5fh	16.25abc
Diazinon 14G	1	3.50jkl	43.2	42.0cdefg	16.0abc
	2	2.90defghijk	56.9	16.0abcde	15.0ab
	3	3.22ghijk	49.6	44.0degh	18.0abc
DiSyston 15G	1	3.45jkl	44.4	43.0defg	18.5bc
	2	3.35ijkl	46.6	30.0abcdefg	17.5abc
UTC	--	4.35mn	--	58.0g	16.25abc
UTC	--	4.45n	--	47.5efg	16.3abc

Table 23. Southeast Experiment Station

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
CGA 12223 15G	0.75F	2.3a	69.5	5.0a	16.25bc
SRA 12869 15G	2.0B	2.35a	68.3	3.0a	16.25bc
SRA 12869 15G	4.0B	2.35a	68.3	11.0ab	17.75c
SRA 12869 EC	2.0B	2.4a	67.0	3.0a	15.75abc
SRA 12869 15G	1.0B	2.6ab	62.4	6.0a	16.5bc
Counter 15G	0.75B	2.6ab	62.4	16.5abc	16.0abc
Furadan 10G	0.75B	2.65ab	61.2	4.0a	17.0bc
SRA 12869 15G	1.0 Cult.	2.65ab	61.4	11.0ab	16.75bc
SRA12869 EC	2.0 Cult.	2.65ab	61.4	13.0ab	16.75bc
CGA 12223 15G	0.75 Cult.	2.90abc	55.0	29.0abc	17.25bc
SRA 12869 15G	4.0 Cult.	2.90abc	55.0	31.0abc	15.75abc
SRA 12869 15G	2.0 Cult.	3.0abc	53.0	32.0abcd	15.75abc
CGA 12223 15G	1.0B	3.0abc	53.0	30.5abcd	15.75abc
SRA 12869 EC	1.0B	3.0abc	53.0	35.0bcde	15.25abc
SRA 12869 EC	4.0B	3.05abcd	51.8	37.0bcde	17.5c
CGA 12223 15G	0.75B	3.05abcd	51.8	35.5bcde	17.5c
CGA 12223 15G	1.0F	3.10abcde	50.6	42.0cdef	12.5a
SRA 12869 EC	4.0B	3.15bcde	49.0	41.0cdef	16.5bc
CGA 12223 15G	1.0 Cult.	3.15bcde	49.0	41.0cdef	18.25c
SRA 12869 EC	1.0 Cult.	3.4bcde	44.0	62.0efg	15.75abc
UTC	---	4.25f	---	55.0defg	13.75ab

Date of Planting: May 15, 1975
Rated: July 24, 1975
Cultivation: June 23, 1975 Treatments applied
Hybrid: DeKalb XL45A

Table 24. Southeast Experiment Station

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
Furadan ST 1.5% + Furadan	1.0B	2.05a	73	23.0a	6.25a
Furadan 10G	1.0B	2.15a	71	15.5a	11.25b
Furadan ST 1% + Counter 15G	1.0B	2.15a	71	25.0a	4.75a
Furadan ST 0.5% + Furadan	1.0B	2.15a	71	15.0a	4.0a
Furadan ST 1%		2.55ab	60	15.5a	5.75a
Furadan ST 0.5% + Counter 1 5G	1.0B	2.55ab	60	24.5a	4.5a
Counter 15G	1.0B	2.60abc	59	31.5ab	11.25b
Furadan ST 1.5%		3.15bcd	45	49.0abcd	3.75a
Furadan ST 1.5%		3.20bcd	44	70.0d	5.5a
Furadan ST 1.0%		3.20bcd	44	47.0abcd	3.75a
Furadan ST 0.5%		3.25cd	42	33.5abc	4.75a
Furadan ST 1.5%		3.30de	41	44.0abcd	5.25a
Furadan ST 0.5%		3.50de	36	68.0cd	5.0a
Furadan ST 1.0%		3.65de	32	43.75abcd	4.0a
UTC		3.85de	--	67.0cd	10.5b
UTC		3.95e	--	65.5bcd	10.25b

Date of planting: May 14, 1975
Rated: July 24, 1975
Hybrid: Pioneer 3780

Table 25. Knutson Farm, Volga

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
Furadan 10G	2.0B	1.95a	71.3	0.0a	12.50abc
Furadan 10G	1.0B	2.05ab	68.2	0.0a	13.75abc
SRA 12869 15G	2.0B	2.15abc	65.2	0.50a	12.50abc
Counter 15G	2.0B	2.20abc	63.7	0.0a	13.50abc
Thimet 15G	2.0B	2.25abc	62.2	0.0a	14.0bc
SRA 12869 15G	1.0B	2.25abc	62.2	0.0a	13.25abc
Counter 15G	1.0B	2.30abc	60.7	0.50a	13.0abc
CGA 12223	2.0B	2.35abc	59.1	0.0a	13.25abc
Dyfonate 20G	2.0B	2.35abc	59.1	0.0a	12.75abc
Dasanit 15G	2.0B	2.35abc	59.1	0.0a	13.50abc
DiSyston 15G	2.0B	2.35abc	59.1	0.50a	13.50abc
Dyfonate 20G	1.0B	2.55abcd	53.1	0.0a	12.0a
BUX 10G	1.0B	2.60abcd	51.6	3.0a	12.75abc
Diazinon 14G	1.0B	2.65bcde	50.0	0.0a	12.75abc
Lorsban 15G	2.0B	2.65bcde	50.0	0.0a	13.0abc
Thimet 15G	1.0B	2.65bcde	50.0	3.5a	13.25abc
Diazinon 14G	2.0B	2.65bcde	50.0	0.0a	13.50abc
Lorsban 15G	1.0B	2.75cde	47.0	2.0a	12.25ab
CGA 12223 15G	1.0B	2.80cdef	45.5	2.0a	14.25c
Dasanit 15G	1.0B	2.8cdef	45.5	0.0a	14.0bc
Mocap 10G	1.0B	2.8cdef	45.5	2.0a	12.5ab
BUX 10	2.0B	3.05def	37.9	0.50a	13.25abc
Mocap 10G	2.0B	3.10def	36.4	3.5a	13.0abc
UTC	--	3.30ef	--	18.5b	13.50abc
DiSyston 15G	1.0B	3.40f	0	3.5a	14.0bc

Date of Planting: May 21, 1975
Rated: July 28, 1975
Hybrid: XL44
Cultivation: June 19 - July 7, 1975

Table 26. Hodgson Farm, Alcester

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
Furadan 10G	2.0B	1.90a	83.0	14.0a	12.0ab
Furadan 10G	1.0B	2.0ab	81.0	13.0a	13.5abc
Counter 15G	2.0B	2.05ab	80.8	66.0efgh	15.25bc
Dyfonate 20G	2.0B	2.10ab	79.1	13.0a	14.5abc
Counter 15G	1.0B	2.20abc	77.2	20.5ab	15.5c
Dyfonate 20G	1.0B	2.35abcd	74.3	14.5a	11.50a
SRA 12869 15G	2.0B	2.45abcde	72.4	9.5a	13.0abc
Mocap 10G	2.0B	2.60bcdef	69.6	38.0bcd	14.5abc
BUX 10G	2.0B	2.65bcdef	68.6	21.5ab	13.5abc
SRA 12869 15G	1.0B	2.75cdef	66.7	59.5defg	14.5abc
CGA 12223 15G	2.0B	2.95defg	62.9	30.5ab	11.25a
Lorsban 15G	2.0B	3.0efg	62.0	55.0def	13.50abc
BUX 10G	1.0B	3.05efg	61.0	46.5cde	14.5abc
Thimet 15G	2.0B	3.05efg	61.0	76.0efghij	12.5ab
CGA 12223 15G	1.0B	3.20fgh	58.1	58.50defg	14.25abc
Thimet 15G	1.0B	3.45gh	53.4	79.5ghijk	13.75abc
Mocap 10G	1.0B	3.50gh	52.4	80.5ghijk	15.25bc
Diazinon 14G	1.0B	3.55gh	51.5	63.0efgh	12.75abc
Diazinon 14G	2.0B	3.55gh	51.5	72.0fghi	13.0abc
Lorsban 15G	1.0B	3.75h	47.7	69.5efghi	14.0abc
DiSyston 15G	2.0B	4.40i	35.3	86.0hijk	15.25bc
DiSyston 15G	1.0B	4.45i	34.3	92.5ijk	15.25bc
Dasanit 15G	2.0B	4.90ij	25.8	98.5jk	12.0ab
Dasanit 15G	1.0B	5.1j	26.7	100.0k	12.25abc
UTC	---	5.1j	---	100.0k	13.5abc

Date of Planting: May 19, 1975
Rated: July 28, 1975
Hybrid: XL 45A
Cultivation: None

Table 27. Grubbrud Farm, Beresford

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent
CGA 12223 15G	3.0B	1.6a	83.1	59.0a
CGA 12223 15G	2.0B	2.0ab	71.9	69.5abcd
CGA 12223 15G	1.0B	2.25abc	64.8	75.5abcdef
SRA 12869 15G	2.0B	2.25abc	64.8	68.5abc
Mocap 10G	3.0B	2.25abc	64.8	73.5abcdef
Lorsban 15G	3.0B	2.25abc	64.8	67.5abc
Furadan 10G	3.0B	2.35abc	62.0	67.0abc
Mocap 10G	2.0B	2.35abc	62.0	84.5bcdef
Counter 15G	3.0B	2.45abc	60.6	72.5abcde
Dyfonate 20G	2.0B	2.45abc	59.2	76.0abcdef
BUX 10G	1.0B	2.5abc	57.8	65.5ab
BUX 10G	3.0B	2.5abc	57.8	83.5bcdef
SRA 12869 15G	3.0B	2.5abc	57.8	82.5bcdef
BUX 10G	2.0B	2.5abc	57.8	81.5abcdef
Counter 15G	2.0B	2.55abcde	56.4	73.0abcdef
Dyfonate 20G	3.0B	2.65abcde	53.6	83.0bcdef
Dasanit 15G	1.0B	2.65abcde	53.6	82.25bcdef
Dasanit 15G	3.0B	2.70abcde	52.2	87.0bcdef
Thimet 15G	3.0B	2.70abcde	52.2	85.0bcdef
Thimet 15G	1.0B	2.75bcde	50.8	84.0bcdef
Dasanit 15G	2.0B	2.75bcde	50.8	69.0abc
SRA 12869 15G	1.0B	2.75bcde	50.8	87.0bcdef
Dyfonate 20G	1.0B	2.90bcdef	46.5	80.0abcdef
Furadan 10G	2.0B	2.90bcdef	46.5	68.5abc
Furadan 10G	1.0B	2.95bcdef	45.1	83.0bcdef
Thimet 15G	2.0B	3.05bcdef	42.3	96.0f
Counter 15G	1.0B	3.0bcdef	42.3	86.5bcdef
Mocap 10G	1.0B	3.1bcdef	40.9	86.0bcedf
DiSyston 15G	2.0B	3.15cdef	39.5	93.5ef
Diazinon 14G	3.0B	3.15cdef	39.5	84.5bcdef
Diazinon 14G	2.0B	3.30cdef	35.3	80.5abcdef
Lorsban 15G	1.0B	3.30cdef	35.3	95.5ef
Lorsban 15G	2.0B	3.30cdef	35.3	90.0cdef
UTC	---	3.35cdef	---	92.5def
Diazinon 14G	1.0B	3.65def	25.0	81.0abcdef
UTC	---	3.75ef	---	82.0bcdef
DiSyston 15G	1.0B	4.0f	15.0	96.0f

Date of Planting: May 9 , 1975
Rated: August 1, 1975
Hybrid: XL45A
Cultivated: June 23, 1975

Table 28. Krog Farm, Lake Benton

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
CGA 12223 15G	2.0B	2.2a	71.5	0.5a	13.25ab
Counter 15G	2.0B	2.4ab	66.7	0.5a	13.75b
CGA 12223 15G	1.0B	2.5abc	64.3	1.0ab	13.50b
SRA 12869 15G	2.0B	2.5abc	64.3	1.5ab	12.50ab
Furadan 10G	2.0B	2.5abc	64.3	7.5 ab	12.25ab
Counter 15G	1.0B	2.55abcd	63.1	0.5a	13.0ab
Furadan 10G	1.0B	2.6abcde	62.0	0.0a	13.0ab
SRA 12869 15G	1.0B	2.6abcde	62.0	1.5ab	11.25
Thimet 15G	2.0B	2.65abcde	60.8	0.0a	13.0ab
Lorsban 15G	2.0B	2.75abcdef	58.4	1.0ab	12.50ab
Mocap 10G	2.0B	2.80abcdef	57.2	1.5ab	13.25ab
Dyfonate 20G	1.0B	2.9bcdef	54.8	3.0ab	13.5b
Dyfonate 20G	2.0B	3.0bcdef	52.4	6.0ab	12.50ab
DiSyston 15G	1.0B	3.1cdef	50.0	7.0ab	13.5b
Dasanit 15G	2.0B	3.1cdef	50.0	1.0ab	13.25ab
BUX 10G	1.0B	3.15def	48.9	14.0ab	12.25ab
Lorsban 15G	1.0B	3.15def	48.9	3.5ab	12.75ab
Diazinon 14G	2.0B	3.15def	48.9	2.5ab	11.75ab
Diazinon 14G	1.0B	3.15def	48.9	4.0ab	12.75ab
Thimet 15G	1.0B	3.2ef	45.3	1.5ab	12.0ab
BUX 10G	2.0B	3.2ef	45.3	5.0ab	12.25ab
DiSyston 15G	2.0B	3.3fg	45.0	3.0ab	13.0ab
Dasanit 15G	1.0B	3.35fg	44.1	6.5ab	12.00ab
Mocap 10G	1.0B	3.85gh	32.2	15.5b	12.50ab
UTC	---	4.2h	---	61.0c	12.50ab

Date of Planting: May 20, 1975
Rated: August 4, 1975
Hybrid: DeKalb XL44
Cultivated: June 24, 1975

Table 29. Tofte Farm, Brookings

Treatment	Rate lb. A/A	Root Rating	Percent Root Protection	Lodging Percent	Stand Count
Counter 15G	3.0B	1.65a	82	0.5a	12.75abc
Furadan 10G	3.0B	1.8ab	80	4.0abc	12.75abc
Furadan 10G	1.0B	2.0ab	75	0.0a	13.50abcd
Mocap 10G	3.0B	2.0ab	75	13.0abcdefg	13.0abcd
SRA 12869 15G	3.0B	2.05abc	74	1.5ab	12.75abc
Dyfonate 20G	3.0B	2.1abc	70	4.0abc	13.25abcd
CGA 12223 15G	3.0B	2.1abc	70	0.0a	12.50ab
Thimet 15G	3.0B	2.1abc	70	4.0abc	15.0cd
Counter 15G	1.0B	2.25bcd	65	4.5abc	13.0abcd
Diazinon 14G	3.0B	2.60cde	61	6.0abcd	13.75abcd
SRA 12869 15G	1.0B	2.60cde	61	1.5ab	13.50abcd
Dyfonate 20G	1.0B	2.70de	55	3.0abc	12.50ab
Mocap 10G	1.0B	2.75def	56	9.5abcdef	13.75abcd
Thimet 15G	1.0B	2.75def	47	6.0abcd	15.25d
Dasanit 15G	3.0B	2.80defg	59	3.0abc	14.25bcd
Mocap 10G Encap	3.0B	2.85efg	54	9.5abcdef	12.50ab
CGA 12223	1.0B	3.0efgh	46	5.0abcd	15.0cd
Dasanit 15G	1.0B	3.1efghi	52	7.0abcd	13.50abcd
Lorsban 15G	3.0B	3.2fghij	46	14.5abcdefg	12.75abc
UTC (Thimet)	---	3.3fghijk	---	14.5abcdefg	13.75abcd
Mocap 10G Encap	1.0B	3.35ghijk	42	18.0abcdefgh	13.50abcd
Diazinon 14G	1.0B	3.5hijkl	40	21.0abcdefgh	11.75a
UTC (Counter)	---	3.6ijklm	---	19.0abcdefgh	13.75abcd
Lorsban 15G	1.0B	3.6ijklm	34	22.5cdefghi	13.0abcd
UTC (CGA 12223)	---	3.7jklmn	---	35.0hijk	13.75abcd
BUX 10G	1.0B	3.75jklmn	39	26.0efghijk	13.25abcd
UTC (Dyfonate)	---	3.80klmno	---	22.0cedfghi	13.25abcd
UTC (Lorsban)	---	3.95lmnop	---	28.50fghijk	12.50ab
UTC (Mocap 10G)	---	4.0lmnop	---	24.0defghi	12.25ab
UTC (Mocap Encap)	---	4.05lmnop	---	28.5fghijk	13.0abcd
UTC (Furadan)	---	4.05lmnop	---	26.5fghijk	13.75abcd
UTC (Diazinon)	---	4.15mnop	---	40.0jk	13.25abcd
UTC (SRA 12869)	---	4.2nop	---	43.5k	12.5ab
BUX	3.0B	4.25nop	28	18.0abcdefgh	14.25bcd
UTC (Dasanit)	---	4.35op	---	38.0ijk	12.25ab
UTC (BUX)	---	4.50p	---	30.5ghijk	13.25abcd

Date of Planting: May 13, 1975
Rated: August 5, 1975
Hybrid: DeKalb XL44
Cultivated: June 25, 1975

SOUTH DAKOTA INSECTICIDE RECOMMENDATIONS FOR CORN ROOTWORM CONTROL, 1976

B. H. Kantack and D. D. Walgenbach

Insecticides recommended for control of corn rootworm larvae on the basis of performance in South Dakota State University's Agricultural Experiment Station Research Plots are given in Table 30.

Table 30. Insecticides recommended for control of corn rootworm larvae

Insecticide/ Formulations	Amount Formulation 1,000 ft. Row (ounces)	Formulation and Amount/ Acre of Row (pounds)
Category A		
Furadan 10G	12	10
Counter 15G	8	6.7
Category B		
Dyfonate 20G	6	5
Dyfonate 10G	12	10
Category C		
Dasanit 15G	8	6.7
Thimet 15G	8	6.7
Mocap 10G	12	10

These corn rootworm insecticides are ranked according to the root protection provided by planting-time treatments during 1974 and 1975, in South Dakota State University's Experiment Station trials.

It is recommended that South Dakota corn growers ROTATE THEIR CORN ROOTWORM CHEMICALS EACH YEAR using the better performing insecticides listed in Category A. Where insecticide availability is a problem, then the grower should select from the next best performing category.

South Dakota State University entomologists strongly recommend insecticide treatments for corn rootworm control on all first year corn following small grains, flax and sorghum. Corn rootworm infestations in corn following small grain and flax were quite common over eastern South Dakota during the 1975 growing season. The predominant species involved was the northern corn rootworm. In addition where corn rootworm beetle populations are very high, farmers should consider treatment corn following soybeans particularly where complete weed control was not achieved.

ROOT PULLING RESISTANCE OF CORN INBRED LINES

J. R. Jenison, L. H. Penny and D. B. Shank

Many corn breeders from both commercial corn companies and publicly supported research programs have used some form of a plant pulling technique to measure root strength or root lodging resistance. However, only limited information is available regarding root systems of corn inbred lines. Since field studies of root systems and specific root characteristics are limited, their relative importance in drought tolerance, lodging resistance, rootworm tolerance, etc., is generally unknown. Before it is possible to study their importance, it is first necessary to establish the repeatability of root characteristics in changing environmental conditions.

We initiated a study in 1974 on root pulling resistance in a group of 49 inbred lines of corn. Purposes of the study were to determine (1) the range of root-pulling resistance that exists among lines, (2) the repeatability of root pulling measurements as well as other root characteristics in changing environmental conditions, (3) the relationship between root-pulling resistance and root characteristics such as root spread, root dry weight, total root abundance, large and fine root abundance, and root rot resistance, and (4) the ability of inbred lines to transmit differences in pulling resistance to hybrids.

The 49 lines chosen for the study included lines from the state corn breeding programs in South Dakota and Minnesota, the USDA Northern Grain Insect Research Laboratory at Brookings, and a few lines from other sources. They were grown in 1974 and 1975 at the Southwest Minnesota Agricultural Experiment Station at Lamberton, Minnesota, at the Northern Grain Insect Research Laboratory plots at Brookings, South Dakota, and at the Southeast South Dakota Experiment Farm.

Root-pulling resistance was measured as the pounds of force required to lift a plant vertically from the soil. We planned to pull 5 plants per plot at the boot stage of plant growth, another 5 plants at the milk stage, and another 5 plants at the late dent stage after root rots had become established. The last pull was abandoned in both years due to severe drought. The roots pulled at the milk stage were cut free from the stalk, washed and root spread and dry weight determined.

Data obtained at the Southeast South Dakota Experiment Farm in 1974 and 1975 for a few representative lines are shown in Table 31 to indicate the range of values with which we are working. Values shown are on an individual plant basis and represent the means of 20 plants (5 plants in each of 4 replications).

Root development during the 1975 season was even more restricted than in 1974. The root system of some lines did manage to develop in the dry period between the first and second pull, however, growth was much slower than would be excpected under normal conditions. Considering the severe drought in both years, data collected in all aspects of this study seem to show an acceptable degree of repeatability between the two years and locations.

This two year study has provided upper root system information on a number of corn inbred lines some of which are used in commercial hybrids grown around Beresford, as well as in other areas of South Dakota. An inheritance study of root pulling resistance was initiated in 1975 using specific entries from the

Table 31. Root Pulling Measurements on a Selected Group of Corn Inbred Lines in 1974 and 1975

	Pounds Pull				Dry Weight (grams)		Root Spread (inches)	
	Boot Stage		Milk Stage					
Inbred Line	1974	1975	1974	1975	1974	1975	1974	1975
NGIL 72227	273	276	321	285	23.2	15.4	8.6	7.1
NGIL 72336	323	215	356	285	17.8	14.0	8.8	6.9
NGIL 72254	253	210	252	249	9.6	9.7	5.4	5.1
NGIL 72358	277	204	265	242	11.0	9.9	5.1	4.9
A632	215	168	200	154	10.5	8.9	7.0	6.8
A634	274	223	298	192	12.6	8.6	8.2	6.3
A556	202	172	216	196	14.5	8.5	4.8	4.1
A660	134	152	135	178	7.3	9.1	4.9	5.3
SDP2A	192	158	211	140	9.4	6.0	7.3	6.0
SD 58-26B	296	260	334	268	19.6	14.6	9.1	7.7
SDP309	175	175	213	213	12.1	8.8	4.8	4.8
SD10	275	247	255	242	15.9	11.6	6.7	6.3
W64A	244	204	246	198	11.6	8.5	7.5	6.3
W117	173	143	149	149	7.2	4.9	6.8	5.7
W182E	160	137	133	164	4.8	3.8	5.3	4.8
C123	218	176	211	238	7.5	6.9	5.1	4.6
Mean (all 49)	234	198	244	220	12.6	9.8	6.6	5.8
LSD (0.05)	38	42	38	47	2.8	2.8	0.8	0.7
CV	10.7%	15.3%	10.5%	15.4%	15.5%	20.3%	8.5%	9.0%

1974 experiments. Further investigations of root characteristics such as upper root system spread and its relative importance to drought tolerance and high plant populations will be attempted in the near future.

CORN PERFORMANCE TRIALS

J. J. Bonnemann

The 1975 Corn Performance Trial included 81 entries, proprietary and experimental, at the Southeast Experiment Farm.

The trials were seeded May 14, 1975 in 30-inch row spacings at seeding rates to achieve 16,000 and 20,000 plants per acre.

The prolonged drouth of late June and July accompanied by over 20 days of 90^{o} or higher temperatures "burned-up" the trial. Tasseling, pollination and development were curtailed by the drouth and heat and were beyond recovery when the adequate and timely rains occurred again in early August. The trial was not harvested as most stalks had only barren, smutted ears.

HERBICIDE DEMONSTRATION PLOTS

W. E. Arnold and L. J. Wrage

These plots demonstrate the performance of corn and soybean herbicides that are recommended by SDSU, labeled or have an experimental label. These treatments have been tested previously in research screening trials. These demonstration plots are larger than research plots, and can be viewed by producers periodically during the season.

Early season weed control ratings for the 1975 treatments are listed in the following tables. A 2-year (1974-75) and 4-year (1972-75) average is also given. The long-term averages give an indication of weed control consistency with varying conditions. All evaluations were made in uncultivated areas.

Corn Herbicide Demonstration. Soil and moisture conditions were favorable in the early season. Weed control was above average for most treatments. Grassy weed infestations were moderate and broadleaved weeds (pigweed species) were light but ample for evaluation.

The strength and weakness of each treatment are indicated by the data presented. The consistency of broad-spectrum weed control with the combination treatments is evident. Slight stunting was observed for the Bladex post-emergence treatment in 1975. This effect might be less apparent under dry conditions or with a reduced rate.

Soybean Herbicide Demonstration. All herbicides provided above-average results in 1975. Soil conditions and moisture were favorable. Weed infestations were light but of sufficient density to evaluate. The broadleaf weeds were primarily pigweed species. Broadleaved weeds such as cocklebur and velvetleaf

were not found in the plot area; therefore, the herbicide for broadleaved control in the overlay or combination treatments show less advantage than they would if the hard-to-control species were present.

Some treatments produced visual effects on the soybean plants. Modown caused severe early-season leaf abnormalities. The treatments with Sencor or Lexone caused slight early-season leaf burn. Cobex caused slight stunting at emergence. In all cases, plants recovered as the season progressed with no visual differences apparent at harvest.

Table 32. Corn Herbicide Demonstration Results, 1975

		Estimated Percent Weed Control				
		1975		2-Yr. Avg.	4-Yr. Avg.	
Treatment	lb/A a.i.	Gr	Bdlf	Gr	Gr	Bdlf
PREPLANT INCORPORATED						
Sutan+	4	95	80	90	91	73
Sutan+ + AAtrex	3+1	95	98	83	92	97
AAtrex	2½	98	99	84	87	98
Sutan+ + Bladex	3+1½	85	95	90	--	--
Eradicane	3	96	90	96	--	--
Eradicane	4	96	85	96	--	--
Eradicane + Bladex	3+1½	94	99	--	--	--
PREEMERGENCE						
Lasso	3	99	90	95	97	88
Ramrod	5	98	80	97	96	75
Prowl	2	99	98	77	--	--
AAtrex	2½	85	98	58	73	99
Bladex	3	94	98	80	86	71
Lasso + AAtrex	2+1	99	99	94	96	98
Lasso + Bladex	2+1½	99	99	94	--	--
Lasso + Banvel	2+½	98	98	94	--	--
Ramrod + AAtrex	3+1	98	99	94	95	90
Ramrod + AAtrex	3+1½	99	--	--	--	--
POST-EMERGENCE						
AAtrex + oil	2+1 gal	80	99	78	66	96
Bladex	2	90	95	98	--	--
Bladex + surfactant	2	95	99	95	--	--
Outfox	3/4	80	75	65	65	85

Evaluated: 7/2

Weeds: Green and yellow foxtail; rough and prostrate pigweed, lambsquarter.

Rainfall after preemergence (5/12): 1st wk. = Tr; 2nd wk. = 1.08 inches

Table 33. Soybean Herbicide Demonstration Results, 1975

Treatment	lb/A a.i.	Estimated Percent Weed Control 1975 Gr	1975 Bdlf	2-Yr. Avg. Gr	2-Yr. Avg. Bdlf	4-Yr. Avg. Gr	4-Yr. Avg. Bdlf
PREPLANT INCORPORATED							
Vernam	2½	90	80	99	88	90	84
Treflan	3/4	95	90	97	94	96	91
Cobex	½	95	90	97	94	--	--
Tolban	1	95	90	93	91	--	--
Treflan + Sencor/Lexone	3/4+½	98	96	--	--	--	--
PREPLANT INC. & PRE							
Treflan + Sencor/Lexone	3/4+½	98	96	99	98	--	--
Treflan + Lorox	3/4+1	98	96	99	98	98	98
Treflan + Modown	3/4+1½	98	96	--	--	--	--
PREPLANT INC. & POST							
Treflan + Basagran	3/4+1	95	90	97	93	--	--
PREEMERGENCE							
Amiben	3	95	85	95	88	84	83
Lasso	3	98	80	97	80	93	75
Lasso + Sencor/Lexone	2+½	98	95	97	94	--	--
Lasso + Lorox	2+1	98	95	97	90	92	88
Sencor/Lexone	½	98	96	92	92	--	--
Lasso + Premerge	2+4½	98	95	--	--	--	--
Modown	2	80	95	--	--	--	--
Lasso + Solo	2+4	95	93	--	--	--	--
Lasso + Amiben	2+2	95	98	--	--	--	--
Lasso + CIPC	2+3	98	95	--	--	--	--

Evaluated: 7/24

Weeds: Green and yellow foxtail, barnyardgrass, prostrate, rough and smooth pigweed.

Rainfall after preemergence (5/28): 1st wk. = 0.38"; 2nd wk. = 0.83"

REDUCED TILLAGE FOR CORN

B. Lawrensen and F. Shubeck

Objectives of Experiment

1. Evaluate reduced tillage methods with continuous corn.
2. How successful is the fluted coulter for seedbed preparation?

Methods and Procedures Used in Reduced Tillage

1. Area was fall plowed.
2. Fertilizer broadcast by hand in spring--100 lbs. per acre of 8-32-16 (oxide).
3. Conventional tilled plots--disked dragged and planted with fluted coulter and tool bar planters May 29
4. Reduced till plots were planted on fall plowing with no disking or dragging. They were planted May 29 with fluted coulter and tool bar planter.
5. Variety - P-A-G SX 63
6. Insecticide - Dyphonate 20G
7. Sprayed over all with Aatrex 4L at 4 lbs. and 2 gallons of oil per acre.
8. Cultivated twice.
9. Harvested Oct. 22

Table 34. Effect of Reduced Tillage on Yield of Continuous Corn

Tillage Method	Fertilizer $N + P_2O_5 + K_2O$	Bushels per acre of #2 corn
Fall plow-no spring seedbed tillage	8 + 32 + 16	44
Fall plow-spring disk, drag	8 + 32 + 16	45

Discussion and Interpretation of Table 34

This is a new experiment started in 1975. The older zero tillage experiment with a corn-soybean sequence was having trouble with weed control because some of the more effective weedicides could not be used on corn for fear of carry over effects on beans.

With continuous corn in this experiment, effective long lasting weed chemicals can be used and hopefully the planting system can be more effectively evaluated.

For 1975 one disking and one dragging was eliminated in the reduced tillage plot. From now on the plans are to have "zero" tillage plots to compare to conventional methods. Yields for 1975 were very similar for the two methods used.

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 and yields?
3. If no serious weed problem exists, is it best to use sweeps or twists in the fall?
4. Can yields be maintained by using a chisel plow in the fall rather than a moldboard plow that subjects the soil to a greater erosion hazard?
5. Is the fertilizing system adequate using a sideband starter and side-dressing the nitrogen? (Reduced tillage methods sometimes require more nitrogen.)

Procedure (Soybeans)

Nov. 6, 1974 - Fall tillage completed.
May 6, 1975 - Moldboard plowed designated plots
May 20, 1975 - Chisel plow sweeps and disk treatments completed. Planted all corn plots.
    Variety - Curry's SC 150
    Insecticide - Dyphonate 20G banded in row
    Herbicide - Lasso II banded over row
May 27, 1975 - Completed all spring tillage in the chisel plow soybean area.
May 28, 1975 - Planted soybean plots
    Variety - Corsoy
    Herbicide - Lasso II banded over row
June 6, 1975 - Cultivated all corn plots
June 13, 1975 - Cultivated soybeans the first time
June 24, 1975 - Cultivated beans the second time
July 1, 1975 - Sidedressed corn with 100 pounds N per acre.
Oct. 14, 1975 - Combined all bean plots
Oct. 27, 1975 - Hand picked corn plots
Oct. 28 to Nov. 6, 1975 - Completed fall tillage

Table 35. Effect of Tillage Treatments on Yield of Soybeans

	Tillage Treatment		Soybeans
	In Fall	In Spring	Bu/A
1	---	Disk-disk-drag	34
2	---	Chop-sweeps-disk-drag	34
3	---	Disk-moldboard plow-disk-drag	34
4	Disk-moldboard plow	Disk-drag	30
5	Disk-twists	Disk-drag	30
6	Chop-twists	Disk-drag	29
7	Chop-twists	Sweeps-drag	30
8	Chop-sweeps	Sweeps-drag	31
9	Disk	Disk-drag	34
10	Chop-twists*	Sweeps-drag	29

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

Discussion and Interpretation of Table 35

Notice that with treatments 1, 2 and 3 where all the tillage was performed in the spring, yields were very consistent--34 bushels per acre. With various fall tillage treatments plus spring tillage, yields were more variable and usually lower.

In general, the fall tillage treatments on corn ground prepared for beans did not prove to be very successful for increasing yields in the 1975 bean harvest. Previous work has shown that chisel plowed ground will allow faster infiltration of rainfall. There was very little rain last fall and what we did receive came slowly, thus minimizing the advantage of increased rate of infiltration attributed to chisel plowing.

Table 36. Effect of Tillage Treatments on Yield of Corn

	Tillage Treatments		Bu/A of
	In Fall	In Spring	#2 corn
1	---	Disk-drag	61
2	---	Sweeps-drag	62
3	---	Plow (moldboard)-disk-drag	60
4	Plow (moldboard)	Disk-drag	55
5	Twists	Disk-drag	46
6	Twists	Disk-drag	48
7	Twists	Sweeps-drag	59
8	Sweeps	Sweeps-drag	53
9	---	Disk-drag	58
10	Twists*	Sweeps-drag	59

*Treatment 10 was not fertilized. 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 36

Tillage treatments 5 and 6 were identical for corn but different for the preceding soybean crop.

Fall tillage of soybean ground preparing for corn did not improve yields of corn in 1975.

Corn yields in this experiment were some of the best at the research farm. Reduced tillage, performed in the spring with a moderately late planting date (May 20) were practices that were beneficial with the climatic conditions of 1975. Notice the relatively high corn yield where the only seedbed tillage treatments were disking and dragging the soybean ground in the spring. It will be interesting to see if these results reoccur in future years with very little moisture in fall preceding the crop together with an early summer drought but adequate moisture in late summer.

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" to 7"?
2. Will planting soybeans with a grain drill (7" spacings) and not cultivating be a profitable venture?

Methods and Procedures

May 29, 1975 - Tandem disked and harrowed fall plowed ground. Planted Corsoy.
June 3, 1975 - Sprayed all plots with Ramrod 65W at 7.5 lbs. per acre.
June 23, 1975 - Cultivated 30 inch rows.
Oct. 10, 1975 - Combined all plots.

Table 37. Comparison of 30" Rows and 7" Rows for Soybeans

Row Spacing	Bu/A
30" rows (planted with tool bar planter)	37
7" rows (seeded with press drill)	42

Interpretation of Table 37

Soybean yields in this experiment were excellent considering the long drougth in July and the latter part of June. Planting date was May 29. Other experiments with earlier planting dates had much lower yields.

Plant populations were 181,000 per acre in the 7-inch rows and 174,000 in the 30-inch rows. This would be approximately 13.8 and 13.3 plants per foot of row if the rows had been spaced 40 inches apart. We calibrated for 150,000 plants per acre which is the equivalent of about 12 plants per foot in 40-inch rows but the germination was a little better than anticipated.

There was a definite yield advantage in 1975 for planting in 7-inch rows. For four years prior to 1975, yields were about the same for the two row spacings. In 1969 and 1970, 7" rows yielded more than 30" rows. When yields were over 30 bushels per acre, 7" rows usually yielded more than 30" row spacings (one exception in 7 years).

DATE OF PLANTING SOYBEANS

F. Shubeck and B. Lawrensen

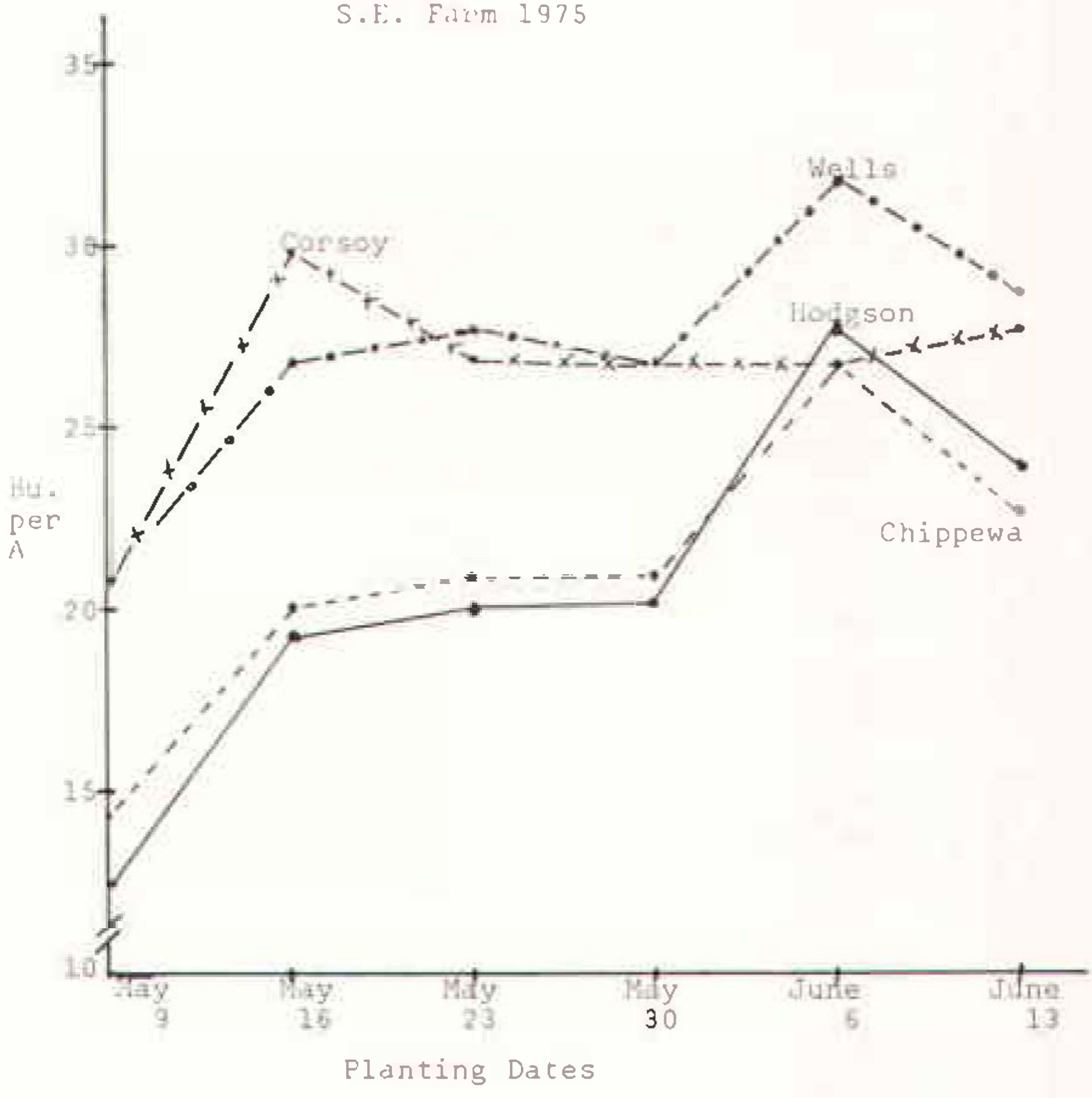
Objectives of Experiment

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 Used in Soybean Study

Nov. 5, 1974 - Fertilized corn area in preparation for beans with
8-40-20
Nov. 8, 1974 - Fall plowed
May 5, 1975 - Sprayed Treflan at 1.5 pints per acre and tandem
disked
May 6, 1975 - Spike tooth harrowed
May 9, 1975 - First planting date
Varieties - Corsoy, Wells, Hodgson, Chippewa 64
Herbicide - Lasso II banded over row
Seed was inoculated in planter box
Soil temperature at 2" depth 56°F
Emergence - May 19
May 16, 1975 - Second planting date
Soil temperature at 2" depth 59°F
Emergence - May 23
Plot area was tandem disked and spike tooth harrowed just before
each planting.
May 23, 1975 - Third planting date
Soil temperature 59°F
Emergence date - May 29
May 30, 1975 - Fourth planting date
Soil temperature 58°F
Emergence date - June 8
June 5, 1975 - Cultivated first and second planting dates
June 6, 1975 - Fifth planting date
Soil temperature 63°F
Emergence date - June 8
June 13, 1975 - Sixth planting date
Soil temperature 65°F
Emergence date - June 19
Plots cultivated as needed
Oct. 16, 1975 - Combined all plots

Figure 2. Effect of Planting Dates on Yield of Soybeans S.E. Farm 1975



Discussion and Interpretation of Figure 2

The two early maturing varieties Hodgson and Chippewa did not do very well when planted early. Water stress became very severe for them in the 40 day drought beginning in the last week of June. When planted later (June 6) these two varieties were able to revive and grow after the drought was broken by a good rain.

The two mid-season varieties Corsoy and Wells yielded more than the early beans at almost every planting date. Moderately early planting dates (May 16) gave good yields with Corsoy and Wells. It is difficult to determine the influence of day length when the drought superimposed such strong effects on growth and yield.

HIGH VIGOR SOYBEANS

B. Lawrensen and F. Shubeck

Objectives of Experiment

1. Will selection of soybean seed on the basis of performance in chemical tests and germination tests under stress conditions be useful in predicting yield performance?

Methods and Procedures

Wayne soybeans from three different sources were obtained for comparative yield tests--High Vigor beans, Certified Wayne, and standard increase. The standard increase seed was purchased from a local elevator. The High Vigor beans originated from a private company in Illinois. According to the company, four different seed tests are reviewed and only superior seed lots are selected and sold under the High Vigor label. These tests include:

1. Cold vigor test--seedlings are grown for one week at 50° then an additional week at 72°. Seedlings are then removed and measured for length.
2. Accelerated aging test--seeds are sapped of their energy by high temperatures and humidity, then germinated.
3. T.Z. test--a chemical test that will detect any physical damage done to the seed.
4. Conventional warm germination test.

Field procedures were as follows:

May 5, 1975 - Moldboard plowed plot area
May 27, 1975 - Double tandem disked area and dragged
May 28, 1975 - Planted all three sources in 30" rows
    Herbicide - Lasso II banded over row
June 23, 1975 - Cultivated all plots
Oct. 9, 1975 - Harvested with Dearborn combine.

Table 38. Effect of Seed Source on Yield of Soybeans

Seed Source	Bu/A
High Vigor	35
Certified	34
Standard increase	37

Discussion and Interpretation of Table 38

From a yield standpoint it appears that excellent seed was obtained from all three sources. The planting date was rather late, giving good yields under 1975 conditions. The high vigor beans appeared to have a little faster growth early in the 1975 growing season. With an earlier planting date and associated cooler temperatures, the comparative performance of the high vigor selection may have been more outstanding.

SOYBEAN INOCULATION STUDY

R. M. Pengra and A. O. Lunden

Objectives

To evaluate three types of soybean root-nodule bacterium inoculants.

Methods

Randomized, four row test plots were set up to test eight treatments of inoculation or nitrogen application. Ten replications were used per treatment at the Southeast Farm location and six replications at the Brookings location. The seeding rate was 7 seeds per foot in 30 inch rows. Corsoy variety soybeans were used and Treflan was broadcast and incorporated at the time of seedbed preparation.

The treatments were: no nitrogen no inoculum (0+0), nitrogen as ammonium nitrate and no inoculation (0+N), regular peat-base inoculant used on the seed (seed), granular inoculant (implant), frozen aqueous inoculant bacterial strain 138 (901), frozen strain 110 (902), frozen strain 5A11 (903), and a mixture of the three above strains (905).

The inoculation for "seed" was done as was directed on the package of commercial inoculant that was used. The "implant" treatment had the granules placed in the furrow at the time of planting at the rate of 6 oz. of granular inoculant per 1000 feet of row or about 10^6 bacterial cells per inch of row. The "seed" treatment had about 10^2 to 10^4 bacteria per inch of row and the frozen inoculant about 10^6 bacteria per inch of row. These figures are based on the manufacturers stated number of bacteria per unit weight on the package.

Results and Discussion

The several criteria used to evaluate the inoculants were: plant height, number and color of nodules and seed yield.

Table 39. Inoculum Performance

Treat-ment	Inoc.**	Southeast Farm N #/a	Southeast Farm Nodules* No./pl.	Southeast Farm Plant ht.cm.	Southeast Farm Seed bu/a	Brookings Plots N #/a	Brookings Plots Nodules No./pl.	Brookings Plots Plant ht.cm.	Brookings Plots Seed bu/a
0-0	0	0	3.5	60.0	32.9	0	0	37.4	39.6
0-N	0	80	1.8	59.4	36.1	50	0	35.8	43.5
Seed	NIT	0	4.6	59.4	35.0	0	Moderate pink†	36.0	41.7
Imp.	Gran.	0	5.1	59.6	32.7	0	Moderate pink†	37.2	41.2
901	138	0	3.5	60.8	35.2	0	0	36.2	41.3
902	110	0	4.1	60.8	34.0	0	0	36.2	41.6
903	5A11	0	4.2	59.9	33.5	0	0	38.0	41.5
905	138, 110 & 5A11	0	5.4	60.2	34.6	0	0	36.6	41.9

*Average of 4 plants per replicate.
**NIT="Nitragin" peat inoculant; Gran.="Nitragin" granular inoculant; 138, 110 and 5A11="Microlife" strain numbers in frozen inoculant.
†Over 20 nodules per plant.

The plant heights were not significantly different. Lodging was evidently not influenced by treatment as no differences could be seen. At the Southeast Farm nitrogen application seemed to suppress nodulation by the residual rhizobia in the soil. No real difference in nodulation can be seen in any other treatments at this location. The soil at the Brookings location evidently had no soybean bacteria (Rhizobium japonicum) as the only plants developing nodules were those inoculated with the peat and granular inoculants. No nodules resulted from inoculation with the frozen inoculants.

From these data we must conclude that nitrogen was not the limiting factor for growth and seed yield at either the Southeast Farm or at the Brookings plots.

The peat base inoculant and the granular inoculant contained adequate numbers of infective bacteria based on nodulation at Brookings, and apparently effective rhizobia based on the pink color of these nodules. The frozen inoculant seemed to be completely lacking in viable, infective rhizobia.

Nitrogen did not appear to be the limiting factor for soybean growth as neither nodulation nor added nitrogen gave greater growth than the plots without either. It appears that the lack of adequate rainfall was the limiting factor particularly at the Southeast Farm as rainfall was below normal during the middle of the growing season.

Under our conditions of growth the high numbers of rhizobia supplied by the granular soybean inoculant (implant) did not give any added benefit for its extra cost over more conventional inoculation.

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 N is returned to the soil.)
2. Will disease and insects gradually build up and reduce yields?
3. Soybeans do not respond to direct application of large quantities of commercial nitrogen like corn. Could we raise continuous beans to reduce expenditures for nitrogen fertilizer yet increase the soil nitrogen reserves from symbiotic soybean nitrogen?

Methods and Procedures

1. Area was fall plowed
2. May 27, 1975 - Spread 75 pounds per acre of 8-32-16 for continuous beans and rotation beans. Broadcast 80-30-20 on corn plots. Tandem disked and spike tooth harrowed.
3. Planted May 27
   Variety - Corsoy soybeans
   P-A-G SX 63 corn
   Insecticide - Dyphonate 20G
   Herbicide - Lasso II banded over row
3. Cultivated plots June 25
4. Harvested Oct. 23

Table 40. 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	--	33
Continuous beans	8 + 32 + 16	--	35
Rotation beans*	0 + 0 + 0	--	38
Rotation beans*	8 + 32 + 16	--	40
Rotation corn*	0 + 0 + 0	25	--
Rotation corn*	80 + 30 + 20	29	--

*Corn and bean rotation.

Discussion and Interpretation of Table 40

This experiment was started in 1975 so no affect on yield can be attributed to rotation as the area was uniformly cropped the year before.

Nitrogen rate of 80 pounds per acre on corn was selected because at this rate, in another experiment at the farm, there was no build-up of nitrates in the soil over a three year period.

Note the small but consistent increase in soybean yields due to commercial fertilizer.

SORGHUM BREEDING

A. O. Lunden

The sorghum research plot included six released South Dakota lines and hybrids, 22 regional grain sorghum entries from seven states and 16 experimental hybrids. The plot was so severely affected by midsummer drought that only the earliest cultivars were headed by August and many were in a state of complete dormancy. Rain in early August broke the dormancy and triggered multiple tillering of all entries. Virtually every plant had two or more tillers with 5, 6 or 7 heads generally produced on each plant. Some entries averaged more than 10 fertile heads per plant although many of the tillers were small and late and were still flowering at frost in October.

Yields were very low in spite of this late tillering and ranged from only 20 to about 40 bushels per acre. Several new early experimental hybrids produced from an early malesterile selection from SD106 appear to be very promising.

SOYBEAN BREEDING RESEARCH AND YIELD TEST RESULTS

A. O. Lunden and G. W. Erion

Soybean yield test plantings in southeast South Dakota included all of the Group II and Group III Northern States Uniform Test entries, 13 standard varieties, over 30 commercial entries and 5 advanced breeding lines. The plots were planted on May 19 at Elk Point and May 21 at Beresford and a killing frost occurred on October 1 at both sites.

Soybean yields were only slightly below the long time averages in spite of severe midsummer drought stress in the Beresford plot and were slightly above average in the Elk Point plot because of the timely application of a much needed irrigation during the second week of August. Yields are shown in Tables 41 and 42. Shattering was especially severe in a few entries and the shattering potential should be considered in variety selection if timely harvest is questionable.

Table 41. Soybean Performance in Southeastern South Dakota (Beresford, 1972-75)

Identification of Entries[1]			1975 Field Data			Average Yield in Bu/Acre				
			Maturity Date (Mo.-Day)	Plant Height (in.)	Potential Shatter Loss[4]	73	74	75	72-75	74-75
Standard Varieties:										
Entry	Maturity Group[2]	Days to Mature[3]								
Hodgson	I	+3	9-30	20	1	28.0	22.5	32.7	--	27.6
Rampage	I	+9	10-1	20	1	30.4	23.5	30.6	30.5	27.0
Corsoy	II	+10	10-2	23	1	37.6	26.9	33.4	35.0	30.2
Hark	I	+11	10-2	20	1	31.9	23.9	28.8	30.2	26.4
Provar	II	+11	10-3	23	1	37.3	22.1	31.7	32.3	26.9
Wells	II	+12	10-3	21	1	37.0	25.2	32.3	33.7	28.8
Harcor	II	+12	10-3	22	1	36.5	25.3	33.9	--	29.6
Amsoy 71	II	+13	10-4	23	1	39.3	25.2	32.5	34.2	28.9
Beeson	II	+15	10-4	23	1	41.3	21.9	32.2	33.2	27.1
Wayne	III	+22	10-10	27	1	42.3	26.4	30.3	35.1	28.4
Woodworth	III	+23	10-11	27	1	49.2	21.9	32.4	--	27.2
Commercial Entries:										
Brand	Entry									
Northrup King	S1346		9-30	18	1			27.6		
Agripro	1235		9-30	20	1		23.2	28.9		26.1
Weathermaster	SB63		9-30	21	1			35.1		
Pride	B186		9-30	22	2			27.2		
Weathermaster	SB73		10-1	20	1			30.8		
SRF	150		10-1	19	1	34.2	22.0	27.3	29.4	24.7
Peterson-Pioneer	85		10-1	18	1				31.4	
Agripro	14		10-1	22	1	25.0	25.0	32.4	25.4	28.7
Weathermaster	73A		10-2	21	1				32.3	
Northrup King	M50		10-2	22	1				34.0	

Table 41 continued.

Identification of Entries	Entry	1975 Field Data: Maturity Date	Plant Height	Potential Shatter Loss	Average Yield in Bu/Acre: 73	74	75	72-75	74-75
Jacques	J98	10-2	21	1			30.7		
Land O'Lakes	G042	10-2	23	1	39.9	24.4	35.1	35.5	29.8
Pride	B216	10-2	21	1			34.8		
Jacques	J104	10-3	1				35.1		
Riverside	404	10-3	23	1		25.3	32.5		28.9
Peterson-Pioneer	105P	10-3	24	1			36.5		
Rob-See-Co	Apache III	10-3	22	1			31.4		
Weathermaster	SB70	10-3	25	1			33.3		
Peterson-Pioneer	3100	10-3	25	1			36.9		
Land O'Lakes	Dixon	10-3	22	1	40.7	25.7	33.1		29.4
Riverside	303	10-3	23	1		25.4	30.3		27.9
Riverside	3034	10-4	27	1			35.1		
Northrup King	M51	10-4	25	1			37.0		
Asgrow	XP2444	10-4	24	1			40.1		
Asgrow	XP2656	10-4	23	1			31.4		
SRF	200	10-4	25	1	39.8	27.8	35.3		31.6
Agripro	20	10-4	23	1			34.8		
Rob-See-Co	Cherokee II	10-4	23	1		24.9	33.0		29.0
Northrup King	S1474	10-5	24	1		25.3	34.5		29.9
Asgrow	A2770	10-5	27	1			34.8		
SRF	307P	10-8	27	1			32.3		
Agripro	25	10-8	25	1		23.2	34.0		28.6
Jacques	J114	10-9	28	1			32.4		
LSD							5.5		

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

Table 42. Soybean Performance in Extreme Southeastern South Dakota (Elk Point, 1972-75)

Identification of Entries[1]			1975 Field Data			Average Yield in Bu/Acre				
			Maturity Date (Mo.-Day)	Plant Height (in.)	Potential Shatter Loss[4]	73	74	75	72-75	74-75
Standard Varieties:										
Entry	Maturity Group[2]	Days to Mature[3]								
Corsoy	II	+10	10-3	40	1	41.6	39.7	43.1	42.4	41.4
Hark	I	+11	10-2	39	3	39.8	35.6	37.0	38.6	36.3
Wells	II	+12	10-4	42	1	40.8	35.8	39.7	40.0	37.8
Harcor	II	+12	10-3	41	1	--	--	45.0	--	--
Amsoy 71	II	+13	10-4	44	1	44.9	35.3	36.3	40.5	35.8
Beeson	II	+15	10-5	41	2	46.2	35.9	38.9	43.0	37.4
Wayne	III	+22	10-6	43	1	44.8	36.9	31.0	39.4	34.0
Woodworth	III	+23	10-8	42	1	45.4	37.4	35.5	40.5	36.5
Calland	III	+24	10-9	37	1	49.4	36.3	31.5	38.9	33.9
Williams	III	+25	10-9	42	1	40.0	38.2	29.7	37.3	34.0
Commercial Entries:										
Brand	Entry									
Pride	B186		9-28	34	5			34.8		
Northrup King	S1346		9-30	34	1			33.8		
Agripro	1235		9-30	31	2			36.9		
Peterson-Pioneer	85		10-1	28	2			35.7		
SRF	150		10-1	38	2	45.2	32.8	34.5	38.3	33.7
Agripro	14		10-1	38	4		38.3	36.3		37.3
Asgrow	XP2444		10-2	38	1			42.5		
Peterson-Pioneer	3100		10-2	38	1			39.1		
Pride	B216		10-2	38	2			38.2		
Riverside	404		10-2	38	1		34.4	43.8		39.1
Weathermaster	73A		10-2	40	1			39.5		
Land O'Lakes	Dixon		10-2	38	1	42.9	39.8	42.8		41.3

Table 42 continued.

Identification of Entries	Entry	1975 Field Data: Maturity Date	Plant Height	Potential Shatter Loss	Average Yield in Bu/Acre: 73	74	75	72-75	74-75
Jacques	J104	10-2	39	1			42.0		
Land O'Lakes	G042	10-3	38	1	46.2	36.5	45.0		40.8
Weathermaster	73	10-3	38	3			36.6		
Jacques	J98	10-3	42	2			43.0		
SRF	200	10-3	45	1	43.9	37.1	37.0		37.1
Agripro	20	10-3	38	1			38.1		
Northrup King	M50	10-3	38	1			39.3		
Agripro	25	10-3	39	1		36.6	37.8		37.2
Rob-See-Co	Apache II	10-3	40	1			42.6		
Asgrow	XP2656	10-4	40	2			40.6		
Rob-See-Co	Cherokee II	10-4	38	1		38.7	39.5		3.91
Weathermaster	SB70	10-4	38	1			40.1		
Peterson-Pioneer	105P	10-4	42	1			39.0		
Riverside	303	10-4	43	1		32.6	42.3		37.5
Northrup King	S1474	10-4	43	2		34.3	45.4		39.9
Asgrow	A2770	10-5	42	1			35.1		
Northrup King	M51	10-5	41	1			38.9		
Riverside	3034	10-5	41	1			35.0		
SRF	307P	10-6	44	1			28.6		
Jacques	J114	10-7	44	1			31.3		
Asgrow	A3300	10-8	43	1			36.1		
LSD							6.1		

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

Corsoy and Harcor were the best standard varieties at Beresford in 1975 but many commercial varieties were highly competitive. The "early" varieties were the best yielders at the Elk Point site in both 1974 and 1975 although the long time soybean performance in that area would probably favor full season varieties like Woodworth or Beeson. Harcor, which is similar to Corsoy but is resistant to phytophthora root rot, has recently been released by Canadian breeders. It is not yet available for commercial production but is being increased through the Foundation Seed program for release to South Dakota farmers and seedsmen for planting in 1977.

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

April 24, 1975 - Chisel plowed with sweeps all oats plots and tandem disked
April 25, 1975 - Spike tooth harrowed all oat plots
April 30, 1975 - Tandem disked and harrowed all oat plots
May 1, 1975 - All oat plots were seeded
    Variety - Noble oats
    Alfalfa - Vernal
    Sweet clover - Madrid
May 2, 1975 - Plowed all corn, soybean, and grain sorghum plots
May 5, 1975 - Tandem disked plots in preparation of seedbed
May 13, 1975 - Tandem disked all corn, soybean and grain sorghum plots and spike tooth harrowed
May 16, 1975 - All corn plots planted with 75 pounds 8-32-16 starter
    Variety - P-A-G SX 63
    Herbicide - Lasso II banded over the row
    Insecticide - Thimet 15G
May 27, 1975 - Tandem disked and harrowed all soybean and grain plots in readiness for planting. Planted the continuous grain sorghum plots.
    Variety - NK 222
    Insecticide - Disyston
    Planted all soybean plots
    Variety - Corsoy
    Herbicide - Lasso II banded over the row
June 5, 1975 - Cultivated all corn plots (first cultivation)
June 13, 1975 - Cultivated all soybean plots
June 24, 1975 - Cultivated all grain sorghum plots
June 26 - Cultivated all corn plots (second time)

Table 43. Effect of Cropping Sequence and Fertilizer on Crop Yield, 1975

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			25.0				
1 Continuous corn	Corn	6 + 11 + 10	70		9.0				
2 Corn-oats	--	0 + 0 + 0		50.0	20.0				
2 Corn-oats	Corn	6 + 11 + 10	70		26.0				
	Oats	30 + 7 + 0		69.0					
3 Corn-oats-oats+alf-alf hay	--	0 + 0 + 0		54.0	31.0	19.0			No stand
3 Corn-corn-oats+alf-alf hay	Corn	6 + 11 + 10			9.0				
	Corn	6 + 11 + 10	70			9.0			
	Oats	15 + 26 + 0		73.0					
	Alf residual	0 + 0 + 0							No stand
4 Oats+sweet clover-corn	--	0 + 0 + 0		56.0	27.0				
4 Oats+sweet clover-corn	Oats	30 + 7 + 0		66.0					
	Corn	6 + 11 + 10			14.0				
5 Corn-soybean-oats	--	0 + 0 + 0		50.0	28.0		29.0		
5 Corn-soybean-oats	Corn	6 + 11 + 10	70		30.0				
	Soybeans	6 + 11 + 10					33.0		
	Oats	30 + 7 + 0		59.0					
6 Corn-oats-soybeans	--	0 + 0 + 0		51.0	39.0		28.0		
6 Corn-oats-soybeans	Corn	6 + 11 + 10	55		18.0				
	Oats	20 + 7 + 0		73.0					
	Soybeans	6 + 11 + 10					31.0		
7 Continuous grain sorghum	--	0 + 0 + 0						58.0	
7 Continuous grain sorghum	Sorghum	6 + 11 + 10	70					70.0	

June 30, 1975 - Sidedressed all specified plots with 70 pounds and 55 pounds rate in the corn and grain sorghum
July 2, 1975 - Cultivated all soybean plots (second time) combined the oat plots
July 29, 1975 - Sprayed the grain sorghum plots with Cygon 267 for greenbug control
Oct. 10, 1975 - Combined the grain sorghum plots
Oct. 14, 1975 - Combined all soybean plots
Oct. 30, 1975 - Hand picked all corn plots
Nov. 7, 1975 - Rotary chopped all corn and grain sorghum plots
Nov. 18, 1975 - Plowed all six ranges except the 1976 alfalfa plots

Discussion and Interpretation of Table 43

In general oats yields were fair and corn yields were very low. There was a consistent yield increase of oats due to fertilizer. This increase amounted to 20 to 22 bushels per acre in some plots.

Nitrogen fertilizer was not successful for raising corn yields in every rotation.

Sorghum yields were considerably higher than corn and increases due to nitrogen were greater.

Unfertilized corn following the legume soybeans, yielded a little more than corn in other rotations.

The stand of alfalfa deteriorated to the point where no yields could be taken.

RESIDUAL PHOSPHORUS - ALFALFA RESPONSE

P. Carson, B. Lawrensen, R. Gelderman and P. Fixen

Objectives

1. Determine the effect of different levels of available phosphorus on the yield of alfalfa.
2. Determine how long it takes a crop having a high phosphorus requirement to reduce the present levels of available phosphorus in the soil as measured by the Bray weak acid soil test.

Methods and Procedures

This experiment was established in 1964 to study the effects of various rates of phosphorus (P) fertilizer on the yield of corn. From 1964 through 1967 four rates of P (10, 20, 40 and 80 lbs. per acre of P) were broadcast and plowed down annually. No phosphorus has been broadcast on these plots since 1968. Each of the phosphorus treatments was divided into thirds with one-third receiving about 10 lbs. of P as a starter fertilizer from 1964 through 1968, one-third receiving 10 lbs. of zinc per acre in 1964 and 1965, and one-third receiving no additional fertilizer.

This land has been cropped to various crops since 1967, such as soybeans, sorghum and oats. It is presently seeded to alfalfa. The experimental area was soil sampled in the spring of 1973. The tests for available phosphorus are reported in Table 44. These tests show the effect of the past fertilizer treatments on available phosphorus. The past fertilizer treatments result in soil tests ranging from 11.8 to 139.3 lbs. of available P/A in the surface 0-4" layer. These tests show that the added fertilizer not only influenced the 0-4" layer, but also had an effect on the 4-8" and the 8-12" layers. The fact that the added fertilizer had an effect on the 8-12" layer is an indication that this land has been plowed relatively deep during seedbed preparation in the past.

This portion of the experiment was started in 1973 when the experimental area was seeded with Iroquois alfalfa. It was hoped that one or more cuttings could be harvested in 1973. Dry weather made it impossible to follow through with this idea. The north two alleys were seeded with Vernal. The south two replications were seeded at a higher rate of seeding than the north two replications. Balan was applied at the rate of 1.38 lbs. of actual material per acre to control early weeds. The Balan did not control the weeds. This was probably due to the dry weather encountered just after seeding. By June 28th the plants present varied all the way from just emerging to plants 12" high and blooming. Sweet clover, dandelions, wild oats, tan weed, lambsquarter, and pigeon grass were present. Tan weed and sweet clover were the only ones considered serious. The field was clipped to help control the weeds and to give the smaller seedlings a chance to become established.

Two crops were harvested in 1974 and 1975. The samples for yield were taken by mowing a 30" x 15' area with a small sickle type mower. The hay was collected and weighed in the field. A sample was taken from each plot to determine moisture content at harvest time and to supply a plant sample for future analysis.

Table 44. The Effect of Past Fertilizer Treatments on the Soil Test[1] for Available Phosphorus, Southeast Experiment Farm, 1974

Averages	Sampled April 1973				
	Treatments, lbs. of P applied[3]				
Depth	0	40	80	160	320
	Soil test values lbs. of P per acre				
0-4"					
A[2]	11.8	26.5	40.0	59.8	121.8
B[2]	15.0	36.25	45.0	71.3	139.3
C[2]	9.8	25.3	38.0	59.3	125.5
4-8"					
A	9.0	22.0	34.8	56.8	122.5
B	12.3	36.0	41.5	77.0	134.0
C	8.5	22.3	36.8	57.3	126.5
8-12"					
A	4.3	12.5	13.0	31.8	38.8
B	6.8	18.0	13.8	26.0	43.5
C	4.8	13.3	15.5	23.3	36.8

[1]Soil test used was Brays week acid test.
[2]A = No starter P.
B = 10 lbs. of P_2O_5 per year for 4 years (1964-1967).
C = Zn added at the rate of 10# of Zn per acre in 1964 and in 1965.
[3]Fertilizer applied over a 4 year period at the rates of 0, 10, 20, 40 and 80 lbs. of P per year.

Results

The effects of different levels of available soil phosphorus on the yield and phosphorus content of the hay are reported in Table 45.

The yield from the first cutting was seriously reduced because of dry weather. The weather remained dry during the growth period for the second cutting. As a result, the yields were low and very few yield differences existed between treatments. The alfalfa did not make sufficient growth during the remainder of the summer to justify sampling. The growth that was present in early September was clipped. The alfalfa made little or no growth after this date.

These data show that higher yields are associated with the higher test values (above 25) for available phosphorus. Moisture was a serious limiting factor for both cuttings in 1975, as is shown by the amount of hay produced. The effect of available phosphorus on yield was not as clear in 1975 as in 1974. The effect of available phosphorus was more closely related to the phosphorus content of the hay produced than it was to the yield. It should be noted that the phosphorus content of the hay for the first cutting was generally lower than the level considered sufficient (less than 0.26%) for optimum yield at all soil test levels below 60 lbs. per acre.

The phosphorus content of the hay from the second cutting was at or above the sufficiency level except for the hay produced in the plots testing in the low range (less than 15 lbs/A). The first cutting was made when the plants were in the late bud stage of growth, and the second cutting was made when the plants were at approximately 1/10 bloom. It should also be pointed out that the yields were more severely limited by a lack of available moisture for the second cutting than for the first.

Table 45. Effect of Levels of Available Soil Phosphorus[1] on the Yield[2] of Alfalfa Hay, Southeast Experiment Farm, 1975

Treatments[4]	Soil Test Value lbs of P/A	1st Cutting lbs hay/A	2nd Cutting lbs hay/A	Total	% Phosphorus Content 1st Cutting	% Phosphorus Content 2nd Cutting
			0 + 0 + 0[3]			
A 0+0+0	11.8	2406	1901	4307	0.19	0.24
B Starter P	15.0	2528	1801	4329	0.19	0.27
C Zinc	9.8	2463	1831	4294	0.18	0.24
			0 + 40 + 0			
A 0+0+0	26.5	2783	2012	4795	0.21	0.28
B Starter P	26.3	2498	1842	4340	0.22	--
C Zinc	25.3	2562	1841	4403	0.21	0.27
			0 + 80 + 0			
A 0+0+0	40.0	2441	1940	4381	0.23	0.30
B Starter P	45.0	2631	1810	4441	0.24	0.33
C Zinc	38.0	2444	1875	4319	0.22	0.30
			0 + 160 + 0			
A 0+0+0	59.8	2609	1979	4588	0.25	0.33
B Starter P	71.3	2560	1877	4437	0.25	0.33
C Zinc	59.3	2678	1973	4651	0.24	0.31
			0 + 320 + 0			
A 0+0+0	121.8	2597	1885	4482	0.26	0.34
B Starter P	139.3	2322	1845	4167	0.27	0.34
C Zinc	125.5	2557	2026	4583	0.26	0.34

[1]Available phosphorus as measured by the Bray Ø1 (weak acid) method.
[2]Yield measured as lbs. of dry hay.
[3]Total amount of phosphorus applied during a 4 year period.
[4]A = No starter fertilizer
B = 10 lbs. of P_2O_5 per year as a starter fertilizer for 4 years (1964-1967).
C = Zinc added at the rate of 10 lb. of zinc per acre in 1964 and 1965.

STANDARD VARIETY SMALL GRAIN TRIALS

J. J. Bonnemann

Three spring small grain trials were seeded at the Southeast Experiment Farm in 1975--spring wheat, oats and barley.

The trials were seeded on April 23, 1975. Yields were not exceptional and the quality and test weight were down. The delay in seeding and the dry, hot weather at the time the trials were maturing were most serious in causing the poorer yields and quality.

The data included in this report are bushels per acre, test weight and available several-year averages. The results are found in Tables 46, 47 and 48.

Table 46. 1975 Standard Variety Barley Trial Yields and Available Averages, B/A

Variety	1974	1975	3 Yr. Av.	1975 T.W.
Liberty	58.1	29.5	43.8	42
Firlbecks III	42.4	31.1	36.7	44
Larker	68.9	31.3	50.1	46
Cree	51.7	33.8	42.7	45
Conquest	63.7	34.5	49.1	45
Primus II	63.7	35.6	49.6	47
Bonanza	52.5	37.1	44.8	44
Prilar	62.0	30.5	46.2	44
Beacon	53.0	32.8	42.9	44
Manker	56.5	33.5	45.0	48
M-18		31.3		46
Mean, B/A		31.4		
CV-%		11.7		
LSD-.05		5.2		

Table 47. 1975 Standard Variety Oat Trial Yields and Available Averages, B/A

Variety	1973	1974	1975	3 Yr. Av.	1975 T.W.
Burnett	97.9	69.4	48.9	72.1	32
Trio	91.9	68.4	44.9	68.4	33
Diana	83.9	89.4	57.1	76.8	33
Holden	84.7	82.4	51.6	72.9	33
Portal	87.6	72.7	52.4	70.9	35
Nodaway 70	89.5	80.0	50.2	73.2	33
Froker	91.8	72.9	49.0	71.2	34
Grundy	77.0	90.2	49.3	72.1	37
Chief	85.6	81.1	48.6	71.9	32
Otee	83.6	84.7	51.3	73.2	34
Dal	81.2	68.2	48.4	65.9	30
Astro	96.6	75.2	48.4	73.4	29
Noble	90.7	88.2	46.9	75.2	32
Stout	88.2	89.2	44.9	74.1	33
Goodland		56.0	46.8		33
Spear	90.3	87.5	51.2	76.3	29
Allan		75.7	52.4		30
Wright		67.6	51.2		34
M-73	82.1	64.2	43.8	63.3	33
E-74			46.8		33
Peterson 747			44.3		32
Mean, B/A			49.0		
CV-%			14.6		
LSD-.05			N.S.		

Table 48. 1975 Standard Variety Spring Wheat Trial Yields and Available Averages, B/A

Variety	1974	1975	2 Yr. Av.	1975 T.W.
Standard height				
Thatcher	22.0	13.9	17.9	53
Fortuna	32.7	14.0	23.3	54
Chris	34.1	14.7	24.4	53
Waldron	36.2	16.6	26.4	53
Ellar	34.4	15.2	24.8	53
Tioga	28.0	14.5	21.2	52
BW 25	33.0	14.7	23.8	55
Nowesta	34.2	14.0	24.1	54
Nordak				
Durums				
Leeds	40.2	14.8	27.5	57
Hercules	34.8	16.4	25.6	55
Rolette	35.3	14.4	24.8	57
Ward	40.3	17.4	28.8	55
Crosby	32.2	20.0	26.1	57
Botno	45.6	19.2	32.4	56
Rugby	37.0	18.9	27.9	57
Semi-dwarf				
Era	36.3	17.8	27.0	52
Bonanza	39.9	15.0	27.4	56
WS 1809	45.0	17.0	31.0	56
Olaf	39.6	15.1	27.3	54
Protor	40.2	14.8	27.5	55
Prodax	32.8	17.3	25.0	52
Bounty 309	34.5	17.1	25.8	56
Profit 75		13.1		55
Kitt	35.5	15.2	25.3	51
Gold Crest		18.9		54
Triticale 203, lbs/A		137		
Mean, B/A		15.6		
CV-%		14.5		
LSD-.05		3.7		

GRAIN SORGHUM PERFORMANCE TRIALS

J. J. Bonnemann

The 1975 Grain Sorghum Performance Trial had 21 hybrids including both Experiment Station and proprietary entries. The plot was seeded on May 14 and harvested on October 2, 1975. The field had been in small grain in 1974. It received a broadcast fertilizer application of 80-40-20 prior to fall plowing in 1974. The row spacing was 30 inches. Ramrod and Di-Syston were banded at the time of seeding for weed and insect control, respectively. Yields were quite variable and quality was down. The trial mean yield was 2315 pounds per acre. This yield is about half of the 1974 yields but much better than expected.

The drouth induced dormancy of mid-summer was broken in early August as rainfall was received in generous amounts at timely intervals. Many stalks recovered to produce 4-5 tillers on the same plant. The late fall permitted these tillers to head, pollinate and reach maturity before a killing freeze occurred in mid-October.

The 1975 trial results appear in Table 49. This and additional data will appear in an upcoming circular, 1975 Grain Sorghum Trials.

Table 49. 1975 Grain Sorghum Performance Trial, Area E, Southeast Experiment Farm, Centerville, Clay County

Brand & Variety	Yield, lb/A	Test Wt. lb/B	Height, inches	Date Headed	Percent Moisture 9/18/75
DeKalb C-42a	3885	52	38	8/04	30.0
ACCO R 1019	3270	54	46	8/02	26.9
Northrup-King NK 180	3105	55	44	7/21	19.6
ACCO 1029A	3035	54	46	8/01	35.+
Pioneer 878	2685	55	41	7/19	16.4
DeKalb B-35	2475	51	40	8/08	19.8
Funk's G-490	2470	50	43	8/09	21.0
Warner W-561	2445	49	41	8/09	17.2
SDAES RS 610	2320	51	42	7/26	18.5
ACCO R 1014	2245	51	42	7/28	17.8
Warner W-55	2220	52	38	7/30	18.2
Warner W-601	2165	53	43	7/21	17.0
Pioneer 866	2095	51	44	8/04	22.7
Funk's G-393	2090	54	43	7/20	16.6
Northrup-King NK X3162	2055	51	40	8/04	16.4
SDAES RS 506	2045	55	41	7/14	18.8
Northrup-King NK 222	1980	51	42	8/04	16.1
Northrup-King NK 233A	1940	51	44	7/18	16.6
SDAES SD 106	1860	48	40	7/13	15.6
Funk's G-251	1530	55	34	7/13	16.9
SDAES SD 503	1205	50	40	7/16	17.5
Mean	2315				

C.V. = 11.1% LSD (.05) 420

SOUTHEAST EXPERIMENT STATION VEGETABLE TRIALS, 1975

Paul Prashar

Acorn Squash

Two varieties, Royal Acorn and Table Queen Bush, of acorn squash were planted on May 16, 1975. The plots were fertilized at the rate of 400 lbs. per acre with 8-32-16. Treflan herbicide was incorporated before planting. The plot size was 100' by 4' and five replications were planted. The rows were 4' apart, hills 4' within a row, and 4 seeds per hill were planted. No thinning was done. In each replication 3 rows were planted and the middle row was harvested for data.

The two varieties were used because they have different types of vegetative growth, vine and bush.

The crop was harvested on Sept. 26, 1975. The yield is tabulated in Table 50.

Table 50. Acorn squash fruit size (lbs.) and yield per acre

Name of variety	Weight/fruit (in lbs.)	Yield/acre (lbs.)
Royal Acorn	1.845	15,370
Table Queen Bush	1.100	11,147

It was a dry year and the size of the fruit was smaller than the normal size for each variety. It is concluded that the fruit size and yield of Table Queen Bush squash is not acceptable for commercial production.

Pickling Cucumbers

Three varieties of pickling cucumbers were planted on May 16, 1975. The plots were fertilized at the rate of 400 lbs. per acre with 8-32-16. Three rows of each variety were planted and the middle row was harvested for data. Three replications of each variety were made. The rows were 32' long and 1' apart. Nine seeds per running foot were planted and no thinning was done. The crop was harvested on July 11, 18, 25 and August 4, 1975. The yield data is tabulated in Table 51.

Table 51. Yield per acre of pickling cucumbers

Name of variety	Yield/acre (lbs.)
Green Star	11,980
Green Pak	13,413
C-5 ND	11,126

The season was dry and pickling cucumbers' yields were very low. Pickling cucumbers for one time harvest should not be grown in this area unless an adequate water supply is available, when needed. Fruit color and shape of Green Pak variety was very desirable.

SEED PRODUCTION OF WARM SEASON GRASSES

James G. Ross and Burton Lawrensen

Breeder seed of summer switchgrass has been produced at the Southeast South Dakota Experiment Farm for a number of years. This has proven to be an excellent location for seed production of this variety. In 1975 invasion of the cool season grass, smooth bromegrass, as well as annual weeds, was controlled by burning in early May followed by application of 1.5 lb. of actual atrazine per acre. On the last week of May 70 lbs. per acre of nitrogen (N) was applied since growth did not start until that time. Canadian thistles were controlled by spraying with 2,4-D throughout the summer. Seed was harvested in early October.

In June 1974, approximately one-fourth acre was seeded in rows 42 inches apart to breeders seed of an unreleased variety of big bluestem, SD42. This variety was selected from native collections made in southeastern South Dakota for forage and seed production. These rows were cultivated in 1975 and seed was harvested on October 24 for testing and possible later release. Big bluestem, once the dominant native grass of eastern South Dakota, is now found only in small colonies along road ditches or sometimes in a native pasture which has not been overgrazed. Relict colonies of the highest forage producing plants are found in road ditches in favorable moisture conditions. These relicts are fast disappearing because of the efficiency of the road making equipment which effectively destroys all roadside vegetation. This wild grass is being domesticated by selection for high seed set among these high forage yielding plants and also selection for lack of hairiness which makes the seed more easily processed. With improvement of these characteristics the splendid forage production of big bluestem should be available for use in a cultivated grass variety. SD42 has many of the desirable characteristics that will make big bluestem an acceptable domesticated grass.

EFFECT OF FERTILIZERS ON YIELDS OF FIVE SPRING WHEAT VARIETIES

Robert Pylman, Paul Fixen, Paul Carson, Fred Shubeck and Ron Gelderman

Objectives of Experiment

1. Determine the effect of rates of nitrogen, phosphorus, and potassium fertilizers on the yield of five varieties of spring wheat.
2. Determine what relationship one element may have on another in influencing the yield of the wheat.
3. Determine the optimum rates of fertilizer addition in relation to soil tests.

Procedure

1. This experiment was one of a series of five located throughout South Dakota in 1975. It was located at the Southeast Experiment Farm in the northeast quarter of the north quarter section.
2. The experiment was located on a Badus silty clay loam. Badus soils are glacial till soils that occupy flats and shallow basins that are somewhat poorly drained. This site was flat rather than a shallow basin. Tests on the soil samples taken when the experiment was established are shown in Table 52. These tests indicate the following: nitrate-nitrogen was present in relatively large amounts, the available phosphorus was considered medium, exchangeable potassium was high, pH (7.3) was slightly alkaline and soluble salt content in the layers below 24" was higher than normally found in a well drained soil. The sodium content does not place this soil in a high sodium risk category.
3. The field was in corn in 1974, and the seedbed was prepared by chisel plowing, disking and dragging.
4. It was seeded on April 23rd with a press drill equipped with a divider that evenly distributed the seed and fertilizer for each row. The soil was a little too wet for planting. This resulted in a relatively non-uniform and reduced stand of wheat.
5. The experimental design used was a composite having five rates of nitrogen, five rates of P_2O_5, and five rates of K_2O. Through the use of statistical comparisons the number of fertilizer treatments was reduced to 23 per variety. See Table 53.
6. Fertilizer treatments used are listed in Table 53.
7. Varieties used and some of their characteristics are designated in Table 54.
8. The plots were sprayed with Bromoxynil plus MCPA to control broadleaf weeds. Grassy weeds were a very serious problem later in the season, and the plots were sprayed with Hoe 23408, a non-labeled herbicide which did an excellent job of grass control in the wheat. A small amount of leaf burn was noted after each application of herbicide.
9. The plots were harvested on July 23rd with a small self-propelled plot combine.

Results

Yield results are presented in Tables 55, 56 and 57. Treatments have been combined to show the response to each element. Table 55 shows yield response of five varieties of wheat to five levels of added nitrogen. The effects of the rates of added nitrogen on the yield can be partially evaluated by looking at the average of each rate for all varieties. This shows added nitrogen had little or no effect on yield at this site. A yield increase from added nitrogen was not expected because of the large amount of nitrate-nitrogen present in the soil profile at planting time. The fact that 60% of the nitrate-nitrogen available to the crop was below plow depth strongly supports the desirability of taking soil samples to a depth of two feet to evaluate the need for additional nitrogen.

The effects of added phosphorus are shown in Table 56. The effect of rates of added P_2O_5 on the yield can be partially evaluated by averaging each rate for all varieties. These results show that the addition of phosphorus had little or no effect on the yield of wheat at this site. A yield increase from added phosphorus was expected, but it was not expected to be large because of the medium soil test.

Table 57 shows the effects of added K_2O on the yields of the wheat. The averages of the treatments show that added potassium did not increase the yield. Individual varieties show no consistent advantage to added potassium.

To provide a clearer picture of the effect of added fertilizer on the yield of wheat under these growing conditions, the yields of the five varieties with and without fertilizer are graphed in Figure 3. Of those plots receiving fertilizer, only those with the highest rate (160-52-43) were plotted in Figure 3. The non-fertilized wheat had a little higher yield for all varieties except Bounty 208. Several things contributed to the relatively low yield at this site; wet conditions when seedbed was prepared, poor stand, weed problems both early and late, dry weather, effects of herbicides and salty subsoil at 36 inches.

Table 52. Tests on Soil Samples from the Wheat Experiment, Southeast Experiment Farm, 1975[1]

Depth in inches	NO_3-N ppm	NO_3-N lbs/A	O.M. %	Phosphorus lbs/A	Potassium lbs/A	pH 1:1	Salts mmhos/cm	Soluble Na me/1
0 - 6	24.8	44.6	3.5	16	613	7.3	1.27	
6 - 12	18.2	32.7	2.4	4	405	7.5	0.59	
12 - 24	18.4	32.8	1.4	4.5	396	7.7	1.17	
		110.1						
24 - 36	9.0	16.2	0.7	9	351	7.9	2.42	5.6
36 - 48	8.7	15.5	0.3	9	266	7.9	4.50	8.6
Total		141.8						

[1]Average of 4 holes for the 6-48 inch depths, a composite of not less than 20 small samples were used for the 0-6 inch layer.

Table 53. Fertilizer Treatments Applied on Wheat

Treatment No.	Identification	N + P_2O_5 + K_2O lbs/A		
1	$N_2P_2K_2$	40	17	6
2	$N_2P_2K_4$	40	17	18
3	$N_2P_4K_2$	40	52	6
4	$N_2P_4K_4$	40	52	18
5	$N_4P_2K_2$	120	17	6
6	$N_4P_2K_4$	120	17	18
7	$N_4P_4K_2$	120	52	6
8	$N_4P_4K_4$	120	52	18
9	$N_3P_3K_3$	80	35	12
10	$N_1P_3K_3$	0	35	12
11	$N_5P_3K_3$	160	35	12
12	$N_3P_1K_3$	80	0	12
13	$N_3P_5K_3$	80	69	12
14	$N_3P_3K_1$	80	35	0
15	$N_3P_3K_5$	80	35	24
16	$N_1P_1K_5$	0	0	24
17	$N_1P_5K_1$	0	69	0
18	$N_1P_5K_5$	0	69	24
19	$N_5P_1K_1$	160	0	0
20	$N_5P_1K_5$	160	0	24
21	$N_5P_5K_1$	160	69	0
22	$N_5P_5K_5$	160	69	24
23	$N_1P_1K_1$	0	0	0

Table 54. Wheat Varieties Used in Fertilizer Study and Their Characteristics

Variety	Name	Awns	Strength of Straw	Light Sensitivity	Maturity[1]
A	Era	Yes	Short	Intermediate	4
B	WS 1809	No	Short	Not sensitive	1
C	Bounty 208	Yes	Short	Not sensitive[2]	1
D	Waldron	No	Tall but stiff	Intermediate	2
E	Chris	No	Tall	Sensitive	3

[1] Number 1 is earliest, a year of high moisture (long season) 7-9 days between; extreme; hot and dry year 2-4 days between extremes.

[2] Cloudy weather insensitive will keep growing.

Table 55. Effect of Applied Nitrogen on Yields of Five Spring Wheat Varieties Grown at the Southeast Experiment Farm, Beresford, 1975

Nitrogen	Variety					
lbs/A	Era	WS 1809	Bounty 208	Waldron	Chris	Average
0	23.6	23.4	20.3	25.4	24.8	23.5
40	22.8	21.8	18.2	26.3	22.8	22.4
80	25.1	19.5	20.3	23.7	23.2	22.4
120	23.1	18.2	17.0	23.4	22.8	20.9
160	23.7	20.8	17.6	21.1	23.1	21.3
Average	23.7	20.7	18.7	24.0	23.3	22.1

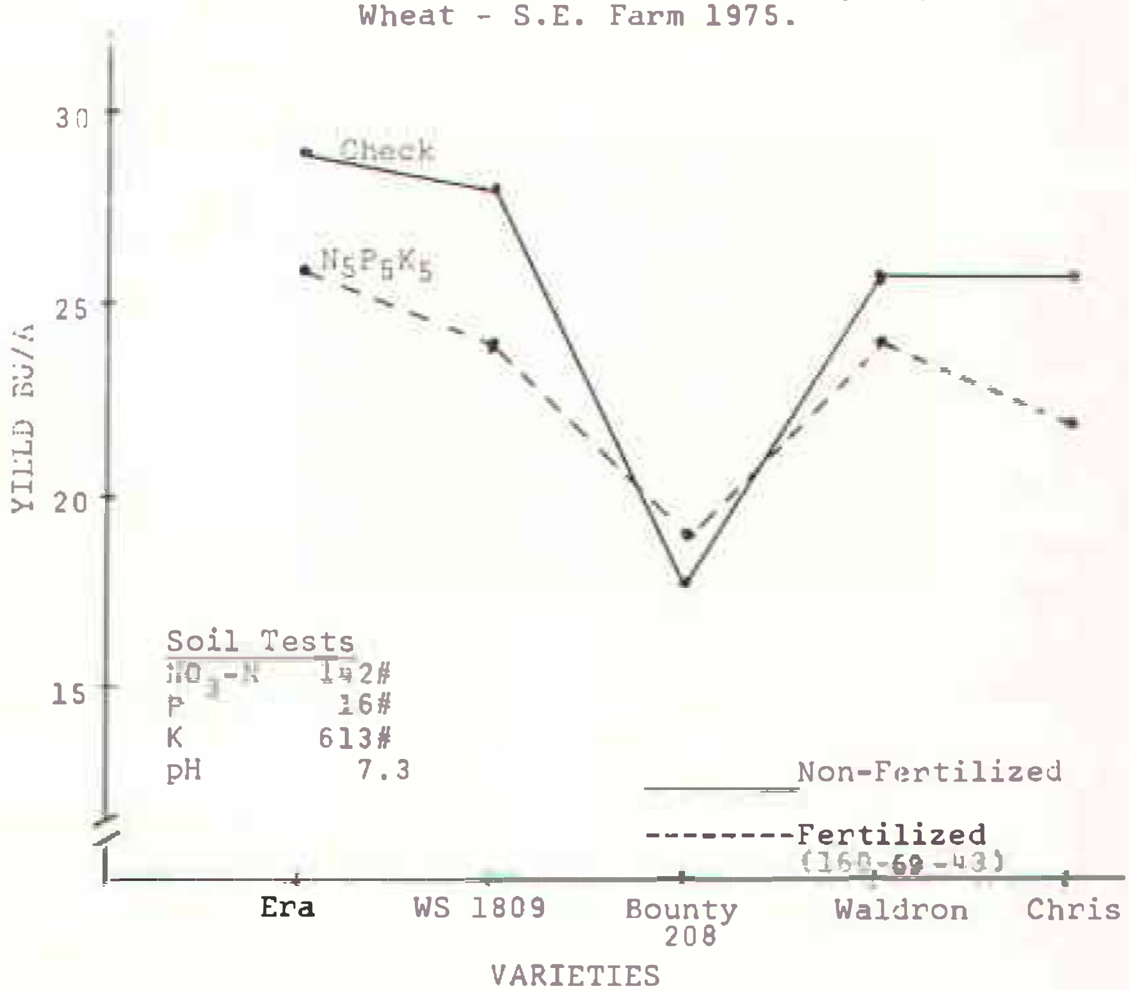
Table 56. Effects of Applied Phosphorus on the Yields of Five Spring Wheat Varieties Grown at the Southeast Experiment Farm, Beresford, 1975

P_2O_5	Variety					
lbs/A	Era	WS 1809	Bounty 208	Waldron	Chris	Average
0	23.7	22.2	18.2	22.4	25.5	22.4
17	24.5	19.1	16.2	24.5	24.8	21.8
35	23.8	18.9	19.6	23.7	22.4	21.7
52	21.4	20.8	19.0	25.1	20.8	21.4
69	24.9	22.5	20.5	24.1	23.3	23.1
Average	23.7	20.7	18.7	24.0	23.4	22.1

Table 57. **Effects of Applied Potassium on Yields of Five Spring Wheat Varieties Grown at the Southeast Experiment Farm, Beresford, 1975**

K_2O lbs/A	Variety					
	Era	WS 1809	Bounty 208	Waldron	Chris	Average
0	24.9	20.9	20.2	23.5	22.9	22.5
6	21.8	21.7	18.9	24.8	22.6	22.0
12	26.1	20.7	18.3	24.1	24.2	22.9
18	24.1	18.3	16.2	24.9	23.0	21.3
24	21.4	22.1	18.8	22.6	24.0	21.8
Average	23.7	20.7	18.7	24.0	23.3	22.1

Figure 3. The Effect of Fertilizer and Variety on the Yield of Spring Wheat - S.E. Farm 1975.



BLOOD MEAL IN DIETS FOR GROWING-FINISHING PIGS

George W. Libal, Alan Vogel and Richard C. Wahlstrom

Dried blood meal is one of the highest protein by-products of the packing industry. The conventional methods of drying blood in the past have been with the drum drying process which subjects the blood to a high temperature for a considerable length of time. Previous research reported at South Dakota State University indicated that performance of growing-finishing pigs was reduced when 4% blood meal replaced an equivalent amount of soybean meal in the diet. This reduction in performance was eliminated by supplementing the blood meal diet with lysine, indicating that the heating process apparently destroyed much of the lysine or rendered it unavailable to the pig.

The experiment reported herein was conducted to obtain information on the value of ring dried blood meal, a process that subjects the meal to less severe heat during the drying process.

Experimental Procedure

Seventy-two pigs averaging approximately 54 lb. initially were allotted to two replications of six treatments on the basis of ancestry, weight and sex. Each lot contained three barrows and three gilts. The pigs were housed in a totally enclosed confinement type building. Pens had partial or fully slatted floors and were equipped with three-hole self-feeders and automatic waterers.

The six dietary treatments were as follows:

1. Corn-soybean meal diet
2. Two percent blood meal replacing 2% soybean meal
3. Four percent blood meal replacing 4% soybean meal
4. Two percent blood meal replacing an equivalent amount of protein from soybean meal
5. Four percent blood meal replacing an equivalent amount of protein from soybean meal
6. Diet 5 plus 0.1% L-lysine

The composition of the 14% protein grower and 12% finisher diets for the six treatments is shown in Tables 58 and 59, respectively. Diets were changed to the lower protein level when the pigs averaged about 110 pounds. Because of a need to use the pens for other purposes, the experiment was terminated at an average weight of approximately 162 pounds.

Results

Growth performance data are summarized in Table 60. Average daily gains were very similar for all treatments in replicate 1. However, in replicate 2 pig gains were more variable and gains were somewhat less for treatments 4 and 5 that received diets containing 2 and 4% of blood meal replacing an equivalent amount of protein. This difference appeared to be due to two pigs in treatment 4 and one pig in treatment 5 that gained considerably slower than other pigs in their respective groups and may not have been due to the blood meal in the diet. Gains of replicate 2 may also have been less than replicate 1 because of less time on the experiment so that they were of lighter weight. When data for average daily gain for the two replicates were averaged together, there was

no significant difference among treatments. It would appear that the lysine in this blood meal was quite highly available, since diet 5 had only 0.45 and 0.30% lysine furnished by the corn and soybean meal in the grower and finisher diets, respectively. This is considerably below the requirements of about 0.65 and 0.55% lysine for pigs of the weights in this experiment.

Somewhat less feed was consumed by pigs receiving the diets containing blood meal. They also required less feed/gain than did the pigs fed the corn-soybean diet. This may be a reflection of feed intake as it has been shown that moderately limiting dietary intake increases feed efficiency.

Summary

Diets containing up to 4% ring dried blood meal replacing an equivalent amount of soybean meal were fed to growing pigs from approximately 54 to 162 lb. live weight. There were no significant differences in average daily gains. Feed consumption and feed/gain were reduced when pigs were fed the diets containing dried blood meal. There was no advantage of adding lysine to the dried blood meal diets and it appeared that the lysine in this blood meal was quite available to the pig.

Table 58. Composition of Diets Fed to 110 Pounds (Percent)

Ingredients	Treatments					
	1	2	3	4	5	6
Ground yellow corn	82.7	82.7	82.7	84.1	85.3	85.2
Soybean meal, 44%	14.6	12.6	10.6	11.2	8.0	8.0
Blood meal	--	2.0	4.0	2.0	4.0	4.0
Dicalcium phosphate	1.5	1.5	1.5	1.5	1.5	1.5
Ground limestone	0.5	0.5	0.5	0.5	0.5	0.5
Trace mineral salt[a]	0.5	0.5	0.5	0.5	0.5	0.5
L-lysine	--	--	--	--	--	0.1
Vitamin-antibiotic mix[b]	0.2	0.2	0.2	0.2	0.2	0.2

[a] Contained 0.8% zinc.
[b] Supplied per lb. of diet: vitamin A, 1500 IU; vitamin D, 150 IU; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 10 mg; choline, 50 mg; vitamin B_{12}, 7.5 mcg and aureomycin, 10 milligrams.

Table 59. Composition of Diets Fed From 110 Pounds (Percent)

Ingredients	Treatments 1	2	3	4	5	6
Ground yellow corn	88.4	88.4	88.4	89.8	91.1	91.0
Soybean meal, 44%	9.0	7.0	5.0	5.6	2.3	2.3
Blood meal	--	2.0	4.0	2.0	4.0	4.0
Dicalcium phosphate	1.4	1.4	1.4	1.4	1.4	1.4
Ground limestone	0.5	0.5	0.5	0.5	0.5	0.5
Trace mineral salt[a]	0.5	0.5	0.5	0.5	0.5	0.5
L-lysine	--	--	--	--	--	0.1
Vitamin-antibiotic mix[b]	0.2	0.2	0.2	0.2	0.2	0.2

[a]Contained 0.8% zinc.
[b]See Table 58.

Table 60. Growth Performance of Pigs Fed Ring Dried Blood Meal

	Treatments 1	2	3	4	5	6
Number of pigs[a]	10	12	12	11	12	11
Avg. daily gain, lb.						
Rep 1	1.49	1.50	1.46	1.51	1.53	1.50
Rep 2	1.37	1.40	1.37	1.20	1.29	1.41
Avg.	1.44	1.45	1.42	1.36	1.41	1.45
Avg. feed consumed/day, lb.						
Rep 1	5.39	5.15	4.85	4.77	4.85	4.66
Rep 2	5.42	5.19	5.00	4.69	4.68	4.71
Avg.	5.40	5.17	4.93	4.73	4.78	4.68
Feed/gain						
Rep 1	3.62	3.43	3.31	3.17	3.17	3.10
Rep 2	3.95	3.69	3.64	3.90	3.64	3.60
Avg.	3.75	3.56	3.48	3.54	3.41	3.34

[a]Two replicates of 6 pigs each per treatment. Two pigs died and 2 were removed, data are not included. Average initial weight 54 lb., final weight 162 pounds.

EFFECT OF VARIOUS LEVELS OF BLOOD MEAL IN SWINE DIETS

Richard C. Wahlstrom, Alan Vogel and George W. Libal

In previous research reported at South Dakota State University it was shown that feeding diets containing up to 4% of ring dried blood meal did not significantly affect rate of gain, feed consumption or feed/gain. The level of 4% blood meal replaced about 6.6% of soybean meal in the diets. The economics of this substitution would depend on the relative prices of blood meal and soybean meal at a given time.

This experiment was conducted to obtain additional data on the value of ring dried blood meal in growing-finishing diets for swine and also to study levels of 4, 6 and 8% blood meal in the diet when added to replace an equivalent amount of protein supplied by soybean meal.

Experimental Procedure

Three replicate groups of 32 crossbred pigs averaging about 56 lb. were assigned to four subgroups of 8 pigs (4 barrows and 4 gilts) on the basis of weight, ancestry and sex within replicate. Each subgroup of 8 pigs was then randomly assigned to dietary treatment. Pigs were kept in partial or fully slatted floored pens, 5 feet by 15 feet, in an enclosed building. Diets were self-fed and pens were equipped with automatic waterers.

The composition of the experimental diets is shown in Tables 61 and 62. Diets were changed to a lower protein level when the pigs averaged about 120 pounds. The four dietary treatments were as follows:

1. Corn-soybean meal diet
2. Four percent blood meal in diet
3. Six percent blood meal in diet
4. Eight percent blood meal in diet

Results

As shown in Table 63, the daily gain was reduced during the growing period when pigs were fed diets containing 8% blood meal. These pigs gained 1.20 lb. daily compared to gains of 1.51, 1.53 and 1.54 for the other three treatment groups. Average daily feed consumption was also about 10% less for pigs fed the 8% blood meal diet and feed/gain was increased approximately 16%.

There were no significant differences among treatments during the finishing period when a 12% protein diet was fed. Only 5.5% blood meal was added to diets 3 and 4 during this period as that was the amount necessary of the high protein blood meal to formulate diets containing 12% protein. These two diets did not contain any soybean meal, but diet 4 was supplemented with 0.15% lysine. Actually, the blood meal analyzed over 80% protein on an as fed basis so the blood meal diets would have contained slightly more protein than calculated. There was no benefit of adding lysine to diet 4.

For the overall experimental period pigs fed the 8% blood meal diet gained about 0.2 lb. per day less than pigs in the other groups and required slightly more feed/gain. Pigs fed diets containing 4% or 6% blood meal gained 1.56 and 1.53 lb. per day, respectively, and required 2.98 and 2.96 lb. of feed/gain

which was comparable to the 1.51 lb. daily gain and 3.08 feed/gain of pigs fed the corn-soybean meal control diet.

The reason for the poorer performance of pigs fed 8% blood meal during the growing period may have been due to a deficiency of isoleucine. Blood meal is low in this essential amino acid and by our analysis the diet contained 0.44% isoleucine. The National Research Council lists a requirement of 0.50% for pigs of this size. The possibility of a lysine shortage cannot definitely be ruled out. However, since there was no response to adding lysine to diet 4 during the finishing period and on the basis of performance of pigs fed diet 3 during this period, it would appear that the lysine in blood meal would have had to be at least 60% available. If one assumes at least 60% availability, a lysine shortage should not have existed in the growing period.

Summary

Ninety-six crossbred pigs were used in an experiment comparing diets containing 4, 6 or 8% ring dried blood meal fed to pigs from 56 lb. to market weight. Diets of 4 and 6% blood meal were equal to a corn-soybean meal diet as there were no significant differences in gain or feed/gain among these three treatments. Pigs fed diets of 8% blood meal gained significantly slower and required more feed during the growing period. There were no differences in performance when 0.15% supplemental lysine was added to diet 4 during the finishing period. Both diets 3 and 4 contained 5.5% blood meal which was the only supplemental source of protein in these diets.

Table 61. Composition of 15% Protein Diets Fed to 120 Pounds

Diet number Blood meal, %	1 0	2 4	3 6	4 8
Ground yellow corn	79.45	82.25	83.55	84.95
Soybean meal, 44%	17.90	11.10	7.70	4.30
Blood meal	---	4.00	6.00	8.00
Dicalcium phosphate	1.20	1.30	1.40	1.40
Ground limestone	0.80	0.70	0.70	0.70
Trace mineral salt	0.50	0.50	0.50	0.50
Premix[a]	0.15	0.15	0.15	0.15

[a]Supplied per lb. of diet: vitamin A, 1500 IU; vitamin D, 150 IU; vitamin E, 5 IU; riboflavin, 1.25 mg; pantothenic acid, 5 mg; niacin, 10 mg; choline, 50 mg; vitamin B_{12}, 5 mcg and tylosin, 8 milligrams.

Table 62. Composition of 12% Protein Diets Fed From 120 to 210 Pounds

Diet number	1	2	3	4
Blood meal, %	0	4	6	8
Ground yellow corn	87.95	90.75	91.65	91.50
Soybean meal, 44%	9.30	2.50	---	---
Blood meal	---	4.00	5.50	5.50
Dicalcium phosphate	1.30	1.40	1.50	1.50
Ground limestone	0.80	0.70	0.70	0.70
Trace mineral salt	0.50	0.50	0.50	0.50
L-lysine	---	---	---	0.15
Premix[a]	0.15	0.15	0.15	0.15

[a]See footnote Table 61.

Table 63. Performance of Pigs Fed Various Levels of Blood Meal

	Level of blood meal, %			
	0	4	6	8
Number of pigs[a]	24	24	24	24
Avg. initial wt., lb.	55.7	55.7	55.8	55.8
Avg. final wt., lb.[b]	212.4	217.8	214.0	196.0
Avg. daily gain, lb.				
55 to 120 lb.[c]	1.51	1.54	1.53	1.20
120 to 210 lb.[b]	1.51	1.59	1.52	1.42
55 to 210 lb.[b]	1.51	1.56	1.53	1.32
Avg. feed consumed/day, lb.				
55 to 120 lb.[c]	4.29	4.26	4.17	3.82
120 to 210 lb.[c]	4.98	5.01	4.82	4.50
55 to 210 lb.[c]	4.66	4.66	4.52	4.18
Feed/gain				
55 to 120 lb.	2.83	2.76	2.73	3.23
120 to 210 lb.	3.29	3.16	3.17	3.20
55 to 210 lb.	3.08	2.98	2.96	3.21

[a]Three replicates of 8 pigs each per treatment.
[b]Significant sex difference ($P<.05$).
[c]Significant treatment difference ($P<.05$).

ANIMAL WASTE MANAGEMENT

Maurice L. Horton, Fred Shubeck, John L. Wiersma, Alan Vogel,
Albert Dittman, Ron Schnabel and Ron Beyer

The animal waste management experiment involving salt levels in beef rations, waste disposal rates, crop yields, water infiltration and runoff was continued during 1975. Livestock feeders, farmers, and extension personnel have shown much interest in the crop yields, soil effects and water infiltration results.

The feedlot consisted of 16 concrete surfaced pens with 10-11 beef steers per pen. Eight of the pens were located in a cold confinement shelter and eight of the pens were located in the open environment. The test animals were fed a ration which included four levels of added salt (NaCl), 0.0%, 0.25%, 0.50%, and 0.75% of the ration on a dry-weight basis.

The wastes (solids plus liquids) produced by the steers were collected and applied to field plots at rates up to 80 tons per acre on a dry-weight basis. Applied wastes were incorporated by chisel plow at or near time of application. All disposal plots were plowed and disced prior to planting.

The field plots were planted to Pioneer 3388 corn at a population of approximately 17,500 plants per acre on May 7-12, 1975. Leaf samples were taken from the growing plants on August 4-11, 1975, for chemical analyses. A portion of each plot was harvested for silage on September 11, 1975, and a portion harvested for grain on October 8, 1975.

Soil samples were taken by power probe from each plot in May and September. Chemical analyses have been performed by the Soil Testing Lab and the Water Quality Lab on the SDSU campus.

Half of the field plots were instrumented with recorders and samplers to collect runoff data. Both quantity and quality of the water from each runoff plot can be determined. The runoff equipment was installed in mid-April and kept serviced and functional until mid-November.

During the first two weeks of July, water infiltration tests were performed on half of the plots. Double ring infiltrometers were used for the tests.

Partial results are reported below under the following headings:

I. Waste Characteristics and Field Application Rates
II. Plant Populations and Heights
III. Silage and Grain Yields
IV. Water Infiltration
V. Runoff

I. Waste Characteristics and Field Application Rates.

The wastes produced during the year were easier to handle and easier to store than previous years due to less rainfall and no heavy late spring snowstorms.

The nitrogen content of wastes removed from the feedlot was generally 3 to 4% with the higher nitrogen content associated with a higher concentrate ration.

The sodium content of the wastes increased from approximately 0.5% with no salt added to the ration to approximately 1.5% where the ration contained 0.75% added salt (NaCl).

Table 64 gives a brief summary of the actual rates of wastes applied to field plots. Application of wastes began in October, 1974, and continued until April, 1975. In addition to the plots established in 1974, some new plots were established at lower application rates.

Table 64. Waste Application Rates to Field Plots

Proposed Annual Rate tons/acre	Salt Level	Amount Applied 1974 tons/acre	Amount Applied 1975 tons/acre	Accumulated Total tons/acre
5**	Low		6.1	6.1
5*	High	6.1		6.1
10*	Low	10.8		10.8
10**	Low		12.2	12.2
10*	High	11.6		11.6
15*	High	14.2		14.2
20*	Low	20.8		20.8
20*	High	18.3		18.3
20	Low	17.3	21.7	39.0
20	High	12.0	22.7	34.7
40	Low	45.3	41.3	86.6
40	High	38.0	41.2	79.2
60	Low	60.4	61.6	122.0
60	High	53.4	62.3	115.7
80	Low	75.7	81.1	156.8
80	High	77.1	81.6	158.7

*Wastes applied only for 1974 season.
**Wastes applied only for 1975 season.

II. Plant Populations and Heights.

During the 1974 growing season it became evident that yields were depressed by the higher rates of manure. Therefore, an attempt was made to determine if the yield reduction was caused by decreased growth, by reduced stand or a combination of the two. Table 65 gives a summary of the plant population and plant height on July 7, 1975.

Table 65. Plant (Corn) Population and Height, July 7, 1975

Proposed Annual Rate tons/acre	Salt Level	Plant Population plants/acre	Plant Height inches
Check	--	14,180	45.2
20	Low	14,389	42.8
20	High	14,048	41.7
40	Low	13,685	28.5
40	High	13,286	29.8
60	Low	13,068	21.2
60	High	12,705	22.1
80	Low	12,052	19.5
80	High	13,140	18.5

There appears to be a general trend in both the number and height of plants, both decreasing with increasing rates of waste application. Therefore, the decrease in yield may be attributed to the combination of decreased stand and growth. However, the reduction in plant height with increasing application rates is more pronounced; therefore, reduced growth of the individual plants apparently is the major factor in reduced yields.

III. Silage and Grain Yields.

Silage and corn grain yields were taken on September 11 and October 8, 1975, respectively. Yield results are given in Table 66.

Table 66. Corn Silage and Grain Yields

Proposed Annual Rate tons/acre	Salt Level	Grain (15.5% water) bu/acre		Silage (70% water) tons/acre	
		1974	1975	1974	1975
Check		45.0	22.3	8.1	11.8
20	Low	63.4	36.0	12.6	11.9
20	High	40.5	36.3	10.1	12.0
40	Low	71.6	42.7	11.2	10.4
40	High	62.6	38.9	11.7	7.6
60	Low	60.7	25.0	8.9	7.8
60	High	70.1	26.9	9.9	5.4
80	Low	71.5	31.4	11.4	8.4
80	High	61.9	12.6	9.5	5.7

The silage yield data show that at application rates exceeding 40 tons per acre silage yields are reduced with increasing rates of waste application. It would appear from the data that grain yields are not as sensitive to waste rates as are silage yields; however, at waste application rates greater than 40 tons per acre corn grain yields begin to decline. The low yields at the lower application rates may partially be explained by the fact that these plots had large

infestations of smut, with as many as half of the stalks being smut infected. There was a decrease in smut infestation with increased application rates.

The yield data for 1974 was quite variable with no clear trend evident. The yield data for 1975 is a result of two years of manure application. The data points out that while yields may not be greatly affected by a single large application, repeated yearly applications exceeding 40 tons per acre do cause yields to decrease. There is a carry-over effect from previous years applications. In a given year not all the manure applied is mineralized nor are all the salts leached below the root zone.

IV. Water Infiltration.

One of the primary concerns is excess sodium in soils with clays of the type found in our area due to the tendency for these soils to disperse or swell. Large amounts of sodium are present when large rates of manure with a high sodium content are applied to the soil. Dispersion of the soil disrupts soil structure and interferes with the movement of air and water into or through the soil, it also makes tillage of the soil more difficult (slick spots). One measure of the soil stability is the rate at which it allows water to enter (infiltration rate).

During the first two weeks of July, 1975, infiltration tests were conducted on half of the field plots. Figures 4 and 5 show the decrease in infiltration rate with time for the different application rates.

The final infiltration rates for all treatments except the 20-high (20 tons per acre--high salt level) were lower than the infiltration rate on the check plots which received no manure. On the plots receiving the largest amounts of manure, despite the fact that water was ponded on the surface, no water entered the soil after a relatively short period of time.

As an indication of the water stability of the soil, the accumulated infiltration at 12 hr was divided by the accumulated infiltration at 1 hr. The results are given in Table 67. The stability ratio did decrease with increasing rates of applied wastes; however, the decrease in infiltration appears to be related more to sealing of the pores with organic materials from the waste than from soil dispersion.

Figure 1. WATER INFILTRATION RATE

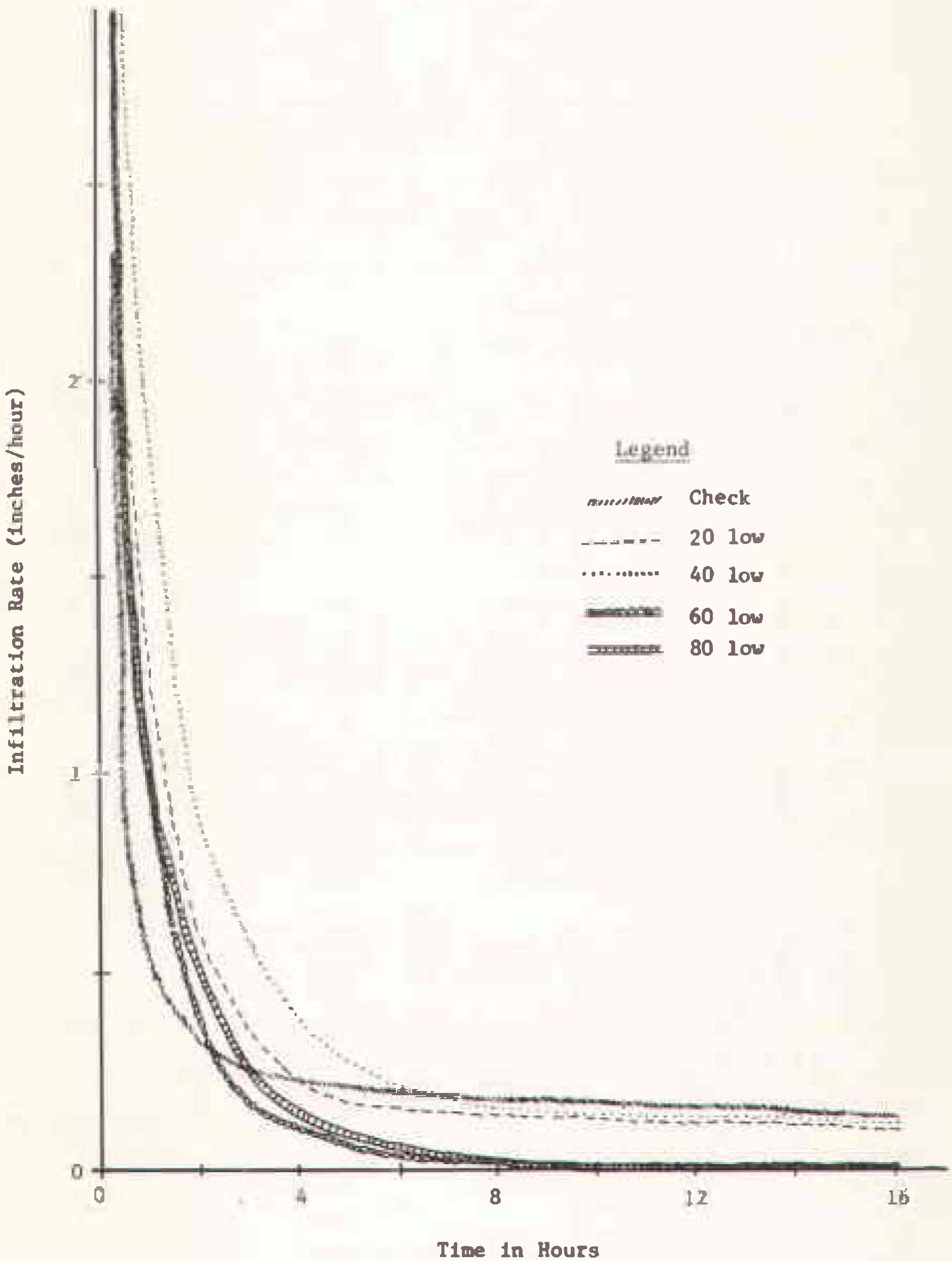


Figure 2. WATER INFILTRATION RATE

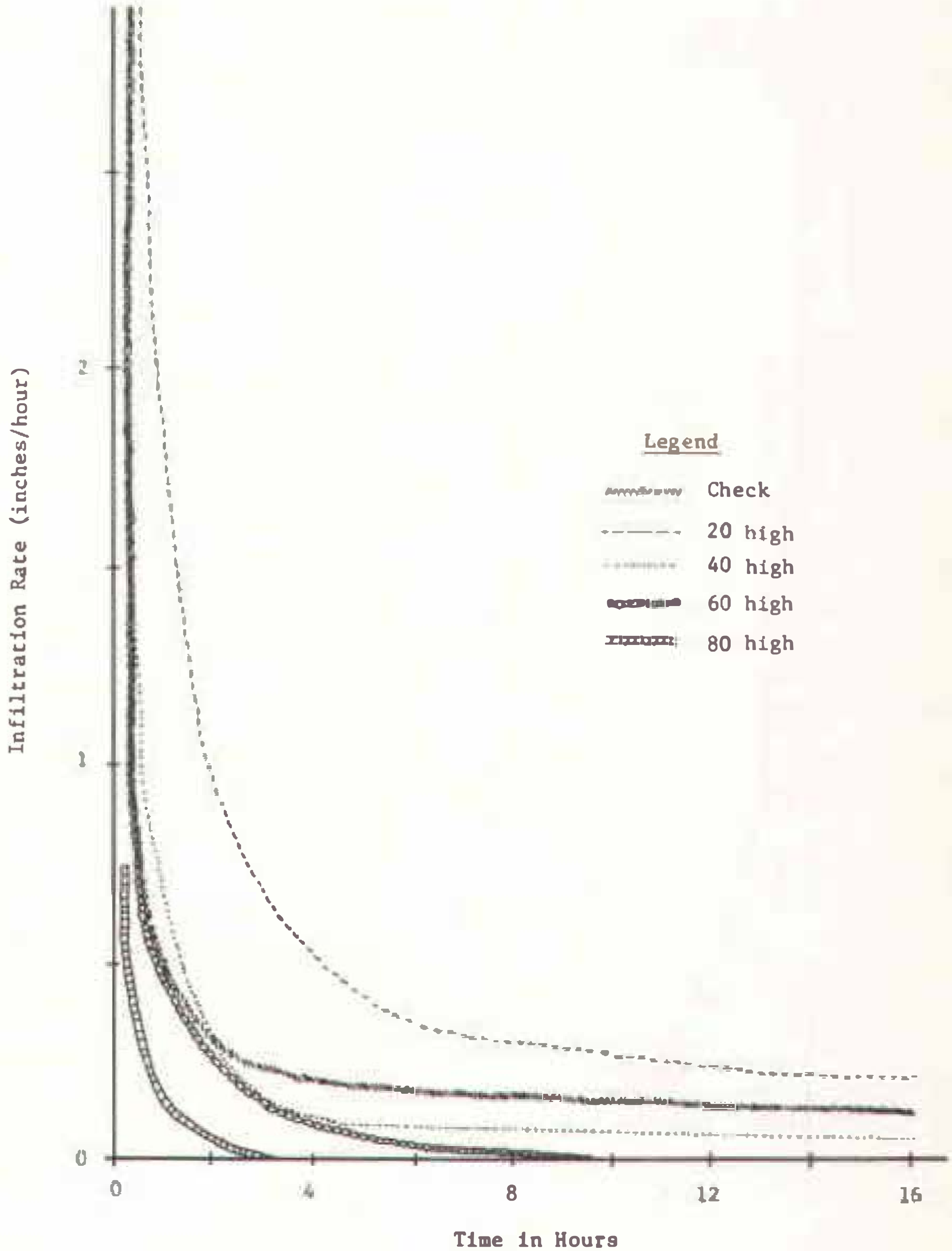


Table 67. Water Stability Ratio

Proposed Annual Rate tons/acre	Salt Level	Accumulated water infiltration at 12 hrs. / Accumulated water infiltration at 1 hr.
Check		3.0
20	Low	2.5
20	High	2.7
40	Low	2.9
40	High	1.5
60	Low	1.6
60	High	1.2
80	Low	1.3
80	High	1.2

A large water stability ratio value indicates that a soil is quite stable and little swelling or clogging occurs upon wetting.

Plots receiving less than 40 tons per acre of manure at either high or low salt levels are quite stable to water entry. The plots receiving 40 tons per acre of manure with a high salt level and plot receiving manure at rates greater than 40 tons per acre at either high or low salt levels are not as stable with respect to water and exhibit a greater tendency to become dispersed. Physical clogging of soil pores by large organic molecules is a possible cause for the low WSR (water stability ratio) values for the plots receiving manure at rates greater than 40 tons per acre.

V. Runoff.

As was the case last year, no runoff was recorded during the 1975 growing season. The runoff instruments were removed from the plots in November due to cold weather. They will be reinstalled next spring as soon as weather permits.

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