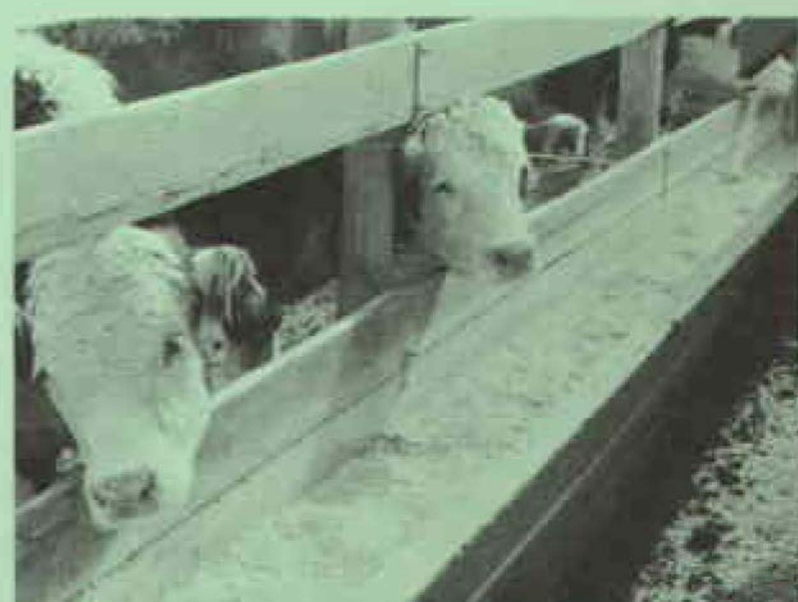
Southeast South Dakota Experiment Farm

ELEVENTH ANNUAL PROGRESS REPORT
DECEMBER 1971



Agricultural Experiment Station
South Dakota State University
Brookings

ELEVENTH ANNUAL PROGRESS REPORT
SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

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This eleventh 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 tenative 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

Duane Acker, Director   A. L. Musson, Assoc. Director

COVER PHOTOS: (Top) Field Day visitors hear about research on soil temperature and fertilizer response.
(Center) Use of systemic insecticides for greenbug control in grain sorghum.
(Bottom) Cattle feeding on protein supplement used in finishing ration experiments.

R. M. Luther (left)
Jacob Fredrikson (center, left)
Burton Lawrensen (center, right)
New office-lab-meeting building (bottom, left)
New road sign (bottom, right)

Research Manager's Report R. M. "Dick" Luther

A year ago I reviewed the activities and accomplishments at the Southeast South Dakota Experiment Farm for the last decade. This year we complete the first year of a new decade, the 70's. The questions yet to be answered, the problems that need to be investigated and the services to be performed appear equally as important and challenging now as those encountered during the last ten years. The search for new ideas, approaches and ultimately solutions to new and continuing problems arising from an ever-changing agriculture is a goal of the Experiment Station staff and those of us at the Southeast Farm.

Several new research studies were initiated this year. Four spring varieties of triticale (created from Durum wheat and rye) were planted for observation and yield tests. Sunflower varieties made their first appearance at the Farm. An experiment to evaluate an insecticide now used for corn rootworm control was tested as a systemic insecticide for the control of first-brood corn borer. Corn rootworm demonstration plots included different levels of recommended insecticides. Herbicide application was related to cultivation and fertility in corn and to cultivation in soybeans. A preliminary study of planting dates for sorghum was also conducted. Studies with raw and roasted soybeans for swine and protein supplements for growing-finishing beef cattle were new additions to the livestock research.

The list of services to our public continues to grow. During the early planting season soil temperatures were relayed to two radio stations and broadcast to farmers in the area. Hayrack tours of the research farm were given to area farmers, vocational agricultural students, fertilizer and chemical sales people and a veterans agriculture class. Numerous contacts by telephone and by persons stopping at the station were handled by farm personnel during the year.

The U. S. Weather Bureau volunteer station was expanded to include evaporation measurements. A study to relate growth of certain shrubs to climate was initiated. Construction of a new weather facility was begun and purchase of additional weather instruments for the facility is in progress.

During the calendar year the new Office Laboratory Building served as a meeting place for about 25 different agricultural meetings. These meetings involved more than 600 people. This figure does not include field day or Farm tour attendance or that of several different small group meetings. Many meetings were for South Dakota Cooperative Extension Service programs such as training schools, workshops and 4-H youth and leader activities. We are highly pleased to be of assistance in these important programs.

Behind the activities and accomplishments of the Experiment Farm is a group of enthusiastic Experiment Station project leaders and a dedicated Experiment Farm staff. We are also pleased to have had the help and support of the Experiment Farm Corporation during the past year.

Superintendent's Report Jacob Fredrikson

Grain and forage grown on the Experiment Farm are used for feed in the beef cattle and swine research programs.

The 1971 production of grain and forage was:

(based on weight at harvest)

Corn	4,455 bu.	Corn silage	190 T
Oats	672 bu.	Alfalfa hay	100 T
Soybeans	315 bu.	Grass hay	5 T
Milo	145 bu.	Straw	9 T

Corn grown on the north quarter of the farm was fertilized in the spring with liquid fertilizer knifed in as a pre-plant application. The rates of fertility used were those recommended by SDSU soils testing laboratory after analysis of soil samples. Eighty-three acres received 90 lbs. of nitrogen (N) and 45 lbs. of phosphate (P_2O_5) per acre. Fifty-five acres received 90 lbs. of nitrogen (N) per acre and also received varying amounts of barnyard manure.

The corn was planted in 30 inch rows this year. This was accomplished by hiring the planting and harvesting of the corn, thus delaying the need for purchasing new machinery. The change to narrower row spacing emphasized the importance of certain cultural and environmental factors that influence corn production. Timing of herbicide application, harrowing, and cultivation became more critical and increased the labor pressure. Banded herbicides gave a lesser degree of control on both grassy and broad leaf weeds this year. Equipment for narrow row farming may not be as readily available on a custom basis as that of conventional 38 or 40 inch row equipment. The availability of custom operators and the importance of getting the operation completed at the appropriate time may offset any benefits of not needing to purchase high cost, specialized equipment with low annual use.

All of the corn rootworm control materials recommended by SDSU extension entomologists (See report of Kantack and Fredrikson) were used on the acreage planted to corn. There was no visible or measurable difference in the performance of these materials.

Table 1 is a summary of the precipitation and temperature data recorded at the weather station during the calendar year. The Experiment Farm continues to be the official U.S. Weather Bureau volunteer weather observer station for the area. The total rainfall for the year was 1.90 inches below the average for the past nineteen years. The rainfall distribution had a marked effect upon the yields of all crops. The degree to which the rainfall distribution affected the performance of crops being studied is discussed in the interpretations which accompany each report. Temperatures followed closely those of the nineteen year average.

June was the month of heaviest precipitation for the year. As is usual in periods of rainfall of this amount (7.20 inches)small low-lying areas on the farm were flooded. Subsoil became saturated and partially sustained most crops in July and August during the low rainfall stress period. The north quarter yields were: 30 bushel (16% moisture) per acre of corn, 12 tons per acre of corn silage, and 4 tons per acre of alfalfa hay.

Soil and air temperatures were recorded from April 26 to June 15. Mr. Paul Evenson made the equipment available at the site of the Starter Fertilizer-Supplemental Heat experiment. Temperatures were recorded at 1.5 and 3.0 inch soil depths and above ground (air). Data for the 1.5-inch depth is compared with air temperature in Figure 1. Soil temperatures sometimes used as planting guides are: corn, 55° F. for three consecutive days; soybeans, mid to upper 60's; sorghum, 70 to 75° F.

TABLE 1. PRECIPITATION AND TEMPERATURE AT THE SOUTHEAST EXPERIMENT FARM, 1971

Month	Rainfall in Inches	19 Year Ave.	Departure	Ave. Temp. (F)	19 Year Ave.	Departure
Jan.	0.00	0.44	-0.44	12.0	16.3	-4.3
Feb.	1.83	1.42	+0.41	23.1	24.6	-1.5
March	0.57	1.32	-0.75	33.5	30.0	+3.5
April	1.61	2.53	-0.92	49.3	46.6	+2.7
May	2.11	3.17	-1.06	56.5	60.8	-4.3
June	7.20	4.24	+2.96	72.3	66.5	+5.8
July	1.97	3.06	-1.09	69.9	75.0	-5.1
Aug.	0.87	2.72	-1.85	73.0	71.0	+2.0
Sept.	1.67	2.80	-1.13	61.7	63.4	-1.7
Oct.	2.89	1.72	+1.17	53.2	54.0	-0.8
Nov.	1.56	0.97	+0.59	34.8	36.2	-1.4
Dec.	0.93	0.72	+0.21	18.6	22.8	4.2
Total	23.21	25.11	-1.90			

Days free of killing frost: May 2 to October 31 = 182 days.

Weather station currently in use. A new weather station will be in operation in 1972.

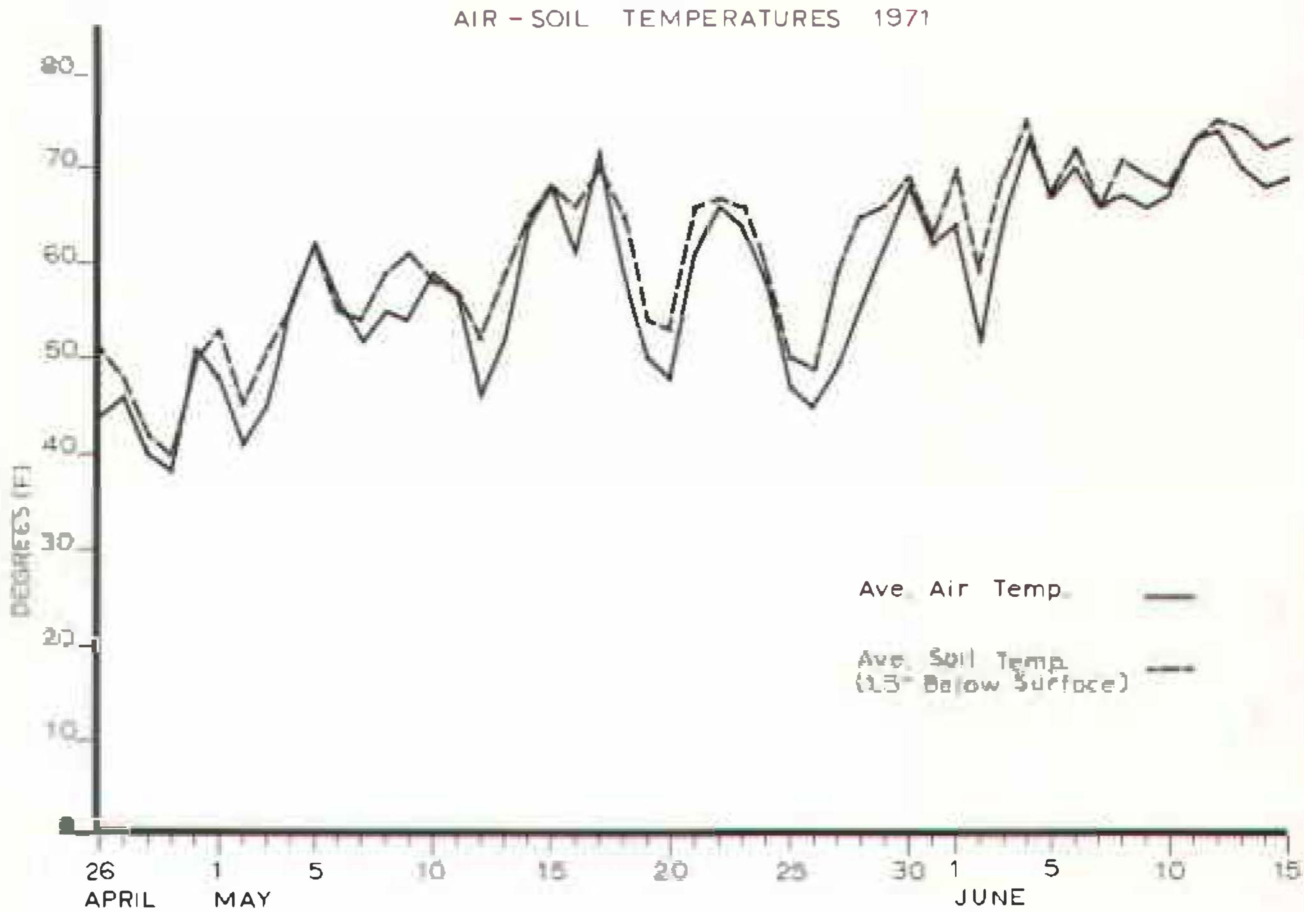


Figure 1. Air and Soil Temperatures - Southeast Experiment Farm, Beresford, 1971.

WEATHER STATION EXPANSION PLANNED FOR EXPERIMENT FARM

The possibility of securing additional climatological data for Southeastern South Dakota has been considered for several years. Such data would be a valuable research tool for scientists doing work at the Southeast Experiment Farm. It would also provide continuity to records of weather patterns for the area.

This year the decision was made to establish a weather station equipped with automated recording instruments. The instruments will measure temperature, relative humidity, precipitation, wind velocity and direction, soil moisture and solar radiation. A site was chosen south of the Office-Laboratory building and enclosed with a chain-link fence. Delays involved in the procurement of instruments prevented installation this fall. However, the station is expected to be in operation in the summer of 1972.

The Experiment Farm is cooperating with Professor Dennis Moe, head of the Agricultural Engineering Department at South Dakota State University and members of his staff in planning the facility. Personnel of the U. S. Weather Bureau are assisting with the project.

CORN PERFORMANCE TRIALS

J. J. Bonnemann

Entries included in the 1971 corn performance trials are those submitted by the participating companies and hybrids developed by Experiment Station breeders.

The corn was drilled in single rows, 30 inches apart, 39 feet long on May 12. It was harvested by picker-sheller on October 19 and 20. The corn was thinned to approximately 16-, and 20,000 plants per acre. Actual stand counts in late August averaged 15, 100 and 18,700 plants per acre. The severe drought greatly retarded growth.

Corn borer infestations were heavy. The plots received Furadan, 2 lbs./A, at seeding with Sevin sprayed at first brood infestation for corn borer control. Stalk breakage was very severe in many entries but upon close examination it was found that stalk rot, not corn borer damage, weakened nearly three-fourths of the stalks broken over. Because of this stalk breakage, variability was higher than desired for good evaluations. This variability probably obscured differences that may have developed between populations. No statistical difference was found for population so only the mean yield of eight replications was reported. The mean yield for the trial was 67.8 bushels per acre. The average moisture percentage for all entries was 18.7 percent.

The results are presented in Table 2. Additional information will be found in Circular 204, 1971 Corn Performance Trials.

TABLE 2. CORN PERFORMANCE TRIAL, AREA E., SOUTHEAST EXPERIMENT FARM

Brand & Variety	Type	Cross	Performance Score	Percent Root Lodged	Percent Stalks Broken	Percent Moisture	Mean Yield, B/A
Pioneer 3388	N	M2X	1	0.0	7.9	20.5	95.3
Pioneer 3387	N	2X	2	2.3	9.8	20.0	92.2
McCurdy 70-01	B	2X	5	0.6	24.3	19.7	90.8
Curry SC-158	N	2X	3	0.7	12.7	18.1	88.4
Pioneer 3518	N	M2X	4	0.6	6.0	19.2	85.5
Pioneer 3571	N	M2X	6	0.5	12.0	18.7	84.0
McCurdy 2X4	N	2X	7	3.9	41.0	16.9	83.4
SDAES SDEX70	N	3X	15	11.1	59.2	17.2	82.2
Weathermaster EP-65	T	3X	11	1.0	50.5	16.4	80.3
Curry SC-161	N	2X	10	0.0	32.0	19.0	78.5
Pride R-601	N	3X	8	1.0	25.2	17.9	77.4
Curry SC-142	N	2X	21	3.0	48.2	16.9	77.1
Green Acres S60	T	2X	19	2.7	31.6	22.8	75.7
Curry XC-157	N	2X	18	3.6	29.6	22.6	75.0
Pioneer 3390	N	M2X	9	5.6	16.7	18.9	74.7
Sokota TS-75	T	2X	25	3.2	40.9	19.0	74.4
Pioneer 3715	N	3X	27	4.8	45.2	16.8	74.1
McCurdy 3X3	T	2X	16	1.6	32.3	17.5	73.7

TABLE 2 continued at top of next page.

TABLE 2. (Cont.)

Brank & Variety	Type	Cross	Perfor-mance Score	Percent Root Lodged	Percent Stalks Broken	Percent Moisture	Mean Yield, B/A
Pride R-728	N	3X	12	2.6	28.4	18.3	73.4
McCurdy 69-109	T	2X	23	1.7	39.9	17.4	73.4
McCurdy 70-4	T	2X	20	1.0	32.5	16.9	72.4
Renk R 282	T	2X	22	2.3	35.1	17.6	72.1
McCurdy MSP 777	T	3X	13	0.6	24.8	18.1	72.10
ACCO UC 3301	N	2X	30	1.0	44.3	17.3	71.9
ACCO UC 8500	T	2X	17	1.7	20.2	21.2	71.3
McCurdy 69-111	T	2X	33	1.3	49.3	18.3	71.2
Sokota MS-84	N	M2X	32	13.0	42.5	21.1	70.7
Renk RK 44	B	2X	14	0.6	24.6	15.6	70.4
ACCO UC 3300	T	2X	36	2.3	54.6	17.0	70.3
McCurdy MSX 44	T	2X	34	1.3	51.8	16.8	70.1
ACCO U 378	N	3X	26	5.8	70.6	73.2	70.1
Sokota SK-92	T	M3X	24	4.3	17.8	22.3	69.0
Green Acres CH 66	N	4X	45	10.0	49.4	21.4	68.3
Western KX-55	T	2X	43	4.3	53.8	17.1	68.3
Pride R-450	N	3X	31	2.4	35.9	17.1	68.0
Green Acres L18	B	4X	39	3.5	38.1	21.8	66.9
Curry TC-358	N	3X	28	2.2	18.8	20.4	66.4
Curtis A201	T	2X	46	6.1	51.0	17.3	66.1
Pride R-771	N	3X	29	1.6	19.9	19.6	65.9
Green Acres 529	T	3X	42	0.7	34.4	22.8	65.7
ACCO UC 4600	T	2X	44	8.0	42.3	19.6	65.5
SDAES PP148A	N	4X	35	5.1	35.8	17.4	64.7
Curtis A 239	T	M2X	49	3.4	47.1	17.7	64.4
SDAES PP 104 A	N	4X	47	8.7	44.0	18.0	64.2
Teweles TXT 87	T	3X	41	2.6	38.3	17.5	63.9
McCurdy 70-5	T	2X	37	2.1	32.7	17.2	63.3
Wilson's 1017	T	2X	40	0.6	37.5	16.3	63.1
Western KX-62	T	2X	51	3.9	45.8	17.1	62.0
Weathermaster EPX-5SP	T	2X	56	4.0	57.4	16.8	61.3
McCurdy MSP 555	T	3X	38	1.6	22.0	18.7	60.1
Green Acres 623	B	4X	53	9.5	35.9	21.9	60.1
Coop S-102	T	2X	48	2.9	35.6	16.1	60.0
ACCO UC 4560	T	2X	52	0.7	44.4	17.0	59.1
Weathermaster EPX-6A	T	2X	59	9.0	57.5	18.1	59.0
ACCO U 369	T	3X	50	4.2	29.4	19.1	59.0
Teweles SXT 25	T	2X	57	12.1	47.2	18.0	58.6
Teweles 460	T	4X	62	11.1	59.1	17.2	55.5
SDAES PP 105 A	N	4X	61	6.1	52.2	18.2	55.4
Weathermaster EP-55	T	3X	60	4.7	46.5	16.9	53.2
Green Acres 1744	N	3X	54	1.3	13.0	22.0	52.7
Green Acres 6374	N	3X	55	5.3	18.9	21.4	52.4
SDAES PP 150	N	2X	66	8.6	73.0	17.5	52.1
Curtis 454	B	2X	65	34.2	65.8	18.8	50.7
Teweles TXT 80	T	3X	63	11.3	47.3	17.3	48.9
SDAES PP 149	N	2X	64	31.1	50.7	19.9	48.9
Pride R-540	N	3X	58	3.4	21.8	18.6	48.6
SDAES SD 604	T	4X	67	12.5	58.4	19.6	42.3
					Mean Yield		67.8

CV = 18%

CORN BREEDING

D. B. Shank

Four corn yield tests on experimental hybrids were conducted. Two trials consisted of advanced inbreds topcrossed to tester material, one was all possible single crosses among inbred lines for new hybrid prediction purposes, and one was a regional top cross test being conducted not only in South Dakota but also in several neighboring states.

Test results were not good. Dry weather coupled with severe corn borer infestation resulted in low yields and severe stalk breakage. The averages for the tests were as follows:

	Yield (Bu./A.)	Stalk Breakage (percent)
Topcross test	65.9	39.5
Topcross test	69.3	47.1
Single crosses	67.4	53.2
Regional test	70.8	47.8

These tests are on advanced breeding material with the purpose of being an aid in selecting new inbreds and hybrids for future commercial use. Because yields were depressed and stalk lodging was abnormally high they were not too valuable for such selection purposes. Check varieties included in the trials did not perform as expected indication that the results could be misleading.

CORN POPULATIONS AND ROW SPACING

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Should we keep corn planters that can plant 35 or 36 inch rows or trade them in for machinery that can plant narrower rows?
2. Are the optimum row spacings and plant populations different for a short season hybrid and a full season hybrid?
3. Is there a greater need for narrow rows with high plant populations?
4. Can moisture loss by evaporation be reduced by narrow rows?
5. Will an erect leaf hybrid perform better than an arched leaf hybrid at populations and row spacings used in this experiment?

Methods and Procedures Used in Corn Row Spacing Experiment

1970 - Experimental area had unfertilized corn.

Nov. 18, 1970 - Broadcast 17.6 tons of barnyard manure per acre. Broadcast 91 lb. of N, 38 lb. P_2O_5 (16.7 lb. P) and 35 lb. K_2O (31.5 lb. K) and plowed.

May 7, 1971 - Broadcast atrazine 80 W overall at 4.4 lb./acre and tandem disked.

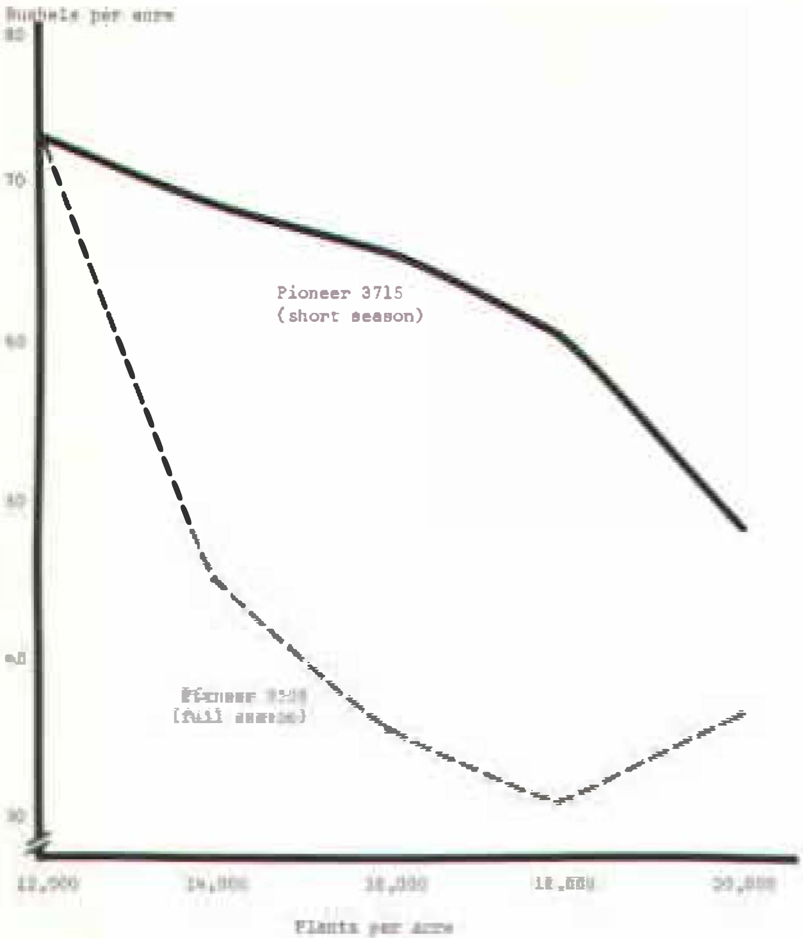


Figure 2. Effect of Plant Populations on Yield of Corn

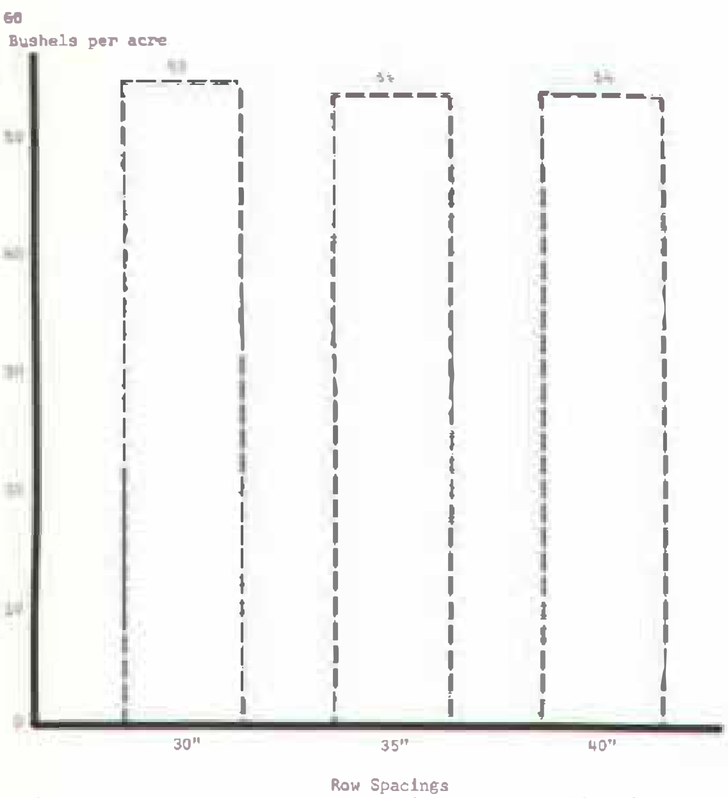


Figure 3. Effect of Row Spacings on Corn Yield*

* Each column represents the average yield of two hybrids and 5 plant populations

May 11- Tandem disked, melroed and planted plot.
Varieties - Pioneer 3715 and Pioneer 3505 (N cytoplasm)
Herbicide - Ramrod 20 G in the row.
Insecticide - Bux Ten.

Discussion and Interpretation of Figure 2

Notice the sharp decrease in yield with the full season hybrid when plant populations were increased over 12,000 per acre. There was a difference of over 40 bushels per acre due to variations in plant populations. The biggest differences in yield due to row spacings over the years that this experiment has been in existence were about 14 to 16 bushels. Therefore, a farmer who must try to outguess the weather, is better off if he is right about the planting rate for the hybrid he used than on how far he spaced his corn rows, especially if the weather conditions are unfavorable.

The yield of the smaller, short season corn also decreased as plant populations were increased but not as much as that of the full season corn.

In most years, the later maturing varieties yielded more than the early varieties used in this experiment. The reverse occurred in 1971 - a year with adequate moisture through June but below average for July and August.

Discussion and Interpretation of Figure 3

There was no distinct yield advantage for any of the different row spacings in 1971. This was the first year in the history of the experiment when narrow rows were not definitely superior in yields to those of widely spaced rows.

TABLE 3. EFFECT OF CORN PLANT DENSITIES ON MATURITY

Plants Per Acre	% of Ears With Silks Showing July 26*	% Ear Moisture at Harvest*
12,000	91.2	28.7
14,000	84.6	28.7
16,000	87.4	28.6
18,000	83.1	30.5
20,000	63.1	30.4

*Averaged from all row spacings and hybrids.

Discussion and Interpretation of Table 3

The two treatments with the greatest number of plants per acre had the least number of ears with silks showing on July 26 and had ears with the greatest amount of moisture at harvest.

With the conditions of 1971, heavy stands had a slight delaying action on maturity. In previous years with adequate rainfall there were small or no differences in maturity due to plant populations.

TABLE 4. EFFECT OF CORN ROW SPACINGS ON MATURITY

Row Spacing In Inches	% of Ears With Silks Showing July 26*	% Ear Moisture at Harvest*
30	79	29
35	84	29
40	84	30

*Averaged from all plant populations and hybrids.

Discussion and Interpretation of Table 4

Casual observations of these plots in the past have suggested possible plant height and maturity differences due to row spacing. When these variations were carefully measured, the apparent differences usually turned out to be random variations.

No definite influence on maturity due to row spacing can be inferred from the data in Table 4.

CORN VARIETY - ROW SPACING - POPULATION STUDY

P. Carson, F. Shubeck, B. Lawrensen, R. Ward and B. Shank

Objectives of Experiment

1. Determine if grain yields are equal when leaf area/acre of "small" very early maturing corn is increased by increasing populations so the leaf area/acre is equal to the leaf area/acre of "big" late maturing corn.
2. Determine if the highest yields are produced by the biggest, late maturing varieties and if earlier varieties can be made to produce equal yields by increasing populations.
3. Determine the effect of widely varying populations and row widths on the growth and yield of corn varieties with a wide range of maturity.

Methods

Populations: 20,000, 40,000 and 80,000 plants per acre.
Row Spacing: 10, 20 and 40 inches.
Hybrids:
1. Pioneer 3505 - Late maturing.
2. Renks NR-1 - 75 day - Early maturing.
3. Agsco 3 x AAA - Very early maturing.

Experimental Design: Completely randomized factorial.
Fertilizer:
N = 162 pounds per acre.
P = 39 pounds per acre.
K = 106 pounds per acre.

Fertilizer was broadcast and worked into the soil before planting.

Weed Control:
Ramrod 20G - applied in a band.
Atrazine - broadcast prior to planting (4.4 pounds per acre).
Date of Planting:
May 19
Date of Harvest:
Agsco 3 x AAA and Renks NR-1 - August 27
Pioneer 3505 - September 1

Insect Control: BUX-Ten at planting time.

The corn was planted with John Deere tool-bar planters. The corn was selectively thinned to desired populations after emergence and received no other treatments or attention until harvest. The corn was under severe moisture stress during August.

This experiment was designed for the moisture conditions normally encountered at the Southeast Experiment Farm. Thus, the prolonged dry period encountered in 1971 caused an exaggeration of the effects of population, hybrid and row spacing expected in this area. Since these conditions existed it was decided to take forage yields in addition to grain yields. This is the second year these conditions were encountered. Leaf area indices were measured on August 2. The corn at this time was rolled and was showing the effects of a moisture shortage. Due to the continued dry weather, no attempt has been made to interpret this data.

TABLE 5. THE EFFECT OF VARIETY, ROW SPACING AND POPULATION ON THE YIELD OF SILAGE. SOUTHEAST EXPERIMENTAL FARM, 1971

Variety[1]	Yield in Tons per Acre[2]			
	10" Rows	20" Rows	40" Rows	Average
	20,000 Plants per Acre[3]			
Very early	9.9	11.0	8.2	9.7
Early	9.3	8.5	7.9	8.6
Late	13.4	12.3	12.1	12.6
Average	10.9	10.6	9.4	
	40,000 Plants per Acre[3]			
Very early	9.5	8.9	9.7	9.4
Early	9.4	9.2	9.2	9.3
Late	10.9	10.8	11.9	11.2
Average	9.1	9.6	10.3	
	80,000 Plants per Acre[3]			
Very early	11.2	8.2	8.6	9.3
Early	10.6	9.0	8.8	9.5
Late	11.6	9.2	9.8	10.2
Average	11.1	8.8	9.1	

1 The very early variety was Agsco 3xAAA, the early variety was Renks NR-1, and the late variety was Pioneer 3505.

2 Yields calculated at 70% moisture.

3 Population goal.

TABLE 6. THE EFFECT OF VARIETY, ROW SPACING, AND POPULATION ON THE PERCENT MOISTURE IN THE PLANTS WHEN HARVESTED FOR SILAGE AT THE SOUTHEAST EXPERIMENTAL FARM, 1971

Variety[1]	Percent Moisture in Plants at Harvest Time[2]			
	10" Rows	20" Rows	40" Rows	Average
	20,000 Plants per Acre[3]			
Very early	22.3	25.0	27.7	25.0
Early	41.3	46.7	40.8	42.9
Late	70.3	70.4	70.4	70.4
Average	48.0	47.4	46.3	
	40,000 Plants per Acre[3]			
Very early	35.9	38.3	23.8	32.7
Early	50.4	54.4	46.4	50.4
Late	70.5	69.8	71.6	70.4
Average	52.3	54.2	47.3	
	80,000 Plants per Acre[3]			
Very early	47.8	47.6	51.4	48.9
Early	62.5	55.7	54.6	57.6
Late	67.5	71.1	71.2	69.9
Average	59.3	58.1	59.1	

1 The very early variety was Agsco 3xAAA, the early variety was Renke NR-1, and the late variety was Pioneer 3505.
2 Silage was harvested August 27, 1971 for two early varieties and September 1, 1971 for the late varieties.
3 Population goal.

TABLE 7. THE EFFECT OF VARIETY, ROW SPACING AND POPULATION ON THE YIELD OF GRAIN AT THE SOUTHEAST EXPERIMENTAL FARM, 1971

Variety[1]	Bushels per acre[2]			
	10" Rows	20" Rows	40" Rows	Average
	20,000 Plants per Acre[3]			
Very early[4]	47	52	48	49
Early[4]	52	52	46	50
Late[4]	57	32	59	49
Average	52	45	51	
	40,000 Plants per Acre[3]			
Very early[4]	42	35	47	41
Early[4]	37	30	45	37
Late[4]	1	4	20	8
Average	27	23	37	
	80,000 Plants per Acre[3]			
Very early[4]	8	27	14	16
Early[4]	5	18	7	10
Late[4]	0	5	0	2
Average	4	17	70	

1 The very early variety was Agsco 3xAAA, the early variety was Renke NR-1, and the late variety was Pioneer 3505.
2 Yields calculated at 15% moisture.
3 Population goal.
4 The two early varieties were harvested August 27 and the late variety was harvested September 1, 1971.

TABLE 8. THE EFFECT OF VARIETY, ROW SPACING AND POPULATION ON PERCENT MOISTURE IN GRAIN AT HARVEST TIME[1] AT THE SOUTHEAST EXPERIMENTAL FARM, 1971

Variety[2]	Percent of Moisture in Corn Ears at Harvest Time[3]			
	10" Rows	20" Rows	40" Rows	Average
	20,000 Plants per Acre[4]			
Very early	19.6	16.3	14.1	16.6
Early	27.7	28.0	26.9	27.5
Late	49.6	57.9	48.3	51.9
Average	32.3	34.1	29.8	
	40,000 Plants per Acre[4]			
Very early	23.2	17.0	13.6	17.9
Early	32.1	32.9	30.2	31.7
Late	57.7	57.4	52.6	55.5
Average	37.6	39.1	32.1	
	80,000 Plants per Acre[4]			
Very early	29.4	23.8	23.8	25.7
Early	36.9	36.6	38.0	37.2
Late	61.8	59.7	--	60.5
Average	42.7	40.0	30.9	

1 The two early varieties were harvested August 27 and the late variety on September 1, 1971.
2 The very early variety was Agsco 3xAAA, the early variety was Renks NR-1 and the late variety was Pioneer 3505.
3 The moisture samples were obtained by taking a section from the center of eight ears of corn.
4 Population goal.

TABLE 9. THE EFFECT OF THE VARIETY, ROW SPACING, AND POPULATION ON THE PERCENT OF PLANTS NOT HAVING EARS AT THE SOUTHEAST EXPERIMENTAL FARM, 1971

Varieties[1]	Percent Plants Not Having Ears			
	10" Rows	20" Rows	40" Rows	Average
	20,000 Plants per Acre[2]			
Very early	7	2	15	8.7
Early	9	9	1	6.3
Late	3	28	9	13.3
Average	6.3	13.0	8.3	
	40,000 Plants per Acre[2]			
Very early	18	26	1	15.0
Early	14	36	7	19.0
Late	98	94	64	85.3
Average	43.3	52.0	24.0	
	80,000 Plants per Acre[2]			
Very early	76	47	72	65.0
Early	58	56	63	59.0
Late	97	93	98	96.0
Average	77.0	65.8	77.7	

1 The very early variety was Agsco 3xAAA, the early variety was Renks NR-1, and the late variety was Pioneer 3505.
2 Population goal.

TABLE 10. POPULATIONS AT HARVEST TIME IN THE VARIETY ROW SPACING AND POPULATION STUDY CONDUCTED AT THE SOUTHEAST EXPERIMENT FARM, 1971

Variety[1]	10" Rows	20" Rows	40" Rows	Average
	20,000 Plants per Acre[2]			
Very early	22,211	15,985	14,692	17,629
Early	21,557	22,856	15,346	19,916
Late	19,944	21,549	16,162	18,552
Average	20,904	20,130	15,400	
	40,000 Plants per Acre[2]			
Very early	31,356	36,894	17,304	28,518
Early	31,356	33,956	26,120	30,477
Late	39,848	50,281	32,650	40,926
Average	34,153	40,377	25,391	
	80,000 Plants per Acre[2]			
Very early	67,938	52,526	60,239	60,234
Early	66,632	50,281	53,873	56,929
Late	55,526	65,953	71,830	64,436
Average	63,365	56,253	61,981	

[1] The very early variety was Agsco 3xAAA, the early variety was Renks NR-1, and the late variety was Pioneer 3505.
[2] Population goal.

Discussion and Interpretation of Tables 5 - 10

The corn forage yields reported as tons of 70 percent moisture silage (Table 5) indicate that a lack of moisture was the dominant feature affecting the yields. The very early variety planted at the lowest population was almost completely dried up by the time it was harvested on August 27 (Table 6). Increasing the population caused the corn to have more moisture in the stalks at harvest time. The late variety produced a little more silage than the other two varieties. This may in part be due to a loss of leaves by the very early and to some extent by the early variety before the silage was harvested. Row spacing and population did not have much effect on the silage yields.

The row spacing, population, and variety had interesting effects on grain yields (Table 7). With 20,000 plants per acre, neither row spacing nor variety greatly affected yield. The variety did greatly affect the moisture content of the grain at harvest (Table 8). The earliest corn produced the driest corn by harvest time. Drier corn in the wider rows was produced with the very early variety but no consistent row effect could be observed for the other two varieties at this population.

Increasing the plant population to 40,000 plants per acre caused the late variety to produce very little grain (Table 7). The variety with early maturity

had the highest yield . Row spacing had no consistent effect on the yield of the two earlier varieties. The late variety produced very little corn except in the wide row spacing.

Doubling the number of plants per acre to 80,000 greatly reduced the yield of all three varieties. The very early variety produced the most corn at this population, followed by the early and then the late variety. The highest yields were obtained in 20 inch row spacing with all three varieties at this population.

Harvesting the late variety on September 1 resulted in grain with a high moisture content (Table 8) for all populations and row spacings. The moisture content of the grain of all three varieties increased as the population increased. The early variety had considerably more moisture in its grain at harvest time than did the very early one.

Row width affected moisture content of corn of the very early variety at all populations (Table 8). Ear moisture decreased as row width widened. This was probably due to better air circulation around the corn plants when planted in wider rows. This same observation does not hold true for the other two varieties. This may be because they were either not physiologically mature or had just attained physiological maturity and had not entered the drying process yet.

The percent barrenness (Table 9) of the plants follows the yield table very closely. The highest percentage of barrenness being found with the larger, later variety and at the higher population. The effect of row spacing in barrenness also followed that of yield very closely.

It should be noted that the population goals were not reached in most cases. The actual populations found at harvest are recorded in Table 10. This variation was due to the wide variation in seed size.

DATE OF PLANTING AND RATES OF NITROGEN FOR CORN

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Will planting dates influence response to fertilizer?
2. How high should annual rates of nitrogen fertilizer be with continuous corn and a soil containing a medium amount of organic matter?
3. Will exceptionally high rates of nitrogen influence disease, insect damage or cause pollution of ground water?
4. Will soil temperatures serve as a dependable guide for selecting the optimum time to plant corn?

Methods and Procedures Used in Rates of Nitrogen and Time of Planting Study

December 1970 - Tandem disked cornstalks and plowed.
April 14, 1971 - Tandem disked plot area.
April 23 - Applied all broadcast fertilizer.
Sprayed Atrazine 80 W over all at 3.5 lbs. per acre.
April 29 - Harrowed area for first planting.
Planted earliest planting.

May 7 - Disked, harrowed and planted for second planting date, using the same procedures as used for first planting.
May 13 - Disked, harrowed and planted for third planting date using the same procedures.
May 17 - Rotary hoed first planting. Grassy weeds were emerging.
May 20 - Disked, harrowed and planted the fourth planting. Same procedures used. Rotary hoed first and second plantings.
June 17 - Cultivated all plots.
June 24 - Cultivated 1st planting (lay-by).
Hybrid - Funks G4444 (N cytoplasm)
Row spacing - 30 inches.
Insecticide - Bux 10 - (1 lb. actual material per acre).
Herbicide - Ramrod 20 G in 14 inch band at planting and atrazine 80 W over-all at 3.5 lbs. per acre applied preplant.
Plant population - 18,000 plants per acre.

TABLE 11. EFFECT OF FERTILIZER AND PLANTING DATES ON YIELD OF CORN (IN BUSHELS PER ACRE)

Broadcast Fertilizer Treatment N + P + K	Planting Dates April 29	May 7	May 13	May 20	Average
0 + 0 + 0	18	9	7	9	10.8
0 + 11 + 58*	21	10	7	7	11.3
80 + 11 + 58*	44	19	23	13	24.8
160 + 11 + 58*	38	26	20	14	24.5
240 + 11 + 58*	36	25	30	16	26.8
Average	31.4	17.8	17.4	11.8	

*These plots received 4 lbs. N, 7 lbs. P and 7 lbs. K starter per acre placed in a band approximately 2 inches to the side and 2 inches below the seed in addition to the broadcast treatment.

Discussion and Interpretation of Table 11

There were too many plants per acre for the climatic conditions of 1971 (Note results in Corn Row Spacing and Population Experiment). Ears were small and many stalks were barren.

There was a clear cut yield advantage for the earliest planting date this year when July, August, and September rainfall was below average.

Broadcast nitrogen at 240 lbs. of actual N per acre did not "burn up the crop" even though rainfall was in short supply. Yield levels at all three nitrogen rates were higher than those in plots receiving no broadcast nitrogen. Nitrogen increased yields over the unfertilized check plots for every planting date.

TABLE 12. EFFECT OF PLANTING DATE ON CORN HEIGHT

Planting Date	Corn Height in Feet	
	July 15	August 16
April 29	5.8	6.3
May 7	5.9	6.5
May 13	5.6	6.4
May 20	5.3	6.5

Tables 11 and 12 were presented to show the effect of early planting on corn growth and development. By August 16, in 1971 (Table 12) height of early planted corn was only slightly less than that of later planting. The highest yields were from the earliest planting date.

Results vary from year to year. For example in 1968, early planted corn (April 26) was one to two feet shorter than late plantings (June 3) when corn from both planting dates reached full height. In 1968, early planted corn had 30% less leaf area and a lower yield than later plantings.

Discussion and Interpretation of Table 13 and 14

There is a question on how effective early planting is for advancing corn maturity.

In Table 13 corn that was fertilized with broadcast nitrogen and planted on the earliest date was pratically all silked by July 23. Corn receiving the same fertility but planted last was all silked by August 4th. The interval in silking dates was approximately 12 days and the interval in planting dates was 21 days. Silking dates were advanced by 12 days by early planting. In a year when drought stress occurred in July, August and September, this advancement was sufficient to have a beneficial effect on yield of ear corn (Table 11).

In 1968 there was a maximum difference in planting dates of 38 days but silking dates were advanced only 9-10 days by planting early.

TABLE 13. EFFECT OF PLANTING DATE ON TIME OF SILKING

Planting Date	Broadcast Fertility* N + P + K	Percent of Silks Showing July 15	July 20	July 23	July 26	July 29	Aug. 4
April 29	0 + 0 + 0	0	13	41	51	73	100
	0 + 25 + 70	16	29	57	55	89	100
	80 + 25 + 70	18	95	100	100	100	100
	160 + 25 + 70	14	81	100	100	100	100
	240 + 25 + 70	0	75	96	96	100	100
May 7	0 + 0 + 0	0	0	0	21	27	100
	0 + 25 + 70	0	7	14	14	57	100
	80 + 25 + 70	0	73	82	77	97	100
	160 + 25 + 70	0	70	91	98	100	100
	240 + 25 + 70	0	38	40	52	77	100
May 13	0 + 0 + 0	0	0	0	0	7	100
	0 + 25 + 70	0	0	13	13	50	100
	80 + 25 + 70	0	24	55	88	91	100
	160 + 25 + 70	0	13	73	100	100	100
	240 + 25 + 70	0	12	77	88	100	100
May 20	0 + 0 + 0	0	0	0	13	25	50
	0 + 75 + 70	0	0	0	0	34	50
	80 + 25 + 70	0	0	9	46	84	100
	160 + 25 + 70	0	0	7	57	88	100
	240 + 25 + 70	0	0	23	69	86	100

*All treatments except 0 - 0 - 0 received 4 lbs. N, 7 lbs. P and 7 lbs. K starter per acre placed in a band 2 inches to the side and 2 inches below the seed.

TABLE 14. EFFECT OF PLANTING DATE ON PERCENT EAR MOISTURE AT HARVEST

Planting Date	% Ear Moisture*
April 29	15
May 7	18
May 13	20
May 20	24

*Averaged from all fertility treatments.

Early planting in 1971 was more successful than other years for hastening silking, reducing ear moisture at harvest and for increasing yields.

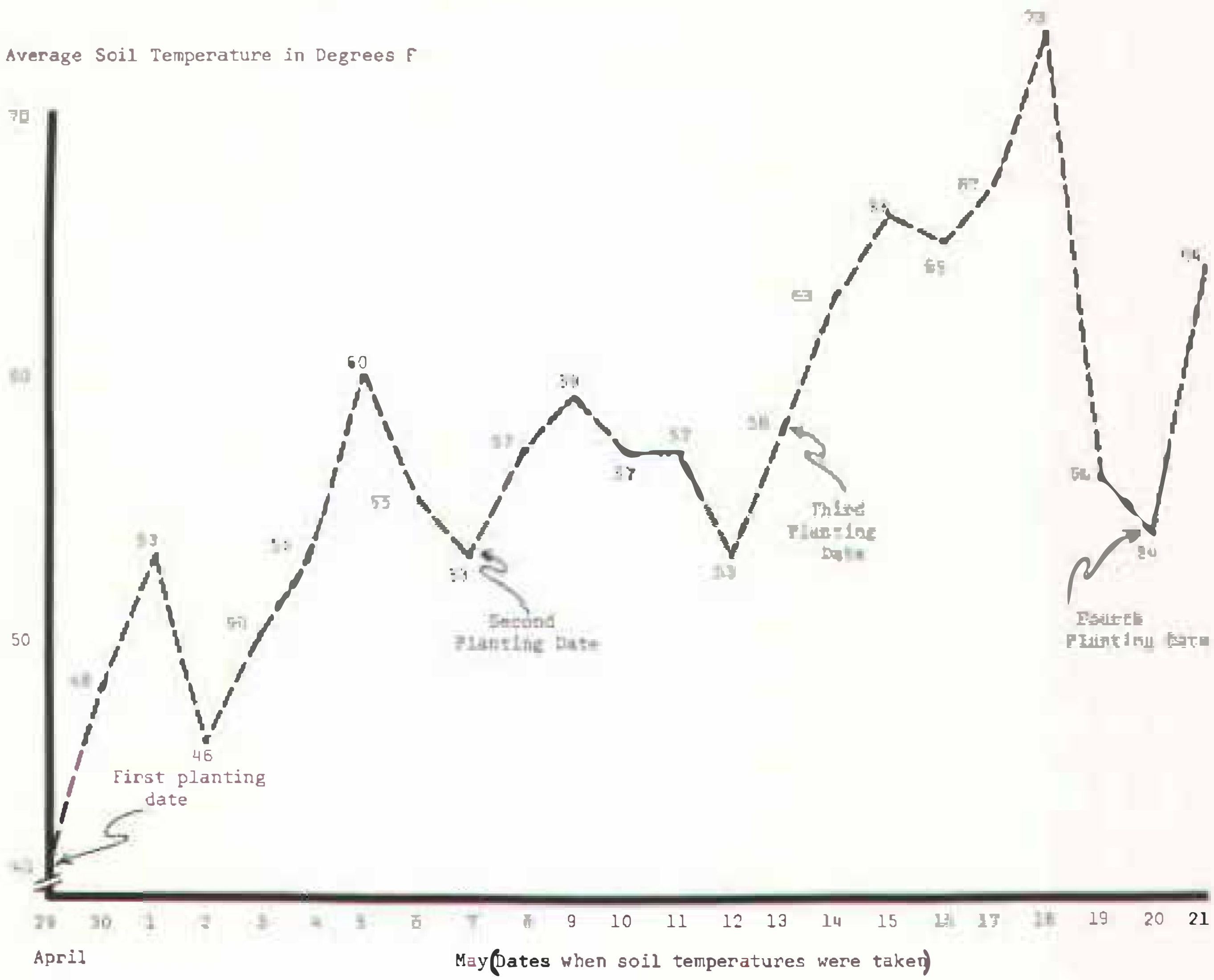


Figure 4. Relation of planting date to soil temperature 3 inches below soil surface.

Discussion and Interpretation of Figure 4

Figure shows soil temperatures three inches below the surface from the first through the fourth planting date. There were some rather wide fluctuations in soil temperatures but the extremes were not as great as in some years.

If a grower followed the rule "three consecutive days at 55° F. or over at three inches below the soil surface before planting", he would have planted about May 10th in 1971. Corn growth progressed quickly in the early part of the growing season this year. Corn planted in early May was nearly five feet tall by July 4th. In this experiment the earliest planted corn yielded the most.

Results were different in 1968. In this year, soil temperatures 4 inches below the surface reached a high close to 70° F. three times and fell below 55° F. three times in the interval between the first and third planting dates. The early planted corn was injured by frost twice and yields were reduced.

LIME EXPERIMENT

Raymond Ward and Burton Lawrensen

A lime experiment was established in 1968 on an acid soil area (soil pH 6.2) just southeast of the Office-Laboratory Building to determine if lime was needed on acid soils in southeastern South Dakota. This experiment was also established at three other locations in southeastern part of the state in 1968. A complete report of the lime experiments will be available at a later date from the Plant Science Department at South Dakota State University.

Methods and Materials

1. May 11. Nitrogen at the rate of 110 pounds actual N per acre was broadcast and disked in. Then 4.4 pounds Atrazine 80W was sprayed over the entire area and the area was spike tooth harrowed. Pioneer 3518 corn was planted to obtain 16,000 plants per acre. The insecticide, Furadan, was used to control rootworms.

2. June 9. The lower elevation end (east end) of the experimental site had been under water for two days.

3. October 7. Ear corn yields were harvested.

Results and Discussion

Yields and moisture content of ear corn harvested from the lime experiment are shown in Table 15. Corn yields were low in 1971 because of low rainfall in July and August. However, June rainfall was great enough to flood the east replication of the site. Therefore, yields shown in Table 15 are an average of three instead of four replications. Plots receiving 4 tons of lime per acre in 1968 had corn yields that were 10-12 bushels per acre higher in 1971. Yield response to lime in 1970 was on the order of 4-7 bushels per acre as shown in Table 16. There was no corn yield response to lime in 1968 and 1969. The yield responses to applied lime in 1970 and 1971 tend to indicate that lime applications may be beneficial on soils in southeastern South Dakota which have a pH of 6.2 or less. The data also suggests that the response to lime may occur in later years after the lime has had time to react with the soil.

The four-year average corn yield increase (Table 16) was six bushels per acre when comparing the check treatment to the lime treatment. Comparison of corn yields between the phosphorus treatment and the lime plus phosphorus treatment also showed a yield response although it was very small. Phosphorus fertilizer was included in the experiment because one of the benefits from liming is increased phosphorus availability. However, this experiment showed no benefit from applied phosphorus. The yield increases were apparently caused by other effects of lime.

Table 17 shows the soil pH of the plow layer before initiation of the experiment, in the spring of 1969, and the fall of 1971. Lime increased soil pH about 0.3 pH unit. We expected 4 tons of lime per acre to increase the plow layer soil pH to about 7.0. One reason the soil pH was not increased as much as expected was that the neutralizing index of the applied lime was 52 percent. The small increase in soil pH also shows the buffering capacity of South Dakota soils.

In summary, an application of lime did not increase the corn yield the first

two years, but increased it 10 bushels per acre the fourth year. This suggests there may be need for lime on soils in southeastern South Dakota that have a plow layer soil pH of 6.2 or less. More research needs to be conducted to determine (1) benefit of lime on different soil types, (2) rates of lime needed, and (3) effectiveness of liming materials.

TABLE 15. EFFECTS OF RESIDUAL LIME AND PHOSPHORUS APPLICATIONS ON THE YIELD OF EAR CORN IN 1971 AT THE S. E. FARM.

Treatment (Applied in 1968)	Ear Corn, Bu/A (15% H_2O basis)	Ear Corn Moisture, %
Check	42	26.4
Lime (4 tons/A)	52	23.8
Phosphorus (60 lbs. P_2O_5/A)	40	23.6
Lime and Phosphorus	52	26.3

TABLE 16. YEARLY EFFECTS OF LIME AND PHOSPHORUS APPLIED IN 1968 ON THE YIELDS OF EAR CORN FROM 1968-1971 AT THE S. E. FARM.

Treatment	Ear Corn Yield, Bu. Per Acre				
(Applied in 1968)	1968	1969	1970	1971	Average
Check	90	91	41	42	66
Lime (4 tons/A)	94	95	48	52	72
Phosphorus (60 lbs. P_2O_5/A)	99	90	41	40	68
Lime and Phosphorus	95	86	45	52	70

TABLE 17. EFFECTS OF APPLIED LIME ON PLOW LAYER SOIL pH AT THE S. E. FARM.

Treatment	Soil pH		
(Applied in 1968)	Spring 1968	Spring 1969	Fall 1971
Check	6.2	6.3	6.1
Lime (4 tons/A)		6.5	6.4
Phosphorus (60 lbs. P_2O_5/A)		6.3	6.1
Lime and Phosphorus		6.5	6.4

STARTER AND POP-UP FERTILIZER FOR CORN

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Will a starter fertilizer high in phosphorus increase corn yields in a soil with medium to low phosphorus supplying ability?
2. Is it best to eliminate the starter sideband and "pop-up" treatments and broadcast all the fertilizer before planting, then plow it down or disk it in?
3. What can we expect from "pop-up" fertilizer in regard to yield, maturity, and early growth?

Methods and Procedures Used in Starter and Pop-Up Experiment

1969 - Corn was grown with several rates and ratios of fertilizer application. Corn grain harvested in the ear and stalks rotary chopped, disked and plowed.
1970 - Corn was grown in this area. It was unfertilized and removed for silage.
May 3 - Fertilizer was broadcast and plowed down. Disked in fertilizer was broadcast on plowing, then disked in. Plots were harrowed using spike tooth harrow.
Stand - 18,000 plants per acre.
Sideband starter applied at planting approximately 3 inches to the side and 2 inches below the seed.
Pop-up applied with seed at planting time.
Insecticide - Furadan 10 G in band at 40 lbs/A.
Herbicide - Ramrod 20 G in 14-inch band at 5 lbs. active ingredient per acre.
May 7 - Sprayed atrazine 80 W overall at 4.4 lbs. per acre.
May 15 - Emergence date - no apparent difference due to fertilizer treatments.
June 17 - Cultivated all plots.
June 22 - Sidedressed designated plots with 80 lbs. N per acre.
Aug. 13 - Treated for 2nd brood corn borers with Sevin Granules, applied with ground rig.
Sept. 28 - Hand picked all plots.

TABLE 18. EFFECT OF STARTER FERTILIZER, POP-UP, SUPPLEMENTAL NITROGEN AND METHODS OF APPLICATION ON CORN YIELDS

Treat-ment No.	Pop-up, Band and & Broadcast Ferterilizer Lbs. per Acre N	P	K	Method	Additional Nitrogen Lbs/Acre	Bu. of #2 Corn /Acre
1	3 +	6 +	5	pop-up	80 plow down	64
2	0 +	0 +	0	------	80 plow down	62
3	12 +	23 +	0	starter band	80 plow down	58
4	3 +	6 +	5	pop-up	80 plow down	57
	9 +	17 +	12	plow down		
5	12 +	23 +	17	starter band	80 plow down	57
6	3 +	6 +	5	pop-up	80 plow down	56
	9 +	17 +	12	starter band		
7	12 +	0 +	17	starter band	80 plow down	55
8	12 +	23 +	17	starter band	80 sidedress	54
9	3 +	6 +	5	starter band	80 plow down	53
	9 +	17 +	12	plow down		
10.	12 +	23 +	17	disk in	80 plow down	53
11.	12 +	23 +	17	starter band (sulfate)	80 plow down	51
12.	12 +	23 +	17	starter band	no additional N	50
13.	12 +	23 +	17	plow down	80 plow down	49
14.	0 +	0 +	0	------	no additional N	44
L.S.D. at 5%						8.8

Discussion and Interpretation of Table 18

There was a difference of 20 bushels between the highest yielding plot and the unfertilized check plot. This difference was statistically significant at the 5% confidence level. It appears that when yields are restricted to 50-60 bushels per acre by weather conditions, we were able to obtain a favorable increase in yield from nitrogen fertilizer at this location.

Last year yields from this experiment were limited by weather. Yields were in the range of 5-10 bu/acre with no yield increases due to fertilizer applications.

Some results are available suggesting that starter nitrogen in the sulfate form is more beneficial than in other forms. The sulfate source is more acid forming and lowers pH in the band. This is supposed to make nutrients in the band more available in slightly acid or neutral soils. However, in this experiment the sulfate form (Treatment 11) increased yields no more than a similar quantity of starter nitrogen using ammonium nitrate (Treatment No. 5).

With the climatic conditions of 1971, a small amount of pop-up fertilizer placed with the seed (Treatment No. 1) appeared to be a little more effective for increasing yields than a larger quantity placed in a sideband (Treatment No. 5). Results from pop-up have been somewhat inconsistent over the last five years.

When starter was applied in a sideband, methods of supplemental nitrogen application-plow down (No. 5) and sidedress (No. 8) both increased corn yields but the difference in yield between the two methods was small.

The largest yield responses were usually due to nitrogen applications (No. 2) rather than to starter or pop-up alone (No. 12). When adequate nitrogen was supplied and more adequate rainfall received, then phosphorus would become the most limiting element and larger yield increases would be expected from starter.

When the quantity of fertilizer used as a starter was divided into two separate applications, a small part of it applied as a pop-up or sideband and the majority of it plowed down (No. 4 and 9) yields were about the same as those from plots receiving the entire amount of starter as a side-band application (No. 5). None of these treatments significantly increased yield over plow down nitrogen alone (No. 2).

When phosphorus was omitted from the starter (No. 7) yields were about the same as when it was included (No. 5). The phosphorus supplying ability of the soil was apparently close to adequate for the climatic conditions of this year. Plowing down an equivalent amount of fertilizer equal to the starter (No. 13) was not very successful for increasing yields this dry year. Deeper applications (as plow down) are sometimes credited for minimizing drought induced nutrient deficiencies that sometimes occur in dry years. The soil drys out at the surface and shallow applications of relatively non-mobile nutrients (as P) become relatively unavailable. Potassium in the starter had little influence on yield this year.

TABLE 19. EFFECT OF FERTILIZER ON PLANT HEIGHT

Pop-up, Band & Broadcast Fertilizer Lbs. per Acre N + P + K	Method of Application	Additional Nitrogen	Plant Height in Feet June 18	July 7
3 + 6 + 5 9 + 17 + 12	pop-up plow down	80 # N plow	1.6	4.9
3 + 5 + 5 9 + 17 + 12	pop-up starter band	80# N plow	1.7	5.0
3 + 6 + 5	pop-up	80# N plow	1.6	5.0
12 + 23 + 17	starter band	80# N plow	1.5	4.8
12 + 0 + 17	starter band	80# N plow	1.4	4.6
0 + 0 + 0	-------	80# N plow	1.3	4.4
0 + 0 + 0	-------	-------	1.3	4.2

Discussion and Interpretation of Table 19

Fertilizer may have a beneficial effect on rate of maturing corn and this becomes an important consideration in the northern fringes of the corn belt. If a 3 day later maturing hybrid with a greater yield potential can be grown and higher quality mature corn produced due to the fertilizer, the value of the fertilizer would be greatly enhanced. Table 19, Figure 5 and Table 20 are arranged in sequence to concentrate attention on the relationship of fertilizer and maturity.

Table 19 shows effect of fertilizer on plant height at an early stage of growth. There were no appreciable differences in date of emergence due to fertilizer treatments, but by June 18 some of the fertilized corn was 0.3 to 0.4 feet taller than corn in the unfertilized check plots. Fertilizer helped to get the corn off to a quick start, however, an early start does not always mean a strong finish.

By July 7 corn in these plots was remarkably advanced this year. Some fertilized plots had corn 5 feet tall.

It is interesting to follow through with maturity differences in this experiment beginning with early height advantage due to fertilizer, to silking dates, to percent ear moisture at harvest and finally to yield relationships.

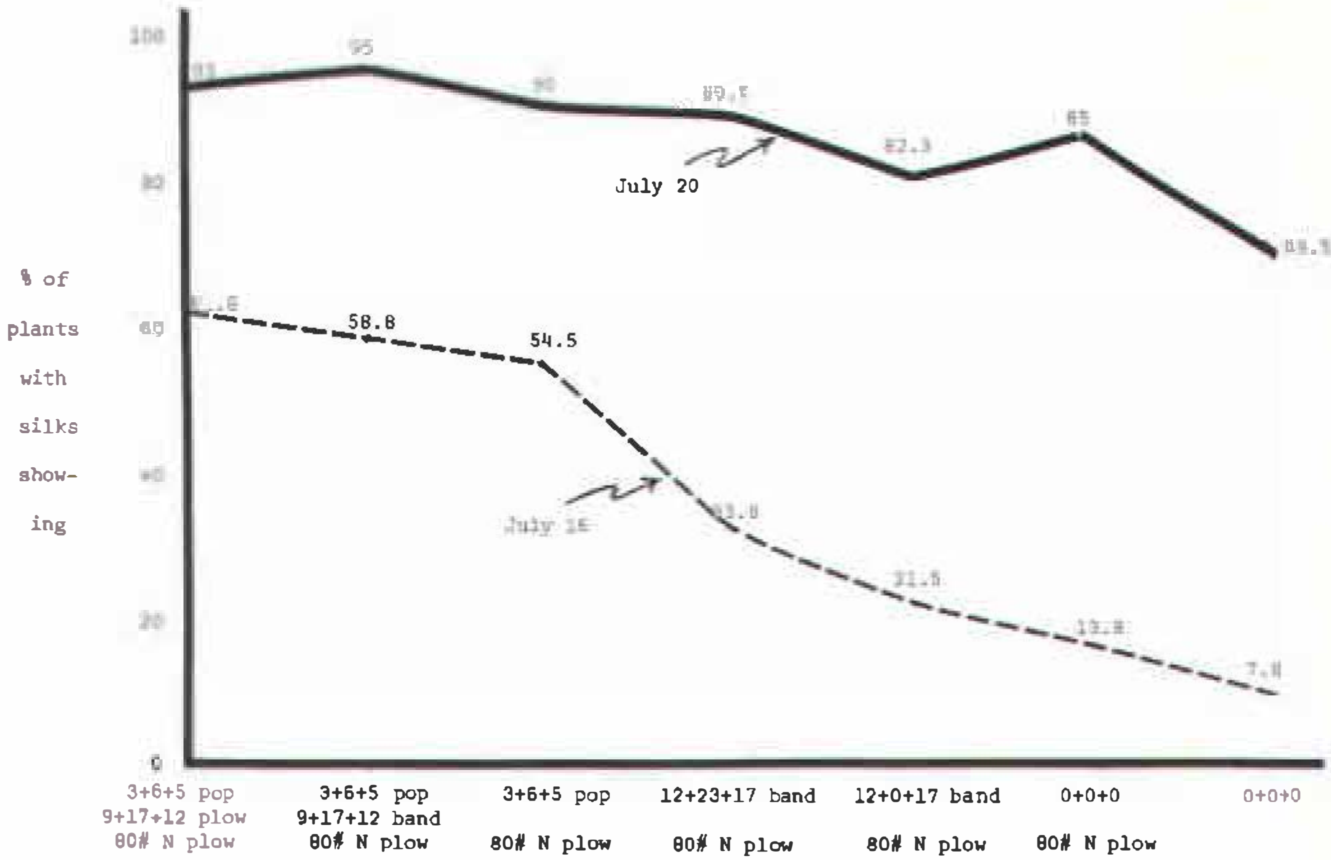


Figure 5. Effect of Fertilizer treatment on silking dates.

<u>Discussion and Interpretation of Figure 5</u>

Figure 5 shows effect of fertilizer on silking dates. This gives an indication of the effect of different treatments on maturity midway in the growing season. On July 16 only 7.8% of the plants had silks showing in unfertilized plots. Eighty pounds of nitrogen per acre advanced the silking date slightly. When phosphorus was omitted from the starter band, silking was slower than when it was included. Pop-up fertilizer speeded up silking.

These same trends were present on July 20 but the differences between treatments were not so pronounced.

TABLE 20. EFFECT OF FERTILIZER ON CORN EAR MOISTURE AT HARVEST

Pop-up Band & Broadcast Fertilizer Lbs. per Acre N + P + K	Method of Application	Additional Nitrogen Lbs per Acre	% Ear Moisture
3 + 6 + 5 9 + 17 + 12	pop-up plow down	80 plow	20
3 + 6 + 5 9 + 17 + 12	pop-up starter band	80 plow	19
3 + 6 + 5	pop-up	80 plow	17
12 + 23 + 17	starter band	80 plow	21
12 + 0 + 17	starter band	80 plow	21
0 + 0 + 0	------	80 plow	20
0 + 0 + 0	------	-------	24

Discussion and Interpretation of Table 20

Fertilizer treatments that hastened silking generally reduced ear moisture at harvest.

There was a 7% difference in moisture between ears from unfertilized plots and ears from plots receiving a pop-up + 80 lb. nitrogen per acre. This is a substantial difference in maturity in favor of the fertilized plots.

Notice that the 3 + 6 + 5 pop-up plus 80 lb. N plow down treatment had the lowest percent ear moisture at harvest and had the highest yield of ear corn. The unfertilized check plot had the highest percent of ear moisture of all treatments and had the lowest yield of ear corn per acre.

For this year, it looks like the fertilized corn plants made a faster start than unfertilized plants. This lead was maintained midway in the growing season and continued on to the end when the corn was picked. Most of the highest yielding plots had the lowest percent ear moisture at harvest.

Data from other experiments indicate that full season corn varieties at their best populations and row spacings usually have a greater yield potential than smaller earlier varieties at their optimum row spacings and populations. Results from this starter experiment show that proper fertilizer use hastens corn maturity. Therefore, growers can expect top yields of dry corn by planting full season varieties and by using a fertility program that prevents nutrient deficiencies and associated delays in maturity.

STARTER FERTILIZER EXPERIMENT WITH CORN

P. Carson, F. Shubeck, B. Lawrenson and R. Ward

Objectives of the Experiment

1. To establish the value of starter fertilizers on the growth and yield of corn.

2. To determine what effects, rates of P and/or K applied as starter, have on the yield of corn.

Methods

1. Experimental design - completely randomized factorial. Plot size was 10 feet x 60 feet. Each plot contained four rows of corn.
2. Nitrogen was applied before planting at the rate of approximately 100 pounds of N per acre.
3. Variety - Pioneer 3518.
4. Weeds were controlled with Ramrod and insects with Furadan by banding at planting time.
5. Corn was planted May 7, 1971.
6. The corn was planted with a John Deere Unit-planter equipped with belt fertilizer applicators to apply fertilizer as a starter beside and below the seed. The rate of planting was 18,000 seeds per acre. The row width was 30 inches.
7. A severe drought during the last part of July and during August greatly influenced the yield.
8. Corn was harvested by hand October 7, 1971. Sixty feet of row were harvested.
9. Fertilizer treatments.

N	+	P	+	K
(lbs. per acre)				
12	+	0	+	0
12	+	6	+	0
12	+	12	+	0
12	+	23	+	0
12	+	0	+	9
12	+	6	+	9
12	+	12	+	9
12	+	23	+	9
12	+	0	+	17
12	+	6	+	17
12	+	12	+	17
12	+	23	+	17

TABLE 21. SOIL TESTS*, RESULTS FROM THE EXPERIMENTAL SITE

Depth Inches	Nitrate Nitrogen ppm	Organic Matter %	Phosphorus lbs/A	Potassium lbs/A	pH 1:1	Salts mmhos/cm
0-6	16.1	3.6	24	451	6.8	0.72
6-12	10.6	2.9	11	324	6.4	0.33
12-18	6.2	1.7	4	288	6.9	0.24
18-24	9.1	1.1	3	288	7.4	0.43
24-30	14.2	0.8	2	353	7.7	0.48
30-36	15.8	0.5	2	222	8.1	0.42
36-42	14.2	0.4	2	254	8.2	0.45
42-48	11.0	0.5	2	248	8.1	0.45

* The tests were made on a composite of four soil cores except for the 0-6 inch sample, which was a composite of many sub-samples.

Results

The yield in bushels/per acre of 15% moisture corn, percent moisture of ear corn at harvest time, and number of ears per stalk are reported in Table 22. The treatments have been listed in this table more than once to make comparisons easier. The treatments did not have any consistent effect on the moisture content of the ears at harvest time or the number of ears per stalk.

The addition of potassium (Treatments 1, 2, 3, 4, 5, and 6) appeared to have no effect on the yields. When higher rates of phosphorus were applied with the potassium (Treatments 7, 8, 9, 10, 11 and 12) no effect on yield was noted.

Adding phosphorus with and without constant rates of potassium (Treatments 13-24) did not have any effect on the yield.

The analysis of the soil samples (Table 21) from this site are high enough in available phosphorus and potassium so that a yield increase was not expected from either added phosphorus or potassium until yields become greater than 55 bushels per acre. This experiment will be continued.

TABLE 22. EFFECT OF RATES OF PHOSPHORUS AND POTASSIUM IN A STARTER FERTILIZER ON YIELD, EAR MOISTURE AT HARVEST AND NUMBER OF EARS PER STALK.

Treatment Number	Treatment N + P + K lbs/A	Yield[1] Bu/A	Moisture[2] %	No. of Ears Per Stalk
1	12 + 0 + 0	50	22.9	0.90
2	12 + 0 + 9	51	23.4	0.83
3	12 + 0 + 17	46	23.8	0.82
4	12 + 6 + 0	55	21.6	0.88
5	12 + 6 + 9	49	24.5	0.83
6	12 + 6 + 17	49	21.9	0.85
7	12 + 12 + 0	49	22.6	0.92
8	12 + 12 + 9	48	23.7	0.85
9	12 + 12 + 17	49	23.3	0.80
10	12 + 23 + 0	49	22.4	0.84
11	12 + 23 + 9	51	21.7	0.84
12	12 + 23 + 17	48	23.0	0.84
13	12 + 0 + 0	50	22.9	0.90
14	12 + 6 + 0	55	21.6	0.88
15	12 + 12 + 0	49	22.6	0.82
16	12 + 23 + 0	49	22.4	0.84
17	12 + 0 + 9	51	23.4	0.83
18	12 + 6 + 9	49	24.5	0.84
19	12 + 12 + 9	48	23.7	0.85
20	12 + 23 + 9	51	21.7	0.84
21	12 + 0 + 17	46	23.8	0.82
22	12 + 6 + 17	49	21.9	0.85
23	12 + 12 + 17	49	23.3	0.80
24	12 + 23 + 17	48	23.0	0.84

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

INFLUENCE OF SOIL TEMPERATURE ON STARTER FERTILIZER RESPONSE

P. D. Evenson, F. Shubeck and B. Lawrensen

Starter fertilizer response was evaluated under three soil temperature conditions. The cool temperatures were created by applying straw or polystyrene mulches to the soil. Warm soil temperatures were achieved by burying heat tapes 5 inches below the soil surface under the corn rows. The tapes were thermostatically controlled to turn on when the soil temperatures dropped below 80 degrees F. Mulch was applied on the soil surface in two heat treatments to reduce evaporation of soil moisture due to elevated temperatures. Medium soil temperature conditions were those which normally occurred during the season.

Starter fertilizer was applied in a 2" x 2" band at the rate of 90 lbs. per acre of 8-32-16 (7-13-12 elemental) and an overall application of 80 lbs. of nitrogen per acre was made on the whole experiment. The experiment was planted on April 30 and harvested on October 15.

Corn yields and ear moisture percentages are shown in Figure 6. Those treatments which had the greatest early season growth (Figures 7 & 8) also matured first and produced the largest yields. The mulched plots produced the lowest yields, had the slowest early growth and had the highest ear moisture percentage at harvest. High ear moisture percentage is an indication of delayed maturity. In contrast, the heated plots produced the highest yields, had the greatest early growth and had the lowest moisture percentage. The check plots were between the mulched and heated plots with respect to these factors.

The mulch tends to reduce evaporation of soil moisture while the heat increases evaporation of soil moisture. Therefore, the response to soil temperature would actually be greater than is shown by the first five bars in Figure 6. This is brought out by the sixth and seventh bars which represent the yield from the heated plots covered with mulch. The mulch increased the yield in the fertilized, heated plots by 25 bushels per acre (123 bushels - 98 bushels). Heat plus mulch increased yields 50 bushels per acre above check plot yields and 63 bushels per acre above mulched plot yields where starter fertilizer was used.

Response to starter fertilizer was smallest (10 bushels per acre) in the mulched plots and greatest (27 bushels per acre) in the heated plots. These types of responses are opposite of the expected responses. This indicates that more studies are needed to fully evaluate the influence of environment on starter fertilizer responses.

This experiment demonstrates the importance of early season growth to final corn yields. Table 1 (Superintendent's Report) shows the precipitation received throughout the growing season. The rainfall during the mid-summer months of July and August was way below the 19-year average while the June rainfall was above normal. Corn in the heated plots had almost reached the maximum vegetative growth the first week in July (Figures 7 & 8), and these were the plots that produced the highest corn yields. Therefore, the corn with the early rapid growth can usually avoid a major portion of the stress which is normally experienced during July and August.

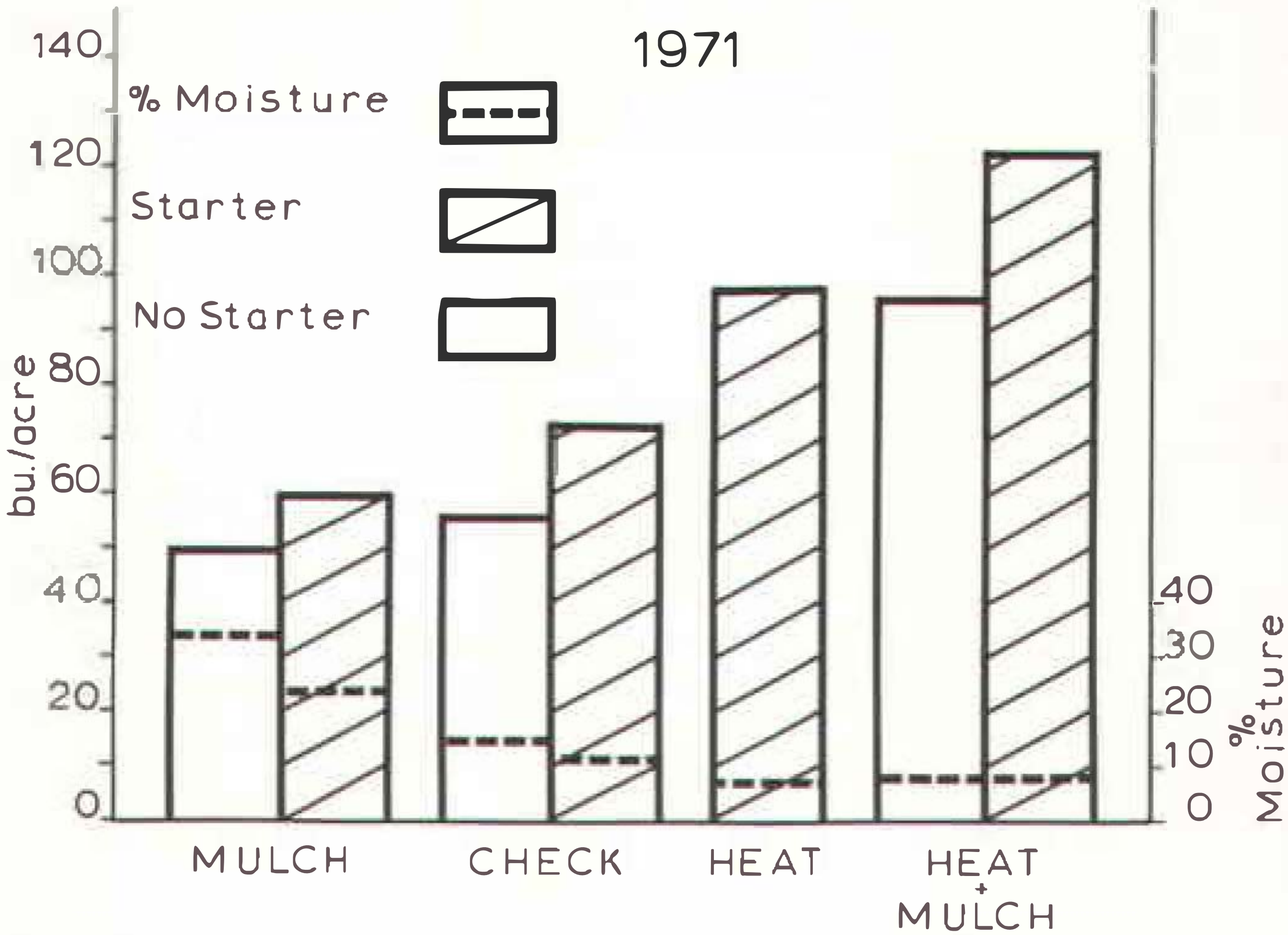


Figure 6. Corn yields and ear moisture percentage as influenced by starter fertilizer (90 lb. per acre of 8-32-16) and various soil temperature treatments.

Progress of experiments on July 2, 1971 (left) and how the site appeared early in the season (below).

Figure 7. Influence of soil temperature treatments on height of fertilized corn.

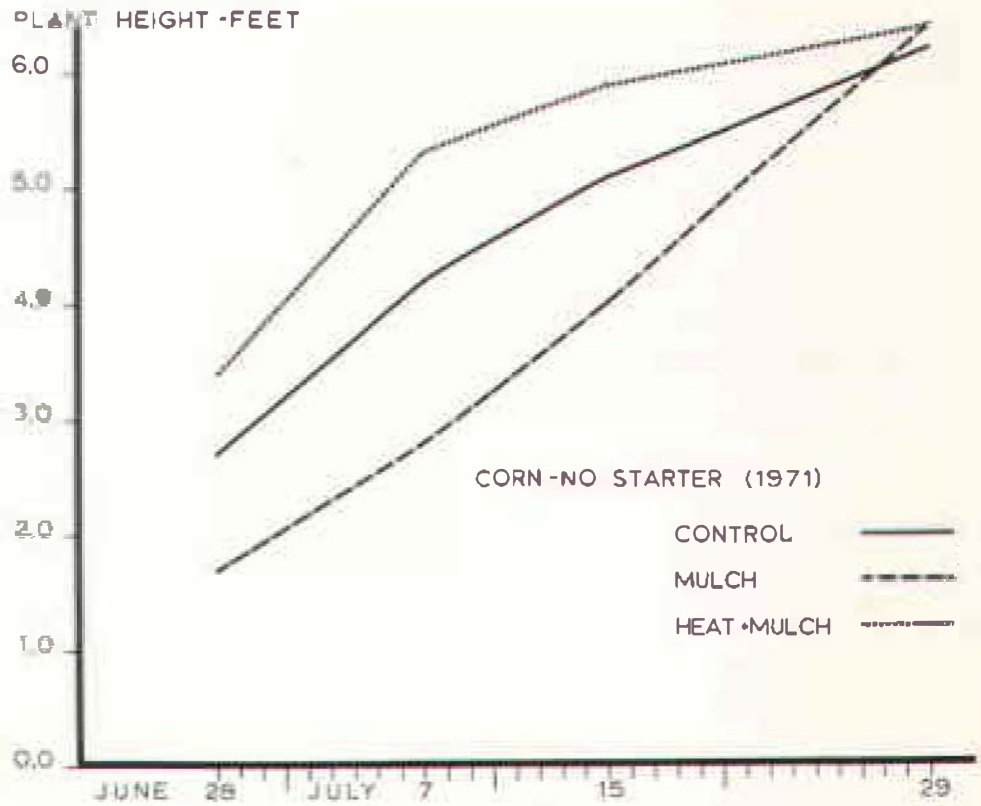
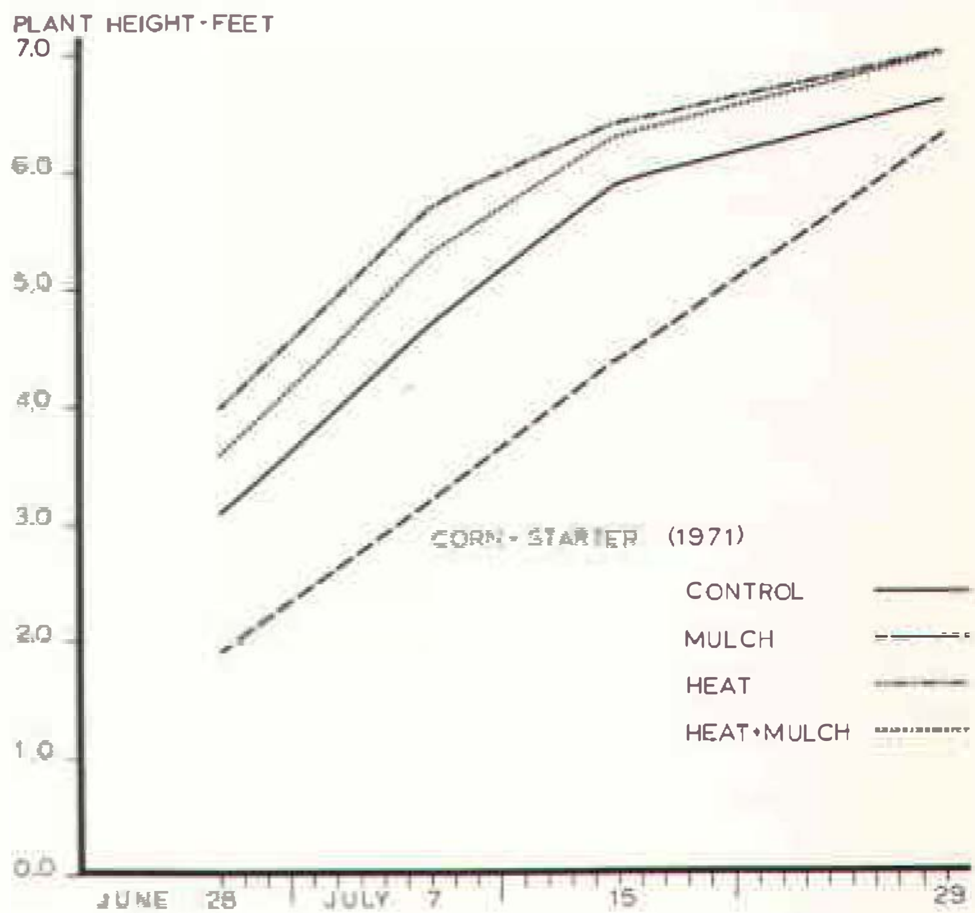


Figure 8. Influence of soil temperature treatments on height of un-fertilized corn.



ORGANIC SOIL CONDITIONER FOR CORN AND OATS

F. Shubeck and B. Lawrensen

Objectives of Experiment

To compare an organic speciality fertilizer or soil conditioner to commercial fertilizer salts for their influence on yield of corn and oats.

Methods of Procedure Used in Soil Conditioners Study

The following methods and procedures were used for corn.

Preceeding crop - oats.
May 12 - Fertilizer broadcast on those plots receiving 60 lb. N and 13 lb. P per acre.
May 12 - Plowed, disked and harrowed.
May 12 - Planted Pioneer 3715 (N cytoplasm).
Two hundred pounds per acre of organic soil conditioner was banded at planting and placed approximately two inches to the side and two inches below the seed.
Insecticide - Bux 10 at 10 lbs. per acre.
Herbicide - Ramrod 20 G at 5 lbs. actual per acre.
June 21 - Cultivated all plots.
June 30 - Sprayed for corn borer with Sevin at 2.5 lbs. per acre of 80 W.
Sept. 28 - Hand picked.

The following methods and procedures were used for oats.

Preceeding crop - corn.
April 8 - Rotary chopped stalks
April 12 - Tandem disked plots. Broadcast fertilizer and conditioner. Tandem disked immediately after broadcasting nutrients. Seeded Kota oats at 2½ bushel per acre.

TABLE 23. EFFECT OF FERTILIZER SALTS AND SOIL CONDITIONER ON YIELD OF CORN AND PERCENT EAR MOISTURE AT HARVEST.

Fertility Treatment	% Ear Moisture At Harvest	Bu. of No. 2 Corn/Acre
None	32.0	40
200 lbs/acre soil conditioner	30.0	41
60 lbs. N + 13 lbs. P/acre	26.5	57
L.S.D. at 5%		9.9

Discussion and Interpretation of Table 23

The highest yielding treatment was 60 lbs. N + 13 lbs. P per acre. These same plots also had the least ear moisture at harvest.

TABLE 24. EFFECT OF FERTILIZER SALTS AND SOIL CONDITIONER ON YIELD OF OATS

Fertility Treatment	Oats, Bu. Per Acre
None	61
200 lbs/acre soil conditioner	72
60 lbs. N + 13 lbs. P per acre	103

Discussion and Interpretation of Table 24

Oats responded very favorably to commercial fertilizer salts. Yield increases amounted to 42 bushels per acre.

FURADAN AS A SYSTEMIC INSECTICIDE FOR EUROPEAN CORN BORER CONTROL

P. A. Jones and B. Lawrensen

Methods, Materials, Procedures

A four replicate, randomized, complete block design was used for the experiment. Plots were planted May 6, 14, and 18 with Pioneer 3518 in 30 inch rows at approsimately 16,000 - 18,000 plants per acre. On the last day of planting, May 18, all plots were melroed, and alleyways melroed and planted to the same variety. All plots were cultivated June 24. Atrazine, at the rate of 4.4 lbs - 80W per acre, was applied at planting in a 14 inch band over the row. The heaviest rate of Furadan, 4.0 lbs actual insecticide per acre (=4.0# a.i./A) was applied as a 4 inch - 7 inch band over the row: the two lighter rates of Furadan (1.0# a.i./A, 2# a.i./A) were placed in the seed furrow at planting time. Evaluation of treatments were based on stand counts and shot-hole counts taken July 12, and corn stalk dissection for larval counts on July 19, and 20. In addition, stalk breakage counts were taken October 18, from 25 plants in each of two rows for a total of 50 plants per treatment. Only those stalks broken below the ear were counted.

Results and Discussion

The various tests used to rate the effectiveness of Furadan as a planting time treatment for reduction of corn borer populations have indicated that planting dates and availability of the systemic insecticide to the corn plant will determine whether there will be a reduction in corn boere populations.

Presence of shot-hole damage in corn leaves (Table 25), which is the first visible sign of actual damage by first brood corn borer larvae, shows a decline as the planting date approaches the dates of infestation; or in other words, as the interval between treatment and attack decreases there is a reduction in feeding of the corn borer on the leaves even at the low rate of Furadan at 1# a.i./A in the furrow. A rate of Furadan at 2# a.i./A in a furrow application

is more effective in reducing initial larval feeding than the heavier rate of 4# a.i./A of Furadan applied as a 7 inch band over the row treatment.

If the corn borer larvae were able to get established after the initial attack then apparently the twelve day interval between first and last treatment was irrelevant, since approximately the same larval population reduction occurred at all three planting dates (Table 26). The 4# a.i./A band treatment with Furadan was better than the lower rates of actual insecticide per acre in reducing the larval population. The assumption might be made that during the extended time between shot-holing and larval stalk feeding that the corn root system developed sufficiently that more Furadan became available to the plant in the 4# a.i./A band treatment than in the lower 1# and 2# furrow treatments.

No differences were noted in stalk breakage between treated and untreated corn. Stalk breakage varied from no breakage up to 20 percent of the stalks broken below the ear. The average stalk breakage from a total of four replicates varied from 4.5 percent in an untreated check to 10.5 percent for one of the treatments.

Yields (Table 27) did not give a precise picture of the influence of Furadan treatments on corn borer reduction. The 1# a.i./A furrow treatment on May 14 was inconsistant with the same treatment of May 6 and May 18. If numbers of larvae present were used as an indication of potential yield, then the 1# a.i./A Furadan treatment of May 14 should have shown a lower yield. The Furadan treatments of 2# a.i./A in the furrow and 4# a.i./A banded gave similar size increases in yield over the untreated check. Using yield only as a guideline, then the 2# a.i./A treatment with Furadan would give the same expected yield increase as double the amount of Furadan applied in a 7 inch band over the row treatment. It can be assumed from the yields that planting date is not an economically important factor in reduction of corn borer larvae by planting time treatments.

To obtain adequate corn borer control with a planting time treatment of Furadan, the rate per acre would have to be more than double the present recommended rate of 3/4# - 1# a.i./A banded, which is used for corn rootworm control. At the present time, the maximum allowable rate for Furadan on corn is 1# a.i./A banded over the row.

"Shotgun" holes, characteristic of corn borer damage, are apparent in corn growing in the row on the right while undamaged corn is growing in the adjacent row on left. Corn on left was treated at planting time with a systemic insecticide at a rate considerably higher than used for control of another insect, corn rootworm. Federal agencies have not approved use of the insecticide at the heavier rate so it is not recommended as a corn borer control in South Dakota.

TABLE 25. PRESENCE OF SHOT-HOLE DAMAGE IN CORN FROM FIRST BROOD EUROPEAN CORN BORERS IN TREATED AND UNTREATED PLOTS. JULY 12, 1971.

Treatment		Planting (Treatment) Dates					
		May 6, 1971		May 14. 1971		May 18, 1971	
Compound and Formulation	Rate (lbs a.i./A) and Application	Plants and Shot-holes* Average % (Range)	% Reduction from Untreated	Plants and Shot-holes* Average % (Range)	% Reduction from Untreated	Plants and Shot-holes* Average % (Range)	% Reduction from Untreated
Furadan 10G	1# Furrow	98 (97-99)	1.0	97 (93-100)	2.1	73 (58-85)	25.5
Furadan 10G	2# Furrow	85 (75-95)	14.2	65 (41-98)	44.4	46 (41-53)	53.2
Furadan 10G	4# Band	88 (80-96)	12.0	82 (76-90)	17.0	66 (45-81)	33.8
UNTREATED		99 (98-100)	----	99 (98-100)	----	98 (97-100)	----

*Shot-hole counts - numbers of plants with shot-hole injury were counted from 17 feet 5 inches of row (1/1000 A. for 30 inch rows) in five locations on the two center rows of each treatment for a total of 87 feet 1 inch per replicate (1/200 A. for 30 inch rows = 87 feet 6 inches). Averages are based on data from four replicates.

TABLE 26. INCIDENCE OF FIRST BROOD EUROPEAN CORN BORER LARVAE IN CORN TREATED WITH THE SYSTEMIC INSECTICIDE, FURADAN, AT PLANTING TIME. (DATA TAKEN JULY 19, 20, 1971).

Treatment		Planting (Treatment) Dates					
		May 6, 1971		May 14, 1971		May 18, 1971	
Compound and Formulation	Rate (lbs a.i./A) and Application	Number of Larvae* Average (Range)	% Reduction from Check	Number of Larvae* Average (Range)	% Reduction from Check	Number of Larvae* Average (Range)	% Reduction from Check
Furadan 10G	1# Furrow	2.6 (1.7-3.1)	21.2	2.3 (1.3-3.1)	25.8	1.8 (1.2-2.4)	18.2
Furadan 10G	2# Furrow	1.4 (.8-2.0)	57.2	1.3 (.8-1.8)	58.1	.9 (.8-1.0)	59.1
Furadan 10G	4# Band	1.2 (.4-2.4)	63.7	1.1 (.7-1.7)	64.5	1.1 (.7-1.9)	50.0
UNTREATED		3.3 (2.8-4.1)	----	3.1 (2.7-3.4)	----	2.2 (1.9-2.7)	----

*Larval counts from dissection of 5 plants from 2 locations in each treatment for a total of 10 plants per replicate in each of 4 replicates.

TABLE 27. YIELDS - EUROPEAN CORN BORER PLOT. (YIELDS CALCULATED AS BU/A. OF NO. 2 EAR CORN - 15.5% MOISTURE).

Treatment		Planting (Treatment) Dates					
		May 6, 1971		May 14, 1971		May 18, 1971	
Compound and Formulation	Rate (lbs a.i./A) and Application	Yield - Bu/A Average (Range)	% Increase in Yield Over Check	Yield - Bu/A Average (Range)	% Increase in Yield Over Check	Yield - Bu/A Average (Range)	% Increase in Yield Over Check
Furadan 10G	1# Furrow	76.9(44.7-98.0)	1.0	77.0(70.6-90.0)	11.4	87.8(71.2-105.7)	1.0
Furadan 10G	2# Furrow	86.5(71.9-110.2)	11.3	81.1(74.9-90.2)	12.0	97.8(81.7-105.7)	11.5
Furadan 10G	4# Band	87.1(80.4-95.4)	11.4	80.3(77.3-83.9)	11.9	105.0(86.3-123.3)	12.3
UNTREATED		76.1(56.2-90.2)	----	67.4(64.3-72.8	----	85.3(80.6-98.9)	----

WESTERN CORN ROOTWORM CONTROL

B. H. Kantack, J. Fredrikson and W. L. Berndt

Corn rootworm populations in 1971 were comparable to those in 1970. Incidence of infestations and severity of infestations were high in numerous fields over eastern South Dakota. Populations were also prevalent in irrigated areas in Fall River County.

Recommended insecticides performed satisfactorily in most cases; however, partial or incomplete control was reported and observed in a number of fields. Incidences of poor control with Bux were more numerous in 1971 than in previous years. This is apparently not a result of resistance to Bux. It is possible that formulation, heavy populations, application, or some other factors are responsible for these incidences of poor performance.

Results of the rootworm control demonstrations are shown in Table 28. A medium infestation was present on this field, 20 - 30 worms per plant, with visible lodging in the untreated checks. Results were as follows:

TABLE 28. YIELDS OBTAINED IN CORN ROOTWORM DEMONSTRATION PLOTS - FARM RESEARCH

Insecticide	Dosage Actual/Acre	Yield[1] Bu/Acre
Furadan	0.75 lb.	55
Bux	1.0 lb.	48
Dyfonate 10G	1.0 lb.	48
Dasanit	1.0 lb.	48
Dyfonate 20G	1.0 lb.	45
Untreated Check	--------	44
Mocap	1.0 lb.	38
Thimet	1.0 lb.	38

[1]Average 4 replicates based on ear corn at 15 percent moisture. Statistical analysis shows mean yield for Furadan significant difference from untreated check mean.

Plots with Furadan applied at 1.0 lb/acre and 2 lbs/acre yielded 60 bu/acre and 67.4 bu/acre respectively in this experiment. The increase at the 2.0 lb. rate was probably a result of corn borer control as this dosage has been shown to afford approximately 50 percent control.

Corn rootworm recommendations for 1972 are: (1) Rotate to another crop whenever possible to break the corn on corn sequence. (2) Use a recommended insecticide treatment on all corn following corn. Recommendations for 1972 are shown in Table 29.

TABLE 29. RECOMMENDED INSECTICIDES FOR CORN ROOTWORM CONTROL IN 1972 (Listed in alphabetical order)

Insecticide	Dosage Actual per Acre
Bux	1.0
Dasanit	1.0
Dyfonate	1.0
Furadan	0.75
Mocap (Jolt)	1.0
Thimet	1.0
Diazinon*	1.0

*Diazinon is recommended for use only NORTH of US Highway 16 in South Dakota.

Caution

Insecticides are poisonous - handle and store them with care. Be sure to read the label and follow directions to the letter. Keep children and pets our of the area where chemicals are stored, mixed, or used. Do not contaminate feed, feed containers, or water troughs. Clean all contaminated planting equipment carefully. Destroy all emptied containers so they cannot be reused for any purpose.

CORN HERBICIDE SCREENING TRIALS

W. E. Arnold and W. B. O'Neal

The performance of several experimental herbicides and herbicide combinations were compared with recommended herbicides for their control of annual weeds in corn. The experimental design was a randomized complete block replicated four times. Pioneer 3518 was seeded May 8. All herbicide treatments were applied with a tractor sprayer which applied 20 gpa at 40 psi. Preemergence treatments were applied May 8. Postemergence treatments were applied June 3 when corn was 5-6 inches tall, foxtail 2-3 inches tall, redroot pigweed 2 inches tall, and lambsquarter and kochia were 3 inches tall.

Early observations of grass and broadleaf weed control were made June 21. Also injury notes were taken at this time. Late season grass and broadleaf weed control was taken August 18. The average of four replications of data is shown in Table 30. MC-4379 and DS-5328 were the most promising experimental herbicides for broadleaf weed control. Acetochlor and SD-15418 were the most promising experimental herbicides for grassy weed control.

TABLE 30. CORN HERBICIDE SCREENING TRIALS

Treatment	Rate lb/A	June 21 % Grass Control	June 21 % BLW[a/] Control	June 21 Corn[b/] Injury	August 18 % Grass Control	August 18 % BLW Control
Preemergence						
Atrazine	2 1/2	93	96	0.0	87	93
Acetochlor	1	41	61	0.2	45	53
Acetochlor	2	88	84	0.0	80	73
Acetochlor	3	94	90	0.5	94	78
Alachlor	1	18	10	0.2	47	20
Alachlor	2	59	49	0.0	61	41
Alachlor	3	76	76	0.0	70	43
MC-4379	1 1/2	68	89	1.0	15	85
MC-4379	2	70	91	3.5	26	71
MC-4379	3	87	92	4.0	44	89
DS-5328	2	18	34	0.2	5	29
DS-5328	3	34	93	1.5	8	85
DS-5328	4	45	82	0.8	30	75
IMC-3950	4	34	33	0.0	33	23
IMC-3950	6	56	51	0.0	40	13
IMC-3950	8	44	40	0.2	40	0
FX-24	1	10	18	0.0	0	39
Bay 94337	3/8	54	49	0.0	48	25
Dicamba + Alachlor	1/2 + 2	83	95	0.2	63	92
DNBP + Linuron	3 1/3 + 1/2	0	15	0.0	17	23
Postemergence						
Atrazine + oil	1 + 1 gpa	89	97	0.2	80	92
SD-15418	2	91	55	0.8	90	35
BAS-3512 + X-77	1/2 + 1/2%	0	55	0.0	10	50
BAS-3512 + X-77	1 + 1/2%	5	39	0.0	0	66
BAS-3512	2	1	15	0.0	0	50
FX-24	1/2	19	23	0.2	13	43
FX-24	1 1/2	70	78	2.0	33	66
DNBP + Alachlor	1 1/2 + 1 1/2	45	39	0.0	45	25
Dalapon+Atrazine+oil	3/8 + 1 + 1 gpa	94	97	0.5	68	94
Dicamba + Atrazine	1/4 + 1 1/4	82	96	0.5	73	90
No Herbicide	--	2	0	0.2	0	0

a/ BLW - Broadleaf weeds

b/ Injury based on 0 = No injury to 10 = Complete kill.

THE EFFECT OF NUMBER OF CULTIVATIONS, FERTILITY AND HERBICIDES ON WEED CONTROL AND CORN YIELDS

W. E. Arnold and W. B. O'Neal

The objectives of this experiment were to determine the effects of number of cultivations, herbicide treatment, and fertility level on weed control and corn yields. The experimental design was a split plot arrangement within a randomized complete block. The number of cultivations were the whole plots and herbicide-fertilization combinations were the split plots. The plots were 10x20 feet and were replicated four times. One hundred ten lbs. actual nitrogen per acre was applied in the form of ammonium nitrate on May 4. The fertilizer application was incorporated with a tandem disk set at 4 inches. Pioneer 3815 corn was seeded on May 8. Preemergence herbicide treatments were applied on May 8 and postemergence treatments were applied on June 3 when corn was 4-5 inches tall and foxtail was 2-3 inches tall. All herbicide treatments were applied with a tractor sprayer in 20 gpa at 40 psi. The first cultivation was June 14 and the second cultivation was June 22. Visual observations of grass control were made on August 19. Harvest samples of corn were taken from two 15 foot rows on October 14.

The averages of 4 replications are shown in Table 31. The increased nitrogen level did not improve corn yields in this experiment. The preemergence treatment of atrazine at 3 lb/A but without cultivation yielded more than the twice cultivated no herbicide. Weed control and corn yields were increased by one cultivation after either a preemergence or postemergence herbicide treatment. However, the second cultivation after herbicide treatment did not appear to increase the grass control or corn yield. The second cultivation on the no-herbicide treated plots that were fertilized did improve grass control but did not increase corn yields. Postemergence treatments were comparable to preemergence treatments when fertilized but was less effective when not fertilized.

A good example of what those signs on experimental plots reading "check" means in research jargon. In this case the plot of corn behind the check sign did not receive a herbicide treatment as did the corn plot at the left.

TABLE 31. THE EFFECT OF NUMBER OF CULTIVATIONS, FERTILITY AND HERBICIDES ON WEED CONTROL AND CORN YIELDS.

Treatment	Rate lbs/A	% Grass Control	Corn Yields Bu/A
No Fertility			
No Cultivations			
Atrazine	3	75	67
Atrazine + oil	1 + 1 gpa	54	47
No Herbicide	---	10	8
One Cultivation			
Atrazine	3	91	76
Atrazine + oil	1 + 1 gpa	88	72
No Herbicide	---	18	34
Two Cultivations			
Atrazine	3	95	79
Atrazine + oil	1 + 1 gpa	88	63
No Herbicide	---	53	46
Nitrogen (110 #/A)			
No Cultivations			
Atrazine	3	70	60
Atrazine + oil	1 + 1 gpa	53	60
No Herbicide	---	0	13
One Cultivation			
Atrazine	3	92	66
Atrazine + oil	1 + 1 gpa	85	69
No Herbicide	---	36	44
Two Cultivations			
Atrazine	3	97	65
Atrazine + oil	1 + 1 gpa	91	72
No Herbicide	---	55	42

SOYBEAN RESEARCH AND TESTING - 1971

A. O. Lunden

Soybean plot entries included standard variety tests, Regional Uniform yield tests, Regional Preliminary tests and several experimental entries. Yields were only slightly below average at the Southeast Farm in spite of very low rainfall during the summer and seed quality was very good. Stands were good, row spacing was 30 inches and harvest conditions were excellent except for slight shattering losses in Hark and Anoka. Yields reported in Table 32 show that Corsoy is still the best entry at the Southeast Research Farm.

Yields on the Forrest Fennel farm just east of Elk Point were considerably below average for that area of the state because of severe late summer drought with growing season rainfall nearly eight inches below normal. Stands were poor because of poor seed and bad weather, row spacing was 40 inches and harvest conditions

were good. Full season varieties such as Wayne and late varieties such as Beeson and Calland were unsatisfactory although Corsoy and Hark were early enough to escape some of the drought injury. Note in Table 32 that average yields favor Wayne at Elk Point.

Seed quality was quite acceptable at both locations in contrast to the poor quality seed produced in 1970. It should be noted that the poor quality seed of the 1970 crop caused some poor stands in 1971 and that unused or remnant seed from that crop should not be considered for planting in 1972. New varieties for 1972 include Amsoy 71 and two early Minnesota releases, Swift and Steele. Amsoy 71 can be profitably grown for the seed trade but is not generally recommended for farmers in South Dakota and Swift and Steele will be recommended farther north.

TABLE 32. SOYBEAN YIELDS - SE FARM AND ELK POINT - 1971

	SE Farm Bu/Acre					Elk Point (Bu/Acre)		
	1968	1970	1971	6 yr ave	3 yr ave	1969	1971	Ave.
Corsoy	43.0	28.2	32.8	38.8	34.7	38.2	38.3	38.2
Wayne	40.2	25.9	34.4	35.7	33.5	45.7	35.5	40.6
Hark	38.3	24.3	28.4	35.3	30.3	37.0	38.0	37.5
Amsoy	34.8	27.4	30.3	34.3	30.8	38.1	36.7	37.4
Provar	34.2	29.6	35.5	36.9	33.1	30.2	37.4	33.8
Rampage	38.0	26.7	29.0		31.3	34.2	33.6	33.9
Wirth	34.9	26.8	26.9		29.6	28.9	26.4	27.6
Chippewa	36.5	25.4	29.1	34.3	30.4	34.4	21.7	28.0
Wirth	34.9	26.8	26.9		29.6	28.9	26.4	27.6
Beeson	32.7	23.8	28.8		28.5	37.4	31.0	34.2
Calland						36.7	30.7	33.7
LSD	NS	7.8	5.2			NS	6.2	

SOYBEAN ROW SPACING

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Study the effect of soybean row spacings and populations on yield.

Methods and Procedures used in Soybean Row Spacing Experiment

Nov. 1970 - Disked down cornstalks and plowed down fertility (85 + 18 + 42).
May 26, 1971 - Tandem disked and spike tooth harrowed.
May 28 - Finished planting.
Variety - Corsoy.
Herbicide - Lasso overall at 2.5% quarts or 2.5 lbs. per acre sprayed.
June 21 - July 2 - Hand thinned all plots to desired populations.
July 6 - Cultivated all row spacings.
Oct. 12 - Combined all plots.

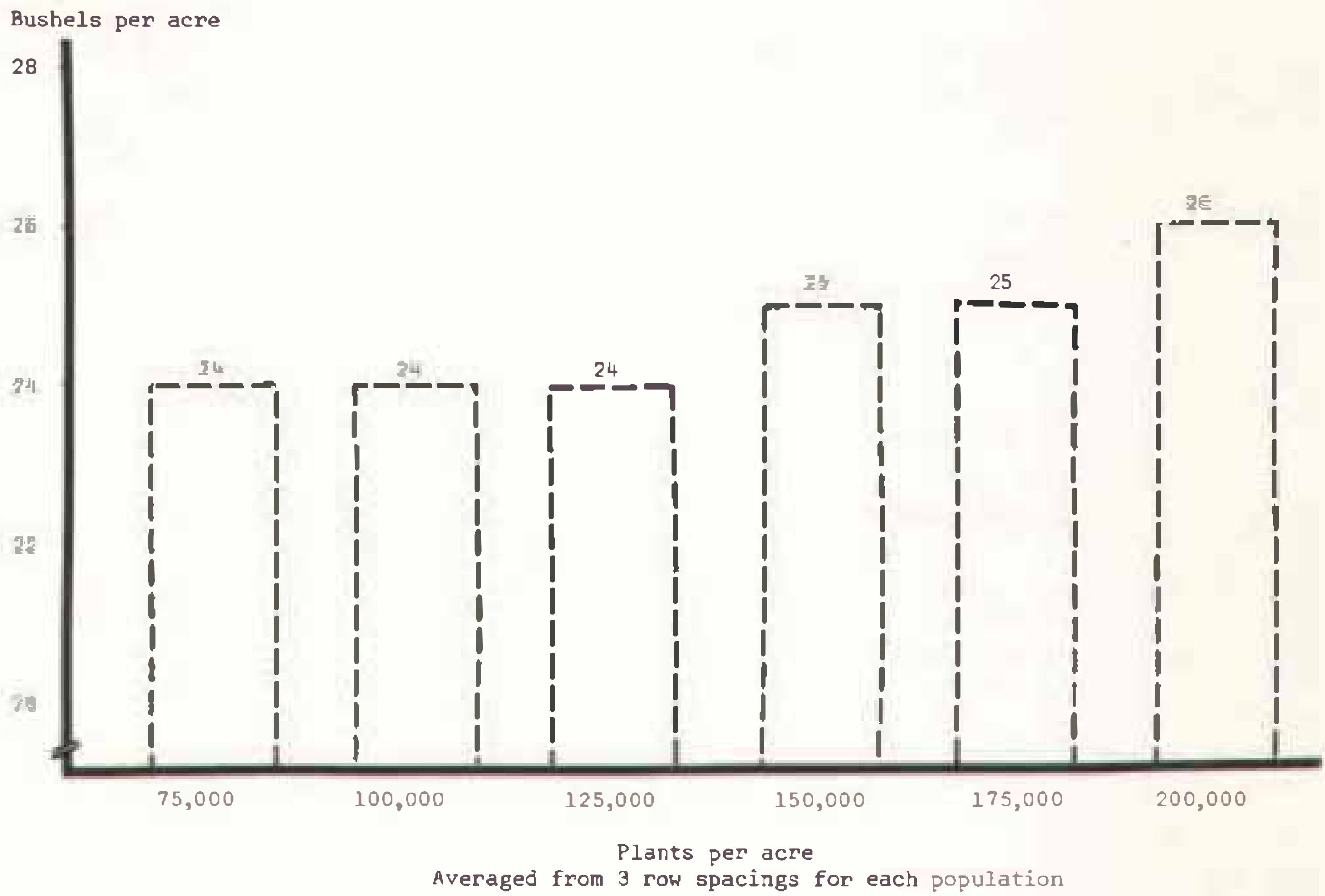


Figure 9. Effect of plant populations on soybean yields.

Discussion and Interpretation of Figure 9 and Table 33 & 34

A stand of 125,000 plants per acre is approximately 4.8 plants per foot of row in 20" rows; 7.2 plants per foot in 30" rows and 9.6 plants per foot in 40" rows.

There appeared to be a small yield increase in favor of dense plant populations. This is somewhat surprising in a year when climatic conditions were dry enough to hold yields down to 24-26 bushels per acre.

TABLE 33. EFFECT OF ROW SPACING ON YIELD OF SOYBEANS*

Row Spacing in Inches	Bushels per Acre
20	23
30	27
40	25

*Averaged from 6 populations for each row spacing.

Thirty inch rows yielded the most beans. This occurred in four of the last seven years. In two years of the seven, 30 inch rows yielded the same as 20 inch rows, and one year the 20 inch rows yielded the highest.

TABLE 34. COMPARISON OF 7 INCH ROW SPACING AND 30 INCH ROW SPACING FOR SOYBEANS

Row Spacings	Bushels/Acre
7 inch	21.5
30 inch	22.3

This study was conducted independently of the preceding row-spacing experiment to evaluate 7 inch row spacings planted with a press drill. Seedbed preparation, weed chemical, variety and other procedures and methods were similar to those used in the previously discussed row spacing experiment. A final population of approximately 150,000 plants per acre was achieved. These plots were not hand thinned to exact populations. There were six randomized replications of each treatment.

In this experiment, the difference in yield due to planting method was small. Last year 7 inch rows planted with a grain drill gave 5 bushels more beans per acre than 30 inch intertilled rows.

SIMULATED HAIL DAMAGE IN SOYBEANS

B. Lawrensen and F. Shubeck

Objectives of Experiment

1. Evaluate extent of simulated hail damage by actual measurements which would determine whether or not to replant soybeans after a hail storm.

2. Inflict damage to the soybean plant simulating that caused by hail.

3. Determine yield loss (% of check) where damage was inflicted.

Methods and Procedures

Plot was fall plowed
June 1 - Tandem disked and harrowed plot. Planted - Variety Corsoy soybeans.
June 3 - Lasso 2.5 qts./acre sprayed broadcast on plots.
June 15 - Rotary-hoed plots
June 29 - Inflicted medium and heavy simulated hail damage to specified plots at Stage 2 of plant growth
June 29 - Evaluation of damage to the soybean plant after the inflicted damage

July 2 - Replanted Chippewa soybeans in plots that had simulated hail damage inflicted at State 2.
July 9 - Inflicted medium and heavy damage at Stage 3
July - Tandem disked, hand raked and replanted Chippewa soybeans after simulated hail damage had been inflicted to the Stage 3 soybeans
July 13 - Cultivated plots
Oct. 15 - Combined all plots

Variety - Corsoy
- Chippewa (replant)
Herbicide - Lasso (2.5 #/A overall)
Plant population - 75,000 plants per acre

TABLE 35. EFFECT OF SIMULATED HAIL DAMAGE ON SOYBEAN YIELDS AT TWO DIFFERENT STATES OF GROWTH COMPARED TO REPLANTING DAMAGED SOYBEANS

Extent of Damage	Stage of Growth* When Damaged	Bushels/Acre
Medium (replant)	2	6.5
Heavy (replant)	2	5.7
Medium (replant)	3	3.0
Heavy (replant)	3	2.5
Medium (original stand)	2	26.5
Heavy (original stand)	2	21.0
Medium (original stand)	3	20.0
Heavy (original stand)	3	24.0
Check (no damage)	-	28.0

* Stage 2 - Plants were 7 inches - 9 inches tall, three trifoliate leaves were completely unrolled and the fourth beginning to unroll.
* Stage 3 - Plants were 12 inches - 14 inches tall, five to six trifoliate leaves were unrolled. One to five percent of plants were flowering.

Discussion and Interpretation of Table 35

This is the second year of the study and it is a follow-up of the first attempt to learn more about simulating hail damage in soybeans. The procedural techniques were the same as last year.

When original stands of beans were allowed to remain without replanting, yields were not always consistent with extent of estimated inflicted damage. (Table 35.) Plants were able to recover from simulated medium hail damage at Stage 2 (not re-planted) and yielded almost the same as the undamaged check. The precise degree of

damage is difficult to inflict and measure. The replant treatment is a new treatment introduced this year. This was necessary to achieve the major objective of this study which is to make a decision whether or not to replant after a hail storm. With climatic conditions of 1971, these results clearly show that it was not profitable to replant soybeans after a simulated hail storm. Dry weather early in July adversely affected replant stands and growth. Consequently, yields were low.

SOYBEAN FERTILITY

(In a corn-soybean sequence)

F. Shubeck and B. Lawrensen

(This experiment was originally planned and started by Dr. D. Hovland)

Objectives of Experiment

1. Which is the better management technique?
   (a) to fertilize soybeans directly or (b) to depend upon the effect of residual fertility when the preceding corn is adequately fertilized.
2. Will applications of manure in addition to commercial fertilizer influence yields?

Methods and Procedures used for Soybeans

May 24 - Broadcast commercial fertilizer.
Broadcast manure on designated plots.
Plowed.
May 25 - Tandem disked, harrowed and planted Corsoy beans.
May 28 - Sprayed with Lasso overall at 2.5 quarts per acre.
June 11 - Tandem disked plots and replanted (covering, washing and emergence problems from 3 inch rain).
Herbicide - Ramrod 20G
June 15 - Cultivated
July 7 - Cultivated.

Methods and Procedures Used For Corn

December 1970 - Fall plowed.
May 6, 1971 - Broadcast 100 lb. N, and 20 lbs. P per acre.
Tandem disked.
May 7 - Spike tooth harrowed
Planted Pioneer 3518 (N)
Insecticide - Furadan 40 lbs/Acre.
Herbicide - Ramrod 20G at 5 lbs. actual per acre.
18,000 plants per acre.
May 20 - Rotary hoed all plots.
June 15 - Cultivated.
June 21 - Cultivated.

TABLE 36. EFFECT OF BROADCAST FERTILIZER ON YIELD OF SOYBEANS

Fertilizer Broadcast for Beans N + P + K*	Bu. of Soybeans Per Acre
30 + 13 + 0	22
30 + 0 + 0	22
12 ton manure per acre	22
0 + 13 + 0 + 12 ton manure per acre	22
0 + 0 + 0	22
30 + 26 + 25	22
30 + 13 + 25	21
0 + 13 + 25	21
120 + 13 + 25	21
0 + 13 + 0	21
30 + 1 + 100	21
0 + 0 + 25	19
L.S.D. at 5%	2.2

*Fertilizer applied on previous corn crop was 113 lbs. of N and 20 lbs. P per acre broadcast on all plots.

Discussion and Interpretation of Table 36

There were no soybean yield increases due to direct fertilization when the previous corn crop was adequately fertilized.

TABLE 37. EFFECT OF RESIDUAL AND DIRECT FERTILIZER APPLICATIONS ON YIELD OF CORN

Fertilizer Broadcast on Previous soybean Crop (1970) N + P + K	Fertilizer Broadcast Direct for Corn (1971) N + P + K	Bu. of Corn Per Acre
30 + 13 + 0	113 + 20 + 0	60
30 + 0 + 0	113 + 20 + 0	60
12 ton manure per acre	113 + 20 + 0	58
0 + 13 + 0 + 12 ton manure per acre	113 + 20 + 0	67
0 + 0 + 0	113 + 20 + 0	65
30 + 26 + 25	113 + 20 + 0	61
30 + 13 + 25	113 + 20 + 0	55
0 + 13 + 25	113 + 20 + 0	53
120 + 13 + 25	113 + 20 + 0	55
0 + 13 + 0	113 + 20 + 0	56
30 + 13 + 100	113 + 20 + 0	61
0 + 0 + 25	113 + 20 + 0	52
L.S.D. at 5%		9.8

Discussion and Interpretation of Table 37

Residual or carry-over from fertilizer applied in 1970 for soybeans had no beneficial effect on corn yields in 1971 when the corn received 113 lbs. of nitrogen and 20 lbs. of phosphorus per acre.

RESIDUAL PHOSPHORUS - SOYBEAN RESPONSE

Raymond Ward and Burton Lawrensen

An 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 pounds P/acre) were broadcast and plowed down annually. No phosphorus has been broadcast during the past four years. Each of the P treatment areas was divided into thirds with one-third receiving 10 lbs. of P per acre as a starter fertilizer from 1964 through 1968, one-third receiving 10 lbs. of zinc per acre in 1964 and 1965, and one-third remaining only as the broadcast phosphorus treatment.

Previous reports have shown yield responses to the residual phosphorus fertilizer. The purpose of this experiment at the present time is to determine the soil test level for phosphorus that is adequate for optimum crop yields. We have an excellent opportunity at this location to find the phosphorus soil test value for optimum yields because we have phosphorus soil tests ranging from low to very high. Previous data have shown that near maximum yields were obtained when the soil test level for phosphorus was 35-40 lbs. of P/A. Crops studied thus far are corn, grain sorghum, and soybeans. Soybeans were grown in 1970 and again in 1971 because of the dry conditions of 1970. However, 1971 turned out to be a similar test to 1970.

Methods and Materials

On May 26, 1971, Corsoy soybeans were planted in 30 inch rows. The seedbed was prepared by fall plowing, spring tandem disking, and then dragging with spike tooth harrow. On May 28, the site was sprayed with 2.5 quarts (2.5 lbs.) of Lasso herbicide using 25 gallons of water per acre. No P fertilizer was applied because this experiment was designed to measure carryover phosphorus fertilizer. No nitrogen fertilizer was applied because Rhizobria bacteria that are found in nodules on soybean roots fix nitrogen for the soybeans. No potassium fertilizer was applied because of high potassium soil tests. On June 9, the northeast corner of the plot had been under water for two days.

Results and Discussion

A visual growth response to the carry-over phosphorus fertilizer was observed through most of the growing season. Soybean growth was less on low phosphorus soil test plots than on medium-high to very high phosphorus soil test plots.

The soybeans were combined October 15, 1971. The average moisture content of the harvested soybeans was 8.2 percent. Yield results are shown in Table 38. Yields were very similar to those obtained in 1970. The first increment of carry-over phosphorus fertilizer produced 3 to 4 more bushels of soybeans. Soybean yields were not increased more with additional increments of carry-over phosphorus fertilizer. In other words, soybean yields were not increased when the phosphorus soil test was higher than the medium-high level. This means that soybean yield increases will not be obtained from phosphorus fertilizer when the soils have been fertilized to a medium-high phosphorus soil test. Other crops will be grown to determine if the optimum phosphorus soil test level is different for each crop.

TABLE 38. INFLUENCE OF VARIOUS RATES OF CARRY-OVER BROADCAST P AND THE ADDITIONAL INFLUENCE OF CARRY-OVER STARTER P AND CARRY-OVER ZINC ON YIELD OF SOYBEANS IN 1971

Total lbs. of P Broadcast/A (1964-67)	Broadcast Phosphorus Soil Test Level	Carry-over Broadcast Phosphorus	Carry-over Broadcast and Starter Phosphorus	Carry-over Broadcast Phosphorus and Zinc
		Soybean Yield, Bu/A		
0	Low	17.8	21.6	19.9
40	Medium-High	22.1	21.7	23.2
80	High	22.4	21.6	21.6
160	Very High	20.0	22.7	22.7
320	Very High	20.9	20.4	22.3

SOYBEAN HERBICIDE SCREENING TRIALS

W. E. Arnold and W. B. O'Neal

The performance of several experimental herbicides and herbicide combinations were compared with recommended herbicides for their control of annual weeds in soybeans. The experimental design was a randomized complete block replicated four times. Corsoy soybeans were planted on May 27. All herbicide applications were made with tractor sprayer which applied 20 gpa at 40 psi. Preplant treatments were applied May 27 and incorporated immediately with a tandem disk set at 4 inches. Preemergence treatments were applied May 29 and postemergence treatments were applied June 16 when soybeans were in the first trifoliate stage of growth and redroot and smooth pigweed plants were 1 inch tall. Early observations of percent pigweed control and soybean injury were made July 9. Late season observations of percent pigweed control were made September 15. The averages of four replications of data are shown in Table 39. BAS-3512, BAS-2903 + Linuron and CIPC + Alachlor appear to control pigweed more effectively than any standard treatment now available. Bay 94337 controlled pigweed but injured slightly the soybeans.

TABLE 39. SOYBEAN HERBICIDE SCREENING

Treatment	Rate lb/A	July 9 % Pigweed Control	July 9 Soybean[a] Injury	September 15 % Pigweed Control
Preplant Inc.				
Trifluralin	3/4	64	0	62
BAS-3921	3/4	66	0	74
BAS-3921	1	69	0	26
Preemergence				
Chloramben	3	56	0	26
Acetochlor	3/4	72	0	15
Acetochlor	2	95	1.0	80
Acetochlor	3	96	0.5	92
Alachlor	3/4	23	0	0
Alachlor	2	76	0	35
Alachlor	3	84	0	78
Bay 94337	1/4	93	0.8	81
Bay 94337	1/2	98	1.0	94
MC-4379	1 1/2	28	0	22
MC-4379	2	34	0	15
MC-4379	3	65	0.5	18
Oryzalin	1 1/2	41	0	15
Oryzalin	2	59	0	45
Oryzalin	3	85	0	71
IMC-3950	4	21	0.2	5
IMC-3950	6	36	0.5	0
IMC-3950	8	36	0	15
PX-24	1	0	0	0
FX-24	2	60	0	48
SD-15418	2	64	1.4	18
SD-15418 + Alachlor	1 1/2 + 1 1/2	75	0.9	35
DNBP	7 1/2	0	0	5
DNBP + Alachlor	3 1/3 + 1 1/2	86	0	55
BAS-2903 + Linuron	3 + 1 1/2	81	0	82
CIPC	6	0	0	5
CIPC + Alachlor	2 + 2	90	0	83
Postemergence				
BAS-3512 + X-77	1/2 + 1/2%	33	0	32
BAS-3512 + X-77	1 + 1/2%	88	0	84
BAS-3512	2	78	0	84
No Herbicide	--	0	0	0

a/ Soybean injury notes based on 0 = no injury to 10 = complete kill.

GRAIN SORGHUM PERFORMANCE TRIALS

J. J. Bonnemann

Entries included in the trial are the choice of the producing companies. Check entries, labeled SD or RS, are included by the Agricultural Experiment Station.

The grain sorghum trial was seeded on May 19 and harvested on September 24. The row spacing was 30 inches. Ramrod was applied at time of seeding. Stands were uniform but cooler than normal temperatures through July retarded growth. Moisture was adequate during the early part of the year. When dry periods of August and early September reduced yields or caused extreme stresses in other crops the grain sorghum grew very nicely and produced excellent yields of good quality grain.

Results of the Grain Sorghum Performance Trial appear in Table 40. Complete results and discussion will be found in the 1971 Grain Sorghum Performance Trials, Circular 205.

TABLE 40. 1971 GRAIN SORGHUM PERFORMANCE TRIAL, AREA E, SOUTHEAST EXPERIMENT FARM.

Brand and Variety	Height, inches	Lodging, Percent	Moisture percent 9/17/71	Date headed	Test Wt. lb/B	Yield, lb/A 1971	Yield, lb/A 1970-71
SD 25702	41		21.0	7/27	58	6320	
Northrup-King 233	48		18.6	7/27	59	6260	
Northrup-King 222	42		20.0	7/27	59	6135	5395
ACCO R1010	46	3	15.1	7/24	60	6020	5570
RS 506	47	5	16.0	7/23	57	5920	5365
Northrup-King 265	45		23.5	8/1	59	5875	5975
SD 503	49		16.4	7/24	58	5825	5460
RS 633	45		22.3	7/29	59	5815	5780
RS 610	46		19.4	7/30	57	5810	5220
Frontier Super 400A	43		19.8	7/29	56	5790	
Pioneer 883	43	3	15.1	7/25	57	5785	
Frontier GX 389	43		16.1	7/27	59	5690	
ACCO R1019	42		24.7	8/2	59	5600	5480
ACCO R1029	45		25.4	8/2	58	5565	5500
Northrup-King 133A	38		20.4	7/26	60	5555	4970
Pioneer 866	48		25.3	7/29	57	5555	5360
Western WS 206	44		21.4	7/30	60	5540	
ACCO Exp. X-7275	43		16.6	7/29	57	5480	
DeKalb C-42a	40		23.3	7/27	57	5340	5390
DeKalb B-36	44		18.0	7/25	57	5300	5170
Frontier 400C	45		23.4	7/30	57	5280	
SD 451	46	5	15.0	7/20	56	4950	4580
ACCO Exp. X-7250	39		16.4	7/24	59	4830	
Coop SG-10	41		32.4	8/14	55	4150	
					Mean	5600	
C.V. = 12.3%						N.S.	

SORGHUM RESEARCH AND TESTING - 1971

A. O. Lunden

Sorghum test entries included State, Regional, and Experimental grain and forage sorghum lines and hybrids. Yields were much higher than expected with the limited rainfall and ranged to over 7,000 lbs. or 125 bushels per acre for some of the new experimental hybrids. The new early maturity open-pedigree hybrid RS506 produced a very satisfactory yield of 110 bushels of 60-lb. grain with no lodging. Other hybrids listed in Table 41 which appear to have excellent potential include a Regional entry from Nebraska, a short South Dakota hybrid whose maturity is similar to that of SD441 and a slightly taller hybrid of median maturity.

Two early maturing lines also appear to have considerable potential for late planting or for early harvest. SD104, which was released as the restorer line to produce RS506, produced about 12 percent more grain than SD102 when planted in May and suffered no appreciable loss in yield when planted as late as June 15. Yields recorded in Table 41 are for lines planted on May 25 in 30-inch rows. Experimental line SD690363, which outyielded SD102 by more than 30 percent and SD104 by 20 percent, evidenced no lodging at any location in 1971 while about 5 percent of the SD104 and 24 percent of the SD102 was broken down before harvest at the Highmore station. These lines are short in stature and would be more competitive relative to the taller hybrids if planted with closer spaced rows.

The experimental forage sorghum hybrid, SD67873, which was discussed in the 1970 report is being considered for release as SD275F. 1971 yields are not included for SD67873 because of seed production failure during the 1970 season. Some seed of SD275F will probably be sold by Foundation Seeds Division for planting in 1972. This hybrid has short thick stalks with many large leaves and large seed heads. SD275F is designed for late fall silage harvest or winter forage, stands well after frost and produces a high yield of good quality forage.

TABLE 41. STATE, REGIONAL AND EXPERIMENTAL GRAIN SORGHUM YIELDS - 1971

A - Open-Pedigree Hybrids available in 1971

Entry	Days to Heading	Plant Height	Seed Test wt	Yields in Pounds per Acre 1967-69-70	1971	Ave.	Bu/A Ave.
SD441	57	55	58	5097	4740	5008	89
SD451	57	48	58	5707	5280	5600	100
RS605	59	52	60	6263	6170	6240	110
NB505	59	44	62	5527	5050	5408	97
SD503	61	48	61	6403	5700	6227	111
RS610	65	47	61	6463	5790	6295	112
RS671	75	44	60	6070	5230	5860	104

TABLE 41. (Con't.)

B - Hybrids and strains for potential release

Entries	Days to Heading	Plant Height	Seed Test wt	1971 Yields #/A	Bu/A
Lines					
SD102	51	40	57	3770	67
SD690363	55	41	58	5190	93
SD104	56	37	60	4220	75
Hybrids					
SD70312	57	44	60	6330	113
SD70036	59	52	61	6900	123
NB684418	65	49	61	7070	126

GREENBUG CONTROL WITH SYSTEMIC INSECTICIDES ON GRAIN SORGHUM - 1971

P. A. Jones, B. H. Kantack, F. Shubeck, B. Tyler and B. Lawrensen

Greenbugs, Schizaphis graminum Rondani, have been of economic importance to grain sorghum growers in South Dakota every season since 1968. The greenbug control study was designed as a continuing project to 1) evaluate various systemic insecticides for greenbug control, 2) to determine most effective rates of insecticides at lowest cost to growers, and 3) to obtain efficacy data for materials which are presently unregistered for use.

Trials were run at three locations as indicated in the accompanying tables of results. Greenbug populations at all locations followed much the same pattern as in previous years, with high populations developing by mid-July, with declines setting in by the end of August and beginning of September. The aphid counts in the accompanying tables illustrate the severity of the infestations.

The results of the greenbug control tests on sorghum at the S. E. Research Farm in 1971 (Table 42) were, in part, inconclusive, since expected yield differences were nullified by impact of environmental factors.

As one measure of systemic insecticide performance, the greenbug counts at 55 days and 65 days after treatment indicated the potential time a specific treatment has to last through the critical period of sorghum head development, when heavy greenbug populations on the lower leaves will adversely effect yields. The relationship between greenbug control and increase in yields was examined, but even with the Di-Syston treatment which gave excellent control of greenbugs, there was no significant statistical difference from the untreated check.

The expected yield increases from the effective greenbug control with Di-Syston were negated by the moisture stress on the sorghum caused by an extremely high plant population and lack of moisture from a prolonged drought. The plant populations of 85,000 plants per acre was much more than the intended plant population of 50,000 plants per acre.

TABLE 42. GREENBUG CONTROL ON GRAIN SORGHUM USING SYSTEMIC INSECTICIDES AS PLANTING TIME TREATMENTS. S. E. RESEARCH FARM, 1971.

Treatment Material and Formulation	Rate/A (lbs. a.i./A	Greenbug Counts[1] 55 Days after Treatment: Ave. No. Greenbugs Per Leaf	Greenbug Counts[1] 55 Days after Treatment: % Reduction Under Check	Greenbug Counts[1] 65 Days After Treatment: Ave. No. Greenbugs Per Leaf	Greenbug Counts[1] 65 Days After Treatment: % Reduction Under Check	Yields[2] Ave. Bu/A	Yields[2] % Increase Over Check
Di-Syston 15G	1.0	1	99	4	91	68.3	5.6
Furadan 10G	1.0[3]	2	98	3	94	70.3	8.7
Furadan 10G	1.0	9	89	8	83	71.3	10.2
Thimet 15G	1.0	36	68	22	54	67.7	4.6
Thimet 15G	1.5	20	77	29	40	67.5	4.3
Cygon 10G	1.0	74	14	37	23	64.0	-1.1
Cygon 10G	2.0	40	54	29	40	68.8	6.3
Untreated Check		86	--	49	--	64.7	---

Plot planted June 2, 1971 with Pioneer 866 grain sorghum (30 inch rows).

(1) Average aphid counts based on 8 replicates per treatment.
(2) Average yields of No. 2 grain sorghum (14% moisture) based on 6 replicates per treatment. Two replicates had lodged almost 100%, so could not be harvested. Combine yields were taken from whole plots.
(3) Furadan applied into the furrow with the seed. All other insecticide treatments were applied as a 4 inch - 7 inch band over the row at planting time.

TABLE 43. A DEMONSTRATION OF GREENBUG CONTROL ON GRAIN SORGHUM USING SYSTEMIC INSECTICIDES AT PLANTING TIME. ADOLPH AND DENNIS PATER FARM, WAGNER, SOUTH DAKOTA.

Treatment Material and Formulation	Rate/A (lbs. a.i./A)	Greenbug Counts[1] Ave. No. Greenbugs Per Leaf	Greenbug Counts[1] % Reduction Under Check	Yields[2] Ave. Bu/A	Yields[2] % Increase Over Check
Di-Syston 15G	1.0	55.5	72.7	42.7	36.8
Furadan 10G	1.0	25.6	87.4	40.8	20.7
Thimet 15G	1.0	93.3	54.1	36.0	15.4
Thimet 15G	1.5	126.3	37.9	37.0	9.4
Untreated 1		139.2		31.9	
Checks 2		136.2		30.5	
3		231.9		34.7	
4		221.2		32.9	
5		243.5		----	
6		240.3		----	
Ave. Check		203.4		32.5	

Plot planted May 28, 1971 with Northrup-King 222, 233 grain sorghum (30 inch rows).

(1) Average aphid counts, 75 days after treatment, based on counts from 4 leaves, 5 plants per subsample; with 4 subsample areas per treatment. (August 11, 1971).
(2) Average combine yields of No. 2 grain sorghum (14% moisture) based on two .8 acre strips per treatment, October 6, 1971. Percent increase in yield based on side-by-side comparisons with untreated check strips.

TABLE 44. A DEMONSTRATION OF GREENBUG CONTROL ON GRAIN SORGHUM USING SYSTEMIC INSECTICIDES AT PLANTING TIME. VENE EITEMILLER FARM, WAGNER, SOUTH DAKOTA.

Treatment	Rate/A	Greenbug Counts (1)		Yields (2)	
Material and Formulation	(lbs. a.i./A)	Ave. No. Greenbugs Per Leaf	% Reduction Under Check	Ave. Bu/A	% Increase Over Check
Di-Syston 15G	1.0	45.6	84.3	47.1	48.1
Furadan 10G	1.0	61.6	78.8	39.8	25.2
Thimet 15G	1.0	176.5	39.1	38.9	22.3
Thimet 15G	1.5	78.3	73.0	43.0	35.2
Untreated 1		300.9		34.6	
Checks 2		308.6		20.3	
3		336.1		31.0	
4		279.1		33.1	
5		226.0		----	
Ave. Check		290.0		31.8	

Plot planted June 8, 1971 with Northrup-King 222 grain sorghum (30 inch rows).

(1) Average aphid counts, 62 days after treatment, based on counts from 4 leaves, 5 plants per subsample, with 4 subsample areas per treatment. (August 10, 1971).

(2) Combine yields of No. 2 grain sorghum (14% moisture) taken October 6, 1971 from plots varying in size from .37 acre to .73 acre in size. Percent increase in yield based on comparison with average of all untreated checks.

The results of the greenbug control demonstrations near Wagner, South Dakota, (Tables 43 & 44), verified the data obtained in 1970. The Di-Syston treatment gave season-long greenbug control accompanied by yield increases which more than repaid the cost of treatment. Greenbug control with the Thimet application declined after 55 - 60 days from treatment, even at the higher rate of 1.5 lbs. a.i./Acre, although it should be noted that with the later planting date, Thimet at the higher rate gave a more competitive yield (Table 44). Furadan treatments held up for the duration of the aphid season, although this greenbug control was not reflected in as high increases in yield as with the Di-Syston treatment. The reason for this was not apparent.

The prevalence and intensity of greenbug infestations in grain sorghum over the past few years leads us to recommend that a planting time treatment of Di-Syston at 1 lb. a.i./acre, in a 4 inch - 7 inch band over the row, is a worthwhile investment for grain sorghum growers.

STANDARD VARIETY OAT TRIALS

J. J. Bonnemann

Small grain rod-row variety trials were limited to oats (Table 45) in 1971. Drill strips of other small grains were seeded for observation only and used for crop tours.

The data included in this report are bushel yield, test weight and available three-year averages.

The oat varieties were seeded on April 8, 1971. Soil moisture was adequate for uniform germination. Temperatures were low and precipitation was limited during April and May. Cool temperatures and above normal quantities of precipitation occurred during June and early July. Growth was very lush. Weeds also became a problem because of the excessive rainfall in early June. The oat yields were very good. Further discussion on the small grain trials will be found in the 1971 Small Grain Variety Trials, Circular 203.

TABLE 45. STANDARD VARIETY OAT TRIALS, SOUTHEAST FARM, 1968-1971[a]

	Bushels/Acre			3 yr.	1971 T.W.
Variety	1968	1970	1971	av.	Lbs/bu.
Dupree	35.9	69.3	79.4	61.5	35.0
Burnett	39.9	79.2	93.2	70.8	35.0
Garland	28.3	76.9	84.9	63.4	36.0
Clintford	33.4	66.8	78.8	59.7	37.5
Trio			88.5		36.0
Lodi	43.9	72.2	70.7	62.3	33.5
Clintland 64	42.7	72.9	78.3	64.6	35.0
Brave	39.2	58.3	93.0	63.5	35.7
Pettis	37.6	82.5	84.1	68.1	38.5
Orbit	24.9	61.2	78.5	54.9	33.2
Jaycee	42.8	71.1	80.8	64.9	35.2
Holden	28.8	72.2	95.0	65.3	36.0
Portal	37.8	76.5	89.2	67.8	36.2
Kelsey	45.2	65.6	92.8	67.9	36.2
Sioux	37.1	62.6	86.4	62.0	35.7
Kota	44.5	74.9	89.2	69.5	35.7
Cayuse			81.0		32.5
Otter		65.1	74.5		34.5
Nodaway 70		79.2	94.6		37.0
Froker		70.3	73.9		34.7
SD 955			82.7		35.2
Chief (SD 1541)		78.1	96.0		35.2
Ill. 66-2287A			88.2		35.0
Random			70.2		30.5
Mean			84.3		
LSD-.05			7.5		
CV-%			6.2		

[a] 1969 hailed out

EVALUATION OF CHEMICAL CONTROL OF LOOSE SMUT ON BARLEY

SUMMARY STATEMENT

L. S. Wood

Loose smut is an important disease of barley and wheat as percent smut is directly related to loss in yield. Five percent smut means an automatic loss in yield of five percent.

Standard seed treatment chemicals, long used for control of seedling diseases caused by pathogens carried on seed coats and/or beneath the glumes, are not effective in controlling loose smut. This is because the loose smut pathogen infects at flowering time and is carried within the embryo. Recently, several systematic fungicides have become available which will give virtually 100 percent control. These systemic fungicides are applied to the seed surface as usual. When seeds take on moisture and start to germinate the systemic fungicide is translocated to the embryo and is able to kill the smut-causing fungus without harming the embryo. With the smut fungus inactivated the embryo develops in a normal manner and results in a healthy spike rather than a smutted one.

In this year's test an established systemic fungicide, Vitavax, was compared on barley with a new material designated H-719 produced by the Uni-Royal company. Vitavax at 3 ounces per 100 pounds of seed was compared with 1/2, 1/4, and 1/16 ounces per 100 pounds of seed of H-719. Four replicates were used for all treatments along with a nontreated control. Smut was controlled as expected using Vitavax. In addition, all rates of H-719 also controlled smut. It is significant that rates as low as 1/16 of an ounce per 100 pounds of seed resulted in control.

Further testing will be needed to confirm this year's results but it is clear that such low rates of application would be a tremendous advantage to growers in markedly reducing the cost of treating seed for control of loose smut.

ALFALFA MANAGEMENT RESEARCH

P. D. Evenson, M. D. Rumbaugh, Dwight Hovland and B. Lawrensen

Experiment I

The objective of this experiment is to determine the influence of soil fertility management in maintaining alfalfa stands and forage yields and in increasing economic return from this crop.

The 1970 and 1971 results from this experiment are in Table 46. It would appear that some phosphorus is needed to maximize yields. Sixty lbs. of phosphorus top-dressed gave maximum increases from the phosphorus rate treatments in both years. However, the split application of 150 lbs. P/A in 1969 and 15 lbs. P/A each subsequent year appears to do as well in 1971 as the 60 lb. yearly application.

The potassium treatment increased alfalfa yields by an average of .36 tons per acre per year over the two years, and the phosphorus plus potassium produced the maximum yields of alfalfa in both years. It should be noted that none of the differences in Table 46 are significant at the .05 level.

TABLE 46. ALFALFA YIELDS, 1970 AND 1971.

Treatments	Yield (Tons/Acre) 1970	1971	Mean
No fertilizer	3.10	3.73	3.42
15 lbs. P/A/year	3.50	4.16	3.83
30 lbs. P/A/year	3.55	4.18	3.87
60 lbs. P/A/year	3.55	4.40	3.98
150 lbs. P (1969) + 15 lbs. P/A/year	3.28	4.40	3.84
300 lbs. P (1969)	3.54	4.24	3.89
200 lbs. K/A/year	3.42	4.13	3.78
300 lbs. P (1969) + 200 lbs. K/A/year	3.61	4.46	4.04

Experiment II

The objective of this experiment is to develop methods of altering temperatures of alfalfa crowns, shoots and foliage during critical periods of plant growth in order to enhance plant dry matter production.

Table 47 contains the 1970 and 1971 results of this experiment. Treatments containing mulch appeared to slightly increase alfalfa yields in 1970 although not significantly so. Alfalfa yields were reduced by the mulch treatments and mulch plus shade treatments in 1970. Some of these reductions were significantly different at the .05 level. No explanation is available at this time for this type of response, but it may be related to the very high June rainfall. More measurements are needed to adequately explain these results.

TABLE 47. ALFALFA YIELDS, 1970 AND 1971.

Treatments	Yield (Tons/Acre) 1970	1971	Mean
Control	3.60	4.26	3.93
15 lbs. N/A	3.74	4.33	4.04
Plastic Shades + Straw Mulch	3.76	3.42	3.59
Cheesecloth Shades + Straw Mulch	3.89	3.87	3.88
Styrofoam Mulch	3.77	3.88	3.83
Straw Mulch	3.56	3.96	3.76
Minor elements	3.53	4.25	3.89

EFFECT OF NITROGEN FERTILIZATION ON SEED PRODUCTION OF SUMMER SWITCHGRASS

J. G. Ross, Burton Lawrensen and J. B. Weber

A stand of Summer switchgrass was established from breeders seed in 40 inch rows for seed production in 1962. Seed has been produced from this field every year by surface application of fertilizer early in the spring and then cutting and chopping the high stubble left from the previous harvest. The large supply of mulch has kept weeds from becoming established and preserves the moisture until the new growth of this warm season grass starts in late May.

On April 7, 1971, two replicates of 4-row plots, 384 feet long consisting of four fertilizer treatments, 0 lbs., 100 lbs., 200 lbs., and 400 lbs. of nitrogen per acre, were established. In September the average yields of uncleaned seed from these were 128 lbs., 212 lbs., 263 lbs. and 340 lbs. per acre, respectively. The response from nitrogen observed in this experiment indicates that this element represents a limiting factor for seed production in this warm season grass similar to its effect on the cool season grasses such as smooth bromegrass. Since growth of the warm season grasses does not start until late May, application of nitrogen would ordinarily not be made until that time because the cool season early-growing weeds would make use of early-applied nitrogen at the expense of the warm season late-growing grass. Early spring fertilization of warm season grass, however, can be made if a deep mulch is applied immediately to control the growth of cool season weeds. Use of this technique has given continuous seed production during the past nine years.

SUNFLOWER VARIETY TRIALS

H. Geise and A. Lunden

Objectives of Experiment

To compare varieties of the various types of sunflowers for adaptation to the Corn Belt area of South Dakota. Evaluation of varieties will be based on characters such as seed yield, seed quality, plant height and damage by birds, diseases and insects.

Results of some of the initial sunflower variety experiments at the Southeast Farm.

TABLE 48. SUNFLOWER VARIETY DEMONSTRATION - SOUTHEAST EXPERIMENTAL FARM, 1971.

Cultivar	Height Inches	Lodging %	% Insect Damage	Test Weight lbs/Bushel	Seed Yield lbs/Acre
OILSEED TYPE					
P21 VR2 x Menn. RR-18-1	91	3	7	30	1632
Peredovik 66	92	2	7	29	956
Krasnodarets	92	10	3	28	798
Record	78	2	58	29	557
VNIIMK 8931 66	91	5	29	30	483
CONFECTIONARY OR BIRDFEED TYPE					
Arrowhead	92	2	5	30	922
Commander	91	2	23	26	622
Mingren	95	4	12	27	584
Greystripe	81	4	98	--	16
Lyng Manchurian 26-2	91	2	99	--	16
Average					659

Discussion of Table 48.

Observations made at the Experimental Farm in 1971 indicated sunflowers could be grown economically. The ten year (1961-70) yield averages* (corn-48.1 bu/A, soybeans - 21.1 bu/A) returned an income (based on local selling price on December 15, 1971) of $48.10 per acre for corn, and $61.19 per acre for soybeans. At the present contract price of sunflower seed ($4.75/Cwt for oilseed, $5.25/Cwt for confectionary), a yield of only 1013 pounds of oilseed and 916 pounds of confectionery seed per acre would be needed to equal the dollar returns of corn.

The yields of the sunflowers would need to be slightly higher to compare with income from soybeans. Production would need to be 1290 lbs/acre of the oilseed type and 1165 lbs/acre of the edible or birdfeed type.

The yields of sunflowers in 1971 were only slighly reduced by birds and shattering. However, in late maturing varieties, yields were severely reduced by insects. These losses can be reduced in several ways. Either by early planting (late April) which will permit the plants to bloom before the insect population has increased to a destructive level, or by the application of an approved insecticide which will control the sunflower head moth.

*Area average yields were obtained from the Crop & Livestock Reporting Service Annual Reports.

MOST PROFITABLE ROTATION

F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Which rotation or cropping sequence will bring the greatest net cash return?

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

Methods and Procedures

Seven rotations or cropping sequences were studied. The longest sequence was corn, corn, oats and alfalfa.

Fertilizer recommendations were based on soil tests.

Varieties used:

Corn - Funks G 4444 (N cytoplasm)
Oats - Kota
Alfalfa - Vernal
Soyeans - Corsoy
Grain Sorghum - Pioneer 866
Sweet Clover - Madrid

Discussion and Interpretation of Table 49

In 1971, a year with abundant moisture in June but dry in July, August and September, was a good year to test the value of rotations for maximum yield. Top yield of oats was in a corn, corn, oats, alfalfa rotation -- 93 bushels per acre with the fertilizer treatment (15+26+0). This amounted to 34 bushels above that from the unfertilized plots in the same cropping sequence. Several other sequences had large oat yield increases due to commercial fertilizers. The value of these increases varied from approximately $1.60 to $4.50 return for each dollar spent for fertilizer at present prices.

Yields of corn were below average. Yield increases from fertilizer were not as great nor as consistent as with oats. Even though moisture was limited in July and August, yields of corn following alfalfa were not seriously depressed when compared to yields in plots with no alfalfa preceding the corn.

The use of a starter sideband application of fertilizer for soybeans placed 2 inches to the side and 2 inches below the seed was a profitable pratice.

Grain sorghum responded very favorably to fertilizer this year. Yields were nearly doubled when (6+11+10) starter and 70 lbs. of sidedressed nitrogen were applied.

The amount of alfalfa recovered from the plots was low. The first cutting was partially washed away by a 3 inch rain in June. Dry weather in July, August and September reduced yields in subsequent cuttings.

TABLE 49. EFFECT OF CROPPING SEQUENCE AND FERTILIZER ON CROP YIELD

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	--	--	33	--	--	--	--
1 Continuous corn	Corn	6 + 11 + 10	70	--	43	--	--	--	--
2 Continuous corn	--	0 + 0 + 0	--	61	25	--	--	--	--
2 Corn-oats	Corn	6 + 11 + 10	70		36	--	--	--	--
	Oats	30 + 7 + 10	--	87	--	--	--	--	--
3 Corn-corn-oats+alf-alf hay	--	0 + 0 + 0	--	59	45	32	--	--	0.75
3 Corn-corn-oats+alf-alf hay	Corn	6 + 11 + 10	--	--	34	--	--	--	--
	Corn	6 + 11 + 10	70	--	--	45	--	--	--
	Oats	15 + 26 + 0	--	93	--	--	--	--	--
	Alf residual	-- --	--	--	--	--	--	--	0.83
4 Oats+sweet clover-corn	--	--	--	65	20	--	--	--	--
4 Oats+sweet clover-corn	Oats	30 + 7 + 0	--	88	--	--	--	--	--
	Corn	6 + 11 + 10	--	--	25	--	--	--	--
5 Corn-soybean oats	--	0 + 0 + 0	--	73	34	--	23	--	--
5 Corn-soybeans-oats	Corn	6 + 11 + 10	77	--	49	--	--	--	--
	Soybeans	6 + 11 + 10	--	--	--	--	26	--	--
	Oats	30 + 7 + 10	--	88	--	--	--	--	--
6 Corn-oats-Soybeans	--	-- --	--	57	57	--	21	--	--
6 Corn-oats-Soybeans	Corn	6 + 11 + 10	55	--	49	--	--	--	--
	Oats	20 + 7 + 0	--	85	--	--	--	--	--
	Soybeans	6 + 11 + 10	--	--	--	--	24	--	--
7 Continuous Grain Sorghum	--	0 + 0 + 0	--	--	--	--	--	35	--
7 Continuous Grain Sorghum	Sorghum	6 + 11 + 10	70	--	--	--	--	67	--

EFFECT OF COOKED SOYBEANS AND TYPE OF HOUSING ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF SWINE

R. C. Wahlstrom, G. W. Libal, J. F. Fredrikson and R. M. Luther

Raw soybeans are an unsatisfactory source of protein for growing pigs because of the presence of a trypsin inhibitor. This inhibitor causes poor utilization of essential amino acids by the pig and subnormal growth results. This inhibitor present in raw soybeans is destroyed by heat in the processing of soybean meal or in cooking the raw beans to a temperature of at least 225° F. Development of equipment capable of rapid cooking of soybeans on the farm has increased the interest of many swine producers in the feeding of cooked soybeans.

Previous research conducted at the Southeast South Dakota Experiment Farm had shown very little difference in rate of gain of growing pigs housed in totally confined or in open-front buildings. However, approximately 9% less feed was required when pigs were housed in the confinement buildings. The present experiment was conducted to obtain further information on the effect of cooked soybeans in rations for growing pigs when housed in a controlled environment confinement building or an open-front building with waterers and feeders in an outside concrete lot.

Procedure

Seventy-two crossbred pigs (40 barrows and 32 gilts) were randomly allotted to two replications of four treatments on the basis of litter, weight and sex. Average initial weights for replicates 1 and 2 were 93.4 and 58.6 lb., respectively.

The four treatments were:

1. Confinement building, soybean meal in diet.
2. Confinement building, cooked soybeans in diet.
3. Open-front building, soybean meal in diet.
4. Open-front building, cooked soybeans in diet.

The diets fed up to an average weight of 120 lb. contained 16% protein. Protein content was reduced to 13% in the diets fed during the finishing phase, 120 lb. to market weight. The composition of the diets is shown in Table 50.

TABLE 50. COMPOSITION OF DIETS (PERCENT)

	To 120 lb.		120 to 210 lb.	
Diet	A-1	B-1	A-2	B-2
Ground yellow corn	72.2	76.5	92.5	85.0
Ground cooked soybeans	25.0	--	14.7	--
Soybean meal, 44%	--	20.7	--	12.2
Ground limestone	0.55	0.55	0.9	0.9
Dicalcium phosphate	1.5	1.5	1.15	1.15
Trace mineral salt	0.5	0.5	0.5	0.5
Vitamin-antibiotic[a]	0.25	0.25	0.25	0.25

[a] Provided per lb. of ration: 1,500 I.U. vitamin A, 150 I.U. vitamin D, 1 mg. riboflavin, 2.5 mg. calcium pantothenate, 7.5 mg. niacin, 50 mg. choline, 5 mcg. vitamin B_{12} and 5 mg. oxytetracycline.

The totally confined house was a fully insulated, ventilated, slotted floor house. The temperature was maintained between approximtely 50 and 60° F. The open-front house was a pole type building, open to the east, with concrete floor and outside concrete feeding floor. A partition, approximately three feet high, confined the pigs to a sleeping area at the rear of the house that was bedded with straw. The experiment was conducted during the winter months from December 8 to March 3.

Fifty-one pigs (39 barrows and 12 gilts) were slaughtered at the termination of the experiment and carcass data were obtained for carcass length, backfat, loin eye area and ham-loin percent. The gilts were not all slaughtered because some were retained for the breeding herd. One barrow failed to weigh 200 lb. at the termination of the experiment and was not included in the carcass data.

Results

A summary of the results of this experiment is presented in Table 51. Table 52 summarizes the data as to the effects of housing type or dietary treatment.

TABLE 51. COOKED SOYBEANS IN RATIONS FOR PIGS HOUSED IN CONFINEMENT OR OPEN-FRONT BUILDINGS

	Confinement		Open-front	
Diet	Soybean meal	Cooked sovbeans	Soybean meal	Cooked soybeans
No. of pigs[a]	18	18	18	18
Av. daily gain, lb.				
Rep 1	1.93	1.89	1.72	1.67
Rep 2	2.00	2.11	1.78	1.74
Av. feed consumed, lb.				
Rep 1	6.32	6.29	5.92	5.92
Rep 2	5.94	6.09	5.56	5.71
Av. feed/gain, lb.				
Rep 1	3.27	3.33	3.47	3.54
Rep 2	2.97	2.89	3.13	3.28
Carcass data				
No. of pigs	13	13	12	13
Av. length, in.	30.1	29.6	29.9	29.9
Av. backfat, in.	1.35	1.44	1.24	1.34
Av. loin eye area, sq. in.	4.59	4.86	5.12	4.79
Av. ham-loin. %	39.22	39.07	39.78	39.32

[a] Two replicates of 9 pigs each per treatment. Av. initial wt., 93.4 and 58.6 lb. for replicates 1 and 2, respectively. Av. final weights approximately 210 lb.

The growth performance data are shown for each replicate since there was a large difference in initial starting weights between replicates. Rate of gain was not significantly different between replicates. However, the heavier pigs in replicate 1 did consume more daily feed and were less efficient in feed conversion than the lighter pigs of replicate 2. These differences are to be expected as heavier pigs have a greater maintenance requirement and require more feed to produce a unit of gain.

TABLE 52. EFFECT OF HOUSING AND DIET ON SWINE PERFORMANCE

	Housing		Diet	
	Confinement	Open-front	Soybean meal	Cooked soybeans
No. of pigs[a]	36	36	36	36
Av. daily gain, lb.	1.99	1.73	1.86	1.85
Av. feed/gain, lb.	3.09	3.34	3.19	3.23
Carcass data				
No. of pigs	26	25	25	26
Av. length, in.	29.9	29.9	30.0	29.8
Av. backfat, in.	1.40	1.29	1.30	1.39
Av. loin eye area sq. in.	4.73	4.99	4.89	4.83
Av. ham-loin, %	39.14	39.54	39.49	39.20

[a] Four lots of 9 pigs (5 barrows and 4 gilts) per treatment.

Pigs fed in confinement gained significantly faster than those housed in the open-front building (1.99 vs. 1.73 lb. per day). This is the first year that a difference of this magnitude has been observed. It was consistent as the four lots of pigs in the confined house had average gains of from 1.89 to 2.11 lb. per day while pigs in those lots in the open-front buildings gained from 1.67 to 1.78 lb. per day. Differences between this experiment and previous ones were heavier initial weights, later starting date and a colder than average January. It is possible that these factors may have had some effect on the growth of the pigs fed in this experiment.

Feed per gain was improved 8% when pigs were fed in the confined house. This is similar to the differences reported in previous experiments. However, actual feed required per pound of gain in this experiment was less in both housing types than in previous experiments. It is possible that the improved feed/gain ratio is a reflection of the faster gains observed in the present experiment. Type of housing had little effect on carcass characteristics. The 0.11 inch greater backfat present on carcasses of pigs fed in the confined building was probably a reflection of the faster rate of gain of those pigs.

The performance of pigs fed soybean meal or cooked soybeans as a protein source did not differ. All pigs gained at a very acceptable rate. The diet containing cooked soybeans should have had a higher energy content due to the fat content of soybeans. However, this higher energy content did not reflect itself in an improved feed/gain ratio. Previous work at this station had shown an improvement of about 6% in feed efficiency when cooked soybeans replaced soybean meal in the diet of growing pigs.

Characass characteristics of pigs fed the two diets were very similar. There was a trend toward slightly greater backfat on carcasses from pigs fed the cooked soybean diet (1.39 vs 1.30 inches). This difference would reflect the higher energy content of the cooked soybean diet.

Table 53 shows the value of properly cooked soybeans at various corn and soybean meal prices. To obtain a comparative value of raw soybeans, the cost of processing (cooking and grinding) must be subtracted from the cooked value. For each dollar per ton processing cost, it is necessary to subtract 3 cents

per bushel from the value of the cooked beans to obtain the value of the raw beans. Therefore, if the cooking cost was $10 per ton, it would be necessary to subtract a 30 cents per bushel from the value of the cooked soybeans as listed in Table 53 to arrive at the true worth of raw soybeans.

TABLE 53. VALUE OF COOKED SOYBEANS (DOLLARS PER BUSHEL)

	Price, 44% soybean meal/ton					
Price, corn/bushel	$70	$80	$90	$100	$110	$120
$1.00	2.13	2.35	2.58	2.80	3.03	3.25
1.00	2.18	2.41	2.63	2.86	3.08	3.31
1.20	2.24	2.46	2.69	2.91	3.14	3.36
1.30	2.29	2.52	2.74	2.97	3.19	3.42
1.40	2.35	2.57	2.80	3.02	3.25	3.47
1.50	2.40	2.63	2.85	3.08	3.30	3.53
1.60	2.46	2.68	2.91	3.13	3.36	3.58
1.70	2.51	2.74	2.96	3.19	3.41	3.64

Summary

Seventy-two crossbred pigs were used to study the effect of type of housing and cooked soybeans as a dietary protein source. In this experiment rate of gain and feed per gain were significantly improved when pigs were housed in a totally confined house compared to open-front housing during the winter months. Growing-finishing pigs fed diets containing cooked soybeans or soybean meal had similar rates of gain and feed/gain ratios.

The faster gaining pigs in confinement had slightly more carcass backfat than those pigs housed in open-front buildings. The backfat of carcasses from pigs fed diets containing cooked soybeans was slightly greater than that of the pigs fed soybean meal diets. There were no differences in other carcass characteristics between treatments.

COOKED SOYBEANS AND RAW SOYBEANS AS SUPPLEMENTAL PROTEIN SOURCES OF GROWING-FINISHING SWINE

R. C. Wahlstrom, G. W. Libal, J. F. Fredrikson and R. M. Luther

Research conducted at the Southeast South Dakota Experimental Farm during the winter of 1970-71 showed that properly cooked soybeans were an excellent source of supplemental protein in diets for growing-finishing swine. Raw soybeans are not utilized satisfactorily by the growing pig. However, there is some difference of opinion on the ability of the finishing pig to utilize the protein in raw soybeans.

The objective of the experiment reported herein was to evaluate the use of cooked and raw soybeans in diets for finishing swine.

Procedure

Seventy-two weanling pigs averaging approximately 44 lbs. were divided into nine lots of eight pigs each. Each lot contained four barrows and four gilts.

Three replicate lots received each of the following dietary treatments:

1. Cooked soybean diet
2. Soybean meal diet
3. Soybean meal diet to 130 lb.; raw soybean diet 130 lb. to market weight

Composition of the diets is shown in Table 54. Diets were formulated to contain approximately 16% protein up to a weight of 130 lb. and 13% protein from 130 lb. to market weight. The cooked soybeans were purchased locally and had been processed with an "on-the-farm cooker." The pigs were housed in a confinement type building. The experiment was conducted during the summer of 1971.

TABLE 54. COMPOSITION OF DIETS (PERCENT)

	Weaning to 130 lb.		130 lb. to market weight		
Treatment number	1	2 and 3	1	2	3
Ground yellow corn	72.2	76.5	82.7	85.0	82.7
Soybean meal (44%)	--	20.7	--	12.2	--
Cooked soybeans	25.0	--	14.5	--	--
Raw soybeans	--	--	--	--	14.5
Ground limestone	0.55	0.55	0.9	0.9	0.9
Dicalcium phosphate	1.5	1.5	1.15	1.15	1.15
Trace mineral salt (1% zinc)	0.5	0.5	0.5	0.5	0.5
Vitamin-antibiotic[a]	0.25	0.25	0.25	0.25	0.25

[a] Provided per lb. of ration: 1,500 I.U. vitamin A, 150 I.U. vitamin D, 1 mg. riboflavin, 2.5 mg. calcium pantothenate, 7.5 mg. niacin, 50 mg. choline, 5 mcg. vitamin B_{12} and 5 mg. oxytetracycline.

Forty-five pigs were removed from the experiment as they reached a weight of approximately 210 lbs. These pigs were slaughtered and carcass data obtained for carcass length, backfat, loin eye area and ham-loin percent. Because of the variation in weights all pigs did not reach a 210 lb. weight by the time the experiment was terminated. This accounted for the smaller number of animals in the carcass data compared to the growth data.

Results

The growth performance data are summarized in Table 55 and the carcass data in Table 56.

During the first few weeks of this experiment the pigs fed the cooked soybean diet grew at a very subnormal rate. A sample of these cooked beans along with a sample of raw (uncooked) beans from the same source were submitted to the South Dakota State University Station Biochemistry Department for determination of urease content. The urease enzyme is present in raw beans but is destroyed by cooking at high temperatures. The urease content of the cooked and raw soybeans was very similar, indicating that the cooked soybeans had not been subjected to a high enough temperature to destroy the urease and they were therefore no better than uncooked or raw beans. A new supply of cooked beans was obtained and incorporated in the diets for pigs in Treatment 1 and a marked increase in gain was noted. Gains prior to the change in cooked soybeans averaged 0.70 lb.

per day while the pigs gained 1.71 lb. per day during the remainder of this period on the new source of cooked beans. However, the overall average as indicated in Table 55 was 1.06 lb. per day for the growing period.

TABLE 55. GROWTH PERFORMANCE OF PIGS FED COOKED OR RAW SOYBEANS

Treatment	Cooked soybeans	Soybean meal	Soybean meal changed to raw soybeans at 130 lb.
No. of pigs[a]	23	24	23
Av. initial wt., lb.	44.5	44.4	44.5
Av. final wt., lb.	184.1	207.1	207.9
Av. daily gain, lb.			
To 130 lb.	1.06	1.64	1.56
After 130 lb.	1.67	1.72	1.32
Av. for experiment	1.19	1.66	1.42
Av. feed cons./day, lb.			
To 130 lb.	3.28	4.19	3.96
After 130 lb.	5.19	5.40	4.47
Av. for experiment	3.53	4.69	4.19
Feed/gain, lb.			
To 130 lb.	3.14	2.56	2.54
After 130 lb.	3.04	3.16	4.17
Av. for experiment	3.11	2.82	3.12

[a] Three replicates of 8 pigs each per treatment. Two pigs died and data were not included.

More feed was required per unit of gain when the pigs were fed the cooked soybean diet. It is assumed that the decreased feed efficiency when fed improperly cooked beans was associated with poor gain. Pigs fed the soybean meal diet had a feed/gain ratio of 2.55 (average) compared to 3.14 for pigs fed the cooked beans.

Feeding raw soybeans as the protein source in diets for pigs from a weight of 130 lb. caused a decrease in gains of 23%. Pigs fed the soybean meal diet gained 1.72 lb. daily while those changed to a diet containing raw soybeans gained 1.32 lb. per day. The average daily gain of pigs fed the cooked soybean diet during the finishing period was similar to that of pigs fed the soybean meal diet during this period. It should be pointed out, however, that the experiment was terminated before pigs fed the cooked soybean diet reached as heavy a weight as the pigs on the other treatments. Therefore, the faster gains made by these pigs during the finishing period were obtained over a shorter period of time and do not represent as much of the total gain.

Feed/gain was increased when the raw soybean diet was fed. These pigs required 4.17 lb. of feed per lb. of gain during the finishing period compared to 3.04 and 3.16 lb. for pigs fed cooked soybean or soybean meal diets, respectively.

There were no large differences in carcass characteristics. Carcasses from the pigs fed the cooked soybean diet did have slightly over 0.1 inch more back-

fat than pigs on the other diets. This trend has also been noted in our previous trials where carcasses from pigs fed cooked beans averaged about 0.1 inch more backfat.

TABLE 56. CARCASS DATA OF PIGS FED COOKED OR RAW SOYBEANS

Treatment	Cooked soybeans	Soybean meal	Soybean meal changed to raw soybeans at 130 lb.
No. of carcasses	12	15	18
Av. length, in.	30.5	30.0	31.2
Av. backfat, in.	1.40	1.29	1.27
Av. loin eye area, sq. in.	4.0	4.4	4.3
Av. percent ham and loin	39.07	39.80	39.54

Summary

This experiment indicated very clearly the importance of proper cooking of soybeans if they are to be used in swine diets. Soybeans should be brought to a temperature of at least 225° F, however, a temperature of 250° F as the bean leaves the cooker after 3 to 5 minutes cooking is recommended. Pigs fed improperly cooked soybeans will perform no better than those fed raw soybeans. It would appear that the poor average gains made during the growth period by pigs fed cooked soybeans in this experiment were due to improper cooking.

Older or heavier pigs will utilize raw soybeans better than younger pigs. However, in the experiment reported here, pigs fed raw soybeans after they weighed 130 lb. gained 23% slower and required 32% more feed per pound. of gain than pigs fed soybean meal as their protein source. There was little difference in performance of pigs fed cooked soybeans or soybean meal during the finishing period.

Backfat thickness was increased about 0.1 inch on carcasses from pigs fed cooked soybeans. Other carcass characteristics did not differ between treatments.

DROUGHT-DAMAGED CORN SILAGE FOR GROWING BEEF CALVES

R. M. Luther and J. F. Fredrikson

Forage harvested from the corn plant for silage during a growing season of below normal rainfall is lower in energy due to the reduction in grain yield. The protein content, on the other hand, is generally higher than "normal" silage because of a higher nitrate content. This experiment was conducted to study the effect of supplementing protein, energy, or both to corn plant forage harvested and ensiled in a dry year. "Normal" silage was not available for comparison. The trial was terminated at 56 days when the silage supply was exhausted.

PROCEDURE:

One hundred thirty-six calves averaging 440 lb. were purchased from three ranches in western South Dakota for the experiment. The calves were partially preconditioned and were weaned from the dam about three months prior to shipment to the Experiment Farm. After weaning they were fed about three lb. oats per head and prairie hay to appetite. On arrival at the Farm they were allotted into eight pens of 17 each on the basis of weight and origin. Four pens of cattle were fed indoors with access to outside lots. Another four pens of cattle were fed in outside lots without shelter.

Corn forage was harvested in mid-August 1970 with a yield of about eight bushels of grain per acre. The material contained 28.4% dry matter, 10.8% protein and 0.22% nitrate nitrogen at ensiling. The ensilage was placed in a stack outside, covered with a sheet of plastic and sealed with earth around the bottom. The 78-ton stack was opened for feeding in January. Silage samples collected at feeding showed chemical contents of 26.1% dry matter, 10.8% protein and 0.26% nitrate nitrogen.

Four experimental treatments were as follows:

A. 3 lb. corn grain and 1 lb. protein supplement
B. 6 lb. corn grain and 1 lb. protein supplement
C. 3 lb. corn grain and 2 lb. protein supplement
D. 6 lb. corn grain and 2 lb. protein supplement

The ration when calves were on full feed consisted of either 1 or 2 lb. protein supplement each with 3 or 6 lb. rolled corn grain and drought-damaged corn silage to appetite.

The experiment was designed such that two levels of energy (3 and 6 lb. corn grain) would be used with the 1 lb. level of protein supplementation and also with the 2 lb. level of protein. As it turned out each energy level was somewhat higher with 2 lb. of protein supplementation than with 1 lb. of protein. This was due to the amounts of corn silage and corn grain consumed and the difference in energy content of the two feeds. Total protein consumed was also affected in like manner. The protein supplements were formulated to contain 32% crude protein. Ingredient composition of the supplements is presented in Table 57.

TABLE 57. COMPOSITION OF SUPPLEMENTS

	Daily Supplement Feeding Rate	
	1 lb./steer	2 lb./steer
Soybean meal (44% Pr.)	25.51%	45.60%
Corn grain	43.49%	38.90%
Urea (281% Pr. Eqv.)	6.00%	3.00%
Trace mineral salt	12.00%	6.00%
Dicalcium phosphate	12.00%	6.00%
Antibiotic premix[1]	1.00%	0.50%
Vitamin premix[2]	100 gm.	50 gm.

[1] To supply 350 mg. chlortetracycline and 350 mg. sulfamethazine per steer daily for first 28 days.

[2] To supply 30,000 I.U. vitamin A per steer daily.

Samples of ensilage, silage and spoiled material were taken for dry matter analysis. Silage losses from the covered stack were estimated by subtracting gross weight of dry matter in spoiled silage from the weight of dry matter in the forage when ensiled. Weights were taken on a conventional farm scale.

RESULTS:

The results of the four ration treatments replicated with inside and outside feeding were combined in presenting results. Energy and protein contents of the ration, Calorie:protein ratios and feed and gain data are presented in Table 58.

TABLE 58. SUPPLEMENTATION OF DROUGHT-DAMAGED CORN SILAGE (JANUARY 20 TO MARCH 17, 1971 - 56 DAYS)

Treatment	A	B	C	D
Protein Supplement, lb.	1	1	2	2
Corn Grain, lb.	3	6	3	6
Ration Composition[2]				
Energy, Mcal.[3]	6000	7350	6800	8160
Crude Protein, %	11.42	11.25	12.14	12.01
Calorie:Protein Ratio	19.2	24.6	19.8	24.6
No. steers	17	17	17	17
Av. initial wt., lb.	440	438	441	440
Av. final wt., lb.	547	556	562	579
Av. daily gain, lb.	1.92	2.10	2.17	2.48
Av. daily ration, lb.				
Silage (wet basis)	23.55	20.59	23.55	20.67
Corn	2.63	4.83	2.63	4.83
Supplement	1.00	1.00	2.00	2.00
Hay and Oats[1]	0.15	0.15	0.15	0.15
Total	27.33	26.57	28.33	27.65
Feed per 100 lb. gain				
Silage (wet basis)	1225	981	1083	832
Corn	137	229	121	194
Supplement	52	47	92	80
Hay and Oats[1]	7	7	6	6
Total	1421	1264	1302	1112

1 Used to start calves on feed.
2 Computed from Morrison's Feeds and Feeding, 22nd Edition.
3 Estimated net energy, megacalories.

Steers fed a pound of protein supplement and about 3 pounds of corn grain (Treatment A) made satisfactory gains of almost 2 lb. per day. However, feed efficiency of this group was poor. Feeding extra energy as corn grain (Treatment B) increased gains 9.2% and improved feed conversion 11.1%.

The calves fed 2 lb. of protein supplement and about 3 lb. of corn daily (Treatment C) gained 2.17 lb per day compared to 2.48 for calves fed 6 lb. of corn grain (Treatment D). The extra energy also markedly improved feed conversion.

Feeding an additional pound of protein improved gains 13% with the lower energy levels (Treatment C vs. A) and 18% with the higher energy levels (Treatment D vs. B). This appears to be the result of greater feed intake in each case. Likewise, ration utilization was improved 8.4 and 12%, respectively. Interestingly enough in these comparisons the computed calorie to protein ratios are essentially the same (Treatment C vs. A, 19.8 and 19.2; Treatment D vs. B, 24.6 and 24.6).

Chemical analyses of forage dry matter ensiled and silage dry matter fed indicate that no nitrate reduction (0.22 vs. 0.26% as NO_3N) occurred during ensiling. The amount of silage dry matter fed did not exceed 1/2 of the total dry matter in the ration. No problem was encountered with nitrate toxicity.

The silage used in this trial appeared to be in good condition throughout the stack. Dry matter losses by weight and percent were:

Silage Dry Matter	Ton	Percent
Total ensiled	22.15	100.0
Fed to cattle	16.02	72.3
Spoiled silage	2.91	13.1
Other losses	3.22	15.6

Costs of materials for the silo structure included a plastic cover for $25.00.

SUMMARY:

Drought-damaged corn silage when properly supplemented with energy as corn grain has a feed value comparable to silage made from the corn plant in a "good" corn year. Supplementing silage with one or two pounds of a 32% protein supplement and three pounds of corn grain resulted in acceptable wintering gains but generally poor feed conversions. Feeding two pounds of protein supplement and six pounds of corn grain improved gains 18% and feed conversion 12% compared to one pound of supplement and the same amount of corn grain. Performance was poorer when three pounds of grain was fed with two pounds of protein supplement.

PROTEIN SUPPLEMENTS FOR GROWING AND FINISHING BEEF CATTLE

R. M. Luther and J. F. Fredrikson

The choice of protein supplements for growing and finishing beef cattle is of concern to cattle producers in Southeastern South Dakota. Today many com-

mercial protein supplements are formulated with nonprotein nitrogen compounds. Of recent interest is the feeding of the nonprotein nitrogen compound, biuret. Biuret is similar to urea but is degraded at a slower rate in the rumen than is urea. Interest in and the use of liquid protein supplements in cattle feeding continues to increase.

This experiment was conducted to compare the performance of cattle fed soybean meal, urea or biuret as nonprotein nitrogen sources, and a commercial liquid molasses-urea mixture in growing and fattening phases of cattle feeding. The growing phase involved feeding corn silage for 82 days. A ration of ground corn with limited hay was used in a 106-day finishing phase. The ration treatments were replicated with inside and outside feeding and the results are presented for the two types of shelter and also combined for evaluating protein supplements.

Procedure

Growing Phase - 82-days

The calves (136 head) used in the previous drought-damaged corn silage trial were reallotted on the basis of weight into eight pens of 17 steers for this experiment. The four types of protein supplements were replicated with inside and outside feeding. Four pens of cattle were fed under shelter with access to outside lots. Another four pens were fed outside without shelter.

The cattle when on full feed received 6 lb. of ground shelled corn, 2 lb. of 33% protein supplement and corn silage to appetite.

The four experimental treatments were as follows:

1. Soybean meal supplement (control)
2. Biuret-corn base supplement
3. Urea-corn base supplement
4. Commercial liquid (molasses-urea) supplement

Ingredient composition of the supplements is shown in Table 59.

New feeder wagon at fence line feed bunks (right).
Weighing liquid molasses-urea supplement for cattle rations (below).

TABLE 59. PERCENTAGE COMPOSITION OF SUPPLEMENTS

Ingredient	Soybean Meal	Corn-Biuret[1]	Corn-Urea	Liquid[2]
Soybean meal (44% Pr.)	71.87	--	--	Contains
Ground corn	15.32	61.35	63.38	cane
Dehydrated alfalfa meal (17% Pr.)	--	15.00	15.00	molasses, phosphoric
Urea (281% Pr. Eqv.)	--	--	8.81	acid, urea
Biuret (230% Pr. Eqv.)[1]	--	10.84	--	vitamins A,
Dicalcium phosphate	6.00	6.00	6.00	D, and E,
Trace mineral salt	6.00	6.00	6.00	trace min-
Antibiotic premix[3]	0.07	0.07	0.07	erals and
Stilbestrol premix[4]	0.25	0.25	0.25	5 mg. stil-
Vitamin premix[5]	0.49	0.49	0.49	bestrol per lb.

1 Kedlor - 230 supplied by Dow Chemical Co., Midland, Michigan.
2 Rumliq 33-5 supplied by Farmers Union Grain Terminal Assn., Sioux Falls, South Dakota.
3 To supply 35 mg. chlortetracycline per pound of supplement.
4 To supply 5 mg. diethylstilbestrol per pound of supplement.
5 To supply 10,000 I.U. vitamin A and 1,988 I.U. vitamin D_2 per pound of supplement.

The supplements were mixed with the corn silage and corn grain in a horizontal batch mixer.

Corn silage used in the experiment was ensiled during early September of 1970 with an average corn grain yield of about 27 bushels per acre. The material at ensiling contained 33.5% dry matter, 3.4% protein and 0.09% nitrate nitrogen. Samples of silage were collected during the feeding period for chemical analysis. The supply of corn silage was nearly exhausted at 82 days and this phase of the experiment was terminated.

Finishing Phase - 106 Days

The rations were changed to ground shelled corn and chopped alfalfa hay. Corn silage was gradually removed from the ration and the cattle brought to a full feed of ground corn and hay. The hay was restricted to 10% of the ration.

Experimental treatments for the supplements were the same as during the growing phase (see Table 59). The cattle remained in the same pens for this phase of the experiment as during the previous phase. During this phase one animal was removed from a soybean meal treatment with a respiratory ailment. Results are presented for animals completing the experiment with an average feed being deducted for the animal up to the time it was removed. The experiment was terminated after 106 days on the finishing ration. The cattle were marketed at a central public market and carcass data were not obtained.

Results

Growing Phase

Results of this phase of the experiment are shown in Table 60.

TABLE 60. PROTEIN SUPPLEMENTS FOR GROWING BEEF STEERS, PHASE I March 17 to June 7, 1971 - 82 DAYS)

17 Steers Per Treatment	Protein Supplement: Soybean Meal	Corn-Biuret[1]	Corn-Urea	Liquid[2]
Shelter				
Av. initial wt., lb.	561	561	561	561
Av. final wt., lb.	778	771	761	760
Av. daily gain, lb.	2.64	2.57	2.44	2.43
Feed/day, lb.				
Hay	0.2	0.2	0.2	0.2
Silage (wet basis)	29.4	29.5	28.9	29.9
Corn grain	5.4	5.4	5.4	5.4
Supplement	1.7	1.7	1.7	1.7
Total, lb.	36.7	36.8	36.2	37.2
Feed/cwt. gain, lb.	1390	1432	1484	1531
No Shelter				
Av. inital wt., lb.	563	561	562	561
Av. final wt., lb.	774	762	730	754
Av. daily gain, lb	2.57	2.45	2.05	2.35
Feed/day, lb.				
Hay	0.2	0.2	0.2	0.2
Silage (wet basis)	29.6	29.8	27.8	30.2
Corn grain	5.4	5.4	5.4	5.5
Supplement	1.7	1.7	1.7	1.7
Total, lb.	36.9	37.1	35.1	37.6
Feed/cwt. gain, lb	1436	1514	1712	1600

1 and 2 - See footnotes on Table 59.

Combined Results for Protein Supplements

34 Steers per Treatment	Soybean Meal	Corn-Biuret	Corn-Urea	Liquid
Av. initial wt., lb.	562	561	562	561
Av. final wt., lb.	776	767	746	757
Av. daily gain, lb.	2.61	2.51	2.25	2.39
Feed/day, lb.				
Hay	0.2	0.2	0.2	0.2
Corn silage (wet basis)	29.5	29.7	28.4	30.0
Corn grain	5.4	5.4	5.4	5.4
Supplement	1.7	1.7	1.7	1.7
Total, lb.	35.8	37.0	35.7	37.3
Feed/cwt. gain. lb.	1410	1474	1587	1565

In comparison to the soybean meal control supplement steer gains were 3.8, 13.8 and 8.4% lower, respectively, for the biuret, urea and liquid supplement (see bottom section of table). The poorer performance of calves fed urea was due in part to reduced feed intake with the calves consuming 1.1 lb. of feed less per day than the controls. Steers fed biuret, urea or liquid supplement required

4.5, 12.6 and 11.0% more feed, respectively, than those fed soybean meal. Gains of cattle fed the liquid molasses-urea mixture were about 6% greater than those of calves fed the dry urea supplement. These cattle also consumed more feed but the efficiency of feed conversion was about the same as that of cattle fed the corn-urea supplement.

During the experiment an effect of shelter was observed in respect to the supplemental treatments. However, performance of cattle fed inside was superior to that of cattle fed outside. With shelter the steers fed biuret gained only slightly less than the controls but required more feed. Steers fed urea or liquid supplement gained 7.6% less than those fed soybean meal. On the other hand, with the cattle fed outside the gains were 4.7, 20.2 and 8.6% less for the biuret, urea and liquid supplements, respectively, compared to the control. The differences in performance due to shelter appear to be involved with energy utilization. For example, cattle fed outside may have required more energy from the ration to maintain body temperature than those inside. Less energy would therefore be available for utilization of the nonprotein nitrogen sources. Nonprotein nitrogen compounds such as urea appear to be utilized more completely when there is an abundant and steady supply of energy from the ration. The rations contained about 58% roughage on a air-dry basis.

Finishing Phase

The results of this phase are presented in Table 61 with the combined data for supplements shown at the bottom portion of the table. The urea and liquid supplements, which supported poorer gains with the silage ration, showed improved (compensatory) gains during the finishing phase. This appears to be the result of the higher energy content of the ration.

Differences in performance were observed between supplements with cattle fed inside and outside. This phase involved warmer weather of the summer and early fall months. Cattle fed biuret, urea and liquid in outside lots gained 14.8, 8.2 and 15.8% less, respectively, and required 8.4, 5.2 and 10.7% more feed respectively, than those afforded shelter. Gains of cattle fed soybean meal were the same when fed inside as when fed outside.

Overall Results - 188 Days

Table 62 shows the combined reusults of the growing and finishing phase with the summary of supplements at bottom of the table. These data show essentially no difference in rate of gain or feed conversion between the soybean supplement and those containing nonprotein nitrogen. Steers fed urea consumed about 5% less feed and required slightly less feed per unit of gain.

The data for shelter-no shelter comparisons show essentially the same trends as reported for the finishing phase. Supplements containing any one of the nonprotein nitrogen sources gave performance fully equal or better than soybean meal when the cattle were provided shelter. However, these same supplements gave performance inferior to that of soybean meal when the cattle were fed without shelter. The slightly lower performance observed with the supplements containing urea in this experiment with outside feeding is in general agreement with other research work on urea utilization.

TABLE 61. PROTEIN SUPPLEMENTS FOR FATTENING BEEF STEERS, PHASE II (June 7 to September 31, 1971 - 106 DAYS)

16 or 17 Steers Per Treatment*	Protein Supplement: Soybean Meal	Corn-Biuret[1]	Corn-Urea	Liquid[2]
	Shelter			
Av. initial wt., lb.	778	771	761	760
Av. final wt., lb.	1020	1029	1032	1035
Av. daily gain, lb.	2.28	2.44	2.56	2.60
Feed/day, lb.				
Hay	2.1	2.1	2.0	2.1
Silage (wet basis)	2.6	2.7	2.6	2.6
Corn grain	16.9	16.7	15.2	17.2
Supplement	2.0	2.0	2.0	2.0
Total, lb.	23.6	23.5	21.8	23.9
Feed/cwt. gain, lb.	1034	964	854	924
	No Shelter			
Av. initial wt., lb.	769	762	730	754
Av. final wt., lb.	1010	982	978	986
Av. daily gain, lb.	2.27	2.08	2.35	2.19
Feed/day, lb.				
Hay	2.0	2.0	2.0	2.0
Silage (wet basis)	2.7	2.6	2.3	2.6
Corn grain	15.5	15.1	14.8	15.8
Supplement	2.0	2.0	2.0	2.0
Total, lb.	22.2	21.7	21.1	22.4
Feed/cwt. gain, lb.	976	1045	898	1023

1 and 2 - See footnotes on Table 59.

Combined Results for Protein Supplements

33 or 34 Steers per Treatment*	Soybean Meal	Corn-Biuret	Corn-Urea	Liquid
Av. initial wt., lb.	774	767	746	757
Av. final wt., lb.	1015	1006	1005	1011
Av. daily gain, lb.	2.28	2.26	2.46	2.40
Feed/day, lb.				
Hay	2.1	2.1	2.0	2.1
Silage (wet basis)	2.6	2.6	2.5	2.6
Corn grain	16.2	15.9	15.0	16.5
Supplement	2.0	2.0	2.0	2.0
Total, lb.	22.9	22.6	21.5	23.2
Feed/cwt. gain, lb.	1005	1005	876	974

*1 steer removed from soybean meal treatment.

TABLE 62. PROTEIN SUPPLEMENTS FOR GROWING AND FINISHING BEEF STEERS, OVERALL (March 17 to September 21, 1971 - 188 DAYS)

	Protein Supplements			
16 or 17 Steers Per Treatment*	Soybean Meal	Corn Biuret[1]	Corn-Urea	Liquid[2]
	Shelter			
Av. initial wt., lb.	561	561	561	561
Av. final wt., lb.	1020	1029	1032	1035
Av. daily gain, lb.	2.44	2.49	2.51	2.52
Feed/day, lb.				
Hay	1.3	1.3	1.2	1.3
Silage (wet basis)	14.3	14.4	14.0	14.5
Corn grain	11.8	11.8	10.9	12.1
Supplement	1.9	1.9	1.9	1.9
Total, lb.	29.3	29.4	28.0	29..
Feed/cwt. gain, lb.	1201	1176	1121	1180
	No Shelter			
Av. initial wt., lb.	559	561	562	561
Av. final wt., lb.	1010	982	978	986
Av. daily gain, lb.	2.40	2.24	2.21	2.26
Feed/day, lb.				
Hay	1.3	1.2	1.2	1.3
Silage (wet basis)	14.4	14.5	13.4	14.7
Corn grain	11.1	10.9	10.7	11.3
Supplement	1.8	1.8	1.8	1.8
Total, lb.	28.6	28.4	27.1	29.1
Feed/cwt. gain, lb.	1194	1268	1226	1283

1 and 2 See footnotes on Table 59.

Combined Results for Protein Supplements

33 or 34 Steers Per Treatment*	Soybean Meal	Corn Biuret	Corn-Urea	Liquid
Av. initial wt., lb.	560	561	562	561
Av. final wt., lb.	1015	1006	1005	1011
Av. daily gain, lb.	2.42	2.37	2.36	2.39
Feed/day, lb.				
Hay	1.3	1.3	1.2	1.3
Silage (wet basis)	14.4	14.4	13.7	14.6
Corn grain	11.4	11.3	10.8	11.7
Supplement	1.9	1.9	1.9	1.9
Total, lb.	29.0	28.9	27.6	29.5
Feed/cwt. gain, lb.	1198	1222	1174	1232

*1 steer removed from soybean meal treatment.

Summary

A growing and finishing trial with 136 steer calves was conducted to study the value of protein supplements containing biuret or urea and a mixture of molasses-urea (commercial liquid). In the growing phase with the feeding of corn silage

and 6 lb. corn per head daily, the performance of calves fed biuret was poorer than those fed soybean meal but superior to cattle fed either the urea or liquid supplement. During the finishing phase with a high energy ration steer performance favored the urea and liquid supplements. The overall results of the 188-day experiment show that performance was very similar for each of the four supplemental treatments. Differences in response to supplementation were observed between inside and outside cattle. Utilization of rations containing the nonprotein nitrogen sources was generally inferior to soybean meal with cattle fed outside without shelter.

VALUE OF SHELTER FOR GROWING AND FINISHING BEEF CATTLE

R. M. Luther and J. F. Fredrikson

Facilities for feeding beef cattle at the Experiment Farm include four pens with feeding inside remodeled cattle barn in which cattle have access to outside lots and another four pens outside without shelter. Nutritional experiments are conducted each year in these facilities. Results for the feeding studies are reported elsewhere in this publication. This report is concerned with the shelter aspects of cattle studies for the period January through September 1971.

Description of Facilities

Four outside pens 56 feet x 64 feet are equipped with fence-line bunks. An automatic electrically heated waterer centrally located serves the pens. The floor of each pen is earth except for a 10-foot concrete apron adjacent to the feed bunk and extending to the waterer. A bedding mound is provided and bedded with corn cobs or straw as necessary. Feed is distributed to bunks with a feed wagon.

The inside pens have an area 16 feet x 50 feet under shelter with an area of 30 feet x 50 feet outside. The cattle barn is east-west oriented with the outside exposed to the north and south. The inside pens have concrete floors and are bedded with straw as necessary. The cattle are allowed free choice to both inside and outside areas. Feed is distributed by roto-tube equipment to a bunk located inside. Two automatic electric heated waterers supply water to the pens.

Design of Experiment

The experiment this year consisted of three feeding periods which are as follows:

- Period I. Drought-damaged corn silage with protein and energy supplementation - 56 days (January 21 to March 17, 1971).
- Period II. Protein supplements to corn silage rations for growing beef calves - 82 days (March 17 to June 7, 1971).
- Period III. Protein supplements to ground corn and alfalfa hay rations for finishing beef cattle - 106 days (June 7 to September 21, 1971)

Details of the feeding trials are described elsewhere in this report. Feed bunk space in each pen can accommodate a maximum of 25 cattle. However, 17 calves per pen were used this year.

TABLE 63. INSIDE OR OUTSIDE FEEDING FOR BEEF STEERS

Period		Inside	Outside
I	No. of steers	68	68
	Av. initial wt., lb.	440	440
	Av. final wt., lb.	562	560
	Av. daily gain, lb.	2.18	2.14
	Feed/day, lb.	27.5	27.6
	Feed/cwt, gain, lb.	1259	1290
	Feed cost/cwt. gain, $	10.78	10.92
II	No. of steers	68	68
	Av. initial wt., lb.	561	562
	Av. final wt., lb.	768	755
	Av. daily gain, lb.	2.52	2.36
	Feed/day, lb.	36.7	36.7
	Feed/cwt. gain, lb.	1457	1551
	Feed costs/cwt. gain, $	11.58	12.37
III	No. of steers	68	67
	Av. initial wt., lb.	768	755
	Av. final wt., lb.	1029	989
	Av. daily gain, lb.	2.47	2.22
	Feed/day, lb.	23.2	21.8
	Feed/cwt. gain, lb.	939	982
	Feed costs/cwt. gain. $	17.87	18.68

Results

Results of the shelter studies are presented in Table 63. During Period I from January 21 to March 17 rate of gain was slightly lower for the outside cattle. They consumed slightly more feed and had higher feed requirements than the inside cattle. This amounted to 31 pounds of additional feed. At prices of $8 per ton for corn silage, $40 per ton for corn grain, $25 per ton for alfalfa hay and $95 per ton for protein supplement the cost of the additional feed would be 14 cents per 100 lb. gain.

During Period II from March 17 to June 7 the cattle fed outside gained less than the inside cattle. They consumed the same amount of feed and had higher feed requirements (6.5%). For each 100 lb. of gain this would amount to 94 lb. more total feed for the outside cattle. Using the above feed prices and adjusting the cost of protein supplement to $75 per ton (calculated from the average cost of the four supplements used), feed cost per 100 lb. gain would have increased 79 cents for this period of the experiment.

Period III covered the period from June 7 to September 21 and was the finishing phase of the feeding studies. During this period the rate of gain was 10.1% less for cattle outside. They consumed 6% less feed and required 4.6% more feed per 100 lb. gain than the cattle inside. This would amount to 43 lb. more feed for cattle outside. At prices used in Period I and II costs would increase 81 cents per 100 lb. gain for the cattle fed outside.

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