Southeast South Dakota Experiment Farm

13th Annual Progress Report 1973

Agricultural Experiment Station
South Dakota State University
Brookings

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THIRTEENTH ANNUAL PROGRESS REPORT
SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

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

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION
BROOKINGS, SOUTH DAKOTA 57006

Duane Acker, Director

R. A. Moore, Associate Director

CENTER ACTIVITIES . . . . Richard M. Luther

The Cornbelt Agricultural Research and Extension Center was the site of a variety of agricultural events and activities in 1973. Only a few of them are highlighted in this report.

New Research Initiated Research work started the spring of 1973 included the following new Plant Science projects: herbicide drift, cocklebur control in soybeans, weed control in alfalfa, phytotoxicity of field bindweed and growth regulators for soybeans. Studies of rootworm resistance in corn were conducted by personnel from the Northern Grain Insect Research Laboratory, USDA at Brookings. A project to evaluate different varieties of potatoes having potential use in the chipping industry was initiated by members of the Horticulture-Forestry Department. A livestock project partially supported by the Environmental Protection Agency was started at the Center in August. This study deals with salt levels for beef cattle, the potential pollution of soil and water by animal wastes containing salt and application rates of feedlot manures.

In addition to these new experiments at least 25 research projects initiated in previous years were continued this year. Results of new and continuing research studies are reported in this publication.

Pollution Indicator Plant Demonstration Dr. Wayne Gardner, Plant Science Department, observed several tobacco varieties and other pollution indicator plants including petunia, gladiola and cotton. This study was part of a network of similar plantings about the state. This demonstration attracted a good deal of interest from people in the area.

4-H Judging School Held An area 4-H judging school was held at the Center in June. Girls and boys from Clay, Union, Bon Homme, Yankton and Turner counties made placings on market and breeding swine, sheep and beef cattle. J. J. O'Connell, Extension Specialist, Animal Science Department, conducted the school. About 135 4-H youngsters participated. Animals were supplied by the Animal Science Department and the Experiment Farm.

Feedlot Health Clinic An area clinic dealing with beef cattle feedlot health and management topics was held in September. The meeting was sponsored by the South Dakota Livestock Associations and Cooperative Extension Services in the southeastern counties of the state. Appearing on the program from South Dakota State University were Dr. James Bailey, Dr. Wayne Berndt and Dr. William Schneider. Dr. Richard Luther, Center Research Manager, conducted a tour of cattle research facilities and explained the research in progress. Approximately 150 people attended.

Crops Twilight Tour The annual tour of oat variety and corn and soybean herbicide plots was held June 26. Mr. Leon Wrage and Mr. Duane Colburn led these discussions. Dr. Ben Kantack discussed current insect problems while Dr. Leon Wood pointed out problems to watch for in crops diseases. The program was provided by personnel from South Dakota State University. Two tours were used to show farmers from the southeast area counties the research in progress.

Crops and Livestock Field Day Field day visitors heard a variety of crops and livestock subjects discussed at the annual open house on September 21. The dismal rainy day did not keep some 450 farmers and agribusiness people from attending the event.

Public Service During April, May and June soil temperatures were collected and tabulated (see Table 3) to inform area farmers of planting conditions. The information was called in to local radio stations. Stations WNAX at Yankton and KVRA at Vermillion broadcast the information daily.

Temperature and precipitation reports from the United States National Weather Service weather station were published by The Centerville Journal each week during the year.

Portions of a television film dealing with soybean production were filmed at the Center. Numerous radio broadcasts relating to activities at the Center were made.

Summer tours were arranged for the Watertown Vocational Technical School and a Farmland industry group. A number of private tours around the Experiment Farm were conducted.

Table 1. Temperatures at the Southeast Experiment Farm

Month	1973 Av. Temperature (F)[1] Maximum	1973 Av. Temperature (F)[1] Minimum	21 Year Average Maximum	21 Year Average Minimum	Departure from 21 Year Av. Maximum	Departure from 21 Year Av. Minimum
January	27.2	8.1	26.5	5.6	+0.7	+2.5
February	31.5	13.6	33.2	11.6	-1.7	+2.0
March	47.6	31.4	43.7	22.8	+3.9	+8.6
April	58.5	34.5	61.8	35.5	-3.3	-1.0
May	69.6	42.4	74.0	47.9	-4.4	-5.5
June	83.1	56.5	83.4	58.1	-0.3	-1.6
July	83.9	60.9	87.6	62.5	-3.7	-1.6
August	88.3	61.1	87.0	60.5	+1.3	+0.6
September	70.9	46.4	75.8	49.9	-4.9	-3.5
October	66.3	38.4	66.5	42.8	-0.2	-4.4
November	43.8	24.9	47.0	25.3	-3.2	-0.4
December	27.2	6.8	32.3	12.2	-4.8	-5.1

[1]Computed from daily observations.
Days free of killing frost, April 12 to October 29 = 201 days.

Table 2. Precipitation at the Southeast Experiment Farm

Month	Precipitation 1973 (inches)	21-Year Average (inches)	Departure From 21-Yr. Av. (inches)
January	0.49	0.45	+0.04
February	0.46	1.32	-0.86
March	3.33	1.35	+1.98
April	1.87	2.47	-0.60
May	2.09	3.32	-1.23
June	2.25	4.31	-2.06
July	3.56	3.25	+0.31
August	0.74	2.70	-1.96
September	4.66	2.88	+1.78
October	1.18	1.69	-0.51
November	1.54	1.02	+0.52
December	0.70	0.81	-0.11
Total	22.87	25.57	-2.70

Table 3. Air and Soil Temperatures at the Southeast Experiment Farm[1] (April 11 to June 7, 1973)

		Air Temperature[2]		Soil Temperature--2" depth		Soil Temperature--4" depth	
Month	Day	Range	Av.	Range	Av.	Range	Av.
April	11	18-61	38	30-41	35	30-38	34
	12	28-55	35	32-44	37	32-40	36
	13	38-58	46	34-44	40	34-40	38
	14	42-63	53	39-47	45	38-43	42
	15	26-39	31	34-45	39	36-44	40
	16	33-54	44	35-50	42	36-45	41
	17	45-69	55	40-53	47	39-48	45
	18	50-73	61	46-54	51	45-50	48
	19	40-63	49	42-51	46	43-48	45
	20	38-63	49	42-51	46	43-48	45
	21	29-57	43	40-51	45	41-47	44
	22	36-63	48	41-52	45	41-47	44
	23	35-68	50	42-52	46	42-49	45
	24	31-50	38	40-45	42	41-45	43
	25	32-55	42	40-48	44	41-46	43
	26	21-50	36	36-49	43	39-46	43
	27	32-52	41	38-53	45	39-49	44
	28	46-68	56	42-51	47	42-48	46
	29	42-65	52	45-56	50	45-51	48
	30	35-46	40	41-45	43	42-45	44
May	1	33-36	34	38-41	40	39-41	40
	2	29-54	41	39-48	43	39-46	43
	3	41-61	50	39-54	47	41-50	46
	4	51-70	60	44-54	50	45-50	48
	5	49-75	60	49-59	54	48-55	52
	6	48-60	53	48-54	51	48-52	51
	7	35-61	48	44-51	48	46-49	47
	8	50-75	62	45-60	54	46-54	51
	9	51-69	58	51-62	56	51-57	54
	10	49-68	58	51-62	55	51-57	54
	11	32-64	49	45-58	52	47-54	51
	12	27-54	41	42-55	48	44-52	48
	13	22-58	42	40-54	47	42-50	47
	14	26-55	42	40-56	48	42-52	47
	15	36-72	55	41-59	51	43-54	49
	16	26-56	43	42-58	49	45-54	49
	17	45-68	56	43-60	53	44-55	50
	18	46-77	62	49-65	57	49-60	55
	19	41-75	60	52-66	59	53-62	57
	20	61-84	71	53-66	60	53-61	58
	21	48-90	67	57-72	64	57-66	62
	22	44-71	58	55-69	61	56-65	60
	23	50-84	66	56-73	65	56-68	62
	24	44-57	49	52-59	55	53-59	56
	25	48-67	56	52-66	59	53-62	57
	26	48-53	51	52-54	53	53-55	54
	27	46-53	51	50-53	52	51-53	52
	28	51-71	60	51-64	58	51-60	56
	29	41-69	55	54-65	59	55-62	58
	30	44-73	60	55-70	62	55-64	60
	31	51-78	65	57-72	64	58-67	63
June	1	61-80	70	60-72	66	60-68	65
	2	54-70	63	60-66	63	61-65	63
	3	56-75	64	60-74	67	61-69	65
	4	44-64	56	58-69	63	60-65	63
	5	45-72	60	58-71	64	59-67	63
	6	54-82	67	59-72	64	59-67	63

[1] Air and soil temperatures based on hourly observations from 8:00 a.m. one day through 9:00 a.m. the following day. Averages are based on 24 observations. All values are reported as Fahrenheit degrees.

[2] Thermometer located 3 feet 3 inches above ground.

Table 4. Evaporation and Wind[1], Southeast Experiment Farm - 1973. (Observations for 24-Hour Period Ending at 8:00 a.m.)

	May				June				July				August				September			
Day	Evap.	Wind	Max.	Min.	Evap.	Wind	Max.	Min.	Evap.	Wind	Max.	Min.	Evap.	Wind	Max.	Min.	Evap.	Wind	Max.	Min.
1	[2]	178	52	41	.35	89	82	56	.21	64	84	64	.26	28	87	55	.23	181	80	67
2	.12	174	52	38	.35	168	83	60	.56	118	92	66	.22	22	83	58	.34	166	84	66
3	.20	109	61	37	.22	137	74	59	.22	47	91	59	.23	40	91	63	.24	118	80	64
4	.26	73	71	41	.29	54	82	60	.19	40	94	70	.20	42	92	64	.25	62	79	55
5	.38	213	68	46	.13	65	79	59	.33	39	97	69	.37	98	91	64	.22	55	80	56
6	.15	130	77	53	.12	51	74	49	.43	127	91	67	.45	163	86	65	.23	44	78	52
7	.10	87	62	53	.45	67	84	57	.50	202	93	70	.14	110	89	64	.19	22	80	55
8	.11	89	64	47	.41	93	89	60	.42	82	97	67	.27	54	91	65	.20	109	73	56
9	.22	115	76	49	.32	105	84	58	.70	120	88	67	.22	34	90	64	.03	51	66	59
10	.27	146	72	49	.38	178	88	76	.24	63	96	68	.24	45	85	60	.09	20	73	58
11	.36	159	69	50	.47	156	86	65	.33	68	95	71	[2]	[2]	[2]	[2]	.20	33	86	56
12	.23	152	67	39	.33	108	87	61	.43	122	94	68	.62	53	90	62	.12	16	73	56
13	.13	112	66	37	.15	57	81	59	.34	59	95	68	.40	46	90	66	.01	24	61	53
14	.22	97	65	37	.26	111	81	60	.18	36	82	61	.28	46	87	62	.04	24	65	44
15	.26	64	68	39	.29	152	84	66	.32	69	82	59	.10	75	74	60	.17	57	71	50
16	.28	119	72	42	.38	125	91	64	.30	53	87	60	.30	79	88	66	.08	77	53	41
17	.31	100	67	40	.45	74	86	56	.41	141	85	61	[2]	101	91	65	.01	46	51	42
18	.25	49	77	43	[2]	144	85	58	.31	141	87	64	.44	166	88	66	.12	30	61	38
19	.32	107	78	53	.29	122	76	50	.36	65	95	66	.42	163	86	68	.17	101	68	42
20	.24	49	78	53	.21	126	70	54	.20	70	80	60	.24	64	93	64	.15	42	73	48
21	.39	135	78	51	.25	91	75	55	.10	59	73	61	.30	134	87	64	.15	120	66	48
22	.57	147	94	53	.33	69	80	51	.09	49	72	63	.31	156	88	66	.08	51	70	49
23	.31	75	85	51	.34	53	85	58	.03	39	69	62	.21	119	82	66	.23	74	74	45
24	.31	86	85	54	.39	77	93	59	.17	73	82	64	.13	78	73	64	.14	191	64	53
25	.20	212	61	53	.41	138	88	64	.19	31	89	65	.23	134	80	65	.21	103	69	52
26	[2]	147	76	48	.33	28	94	69	.24	89	82	63	.19	64	86	68	.03	83	68	52
27	.38	279	64	51	.45	99	88	61	.31	67	86	64	.46	162	89	66	.03	81	60	52
28	.33	177	64	48	.22	86	80	58	.36	54	85	63	.61	193	88	65	.13	71	67	52
29	.27	133	78	52	.36	56	84	59	.31	75	88	63	.50	132	88	67	.66	84	66	57
30	.18	47	76	51	.28	49	85	59	.19	40	88	63	.18	68	84	67	[2]	68	58	54
31	.28	44	82	54					.19	47	86	58	.30	135	88	66				
Total or Avg.	7.63	3804	71.1	46.9	9.20	2928	83.3	59.3	9.16	2349	87.3	64.3	8.82	2804	86.8	64.2	4.75	2204	69.9	52.4

[1]Explanation of Abbreviations: Evap. = Evaporation of water from an open pan 10" deep, 47.5" in diameter. Hook gauge readings. Wind = Anemometer measures miles of total wind moving across evaporation pan. Max. = Maximum temperature of water in pan. Min. = Minimum temperature of water in pan.

[2]Observation missing.

[3]48-hour observation.

WEATHER STATION EXPANSION COMPLETED AND OPERATIONAL

W. F. Lytle and E. A. Dowding

During the late summer of 1972 the expansion of the weather station was completed. Thus, 1973 was the first full year of operation of a more detailed observation of the climatic conditions that occur at the Experiment Farm.

The observations that are capable of being made are:

1) Continuous recording of:
   a) dry bulb temperature at 1/3, 1, and 2 meters above surface.
   b) wet bulb temperature of 1/3, 1, and 2 meters above surface.
   c) soil temperature at 5, 10, 20, and 50 cm depths.
   d) wind direction and velocity of a height of 9 meters.
   e) precipitation.

2) Periodic readings of:
   a) soil moisture at 10, 20, and 50 centimeter depths below sod surface.
   b) soil moisture of 10, 20, and 50 centimeter depths below black surface.
   c) pan evaporation.

Measurements are taken at a site located 500 feet south of the office-laboratory building. The data collected is a valuable research tool for scientists doing work at the Experiment Farm as well as others in the area insterested in this type of information.

Experiment Farm personnel collect the data and maintain the records for use by interested persons.

In addition to the above mentioned measurements, data is collected on maximum and minimum temperature and precipitation to be published in the official reports of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and National Weather Service.

The system was planned and installed by personnel from the Agricultural Engineering Department at South Dakota State University and U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and National Weather Service.

AIR POLLUTION DETECTION IN SOUTH DAKOTA USING SENSITIVE INDICATOR PLANTS

W. S. Gardner and R. M. Luther

The Southeast Experiment Farm was used in 1973 as one location for sensitive indicator plants for detection of air pollution in South Dakota (Table 5). The ozone-sensitive tobacco plants indicated that ozone air pollution was present at the Southeast Farm in 1973. The amount of injury was classified as very mild to moderate (Table 5) and was comparable to the level of injury found at Elk Point

and Sioux Falls. There was no indication of sulphur dioxide, fluoride or peroxyacetyl nitrate (PAN) pollution at any location in South Dakota.

Cotton and elm leaves at the Southeast Experiment Farm were deformed and showed symptoms similar to that caused by 2,4-D and other related weed killers. Thus, cotton plants helped to identify the presence of another air pollutant in South Dakota - herbicide drift.

Table 5. Indicator Plants Used to Identify Plant-injurious Air Pollutants in South Dakota - 1973. Southeast Research Farm.

Indicator	Cultivar	Known Reaction	Pollutant	Injury Response	Injury Severity
Tobacco	Bel-B	Resistant	Ozone	Positive	Very mild
Tobacco	Bel-C	Moderately sensitive	Ozone	Positive	Mild
Tobacco	Turkish	Moderately sensitive	Ozone	Positive	Mild
Tobacco	Bel-W3	Very sensitive	Ozone	Positive	Moderate
Tobacco	Glutinosa	Sensitive	PAN*	Negative	
Petunia	Fiesta	Very sensitive	PAN*	Negative	
Gladiolus	Snow Princess	Very sensitive	Fluoride	Negative	
Cotton	Acala-SJ1	Sensitive	Sulphur dioxide	Negative	
Cotton	Acala-SJ1	Very sensitive	Herbicide (2,4-D)	Positive	Moderate
Elm	Siberian	Very sensitive	Herbicide (2,4-D)	Positive	Moderate

*Peroxyacetyl nitrate - a photochemical air pollutant.

STARTER FERTILIZER EXPERIMENT WITH CORN

P. Carson, F. Shubeck, B. Lawrensen and B. Byrnes

Objectives of 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. The experiment was located on the Dean Larson farm southeast of Wakonda. The soil at this site is Badus silty clay loam. Badus soils are glacial till soils that occupy flats and shallow basins and are somewhat poorly drained. They may be saline in some places. This soil was not saline at the surface but higher salt concentrations were found at 30-36 inches below the surface. Tests on the soil samples taken at planting time are shown in Table 6. These tests show phosphorus to be very low, potassium to be high, and nitrogen to be in the medium to high category.

Table 6. Soil Tests* Results from the Experimental Site

Depth In Inches	Nitrate Nitrogen ppm	% Organic Matter	Phosphorus Lbs/A of P	Potassium Lbs/A of K	pH 1:1	Soluble Salts mmohs/cm	Texture
0-6	10.8	3.9	4	725	6.4	.29	Silty
6-12	4.9	3.4	3	460	6.5	.30	Clay
12-18	2.9	2.3	3	430	6.8	.70	Loam
18-24	5.6	1.6	2	320	7.1	.68	
24-30	6.6	1.1	3	265	7.5	.77	
30-36	13.2	0.8	2	250	7.6	4.10	
36-42	10.7	0.7	3	225	7.7	8.00	
42-48	15.8	0.6	14	205	7.8	13.30	

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

2. Experimental design - completely randomized factorial. Plot size was 10 feet x 60 feet. Each plot contained four rows of corn.
3. Nitrogen was applied before planting at the rate of approximately 120 pounds of N per acre.
4. Variety - Sokota MS-84
5. Weeds were controlled with Ramrod at 25#/A and insects with Dyfonate 20G by banding 1 lb/A of active material at planting time.
6. Corn was planted May 15, 1973.

7. Corn was planted with John Deere tool bar planters 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.
8. The seed bed prepared in the spring of 1973 and was cloddy at planting time. This resulted in uneven germination. Because of this the plants showed much variation in size early in the season. In spite of the germination problem a relatively good and uniform stand was obtained.
9. Corn was harvested by hand October 26, 1973. Sixty feet of row was harvested from each plot.
10. Fertilizer treatments: Please note that the fertilizers are reported as lbs of N + P + K instead of N + P_2O_5 + K_2O.

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

11. The weather was considered dry during most of the growing season. However, these plots did not show ill effects from the dry weather until late in the growing season (last part of August). By harvest time the effects of the dry weather were very pronounced throughout the experiment. The ill effects of the dry weather appeared to increase as one progressed west into the better drained soils in the plot area.
12. Leaf samples were taken for analysis at silking time and yield samples, ear moisture samples, stalk lodging and stalk breadage notes were taken at harvest time.

Results

The yield in bushels per acre of 15% moisture corn, percent moisture in ear corn at harvest time, the number of ears per stalk at harvest time, percent of stalks broken, percent of stalks lodged and final population are reported in Table 7. Some treatments have been listed in this table more than once to make comparisons easier.

The addition of phosphorus when no potassium was added caused a gradual yield increase (12 bu/A, see treatments #1-4 Table 7) as the rate of phosphorus application increased. When a low rate of potassium (9 lbs/A) was included with the four rates of phosphorus (treatments 8, 5, 6, and 7) the yield pattern was very nearly the

same as when phosphorus alone was applied. When the phosphorus rates were combined with the higher rate of potassium (17 lbs/A) the spread in yields (98 to 108) was almost as great but the yields were more erratic (see treatments 12, 9, 10 and 11).

The addition of potassium without the addition of phosphorus (treatments 1, 8 and 12) show a yield increase of 1 bu per acre for 9 lbs of K addition per acre and a yield increase of 8 bu when 17 lbs of K was applied. When a constant rate of phosphorus (6, 12 or 23 lbs/A) was applied with the rates potassium the yield increases were not consistent. In summary, it can be said that the addition of phosphorus as a starter fertilizer produced consistent yield increases where the phosphorus soil teat was very low. The addition of potassium in the starter fertilizer produced yield increases but these increases were not always consistent.

The addition of phosphorus tended to hasten maturity as indicated by the percent moisture in the ears at harvest time (note treatments 1-4, and 8, 5, 6, and 7 and 12, 9, 10 and 11). The application of potassium had little or no effect on the moisture content of the ears at harvest time.

The treatments used in this experiment had no consistent effect on % lodging, % broken stalks, or the final plant population.

The number of ears per plant was not influenced by the addition of phosphorus but where potassium alone was applied (treatments 1, 8 and 12) the percentage of plants having ears increased as the rate of potassium increased. However, when phosphorus was applied with potassium no consistent effect of added potassium was detected.

Table 7. Effect of Rates of Phosphorus and Potassium in a Starter Fertilizer on Yield, Ear Moisture at Harvest, the Number of Ears Per Stalk, Percent of Stalks Lodged, Percent of Broken Stalks and the Final Plant Population of Corn Grown Near the Southeast Experiment Farm, 1973.

Treatment Number	Treatment N + P + K lbs/A	Yield[1] Bu/A	Moisture[2] %	% Having Ears	%[3] Lodged	%[4] Broken	Final[5] Population
1	12 + 0 + 0	90	33.5	94.8	17.2	23.5	15,167
2	12 + 6 + 0	96	31.9	94.1	21.5	34.3	15,892
3	12 + 12 + 0	102	31.3	93.0	21.4	25.7	16,675
4	12 + 23 + 0	101	29.5	92.9	9.9	42.5	17,052
1	12 + 0 + 0	90	33.5	94.8	17.2	23.5	15,167
8	12 + 0 + 9	91	33.3	97.8	22.9	36.3	15,805
12	12 + 0 + 17	98	35.5	102.0	30.9	29.1	15,747
8	12 + 0 + 9	91	33.3	97.8	22.9	36.3	15,805
5	12 + 6 + 9	101	31.3	91.2	13.1	40.1	16,617
6	12 + 12 + 9	89	29.1	90.7	7.7	51.9	17,052
7	12 + 23 + 9	104	29.0	96.8	14.9	41.8	16,530
12	12 + 0 + 17	98	35.5	102.0	30.9	29.1	15,747
9	12 + 6 + 17	104	30.8	90.9	16.0	37.6	16,820
10	12 + 12 + 17	96	32.8	91.7	14.8	33.3	15,660
11	12 + 23 + 17	108	29.2	93.5	9.5	41.0	16,820
2	12 + 6 + 0	96	31.9	94.1	21.5	34.3	15,892
5	12 + 6 + 9	101	31.3	91.2	13.1	40.1	16,617
9	12 + 6 + 17	104	30.8	90.9	16.0	37.6	16,820
3	12 + 12 + 0	102	31.3	93.0	21.4	25.7	16,675
6	12 + 12 + 9	89	29.1	90.7	7.7	51.9	17,052
10	12 + 12 + 17	96	32.8	91.7	14.8	33.3	15,660
4	12 + 23 + 0	101	29.5	92.9	9.9	42.5	17,052
7	12 + 23 + 9	104	29.0	96.8	14.9	41.8	16,530
11	12 + 23 + 17	108	29.2	93.5	9.5	41.0	16,820

[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.
[3]Plants leaning at 60° or more from the ground but not broken below the ear.
[4]Planta broken below the ear.
[5]Approximately 18,000 seeds were planted.

SOIL TEST EXPERIMENT

P. Carson, B. Lawrensen, B. Byrnes and F. Shubeck

Objectives

1. Compare yield results from fertilizer applied as recommended by four soil testing laboratories.

Methods and Materials

1. The experimental site was located on the Dean Larson farm southeast of Wakonda. The soil at this site is a Badus silty clay loam. Badus soils are glacial till soils that occupy flats and shallow basins and are somewhat poorly drained. This soil was better drained than the soil area used for the starter fertilizer experiment. Tests on the soil samples taken at planting time are shown in Table 8. These samples were not part of those divided and sent to all the laboratories involved.

Table 8. Soil Tests* Results from the Experimental Site

Depth In Inches	Nitrate Nitrogen ppm	% Organic Matter	Phosphorus Lbs/A of P	Potassium Lbs/A of K	pH 1:1	Soluble Salts mmohs/cm	Texture
0-6	10.8	3.9	4	725	6.4	.29	Silty
6-12	4.9	3.4	3	460	6.5	.30	Clay
12-18	2.9	2.3	3	430	6.8	.70	Loam
18-24	5.6	1.6	2	320	7.1	.68	
24-30	6.6	1.1	3	265	7.5	.77	
30-36	13.2	.8	2	250	7.6	4.10	
36-42	10.7	.7	3	225	7.7	8.00	
42-48	15.8	.6	14	205	7.8	13.30	

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

2. A soil sample was taken from the 0-6" layer at the experimental site. The sample was divided in five equal portions and sent to five soil testing laboratories. The laboratories were chosen from those serving the agriculture of South Dakota. Three of those chosen were commercial laboratories and one was the laboratory operated by South Dakota State University and one was Iowa State University Soil Testing Laboratory. A recommendation for 100 bushels of corn per acre was requested.
3. Fertilizer treatments used in this experiment were those recommended by the different laboratories. In addition, one treatment with no fertilizer was included making six treatments in all. The recommendations made by the laboratories were as follows:

Laboratory Number	N	+	P_2O_5 lbs/A	+	K_2O
1	95	+	50	+	10
2	170	+	77	+	30
3	130	+	105	+	40
4	140	+	95	+	30
5	90	+	60	+	10

All fertilizer was broadcast on the surface and worked into the soil with a disk before planting. The 10# of K_2O recommended by laboratories 1 and 5 was to be applied only if a planter equipped with a fertilizer attachment was used to apply this fertilizer. Since all the fertilizer was broadcast this 10# of K_2O was left out of both treatments.

4. Plot size was 20 x 60 feet. Treatments were replicated four times and were randomized within each replication.
5. Sokota MS-84 was planted at a rate of approximately 18,000 seeds per acre in 30 inch rows on May 15.
6. Ramrod was applied at planting time at the rate of 25 lbs/A in a band over the row. The corn was cultivated two times.
7. Dyfonate 20G was applied at the rate of 1 lb/A of active material.
8. The seed bed was prepared in the spring of 1973 and was cloddy at planting time. This resulted in uneven germination. Because of this the plants showed much variation in size early in the season. In spite of the germination problem a relatively good and uniform stand was obtained.
9. Leaf samples were taken for analysis at silking time and yield samples, ear moisture samples and stalk breakage and stalk lodging notes were taken at harvest time. The experiment was harvested on October 26, 1973.
10. The weather was characterized by being dry during most of the season. These plots were more affected by the dry weather than the starter fertilizer trials which were located on a more poorly drained portion of the field. The experimental area appeared to have large variations in plant growth within it which may have been due to variations in the supply of available moisture. These variations did not follow plot lines.

Results

The yield of grain, ear moisture content at harvest, the percent of stalks having ears, percent lodging, percent breakage and final plant population is found in Table 9. The yields produced by the recommendations made by laboratories 2 and 5 are higher and lower, respectively, than the yields obtained by the other treatments. These yield differences were not statistically different.

Stalk lodging was relatively consistent and relatively low throughout the experiment. This indicated that the Dyfonate 20G worked equally well regardless of fertilizer treatment.

Stalk breakage was very high in this experiment. Stalks were badly deteriorated because of stalk rot organisms. Stalk rot causes more damage after a period of extremely dry weather during the summer when plants are under severe moisture stress. In observing the experiment it appeared that the pattern of stalk breakage disregarded fertilizer treatments. The average results show no trend that could

be traced to fertilizer treatment. No statistical difference was found in stalk breakage between treatments.

It would appear that dry weather made it impossible for the fertilizer to express itself in this experiment because the experiment just to the east of this one on a soil that had similar soil test values a substantial yield increase was obtained from added phosphorus.

Table 9. The Effect of Recommendations Made on the Same Soil Sample by Five Soil Testing Laboratories on the Yield, Moisture Content of the Ears at Harvest, Percentage of Lodged and of Broken Stalks and the Final Population of Corn Grown on a Farm Near the Southeast Experiment Farm, 1973.

Laboratory Number	Yield[1] Bu/A	Moisture[2] %	Having Ears %	Lodged[3] %	Broken[4] %	Final[5] Population
1	90	26.4	97.8	6.7	60.7	16,240
2	100	27.7	97.0	4.4	53.7	16,472
3	90	27.2	90.0	11.5	35.4	16,385
4	90	27.1	92.1	7.9	48.3	17,400
5	78	26.8	97.9	4.5	53.2	16,095
6	89	24.6	98.3	10.5	47.0	16,530

[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.
[3]Plants leaning at 60^{o} or more from the ground but not broken below the ear.
[4]Plants broken below the ear.
[5]Approximately 18,000 seeds were planted.

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 optimum row spacings and plant populations different for a short season hybrid than for a full season hybrid?
3. Is there a greater need for narrow rows with high plant populations?
4. Can moisture loss by evaporation from the soil surface be reduced by narrow rows?
5. Will subsoil moisture at the beginning of the season, when added to expected rainfall in July and August, serve as a reliable guide to determine optimum number of plants per acre?

Methods and Procedures Used in Corn Row Spacing Experiment

Nov. 1972 - Applied 12 ton manure per acre.
Dec. 1972 - Fall plowed.
Arpil 18, 1973 - Fertilized total plot area with 154 lbs of N, 28 lbs. P, 33 lbs. K per acre.
April 18, 1973 - Sprayed area with Aatrex 4L at 3½ lbs/acre. Fertilizer and Aatrex disked in.
May 7, 1973 - Tandem disked and spike tooth harrowed.
May 8, 1973 - Planted all plots. Varieties - Pioneer 3388 (117 day maturity) and Pioneer 3579 (105 day maturity).
May 8, 1973 - Ramrod 20G in 14 inch band at 25 lbs. per acre on area actually covered by weedicide.
Insecticide - Furadan 10G in 5 to 7 inch band at 4 lbs. active ingredient per 13,080 linear feet of row.
June 1-3, 1973 - Plants thinned to desired populations.
June 12-15, 1973 - Cultivated all plots.
Oct. 1, 1973 - Hand picked.

Table 10. Effects of Corn Plant Populations on Plant and Ear Characteristics (Results from all 3 row spacings were averaged for each population.)

Hybrid	Final Stand	% Ear Moisture at Harvest	% Broken and Lodged Stalks	Ear Wt. at Harvest (lbs)	Bu per Acre
Pioneer 3579	12,000	27.8	2.1	0.64	107
Pioneer 3579	14,000	27.0	4.0	0.56	113
Pioneer 3579	16,000	26.1	4.2	0.54	112
Pioneer 3579	18,000	25.3	5.5	0.51	126
Pioneer 3579	20,000	24.8	15.0	0.41	108
Pioneer 3388	12,000	32.1	0.0	0.61	108
Pioneer 3388	14,000	31.1	1.0	0.57	101
Pioneer 3388	16,000	30.0	0.8	0.55	109
Pioneer 3388	18,000	29.6	2.0	0.45	111
Pioneer 3388	20,000	30.5	2.7	0.46	111

Discussion and Interpretation of Table 10

Pioneer 3579 is listed as a 105 day maturity hybrid and Pioneer 3388 is 117 day maturity. The earlier maturing hybrid showed yield increases with increased populations up to 18,000 plants per acre. Yields of the full season hybrid increased very little with increases in populations. The early maturing corn yielded a little more than the full season hybrid at 14,000, 16,000 and 18,000 plants per acre. In previous years the full season hybrid usually yielded the most corn when planted at its best population and row spacing.

Broken and lodged stalks have been a serious problem this year. Note the relatively large increase in stalk breakage in the early hybrid when populations were increased from 18,000 to 20,000. This same trend has occurred previously.

It may be due to smaller weaker stalks at high populations and to more stalk rot and root rot developing under stress conditions. The later maturing hybrid showed a similar trend but the percentages of broken stalks were generally lower than those of the earlier hybrid.

With the early hybrid, ear moisture at harvest appeared to decrease as populations increased. This decrease in moisture may be related to greater amounts of stalk breakage and disease at higher plant populations with the early hybrid. Ear moisture was influenced very little by populations with the full season hybrid.

Plant populations with the largest ears did not always have the greatest total bushels per acre. For this one year with the early hybrid, ears that averaged a little more than ½ lb. resulted in highest total yield. Populations of 16,000-18,000 had ears weighing 0.54 and 0.51 lbs., respectively. For the full season corn, populations of 16,000 and 18,000 had ears averaging 0.55 and 0.45 lb., respectively.

Table 11. Effect of Row Spacing on Plant and Ear Characteristics. (Results from all 5 populations were averaged for each row spacing.)

Hybrid	Row Spacing in Inches	% Ear Moisture at Harvest	% Broken and Lodged Stalks	Ear Wt. at Harvest (lbs)	Bu per Acre
Pioneer 3579	30	26.2	7.8	0.51	111
Pioneer 3579	35	26.0	5.5	0.55	115
Pioneer 3579	40	26.4	4.7	0.55	114
Pioneer 3388	30	30.6	1.3	0.52	112
Pioneer 3388	35	29.7	1.3	0.51	104
Pioneer 3388	40	31.4	1.3	0.55	108

Discussion and Interpretation of Table 11

There were no outstanding yield increases in favor of narrow rows this year. Thirty inch rows appeared to yield a little more than wider rows with the full season hybrid. One possible explanation follows: plant canopy effect for reducing evaporation loss of moisture at the soil surface would be greatest when several small rains occur during the hottest part of the summer. This summer there was very little rainfall. Corn plants were drawing on subsoil moisture built up the previous year. This moisture deep down in the soil was relatively safe from evaporative forces, so the beneficial effect from narrow row canopy was minimized. Consequently, yield affects from narrow rows would also be minimized.

Ear weight at harvest was not influenced very much by different row spacings.

Row spacings had little or no affect on % lodged stalks and % ear moisture at harvest.

RATES OF NITROGEN AND DATE OF PLANTING CORN

F. Shubeck and B. Lawrensen

Objectives of Experiment

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

Methods and Procedures Used in Rates of Nitrogen Study

April 6, 1973 - Rotary chopped stalks.
April 26, 1973 - Tandem disked total plot area.
April 27, 1973 - Plowed all plots.
April 30, 1973 - Tandem disked all plots.
May 2, 1973 - Spike tooth harrowed all plots.
May 4, 1973 - Fertilized, tandem disked first planting date plots (May 4). Planted all first planting date plots.
May 10, 1973 - Fertilized, tandem disked, spike tooth harrowed all second planting date plots.
May 11, 1973 - Planted all plots (second planting date).
May 15, 1973 - Fertilized, tandem disked, spike-tooth harrowed all third planting date plots.
May 18, 1973 - Planted all plots (third planting date).
May 23, 1973 - Fertilized, tandem disked, spike-tooth harrowed all fourth planting date plots.
May 25, 1973 - Planted all plots (fourth planting date).
May 31, 1973 - Rotary hoed first, second, third planting dates.
June 21, 1973 - Cultivated all plots (lay-by).
Nov. 6-7, 1973 - Harvested.
Variety - Trojan TX 111
Insecticide - Dyfonate 20G/# 1 lb. actual
Herbicide - Ramrod 20G - in 14" band

Table 12. Effect of Fertilizer and Planting Dates on Yield of #2 Corn

Broadcast Treatment	Planting Dates				
N + P + K	May 4	May 11	May 18	May 25	Average
0 + 0 + 0*	31.0	31.0	27.0	20.0	27.0
0 + 25 + 70*	30.0	30.0	11.0	10.0	19.0
80 + 25 + 70*	38.0	38.0	41.0	46.0	43.0
160 + 25 + 70*	36.0	36.0	29.0	32.0	36.0
240 + 25 + 70*	24.0	24.0	49.0	31.0	35.0
Average	32.0	36.0	34.0	28.0	33.0

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

Discussion and Interpretation of Table 12

Yields were very low in this experiment in 1973. What went wrong? There are several possible reasons.

One possible explanation is soil compaction. This is a built-in danger, associated with early planting. The plot area was too wet to plow in the fall so it was plowed in the early spring. It was also too wet in the spring but it had to be plowed in order to get the early planting done. As a result, soil bulk densities increased to 1.6 (roots begin to slow down in growth with densities over 1.4).

Another possibility is nutrient inbalance due to the very high rates of nitrogen applied. Plant tissue analyses in the past have indicated that the phosphorus and potassium applied was sufficient to balance the high rates of nitrogen. Tissue analyses for 1973 corn will be done but are not completed at present.

Large quantities of nitrogen sometimes change soil pH or its relative acidity. In another North Central state, large quantities of nitrogen caused run-away acidity in their soil. The soil at the Southeast Experiment Farm is heavy in texture, high in calcium and well buffered against changes in pH. In 1970 after three years of high rates of nitrogen application, the soil pH changed only 3/10 of one pH unit from pH 6.8 to pH 6.5. Soil analyses for 1973 are not completed but no large changes in soil pH are expected.

Another possibility is salt damage from the high rates of fertilizer application. This isn't too probable because plots receiving large quantities of broadcast nitrogen yielded more than those receiving no broadcast nitrogen.

The low yields in this experiment cannot be attributed to the hybrid. The same hybrid in competitive corn performance trials located at the Research Farm yielded 119 bushels per acre in 1973 and averaged 143 bushels per acre for 1972-73.

Insects and diseases are other possibilities. Stalk rot and insect damage appeared to be no greater than that in other experiments. Nematodes that live in the soil and destroy root hairs may have had an influence.

Corn plants were very tall with both leaves and stalks normal in color and appearance. The number of barren stalks was abnormally large. Wisconsin researchers have found that barren stalks in a drought period are sometimes due to a boron deficiency. When leaf analyses are completed, we will know if boron was a problem. Too many plants in a dry year will increase the number of barren stalks. However, plant populations in this experiment were about 16,000 which is not excessive. Lack of oxygen in this compacted soil that was water logged early in the season may have adversely affected ear initiation and in this way account in part for the high incidence of barreness.

Sometimes the date of planting has a strong influence on yield because corn from any one planting date may reach a critical point in growth at exactly the same time as a period of excessive heat or drought occurs. In this experiment all planting dates gave a low yield.

Another possibility is nitrite toxicity. This unusual situation is closely associated with conditions existing with this experiment as soil compaction, poor aeration, heavy soil texture, imperfect drainage, and large amounts of nitrogen. In well aerated soils, nitrite toxicity is not a problem because soil organisms quickly convert nitrites (NO_2) to nitrates (NO_3) which is the form of nitrogen most used by plants. Nitrites are intermediate products in the normal breakdown of plant residues by soil organisms and in the conversion of ammonia fertilizer to nitrates. However, stalk and leaf growth was excellent and the healthy appearance of the plants would be inconsistent with the presence of toxic substances in the soil.

A more simple explanation follows: There was adequate moisture and fertility to build a huge factory of leaves and stalks which transpired large quantities of water in the growing process. As water was removed from the soil, the remaining water was held more tenaciously by the soil particles. When it came time to form ears, the plants were unable to adsorb sufficient water for ear formation because of the limited quantities and restriction imposed by soil compaction and poor aeration.

Detailed discussion of possible causes for poor yields in 1973 was presented with the hope that it will give the reader a better understanding of the problems related to soil fertility, soil conditions and plant growth.

CORN BREEDING

D. B. Shank

Two performance tests, each containing experimental hybrids, were conducted in 1973. One small trial with 24 entries was for the purpose of re-testing some of the better performing hybrids from the 1972 single cross test which was grown at the same location. In addition, many entries in this trial were new hybrids ranging from single crosses to double crosses. The other test in 1973 was of a new series of single crosses.

In spite of adverse weather in August, which included hot winds and almost no rainfall, yields were fairly good. The repeat test averaged 101.8 bushels per acre and the new single cross test produced 84 bushels per acre over all entries. However, the drought conditions created stresses on the plants which allowed stalk and root rot organisms to develop, resulting in severe stalk lodging at the time of harvest. They also caused large variability within the tests as local spots containing poorer plants showed up in many areas.

In both tests several of the experimental hybrids performed well in comparison with the check entries which were hybrids that had consistently been at the top of the commercial corn performance trials for several years. The information presented in Table 13 illustrates this point. The wide range in stalk lodging may also be noted. The results do indicate that some of the newer material may be of value to farmers in southeastern South Dakota in the near future if it continues to perform well.

Table 13. Results From a Corn Test of Experimental Hybrids Conducted at the Southeast South Dakota Experiment Farm in 1973.

Hybrid*	Type of Cross	Yield Bu/A	Moisture %	Broken Stalks %
17	2x	137.4	17.9	17.5
9	2x	134.6	19.6	16.4
3	4x	122.7	18.3	6.7
21 (ck)	2x	119.3	20.5	1.7
10	2x	115.4	17.4	0.0
24	2x	120.2	19.2	8.8
2	3x	115.1	19.1	6.7
6	3x	110.8	18.3	3.8
1	3x	116.1	20.6	25.0
18	2x	108.4	16.9	24.0
7	3x	112.9	20.7	29.8
8	2x	109.9	17.4	32.1
15	2x	110.8	22.1	28.3
23 (ck)	2x	109.0	20.4	28.8
22 (ck)	M2x	93.0	20.7	7.7
13	2x	91.5	21.9	14.5
19	2x	108.3	20.9	58.9
11	2x	111.6	20.0	70.2
14	2x	100.5	23.7	51.7
20	2x	96.9	17.4	61.1
12	2x	90.6	23.6	81.0
16	2x	70.1	19.3	74.1
5	3x	28.2**	20.8	0.0
4	3x	10.7**	18.5	0.0
Means		101.8	19.8	27.0

*Pedigrees are not listed since most of them are composed of non-released inbred lines.
ck = check hybrid
**Yields extremely low because of a very poor stand.

CORN PERFORMANCE TRIALS

J. J. Bonnemann

The total number of entries in the Southeast Experiment Farm trial was 95. It was the largest entry list since the trials were begun in 1961. The entries included were both proprietary and Experiment Station corn hybrids.

The corn was drilled in single rows, 32 feet long, 30 inches apart on May 11, 1973. Harvest was by picker-sheller on October 29 and 30. Two populations were intended at 16,- and 20,000 plants per acre but actual counts in late August

averaged 15,550 and 18,200 for the two populations. The yield is reported as the mean of the two populations for each entry as the differences found were not statistically significant.

The yields for 1973 are good for many hybrids, especially in light of the severe stresses created in mid-August and subsequent stalk breakage. The corn ears matured on green stalks as it was mid-October before a killing frost (28^o) was recorded. The moisture at harvest averaged 18.4% for all entries. The mean yield for the entire trial was 97.8 bushels per acre.

The results are presented in Table 14. Additional information will be found in an upcoming circular, 1973 Corn Performance Trials.

Table 14. Corn Performance Trial, Area E, Southeast Experiment Farm, Beresford, S.D., 1973

Brand & Variety	Type & Cross	Yield B/A	Percent Stalk Lodged	Percent Moisture
Curry's SC-150	N 2X	142.3	6.4	22.6
Payco SX-1093	N 2X	140.2	5.1	25.6
Trojan TXS 108A	N 2X	135.5	12.4	17.9
Pride R-803	N 2X	131.7	14.8	20.4
McCurdy's MSX 55A	N 2X	125.7	18.4	18.4
Pioneer 3366	N 2X	121.1	15.9	18.9
Western KX-64	N 2X	119.7	16.2	18.4
Trojan TXS 111	N 2X	119.0	9.6	18.8
Pride R-793	N 3X	117.9	9.5	19.3
ACCO U 378	N 3X	117.5	25.5	20.6
Cargill 890	N M2X	116.7	37.6	17.7
Funk's G-4321	N 2X	113.7	14.9	16.7
McCurdy's 2X4	N 2X	113.1	28.4	17.7
Trojan TXS 113	N 2X	112.6	21.2	20.6
Funk's G-4445	N M2X	111.9	34.0	17.7
McCurdy's MSX 67	N 2X	110.7	31.3	18.1
Cargill 449	N 3X	110.6	39.3	17.6
Renk RK 66	N 2X	110.1	9.7	17.2
Pioneer 3195	N 2X	110.1	9.9	22.4
Pioneer 3388	N M2X	109.0	8.3	20.2
P-A-G 344	N 3X	108.1	21.5	20.5
P-A-G SX 83	N 2X	108.0	22.8	22.0
Fontanelle 400	N 2X	107.8	31.4	16.8
Curry's SC-160A	N 2X	106.7	29.9	20.6
Curry's SC-144	N 2X	105.8	7.7	16.9
P-A-G SX 53	N 2X	104.3	44.1	17.8
Funk's G-4465	N M2X	104.1	35.4	19.0

Table 14 continued on next page.

Table 14. Continued

Brand & Variety	Type & Cross	Yield B/A	Percent Stalk Lodged	Percent Moisture
Pride R-522	N 2X	103.9	17.9	16.6
McCurdy's 69-111	N 2X	103.8	35.9	19.3
ACCO U 370	N 3X	103.4	38.5	19.1
Diaco SX-17	N 2X	103.1	32.3	17.3
ACCO UC 6601	N 2X	102.8	46.6	20.0
Wilsons 1016	N 2X	102.2	36.4	17.1
P-A-G SX 454	N M2X	102.1	21.5	18.5
Coop S-201	N 2X	102.0	28.6	17.4
Pioneer 3520	N 3X	101.2	8.5	18.2
Trojan TXS 102	N 2X	100.7	37.2	16.6
Funk's G-4444	N 2X	100.5	30.6	17.5
Pride R-450	N 2X	100.4	23.7	16.8
Pride R-810	N 2X	100.0	29.2	20.8
Pioneer 3517	N M2X	99.5	6.9	19.3
Maygold F23	N 2X	99.3	41.8	16.9
SDAES Ex 98	N 3X	98.8	36.3	19.3
McCurdy's MSX 54	N 2X	98.1	18.3	17.2
Cargill 875	N M2X	97.9	33.1	17.0
McCurdy's MSX 67E	N 2X	97.8	14.6	16.9
Funk's X-25792	N M2X	97.1	24.6	17.0
SDAES PP 180	N 3X	97.1	35.4	20.2
Trojan TXS 94	N 2X	95.8	43.0	16.7
Fontanelle 555	N M2X	94.9	50.3	18.7
Pride R-694	N 2X	94.8	28.1	19.4
P-A-G 7317	N 3X	94.8	27.7	16.6
Cargill 930	N M2X	94.6	29.8	19.9
Green Acres S60	N M2X	94.4	26.3	20.1
Funk's G-4366	N 3X	94.2	45.4	17.1
Asgrow RX 58	N 2X	94.0	40.2	17.5
ACCO UC 4561	N 2X	93.6	45.5	17.4
SDAES PP 178	N 3X	93.3	15.7	17.3
Funk's G-4404	N 2X	92.8	23.9	16.1
Wilsons 1017	N 2X	92.8	45.9	17.0
Coop S-221	N M3X	92.5	35.5	19.2
Renk RK 55	N 2X	92.5	35.5	16.4
Trojan TX 105	N 3X	92.1	45.1	17.4
McCurdy's 3X3	N 2X	91.9	50.5	17.9
Asgrow RX 60	N 2X	91.8	20.7	16.3
O's Gold SX 3104	N 2X	91.6	53.3	17.2
Pioneer 3387	N 2X	91.5	16.8	18.9
Green Acres M24	N 4X	91.2	21.5	21.6

Table 14 continued on next page.

Table 14. Continued

Brand & Variety	Type & Cross	Yield B/A	Percent Stalk Lodged	Percent Moisture
ACCO TGG 678	N 4X	91.0	44.0	21.2
Funk's G-4567	N M3X	90.9	36.9	18.7
Pride R-771	N 3X	90.8	30.0	19.2
ACCO UC 4601	N 2X	89.7	55.7	20.8
Green Acres L17	N 4X	89.0	32.3	21.7
McCurdy's MSP 333	N 3X	88.2	43.2	16.6
Disco SP-170	N 3X	88.0	43.0	17.8
SDAES PP 177	N 3X	87.7	35.0	17.1
SDAES EX 97	N 3X	87.3	8.0	18.1
Asgrow RX 64	N 2X	86.9	33.5	17.0
Todd M68	N 3X	86.3	21.4	20.0
Pride R-728	N 3X	86.0	52.9	17.7
Maygold 2095	N 3X	85.5	50.0	16.7
SDAES PP 186	N 2X	85.3	6.6	20.0
Trojan TX 100	N 3X	83.9	35.1	16.2
Payco 3X-1077	N 3X	82.5	51.6	16.9
Todd M50	N 2X	80.0	39.7	16.4
O's Gold SX 2145	N 2X	79.2	51.9	17.2
Maygold 94	N 4X	78.5	34.6	17.9
Trojan TXS 92	N 2X	77.6	21.5	16.2
Todd M55	N 2X	74.5	35.9	17.1
Curry's WC-1442	N 2X	73.6	27.5	16.0
ACCO TGG 10	N 4X	73.4	36.0	19.6
Todd M20	N 2X	68.7	34.5	16.4
Green Acres 97	N 2X	64.8	62.0	22.3
SDAES SD 604	T 4X	57.0	70.2	18.8
SDAES PP 188	N 2X	53.2	21.7	19.2
	Mean	97.8		18.4

CV - 15.6% LSD (.05) 17.3

ROOTWORM RESISTANCE IN CORN

L. H. Penny

An attempt was made in 1973 to measure differences in yield loss in corn due to rootworm damage. Six single crosses thought to differ in their ability to tolerate rootworm infestation were planted in a paired-plot design of six replications. The experiment was planted on land that had grown a late-planted corn trap crop to attract adult rootworms for egg laying in 1972. One plot of each pair was treated with a soil insecticide at the recommended rate at planting time, and the other plot was left untreated. Yield comparisons are shown in Table 15. The average yields of the untreated plots were significantly lower than those of the

treated plots indicating considerable rootworm damage. However, the differences among hybrids in yield loss were not statistically significant. Either the hybrids did not differ in rootworm tolerance or the insect infestation was too spotty within the experimental plot area for tolerance differences to be detectable.

Other experiments of corn inbred lines and hybrids in the same area intended for rootworm tolerance evaluation were unsuccessful because of the spotty rootworm infestation.

Table 15. Rootworm Damage Expressed in Yield Reduction for Six Corn Hybrids in 1973.

	Yields (Bu/A)		
Hybrid	Soil insecticide	No. insecticide	Percent reduction
SD10 x B14A	105.8	99.4	6.0
SD10 x MS214	87.4	81.4	6.9
A556 x MS214	98.0	85.6	12.6
A619 x A632	105.8	95.2	10.0
W64A x W117	100.9	97.2	3.7
A554 x W182E	83.4	75.5	9.5
Average	96.9	89.0	8.1

INSECTICIDE TESTS FOR CONTROL OF WESTERN CORN ROOTWORM

P. A. Jones

Objectives

The main objective of this project is to field test under South Dakota conditions both registered and unregistered insecticides for control of larvae of western corn rootworm, Diabrotica virgifera LeConte. These tests are necessary before insecticides are recommended to South Dakota growers. The test conducted at the Beresford station is one of three similar tests in eastern South Dakota. This is done to obtain varying conditions of soil and weather and levels of rootworm infestation.

Methods and Procedures

In 1972 corn was planted late to have green or immature corn available from mid-August to killing frost to attract western corn rootworm adults to the plot during their egg laying period. The following operations were then carried out in 1973.

Plowed - Spring 1973
Fertilized - 287#/A 34-0-0; 106#/A 0-46-0; 41#/A 0-0-60

Corn Variety - Sokota SK92
Row width - 30"
Herbicide - Bladex 1.0+#/A. at planting time
Corn planted and treated, May 19, 1973, with John Deere 4-row Flexi-Planter equipped with Noble Metering Units.
Plot Rotary Hoed - June 1
Cultivated - June 25
Cultivation treatments applied June 28 with specially adapted John Deere 2-row cultivator.

Treatments were applied on 2-row plots, 150' long and replicated four times. Unless otherwise indicated all treatments listed in the tables were applied as planting time treatments in 5-7 in. band over-the-row. Furrow treatments were applied into the seed furrow. The liquid insecticides were applied immediately after planting. Cultivation treatments were applied as 4-6 in. bands on either side of the corn row, then incorporated by cultivation.

During the course of the season the following tests were used to evaluate the insecticides.

1) Stand counts, June 22, were used to determine if insecticides affected seed germination and growth. Counts were made from 32'8" of row per treatment per replicate.
2) Larval counts, July 5-7, determine overall level of rootworm infestation. Counts were taken in all untreated areas of the field.
3) Root pulls, i.e. the number of pounds force required to pull a corn plant from the ground, were taken July 23, 25 to give an indication of the amount of root injury by larvae sustained by the plant. Five plants per treatment per replicate are used.
4) Root ratings, July 31, are used to determine actual injury to the root system. Root ratings are carried out on all plants taken from the soil to obtain the root pull data. The accompanying illustrations show the root rating system as used in South Dakota.
5) Lodging is also an indicator of damage. Lodging counts were taken August 23 by counting number of plants in 100 either goosenecked or leaning at more than 30^{o} from the vertical.
6) Yields are used as a final performance factor for the insecticides. Yields were taken Oct. 29 and Nov. 4 by hand picking corn from a length of row equal to 1/250 A.

<u>Results and Discussion</u>

<u>Table 16</u>: Statistical analysis of the stand count, root pull, and root rating data indicated there were highly significant differences between the treatments. The analysis also indicated that there were no significant differences in the larval counts, which meant that the field was evenly infested with rootworm larvae. There were an average of 38.1 corn rootworm larvae per root system, with a range in number of larvae from 2-85. Based on subsequent damage to the corn roots and in comparison to other fields this was considered a medium infestation of rootworm.

<u>Table 17</u>: The highly significant differences between treatments, as measured by stand counts was primarily due to in-furrow applications of two experimental compounds, SN-316 and SD 8832.

Tables 18 and 19: The tables of root pulls and root ratings indicated that all the presently recommended treatments performed satisfactorily and that there are 2 or 3 promising new insecticides being developed.

Table 20: Lodging taken August 23 was relatively light in the treatments using recommended insecticides. It might be noted that the lodging increased in cultivation treatments. Cultivation treatments are not generally recommended for use in South Dakota.

Table 21: Yields were surprisingly high, even in untreated corn which had rootworm damage. This indicated that there may have been some root regrowth later in the season after the majority of the larval damage had occurred. However, the table also shows that even in medium infested fields use of recommended materials will be repaid in increased yields.

Table 16. Analysis of Variance Table for Stand Count, Larval Count, Root Pulls, Root Ratings in Corn Rootworm Control Tests

Beresford, Clay County	Source	df	Mean Square	F
Stand Count	R	3	58.3377	
	T	37	22.0267	3.037**
	RT	111	7.2521	
	Residual	152	9.8882	
Larval Count	R	3	760.0556	1.779 NS
	T	3	282.0556	0.616 NS
	RT	9	457.9259	
	Residual	32	427.1875	
Root Pulls	R	3	18661.8189	
	T	37	74498.545	8.008**
	RT	111	9302.179	
	Residual	608	6371.196	
Root Rating	R	3	8.0012	
	T	37	10.31185	7.548**
	RT	111	1.3661	
	Residual	608	0.6544	

** = Highly significant.
NS = Not significant.

Table 17. Ave. Stand Counts Taken June 22 from Insecticide Research Field, Southeast Experiment Station, Beresford, Clay County, South Dakota, 1973.

Treatment	Rate (lbs. ai/A)	Stand Count
Lorsban (M3454) 10G	1	26.125
Check 3		26.0
Landrin 15G	1	26.0
Check 1		25.625
Chevron 17033 10G (Furrow)	1	25.625
Dyfonate 20G	1	25.50
Chevron 17116 10G	1	25.50
Bux 2E	1	25.375
Bay 92114 10G	1	25.25
Thimet 15G	1	25.25
SN-316 10G	0.75	24.875
Dyfonate 4F	1	24.75
Chevron 18373 50WP	1	24.75
Lorsban (M3454) 10G	0.75	24.625
SN-316 10G (Cultivated)	0.75	24.50
Furadan 10G	0.75	24.375
Furadan 10G	3	24.375
N-303	0.75	24.375
Check 4		24.0
Counter 15G	1	24.0
Bay 92114 4EC	0.75	23.875
Check-X		23.875
Counter 15G	0.75	23.875
Mocap 10G	1	23.875
Landrin 15G (Cultivated)	1	23.75
Bux 10G	1	23.625
Bay 92114 4EC	1	23.50
Mocap 10G (Cultivated)	1	23.50
Loraban (M3454) 10G (Cultivated)	0.75	23.375
N-505	0.75	23.375
Bay 92114 4EC	0.6	23.25
Chevron 17033 10G	1	23.25
Loraban (M3454) 10G (Cultivated)	1	23.25
Check 2		23.0
SD 34110 10G (Furrow)	1.5	22.25
Chevron 17458 50WP	1	22.0
SN-316 10G (Furrow)	0.75	19.75
SD 8832 10G (Furrow)	1.5	17.5

Table 18. Root Pull Values of Insecticide Treatments for Control of Corn Rootworms, Southeast Experiment Station, Beresford, South Dakota, 1973. Root pulls obtained July 23, 24, 1973.

Treatments	Rate (lbs. ai/A)	Ave. (lbs.)
Chevron 17033 10G	1	371.3
Furadan 10G	3	367.0
Furadan 10G	0.75	348.3
Bay 92114 10G	1	335.8
N-505	0.75	335.8
SN-316 10G	0.75	332.5
Chevron 17116 10G	1	328.5
Counter 15G	1	327.5
Landrin 15G	1	326.0
Bay 92114 4EC	1	324.8
Bay 92114 4EC	0.75	323.5
Bux 2E	1	322.8
N-303	0.75	318.8
Bay 92114 4EC	0.6	318.0
SD-8832 10G (Furrow)	1.5	317.8
Chevron 17033 10G (Furrow)	1	314.3
Bux 10G	1	309.8
Dyfonate 20G	1	306.3
Mocap 10G	1	302.9
Counter 15G	0.75	282.5
Thimet 15G	1	281.0
Mocap 10G (Cultivated)	1	277.0
SN-316 10G (Cultivated)	0.75	274.3
Lorsban (M3454) 10G (Cultivated)	0.75	266.8
Lorsban (M3454) 10G	0.75	266.5
SN-316 10G (Furrow)	0.75	262.8
Landrin 15G	1	252.5
Lorsban (M3454) 10G	1	251.3
Dyfonate 4F	1	247.8
Chevron 17458 50WP	1	219.3
Lorsban (M3454) 10G (Cultivated)	1	207.5
Check 3		188.5
Check 4		182.5
Check 2		176.5
Chevron 18373 50WP	1	173.5
Check 1		173.0
SD 34110 10G (Furrow)	1.5	170.0
Check-X 1		167.5

Table 19. Root Rating Values of Insecticide Treatments for Control of Corn Rootworms, Southeast Experiment Station, Beresford, Clay County, South Dakota, 1973. Ratings obtained July 31, 1973.

Treatment	Rate (lbs. ai/A)	Root Rating
Chevron 17033 10G	1	1.55
Bay 92114 4EC	0.75	1.65
Furadan 10G	3	1.65
N-303	0.75	1.65
N-505	0.75	1.65
SN-316 10G	0.75	1.675
Bay 92114 10G	1	1.70
SN-316 10G (Cultivated)	0.75	1.70
Bux 2E	1	1.75
Chevron 17033 10G (Furrow)	1	1.80
Landrin 15G (Cultivated)	1	1.80
Lorsban (M3454) 10G	0.75	1.80
Lorsban (M3454) 10G	1	1.80
Thimet 15G	1	1.80
Bux 10G	1	1.85
Dyfonate 4F	1	1.85
Bay 92114 3EC	0.6	1.95
Bay 92114 3EC	1	1.95
Counter 15G	0.75	1.95
Counter 15G	1	1.95
Furadan 10G	0.75	1.95
Lorsban (M3454) 10G (Cultivated)	0.75	1.95
Lorsban (M3454) 10G (Cultivated)	1	1.95
Dyfonate 20G	1	2.0
Landrin 15G	1	2.0
SN-316 10G (Furrow)	0.75	2.0
Chevron 17116 10G	1	2.10
Mocap 10G	1	2.25
SD-8832 10G (Furrow)	1.5	2.25
Mocap 10G (Cultivated)	1	2.30
Check 4		2.70
SD-34110 10G (Furrow)	1.5	3.10
Chevron 17458 50WP	1	3.25
Check 3		3.60
Chevron 18373 50WP	1	3.60
Check-X 1		3.65
Check 2		4.0
Check 1		4.05

Table 20. Lodging Data from Corn Rootworm Insecticide Research Field, Southeast Experiment Station, Beresford, Clay County, South Dakota, 1973. Counts taken Aug. 23, 1973.

Treatment	Rate (lbs. ai/A)	Lodging (%)
Bay 92114 10G	1	0
Bay 92114 4EC	0.75	0
Bay 92114 4EC	1	0
Bux 10G	1	0
Bux 2E	1	0
Chevron 17033 10G	1	0
Chevron 17033 10G (Furrow)	1	0
Chevron 17116 10G	1	0
Counter 15G	0.75	0
Counter 15G	1	0
Dyfonate 20G	1	0
Furadan 10G	0.75	0
Landrin 15G	1	0
N-505	0.75	0
SN-316 10G	0.75	0
SN-316 10G (Furrow)	0.75	0
SD 8832 10G (Furrow)	1.5	0
Bay 92113 4EC	0.6	0.3
Furadan 10G	3.0	0.3
N-303	0.75	0.3
Lorsban (M3454) 10G	1	0.5
Lorsban (M3454) 10G	0.75	0.8
Lorsban (M3454) 10G (Cultivated)	1	1.0
Dyfonate 4F	1	1.3
Landrin 15G (Cultivated)	1	2.3
SN-316 10G (Cultivated)	0.75	2.3
Thimet 15G	1	2.8
Mocap 10G	1	4.0
Lorsban (M3454) 10G (Cultivated)	0.75	4.5
Mocap 10G (Cultivated)	1	6.0
Chevron 18373 50WP	1	8.3
Check 1		9.3
SD 34110 10G (Furrow)	1.5	10.8
Check 2		14.5
Check 3		15.3
Check 4		17.3
Chevron 17458 50WP	1	17.3
Check-X		21.3

Table 21. Yield Data from Corn Rootworm Insecticide Research Plot, Southeast Experiment Station, Beresford. Yields Taken 10-29-73 and 11-4-73 and Calculated as No. 2 Corn at 15.5% Moisture.

Treatment	Rate (lbs. ai/A)	Yield (Bu/A)
Mocap 10G	1	124
Counter (AC92100) 15G	1	114.6
Chevron 17033 10G	1	113.6
SN-316 10G	0.75	111.3
Chevron 17033 10G (Furrow)	1	111.2
Chevron 17116 10G	1	109.7
Bay 92114 4EC	0.6	109.5
N-505	0.75	109.2
SN-316 10G (Cultivated)	0.75	109.2
Counter (AC 92100) 15G	0.75	108.8
Dyfonate 4F	1	108.7
Chevron 17458 50WP	1	108
Lorsban (M3454) 10G	1	106.1
Bay 92114 10G	1	105.9
Furadan 10G	3	105
Dyfonate 20G	1	104.6
Mocap 10G (Cultivated)	1	102
Landrin 15G	1	101.4
Bay 92114 4EC	0.75	101.4
Furadan 10G	0.75	100.6
Landrin 15G (Cultivated)	1	100
Thimet 15G	1	99.6
Lorsban (M3454) 10G (Cultivated)	1	99.2
Bay 92114 4EC	1	99
Lorsban (M3454) 10G	0.75	98.9
N-303	0.75	98.8
SN-316 10G (Furrow)	0.75	98.3
Untreated check (Average from 5 checks)		97.3
Bux 10G	1	97.1
Chevron 18373 50WP	1	94.9
SD 34110 10G (Furrow)	1.5	93.4
Bux 2E	1	93.2
Loraban 10G (Cultivated)	0.75	92.5

1973 Corn Rootworm Research and Extension Activities

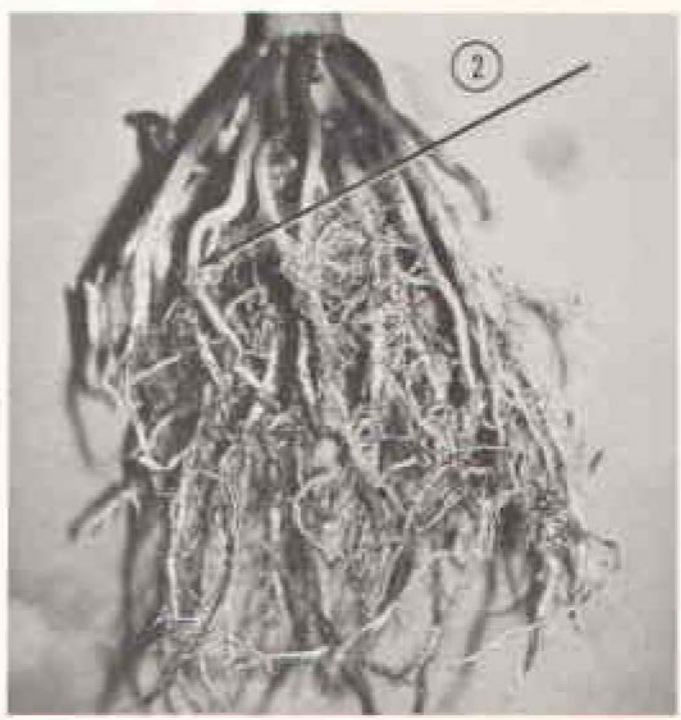
South Dakota State University

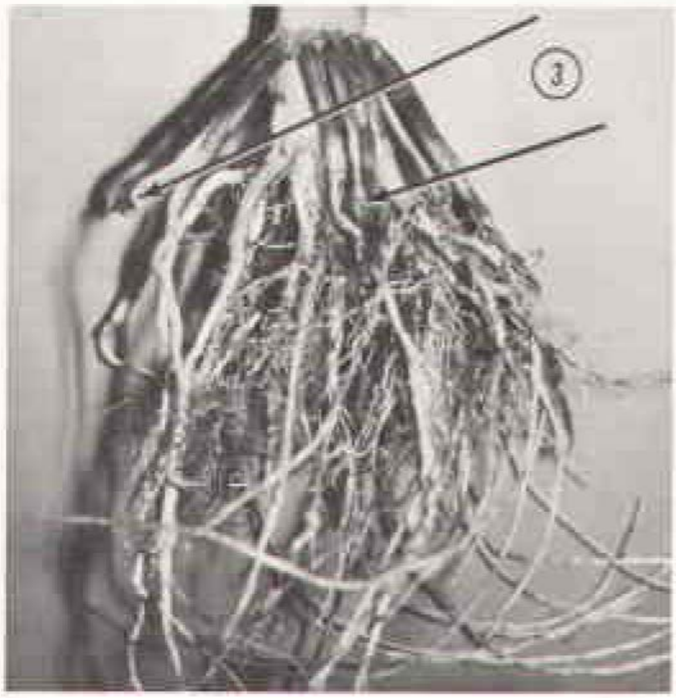
Representative root systems from various insecticidal treatments in SDSU research plots near Madison. Ben Kantack (left), Extension entomologist, holds healthy root systems showing satisfactory insecticidal control. Phil Jones (right), research entomologist with the Agricultural Experiment Station, shows roots demonstrating poor insecticidal control.

Root rating system as used in South Dakota.

Rating 1 -- No noticeable feeding damage (completely clean roots).

Rating 2 -- Feeding scars present (the arrow shows one such area) but no root pruning. To qualify as a pruned root, the root must have been pruned to within 1 1/2 inches of the plant. (Look carefully -- these scars show as small discolored leisons on any roots and are hard to see).

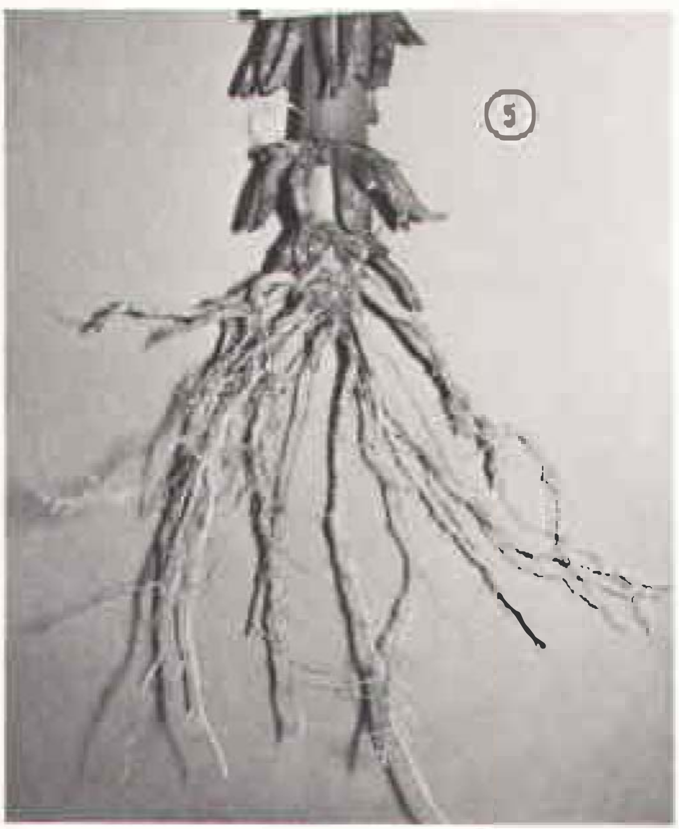




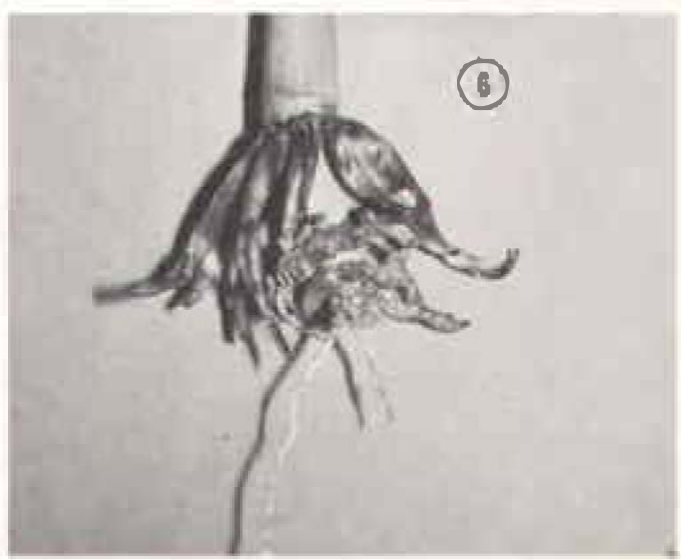
Rating 3 -- At least one root pruned but less than an entire node of roots pruned. Arrows indicate pruned roots.

Rating 4 -- At least one full node of roots pruned (see arrow) but less than two full nodes. Brace roots are considered roots if they are below the soil surface.

Rating 5 -- At least two full nodes pruned but less than three full nodes.



Rating 6 -- Three or more full nodes of roots pruned.



SOUTH DAKOTA CORN ROOTWORM CONTROL INSECTICIDE RECOMMENDATIONS FOR 1974

B. H. Kantack

Based on research and observations in 1973, one major change for 1974, is that South Dakota State University will strongly recommend that corn growers rotate insecticides applied for rootworm control. In other words, if you used one rootworm insecticide this year, use a different one next year.

Field observations for the past five years on insecticide performance against western corn rootworm have strongly indicated that nearly all problems of poor rootworm control were encountered on fields where the same insecticide has been used for several years. This circumstantial evidence indicates that possible tolerances or maybe some type of resistance may build up under prolonged use of any one insecticide in a given field. Hence, the change in our recommendations for rotation of rootworm chemicals in 1974.

We feel that South Dakota corn growers stand to benefit in implementing these insecticide rotation practices; in that poor insecticide performance cases against western corn rootworm may be prevented. One thing for sure is that the corn grower will not lose anything by following this practice.

Insecticide	Amount Formulation Per 1000 Feet of Row	Amount Actual Per 13,000 Feet of Row
Dasanit 15G	8 ounces	1 pound
Dyfonate 10G	12 ounces	1 pound
Dyfonate 20G	6 ounces	1 pound
Furadan 10G	12 ounces	1 pound
Thimet 15G	8 ounces	1 pound
Mocap 10G	12 ounces	1 pound

What about first year corn? We have had a number of complaints of serious rootworm damage on first year corn in 1973 in South Dakota. The adult beetle populations were extremely high throughout our major corn growing areas this past season. In view of these facts, we are recommending a rootworm treatment for first year corn in South Dakota for 1974.

PHYTOTOXICITY OF SUBSURFACE INJECTED TRIFLURALIN AND/OR DICAMBA TO CORN

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

Injected trifluralin and/or dicamba have shown potential as a method of controlling field bindweed. A factorial experiment with four replications in a randomized complete block design was initiated to determine the injury of these injected herbicides to corn. Herbicides were injected on June 1 in a silty loam soil with 3.0% organic matter and a pH of 6.6. Herbicides were injected into a layer 7 inches beneath the soil surface in 30 gpa spray solution at 40 psi. Seedbed preparation and planting of Pioneer 3579 seed corn were done immediately after injections on June 1. Alachlor plus atrazine (2 + 1) lb/a was applied over the entire experiment for annual weed control. Corn plant populations were determined at emergence

and at harvest by counting the number of plants in 40 feet of corn row. Extended-leaf height measurements were made June 27 and July 19 and tassel height measurements and root extraction pressures were made October 6 on four plants in each plot. Silage yields (lb dm/a) and corn yields (bu/a) at 15.5% moisture were determined by harvesting samples from 100 ft^2 area in each experimental unit. All data is presented as percent of control. Trifluralin and/or dicamba combinations had little effect on corn plant density either early or late in the growing season. Height measurements indicate stunting of corn by trifluralin in June and July, however, there was no apparent stunting remaining in October. Root extraction pressures were decreased in the trifluralin treated plots indicating possible root injury by that treatment. Silage and corn yields were not affected by injected treatments of trifluralin and/or dicamba.

Table 22. Phytotoxicity of Subsurface Injected Trifluralin and/or Dicamba to Corn.*

Injected Herbicide Treatments	Rate lb/a	Corn Plant Population Plants/40 ft of row Emergence	Harvest	Corn Heights Extended Leaf June	July	Tassel Oct.	Root Extraction Pressure	Silage Yield	Corn Yields
Trifluralin									
+ dicamba	0 + 0	100	100	100	100	100	100	100	100
+ dicamba	0 + 1/2	104	97	97	106	104	96	102	101
+ dicamba	0 + 1	107	103	102	101	104	90	113	112
Trifluralin									
+ dicamba	1 + 0	109	101	94	93	100	68	104	100
+ dicamba	1 + 1/2	99	98	94	101	102	83	100	100
+ dicamba	1 + 1	96	92	99	84	102	85	96	96
Trifluralin									
+ dicamba	2 + 0	101	96	97	97	100	64	94	93
+ dicamba	2 + 1/2	106	100	97	93	106	58	110	109
+ dicamba	2 + 1	104	99	93	87	100	73	99	102
Trifluralin									
+ dicamba	3 + 0	96	95	85	82	101	74	100	101
+ dicamba	3 + 1/2	102	97	95	95	96	66	101	100
+ dicamba	3 + 1	103	99	81	90	101	66	108	107

*All data presented as percent of control.

PERFORMANCE OF HERBICIDES IN CORN AND SOYBEANS

W. E. Arnold, W. B. O'Neal and L. J. Wrage

Herbicide screening experiments are conducted at the Southeast Experiment Farm to give area farmers a chance to compare the performance of several herbicides which may be used in their area. The performance of herbicides used on corn and soybeans this year as compared to previous years is presented in the following tables.

Corsoy soybeans were planted in 30-inch rows May 30. Preplant incorporated treatments were applied on May 30 and incorporated with a tandem disking at a 4-inch depth followed by two flextinings. Preemergence applications were made May 30. Post-emergence applications were made June 21 when the soybeans were in the first and second trifolicate stage and the weeds, pigweed sp., and foxtail sp., were 1 to 3 inches tall.

Pioneer 3388 seed corn was planted in 30-inch rows May 16. Preplant incorporated treatments were applied May 16 and incorporated with a tandem disking at the 4-inch depth followed by two flextinings. Preemergence treatments were applied May 19. Post-emergence treatments were applied June 14 when the corn was 5 inches tall and the weeds, foxtail sp., and pigweed sp., were 2 to 3 inches tall.

All herbicide treatments were applied in a 20 gpa water spray at 40 psi. The planting and spraying information for previous years are reported in the Southeast South Dakota Experiment Farm Progress Report for the year in question.

Corn herbicides performed quite well. The new tank-mix combination of Lasso + Bladex gave good weed control and does not have any carryover potential to injure crops next year. No rain waa received for about 2 weeks after application of herbicides to soybean plots. The preplant incorporated treatments gave good control of weeds, but the preemergence herbicides did not because of the lack of rainfall. Basagran, a post-emergence herbicide for broadleaf weed control in soybeans, and Cobex, a preplant incorporated treatment for grasses in soybeans, gave good weed control. Metribuzin, a preemergence herbicide primarily for broadleaf weed control in soybeans, did not perform as well as it has in previous years in the research plots.

Table 23. Corn Herbicide Plots

Herbicide	Rate lb/A Act.	Est. % Early Season Weed Control 1973 Gr	Bldf	4-Yr. Avg. (70-73) Gr	Bdlf
PREPLANT INCORPORATED					
atrazine (AAtrex)	2½	90	95	90	97
butylate + atrazine (Sutan + AAtrex)	3+1	99	94	91	96
butylate (Sutan)	4	90	50	84	63
PREEMERGENCE					
atrazine (AAtrex)	2½	85	99	88	99
alachlor (Lasso)	2½	99	80	86	62
alachlor + atrezine (Lasso + AAtrex)	2+1	98	95	89	85
alachlor + linuron (Lasso + Lorox)	2+1	95	80	--	--
alachlor + cyanazine (Bladex)	2+1½	95	90	--	--
propachlor (Ramrod)	5	99	60	93	52
propachlor + atrazine (Ramrod + AAtrex)	3+1	95	90	93	89
propachlor + linuron (Ramrod + Lorox)	3+1	95	75	90	81
cyenazine (Bladex)	2½	90	30	81	55
POST-EMERGENCE					
cyprazine (Outfox)	3/4	70	100	--	82
cyanazine (Bladex)	2	30	20	--	--
atrazine + oil (AAtrex)	2+1 gal	60	100	69	92

Gr = annual grasses
Bdlf = annual broadleaved weeds

Table 24. Soybean Herbicide Plots

Herbicide	Rate Lb/A Act.	Est. % Early Season Weed Control 1973 Gr	1973 Bdlf	4-Yr. Avg. (70-73) Gr	4-Yr. Avg. (70-73) Bdlf
PREPLANT INCORPORATED (ppi)					
vernolate (Vernam)	2½	90	80	88	85
trifluralin (Treflan)	3/4	99	90	88	88
dinitralin (Cobex)	½	99	90	--	--
SPLIT APPLICATION (ppi & pre)					
trifluralin and linuron (Treflan & Lorox)	3/4+1	99	95	--	--
trifluralin and metribuzin (Treflan & Sencor, Lexone)	3/4+½	99	95	--	--
PREEMERGENCE (pre)					
chloramben (Amiben)	2½	50	65	76	79
alachlor (Lasso)	2½	80	50	90	70
alachlor + linuron (Lasso + Lorox)	2+1	75	75	90	85
fluorodifen (Preforan, Soyex)	4	50	65	76	78
alachlor + metribuzin (Lasso + Sencor, Lexone)	2+3/8	75	85	--	--
alachlor + chlorbromuron (Lasso + Maloran, Bromex)	2+1½	80	88	--	--
metribuzin (Sencor, Lexone)	½	65	80	--	--

Gr = annual grasses
Bdlf = annual broadleaved weeds

SOYBEAN RESEARCH AND TESTING

A. O. Lunden and G. W. Erion

Soybean research plots near Beresford and Elk Point included Advanced Breeding yield tests, Regional Uniform Nurseries and Standard Variety and Commercial Soybean Yield Tests. Yields were only slightly below average for early to midseason entries and slightly above average for full season entries in spite of very limited rainfall in 1973. Yields are recorded in Table 25. Plots were planted on May 22 and harvested on October 10.

Entries from seven private seed companies were included to provide information about general adaptation of some of the most important commercial soybean strains. Seven of the 15 entries which were also grown in the 1973 test provide data for two-year average yields. It is quite apparent that some of the commercial entries are top yielders at each of these locations but that others are certainly not adapted to southeastern South Dakota. Maturity estimates are based on the number of days needed to mature and ranged from 126 days for SRF 100 at Beresford to about 147 days for Calland and Williams at Elk Point. The range from earliest to latest maturity was much smaller than normal due to generally good conditions for ripening and drying.

Corsoy, which has been an excellent soybean in most of the state, is still the best variety selection for the Beresford area. Wells, a new variety in 1972, is only slightly below Corsoy in yield potential, is more resistant to lodging and is resistant to Phytophthora root rot. Wayne, the best standard variety in the Elk Point plot, is also a top yielder at Beresford but is too late to be a good variety selection for that area.

A new full season Group III Regional entry which is being increased for release in 1975 has an excellent yield record at Elk Point. This strain, with the proposed name of Woodworth, has consistently averaged nearly two bushels per acre more than Wayne in four years of testing at Elk Point while being more resistant to lodging and slightly earlier. Woodworth should normally not be expected to mature at Beresford but in 1973, a favorable year for late entries, this new soybean yielded far better than any entry in the yield test at that location. The 49.2 bushel yield must be discounted on maturity potential so it cannot be recommended on basis of this one-year of yield testing. Area recommendations will be made after the 1974 yield plots are harvested.

Table 25. 1973 Soybean Yields of Standard Varieties and Commercial Entries at Beresford and Elk Point.

Identification & Relative Days to Maturity	Days Until Maturity		Yield at the SE Farm			Yield at Elk Point			Plant Height (inches)		Lodging (erect score = 1.0)	
	SE Farm	Elk Point	1973	2 year average	5 year average	1973	2 year average	5 year average	SE Farm	Elk Point	SE Farm	Elk Point
Corsoy +10	130	132	37.6	39.8	36.8	41.6	43.5	40.8	41	30	1.8	4.2
Wayne +22	138	139	42.3	41.8	36.8	44.8	44.9	42.0	42	34	2.2	3.2
Amsoy +13	132	135	39.3	39.6	34.3	44.9	45.5	41.2	45	35	1.4	1.5
Beeson +15	135	136	41.3	39.1	32.7	46.2	39.3	38.0	41	33	--	1.7
Calland +24	--	141	--	--	--	49.4	43.7	38.0	--	35	--	1.2
Hark +11	140	132	31.9	33.9	31.9	39.8	40.6	39.0	38	32	1.2	1.2
Provar +11	130	133	37.3	37.7	35.0	43.2	42.6	37.9	38	30	1.2	2.8
Rampage +9	129	130	30.4	34.0	32.4	37.7	38.0	35.9	30	27	1.1	1.5
Wells +10	132	134	37.0	38.5	33.3	40.8	42.2	--	40	31	1.0	1.2
Wirth +4	128	--	28.3	32.8	30.0	--	--	--	35	--	1.2	--
Chippewa 64 +3	127	--	26.5	29.4	30.0	--	--	--	35	--	1.2	--
Steele +4	128	--	25.3	35.9	--	--	--	--	39	--	1.5	--
Woodworth +20	139	138	49.2	--	--	45.4	49.7	--	40	32	1.2	1.2
Williams +25	--	141	--	--	--	43.8	42.5	37.5	--	34	--	1.0
AGRIPRO-4124	130	130	39.5	--	--	42.9	--	--	41	30	1.1	1.7
FEL-G042	131	135	39.9	41.2	--	46.2	--	--	43	32	1.5	3.2
FEL-G044	131	132	35.9	--	--	47.0	44.6	--	42	32	1.7	4.0
FEL-Dixon	133	136	40.7	--	--	42.9	--	--	37	30	1.6	2.5
MRC-Cherokee	135	137	38.2	--	--	45.4	--	--	41	32	1.3	2.5
PET-100	132	--	34.0	--	--	--	--	--	40	--	1.4	--
SRF-100	126	--	25.5	--	--	--	--	--	35	--	1.2	--
SRF-150	131	129	34.2	34.0	--	45.2	42.8	--	40	31	1.3	2.0
SRF-200	133	132	39.8	--	--	43.9	--	--	44	36	1.2	1.5
SRF-69-691	132	135	38.8	--	--	44.3	--	--	41	32	1.1	2.1
TEW-2D-300-1	126	128	31.4	--	--	38.3	--	--	37	30	1.8	2.0
TEW-2D-355-1	127	128	33.5	--	--	46.0	--	--	37	34	1.8	3.0
TEW-XK-505	134	134	38.5	39.0	--	41.8	43.0	--	43	34	1.5	1.7
TEW-SK-585	137	138	42.9	42.4	--	45.1	44.2	--	41	36	1.4	1.2
Tama-S-20	131	137	36.0	37.8	--	37.4	37.7	--	42	30	1.8	4.5
LSD			7.6	5.2	4.8	5.9	6.3	5.8				

DATE OF PLANTING SOYBEANS

F. Shubeck and B. Lawrensen

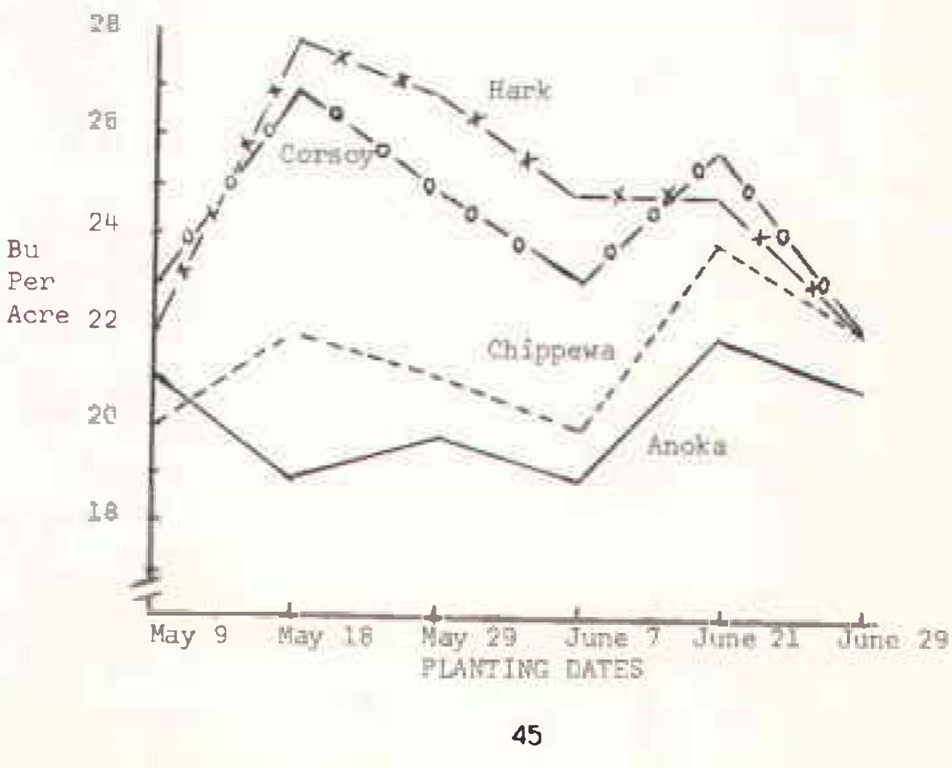
Objectives of Experiment

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

Methods and Procedures Used in Soybean Study

Nov. 13, 1972 - Fall plowed experimental plot area.
May 9, 1973 - Sprayed total plot area with Treflan at the rate of 1.5 pts per acre. Tandem disked to incorporate immediately. Spike tooth harrowed. Planted all plots (first planting date).
May 18, 1973 - Second planting date.
May 29, 1973 - Third planting date.
June 7, 1973 - Fourth planting date.
June 21, 1973 - Fifth planting date.
June 22, 1973 - Cultivated first, second, third planting dates.
June 29, 1973 - Sixth planting date.
Varieties - Corsoy, Hark, Anoka, Chippewa
Herbicide - Lasso 10G banded
NOTE: Before each planting date, the plot area was tandem disked and spike-tooth harrowed.

Figure 1. Effect of Planting Date on Soybean Yield

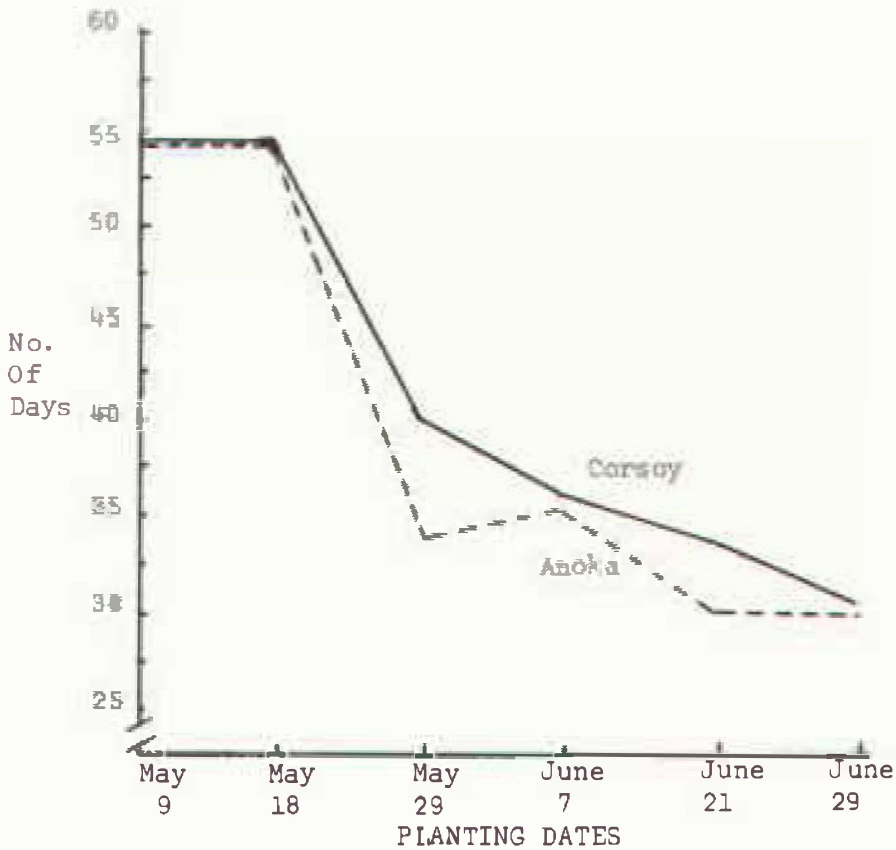


Discussion and Interpretation of Figure 1

Yield responses of the four soybean varieties can be divided into two pairs--the later maturing Hark and Corsoy comprise one pair and the early maturing Chippewa and Anoka make up the other pair. The later maturing pair yielded more than the early maturing pair at all planting dates except the very last one (June 29). Very early planting (May 9) did not increase yields of any of the four varieties.

On the basis of one years results, it looks like the full season beans reached a peak in yield when planted moderately early (May 18) and gradually decreased in yield as planting dates were delayed. Yields of early beans were not so dependent on planting dates for maximum yield. They maintained their ability to produce beans without a serious decrease over a long interval of planting dates.

Figure 2. Effect of Soybean Planting Dates on Number of Days Between Emergence and First Flowering.



Discussion and Interpretation of Figures 2 and 3

Figure two shows the influence of planting dates on number of days between emergence and first flowering for an early variety (Anoka) and a later variety (Corsoy). Results at other stations indicate that planting dates should be selected to give a maximum growth period at this interval for each variety to obtain maximum yield. The greatest number of days between emergence and first flowering occurred with the two earliest planting dates for both soybean varieties.

Figure 3. Effect of Soybean Planting Dates on Plant Height at Maturity.

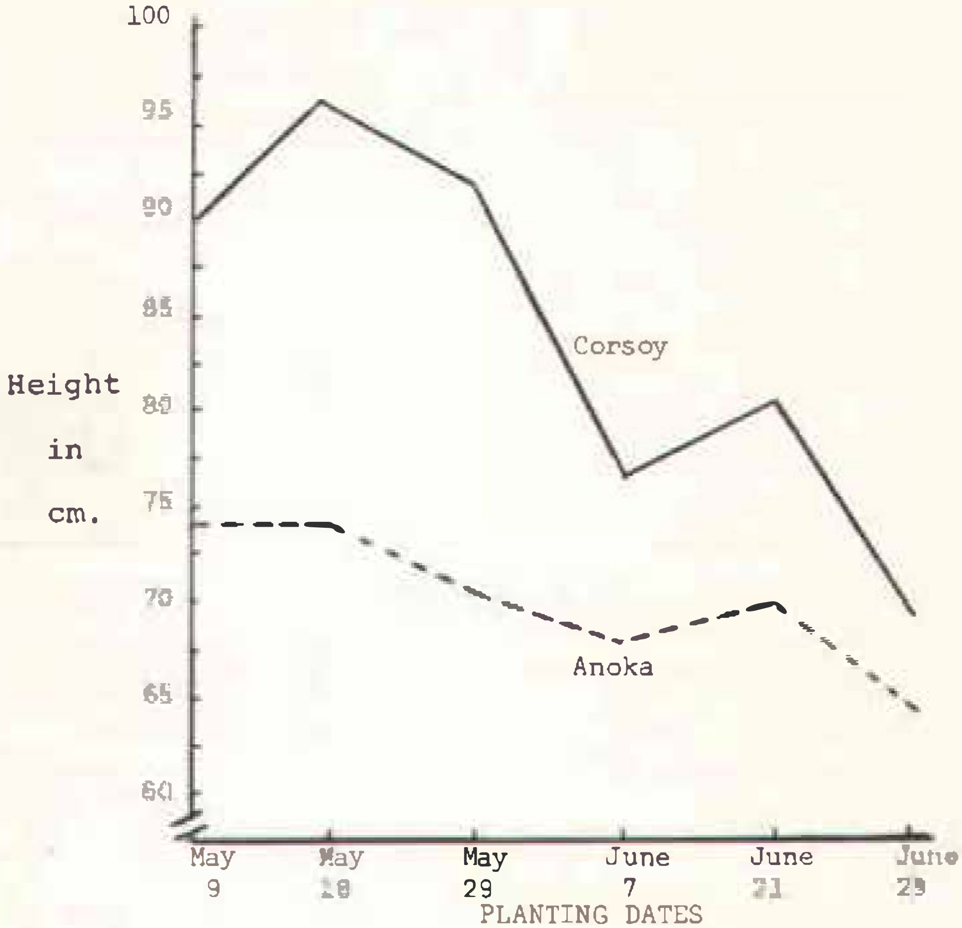


Figure three shows relationship of planting dates to plant height at maturity for the same two varieties. Plant height of the later maturing variety (Corsoy) appeared to be influenced more by planting dates than the early variety, Anoka.

Even though both varieties showed more days between emergence and flowering and greater plant height when planted early, the yield advantage for early planting was greater for the full season variety than the early maturing variety.

SOYBEAN ROW SPACING (30" VS 7")

F. Shubeck and B. Lawrensen

Objectives

1. What are the possibilities of planting soybeans with the grain drill and not cultivating?
2. Is there a yield advantage in narrowing rows down to 7 inches?

Methods and Procedures

May 8, 1973 - Sprayed Treflan on fall plowing at the rate of 1.5 pts. per acre. Tandem disked to incorporate.
May 17, 1973 - Tandem disked and spike-tooth harrowed plot area.
May 18, 1973 - Planted 30" rows with John Deere unit planter. Drilled 7" rows with John Deere press drill.
Variety - Corsoy
June 21, 1973 - Cultivated 30" rows.
July 16, 1973 - Rogued weeds from plots.
October 18, 1973 - Combined plots.

Table 26. Comparison of 30" Rows and 7" Rows for Soybeans

Row Spacing	Bu/A
30" rows (planted with tool bar planter)	23.0
7" rows (seeded with press drill)	23.0

Discussion and Interpretation of Table 26

Yields were the same for both methods of planting for the last three years. Narrowing the rows to 7 inches did not increase yields over the 30 inch row spacing.

Two broadleaf weeds (pigweed and cocklebur) were a problem in the 7 inch row spacing where they could not be cultivated.

CHISEL PLOW SOYBEANS AND CORN 1973

F. Shubeck and B. Lawrensen

Objectives

1. How much tillage is necessary for optimum yields?
2. Will fall tillage increase moisture storage?
3. Without a serious weed problem, which is the best to use in the fall, sweeps or twists?
4. Can yields be maintained with chisel plowing in the fall rather than moldboard plowing in the fall and subjecting soil to greater erosion hazard?
5. Can disking stalks in the fall be eliminated by chopping and using chisel points with a twist?
6. Is system of fertilizing adequate, using a sideband starter and side-dressing nitrogen?

Procedure (Soybeans)

Nov. 24, 1972 - All specified tillage treatments in the fall performed in the corn plots.
May 14, 1973 - Performed all specified spring tillage treatments.
May 23, 1973 - Planted all soybean plots.
  Variety - Corsoy
  Herbicide - Lasso 10G banded
  Fertilizer - Starter band 100# (8-32-16)
June 11, 1973 - Rotary hoed all plots.
July 5, 1973 - Cultivated all plots.
October 11, 1973 - Soybean harvest.

Procedure (Corn)

Nov. 24, 1972 - Fall tillage treatments completed on all specified plots.
May 14, 1973 - Spring tillage treatments carried out in all specified plots.
May 16, 1973 - Planted all corn tillage treatments.
  Variety - Pioneer 3388
  Herbicide - Ramrod 20G (banded)
  Fertility - Starter 100# (8-32-16)
  Insecticide - Dyphonate 20G (banded)
June 1, 1973 - Rotary hoed all plots.
June 12, 1973 - Cultivated corn plots.
June 27, 1973 - Side-dressed nitrogen at 100 lbs N/acre.
June 28, 1973 - Lay-by cultivation.
October 4, 1973 - Harvested corn.

Table 27. Effect of Tillage Treatments on Yield of Soybeans

	Tillage Treatment In Fall	Tillage Treatment In Spring	Soybeans Bu/A
1	---	Disk-disk-drag	31.0
2	---	Chop-sweeps-disk-drag	27.0
3	---	Disk-plow-disk-drag	27.0
4	Disk-plow	Disk-drag	27.0
5	Disk-twists	Disk-drag	29.0
6	Chop-twists	Disk-drag	26.0
7	Chop-twists	Sweeps-drag	25.0
8	Chop-sweeps	Sweeps-drag	27.0
9	Disk	Disk-drag	29.0
10	Chop, twists*	Sweeps-drag	31.0

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

Discussion and Interpretation of Table 27

The apparent differences in soybean yields due to tillage treatments were not significant at the 5% confidence level. This is the first year for the chisel plow experiment. Results for this first year indicate that yields of beans from chisel plowed plots were about the same as those from plots plowed with a moldboard plow.

Table 28. Effect of Tillage Treatments on Yield of Corn

	Tillage Treatment In Fall	Tillage Treatment In Spring	Corn Bu/A
1	---	Disk-drag	94.0
2	---	Sweeps-drag	94.0
3	---	Plow-disk-drag	109.0
4	Plow	Disk-drag	93.0
5	Twists	Disk-drag	86.0
6	Twists	Disk-drag	98.0
7	Twists	Sweeps-drag	89.0
8	Sweeps	Sweeps-drag	92.0
9	---	Disk-drag	92.0
10	Sweeps*	Sweeps-drag	92.0

*Treatment 10 was unfertilized. All other corn plots received 100 lbs. of 8-32-16 (oxide) as a starter sideband. One hundred lbs. of nitrogen per acre were applied as a side-dressing when the corn was about 18 inches high.

Discussion and Interpretation of Table 28

There were no significant differences in corn yield due to tillage methods. Treatments 5 and 6 are identical for corn but are different for the preceding crop soybeans. Soil test results show accumulations of salts 1.5 feet below the suface in some plots. The apparent yield differences shown in Table 28 are probably due to soil variations.

This site has some restrictions in drainage which would account for salt concentrations close to the surface. Research in other states has shown improved moisture infiltration due to chisel plowing. Reduced tillage, less soil erosion, better seedbed preparation in with heavy soils are other aspects in favor of chisel plowing that must be considered.

This experiment will give us a good opportunity to see the overall performance of the chisel plow in a heavy textured, imperfectly drained soil with salt accumulation in the profile.

GRAIN SORGHUM RESEARCH

A. O. Lunden and G. W. Erion

Grain sorghum plantings at the Southeast Farm emphasized testing of the new early maturing South Dakota Experiment Station releases as well as the customary Regional Test entries and experimental hybrids. The main test was planted on May 24 in 30 inch rows and a late narrow row planting was made on June 8. Yields and agronomic data are presented in Table 29.

The two new early varieties, SD104 and SD106, have produced excellent yields in the past three years with yields averaging about 15% and 34% better than the popular early line SD102. RS506 also has an excellent yield record relative to other mid- to full-season hybrids and has averaged 114 bushels per acre for the last three years at Beresford. These grain sorghums have all been somewhat resistant to bird losses because of open heads instead of the high-tannin type of bird resistance most frequently found in hybrids. Lodging was extremely variable in these plots with specific entries ranging from 0 to 100% lodged in adjoining replications.

Time of planting is very important to achieve optimum weed control and to ensure the best possible plant population for maximum yield. Results from this test and several others suggest that grain sorghum should be planted about June 1 to enhance seed germination and plant growth immediately after planting. Row spacing appears to be less important and few advantages exist for rows closer than 30 inches. 1973 plantings were more resistant to lodging in 30 inch rows than in 12 inch rows. SD104 is good and SD106 is especially well adapted for early harvest or late planting in the Beresford area.

Table 29. Grain Sorghum Yields at Beresford, S. Dak. for Early and Late Planting in 1973.

Entries	Yield-Early Planting 1973 #/Acre	3 year average #/Acre	3 year average Bu/Acre	Late Pl. 1973 #/Acre	Plant Height Early	Plant Height Late	Lodging Early	Lodging Late	Bird Losses Early	Bird Losses Late
Varieties										
SD 102	3180	3420	61	3430	42"	44"	4%	9%	0	0
SD 104	4100	3920	70	4310	39"	42"	30%	19%	0	0
SD 106	4730	4590	82	4500	45"	45"	12%	7%	0	0
Hybrids										
SD 503	4950*	5490*	98*	4540*	55"	55"	0	19%	65%	20%
RS 506	5880	6380	114	5080	53"	50"	7%	34%	0	0
RS 610	5360*	5990*	107	3100*	49"	46"	0	1%	8%	14%
LSD	NS	450	8.0	650						

*Yields corrected for bird losses.

GRAIN SORGHUM PERFORMANCE TRIALS

J. J. Bonnemann

Thirty-four grain sorghum hybrids were entered in the 1973 Grain Sorghum Performance Trials at the Southeast Experiment Farm. Six of the hybrids were included by the Agricultural Experiment Station.

Seeding was on May 23 and harvesting on October 4. The row spacing was 30 inches. Di-Syston and Ramrod were banded at the time of seeding for insect and weed control, respectively. The grain quality was good as were most yields. The trial mean was about 5300 pounds per acre.

Table 30 presents results of the 1973 trial. An upcoming circular, 1973 Grain Sorghum Performance Trials, will present additional data.

Table 30. 1973 Grain Sorghum Performance Trials, Area E, Southeast Experiment Farm, Beresford, S.D.

Brand and Variety	Rank	Yield, lb/A	Test Wt. lb/B	Height, inches	Lodging, percent	Percent moisture 9/19/73
Asgrow Dorado E	5	6045	55	47	5	20.1
DeKalb C-42A	1	6628	56	47	10	25.4
DeKalb C-42Y	33	3675	55	51	0	32.3
DeKalb C-42C	13	5528	56	51	0	29.4

Table 30 continued on next page.

Table 30. Continued

Brand and Variety	Rank	Yield, lb/A	Test Wt. lb/B	Height inches	Lodging, percent	Percent moisture 9/19/73
Frontier 400C	20	5347	55	51	5	24.6
Frontier Super 400A	4	6217	54	51	0	23.6
Northrup King NK 222	9	5730	57	45	2	23.9
Northrup King KK 265	12	5539	56	54	12	23.8
Northrup King NK 180	16	5465	56	47	10	21.3
Northrup King NK 233A	24	5180	59	48	3	22.3
Northrup King NK 266A	7	5788	56	51	3	23.7
Northrup King Savanna 3	3	6449	55	49	0	29.5
ACCO R1029	6	5866	57	47	0	26.3
ACCO R1010	26	4984	57	60	5	21.0
ACCO R1019	17	5446	56	48	15	21.6
ACCO X-7275	29	4775	54	42	0	29.3
Pioneer 866	23	5181	56	53	25	28.3
Pioneer 8681	8	5718	53	49	3	24.5
Pioneer X-8385	11	5592	53	49	0	23.9
SDAES NB 635	31	4490	54	52	5	30.8
SDAES SD 451	21	5263	56	53	5	18.4
SDAES SD 503	27	4917	56	61	8	21.5
SDAES RS 506	18	5435	56	52	20	21.8
SDAES SD 104	34	3675	54	41	38	20.6
SDAES SD 106	28	4798	54	45	12	18.9
Excel 433	2	6463	56	44	0	20.4
Niagara NCX 1002S	10	5601	57	47	3	23.2
Western WS 210	19	5361	55	52	0	32.3
Horizon 25	25	5170	56	47	6	25.8
Horizon 45	22	5220	55	44	0	25.4
Horizon 80	14	5475	55	50	0	32.0
Horizon 84	30	4625	55	39	0	24.2
Horizon EX 920	32	3828	55	54	0	34.8
SDAES RS 610	15	5466	55	52	2	24.1
Mean		5322				

CV = 15.1% LSD (.05) 1301

PERFORMANCE OF EXPERIMENTAL HYBRIDS

C. M. Nagel and J. R. Jenison

Growing conditions during the 1973 season were less favorable for corn. Research on the control of the major corn diseases, includes root, stalk rot and southern corn leaf blight. Southern corn leaf blight was of minor importance during 1973. Control of these serious diseases is based on the development of disease resistant inbred lines of corn usually derived from open-pollinated corn varieties, commonly grown prior to 1930. Through a program of selection for healthy plants under natural field infection and inoculation experiments and then inbreeding for 6-8 generations using large plant populations, disease resistant lines may result. However, the success ratio is considerably less than 1 percent. This information will indicate how difficult it is to discover new sources of disease resistance in plants. Foliage diseases on corn usually are easily recognized however, in the case of root rot and stalk rot, the disease organisms destroy the pith and roots and therefore damage is usually less noticeable during the growing season.

Tables 30 a, b, c and d present the performance data of 130 experimental hybrids resulting from inbred lines produced from research under this project. The specific identity, with regard to all of the commercial checks shown in the tables, should include the word variety for clarity, i.e. Pioneer variety 3390, etc.

Table 30a. Performance Rating of New Experimental Hybrids Varying in Root and Stalk Rot Resistance Compared With 4 Different Commercial Hybrids Commonly Grown in the Area. Southeast Experiment Farm. Experiments Were Check Planted in 38-Inch Rows, 4 Kernels Per Hill. Planted May 9, Harvested October 6, 1973. Plants/Acre, Average 15,400.

Expt'l Hybrid or Commercial Check	Yield Bu/A	Ear Moisture at Harvest %	% Lodging	Performance Score Ranking
Experiment #1				
Expt'l #1	112.3	30.3	5.7	108.1
Pioneer 3390 (check)	112.2	31.8	0.0	108.2
Expt'l #2	111.9	22.6	0.0	112.5
3	109.1	32.6	0.0	106.2
4	108.8	33.1	0.0	105.8
5	108.1	30.0	4.5	106.2
6	107.1	29.5	0.0	106.6
7	106.4	25.5	0.0	108.1
8	104.1	32.0	0.0	103.8
9	104.0	27.8	1.9	105.5
DeKalb XL 361 (check)	102.9	30.5	1.9	103.6
Funks G 4444 (check)	101.8	19.9	0.9	108.2
Expt'l #10	101.3	21.3	0.0	107.4
11	100.3	27.3	0.0	104.1
12	98.8	26.7	0.0	103.5
13	97.2	25.7	3.2	102.6
14	96.4	34.3	0.5	98.6
15	96.4	17.4	16.0	104.1
16	95.9	37.7	1.1	96.5
17	95.7	30.5	7.3	98.9
18	95.6	22.9	0.0	103.6
19	95.1	26.1	0.5	101.8
20	92.8	28.2	1.7	99.3
Pioneer 3387(check)	92.0	29.9	0.5	98.3
Expt'l #21	91.2	30.1	4.4	97.2
22	89.4	23.6	13.5	97.8
23	86.5	24.0	1.0	98.1
24	85.4	23.2	0.5	98.0
25	83.0	26.7	5.7	94.2
26	82.9	27.1	10.2	93.2
27	82.1	30.6	0.5	92.7
28	82.0	23.2	28.3	91.7
29	80.6	28.5	33.3	87.6
30	76.9	28.9	5.2	90.0
31	74.9	17.9	10.8	93.2
32	74.5	31.0	27.5	84.1
33	66.0	25.5	2.7	86.1
34	60.3	28.3	36.6	76.4

C.V. = 14.6%
F = 2.72**
L.S.D. (.05) = 12.8 bushels

Table 30b. Continued

Expt'l Hybrid or Commercial Check	Yield Bu/A	Ear Moisture at Harvest %	% Lodging	Performance Score Ranking
Experiment #2				
Expt'l #35	118.3	29.0	6.5	112.8
Pioneer 3390 (check)	117.7	29.5	0.0	113.2
Expt'l #36	109.5	33.5	0.6	106.7
37	108.7	30.0	2.0	107.7
Pioneer 3387 (check)	105.6	30.3	0.0	106.2
Expt'l #38	104.0	33.6	2.0	103.5
39	101.6	22.4	1.0	107.7
40	100.9	29.9	0.0	103.8
41	100.2	29.9	2.1	103.2
42	97.8	28.4	0.0	103.2
DeKalb XL 361 (check)	95.7	31.2	0.0	100.4
Expt'l #43	95.0	29.8	0.5	100.6
44	94.8	22.0	0.0	104.4
45	94.5	28.3	1.2	101.0
46	93.0	31.3	0.5	98.8
Funks G 4444 (check)	92.8	20.5	2.0	103.7
Expt'l #47	92.7	20.0	2.6	103.8
48	91.6	30.6	0.0	98.5
49	89.9	25.3	0.0	100.1
50	89.9	30.9	1.1	97.2
51	89.2	20.5	0.0	102.0
52	86.9	28.5	0.0	97.0
53	86.7	30.8	0.5	95.7
54	86.4	27.2	0.5	97.2
55	84.7	28.9	6.0	94.6
56	84.0	31.6	0.0	93.8
57	83.0	32.5	3.3	92.4
58	82.7	21.8	0.0	97.9
59	82.0	27.4	0.0	94.8
60	81.0	27.3	0.6	94.2
61	79.9	25.0	1.4	94.6
62	78.1	26.4	3.9	92.6
63	76.9	19.9	0.0	95.7
64	75.4	20.9	7.2	93.3
65	73.6	32.7	0.0	87.7

C.V. = 12.5%
F = 2.91**
L.S.D. (.05) = 10.8 bushels

Table 30c. Continued

Expt'l Hybrid or Commercial Check	Yield Bu/A	Ear Moisture at Harvest %	% Lodging	Performance Score Ranking
Experiment #3				
Expt'l #66	127.8	25.4	0.7	116.6
67	121.9	26.7	1.4	112.8
Pioneer 3390 (check)	112.6	25.6	4.2	108.0
Expt'l #68	108.4	21.3	0.0	108.4
69	107.8	23.9	7.7	105.7
70	107.0	19.6	1.2	108.3
71	106.7	25.2	10.9	104.0
72	106.7	25.5	9.7	104.0
73	106.3	18.7	6.4	107.4
74	105.9	24.9	5.9	104.5
75	104.0	18.9	31.4	102.1
76	104.0	21.0	21.5	102.7
77	102.8	30.3	2.9	101.0
78	99.7	22.3	3.4	103.0
79	97.3	20.4	8.2	101.7
80	96.1	25.7	3.8	99.4
81	95.6	22.3	10.4	99.6
82	95.3	20.3	5.0	101.2
83	95.0	27.3	2.7	98.3
84	92.5	17.0	8.6	100.6
DeKalb XL 361 (check)	91.6	27.5	1.9	96.6
Expt'l #85	91.3	19.0	37.0	94.4
86	90.5	22.7	19.1	95.3
Pioneer 3387 (check)	89.6	25.2	1.4	96.6
Funks G 4444 (check)	89.4	17.0	3.7	99.8
Expt'l #87	88.9	18.2	15.4	97.1
88	87.8	18.0	3.8	98.5
89	87.4	20.8	4.5	96.9
90	85.1	16.3	4.9	97.7
91	83.2	29.6	2.0	91.2
92	81.1	19.5	23.0	91.2
93	79.9	21.5	4.1	92.7
94	78.6	15.9	16.9	92.5
95	78.5	18.3	7.4	93.0
96	77.5	21.8	13.2	89.9
97	72.7	24.2	6.5	87.4

C.V. = 10.4%
F = 4.82**
L.S.D. (.05) = 9.4 bushels

Table 30d. Continued

Expt'l Hybrid or Commercial Check	Yield Bu/A	Ear Moisture at Harvest %	% Lodging	Performance Score Ranking
Experiment #4				
Expt'l #98	114.0	22.9	17.0	107.5
99	113.7	15.4	6.5	112.5
100	112.0	18.1	1.6	111.3
101	111.1	21.3	19.4	106.2
102	109.3	15.4	9.7	109.6
Pioneer 3387 (check)	108.4	20.6	1.2	108.5
Expt'l #103	107.5	24.0	8.8	105.2
104	106.5	17.2	15.0	106.4
105	106.1	21.1	22.9	103.0
Pioneer 3390 (check)	104.8	19.0	13.2	105.1
106	103.7	21.6	9.3	104.1
107	98.9	18.1	29.8	99.3
108	98.0	15.3	30.5	99.9
109	97.1	24.4	8.6	99.6
110	96.8	16.7	15.9	101.5
111	96.8	16.0	20.9	100.8
112	96.4	15.7	18.6	101.1
113	96.2	19.3	13.2	100.5
114	95.8	18.9	29.3	97.5
Funks G 4444 (check)	95.1	15.0	26.2	99.4
Expt'l #115	95.1	14.9	8.6	102.7
116	94.7	14.4	38.7	97.1
117	94.4	20.1	17.3	98.5
118	94.1	14.1	30.6	98.4
119	93.9	14.4	41.1	96.2
120	93.7	14.7	17.7	100.4
121	91.1	16.1	17.8	98.4
122	91.0	15.7	27.3	96.8
123	90.1	16.0	27.4	96.1
DeKalb XL 361 (check)	89.3	20.3	22.3	94.8
Expt'l #124	88.6	14.3	33.5	94.9
125	88.1	18.8	13.6	96.5
126	83.3	19.4	8.1	94.7
127	82.6	19.9	20.3	91.9
128	82.1	21.8	28.4	89.3
129	77.8	21.4	34.3	86.1
130	77.3	21.1	24.0	87.9

C.V. = 10.5%
F = 2.76**
L.S.D. (.05) = 9.5 bushels

STANDARD OAT VARIETY TRIALS

J. J. Bonnemann

Small grain rod-row trials have been limited to just oats at the Southeast Experiment Farm for several years. Seeding of other small grain drill strips is done by farm personnel for observational purposes.

The data included in this report (Table 31) are bushel weight, test weight and available three-year averages.

The trials were seeded on April 13. Climatic conditions during the growing period were quite favorable and very good yields were harvested from four replications. Test weights were good for all varieties.

Table 31. Standard Variety Oat Trials, Southeast Experiment Farm, Beresford, 1971-1973.

Variety	1971	1972	1973	3 Yr. Av.	1973 T.W.
Dupree	79.4	76.5	83.2	79.7	36
Burnett	93.2	68.4	97.9	86.5	38
Garland	84.9	--	87.5		38
Lodi	70.7	69.2	86.7	75.5	38
Clintland 64[a]	78.3	70.6	77.7	75.5	36
Brave	93.0	66.6	91.5	83.7	38
Trio	88.5	88.9	91.9	89.7	38
Pettis	84.1	83.4	86.4	84.6	38
Diana		84.2	83.9		35
Holden	95.0	60.6	84.7	80.1	36
Portal	89.2	72.2	87.6	83.0	37
Kelsey	92.8	75.9	103.8	90.9	37
Kota	89.2	66.6	92.9	82.9	40
Cayuse	81.0	66.4	104.0	83.8	36
Otter	74.5	60.9	89.3	74.9	37
Nodaway 70	94.6	83.1	89.5	89.1	38
Froker	73.9	86.8	91.8	84.2	39
Grundy		83.9	77.0		37
Chief	96.0	81.9	85.6	87.8	36
Random	70.2	60.1	94.2	74.8	32
Otee	88.2	80.3	83.6	84.0	38
Dal		79.6	81.2		37
Astro			96.6		39
Noble			90.7		38
Stout			88.2		37
M-73			82.1		36
SD 955	82.7	90.9	90.3	88.0	36
McCurdy 3306		77.8	91.7		40
Mean, B/A			88.1		
LSD (.05)			5.7		
CV = %			4.6		

[a]Low germination, 1973.

PEA BEANS FOR SOUTH DAKOTA

Paul Prashar

We are always looking for new agricultural crops which can increase the income of our farmers without too much expense for machinery. Pea beans are the beans which are generally used as pork and beans. Pea beans are grown, harvested, and handled similar to soybean operations. Cultural requirement, fertilizer, and other operations are also very similar. One advantage of the pea beans over soybeans is that the crop is generally harvested about the time of first frost or earlier. This means the crop is harvested before the farmers get busy with their corn picking and soybean harvest.

At present most of the pea beans are grown in Saginaw Valley, Michigan, and some in New Jersey. The Campbell Soup Co., which is one of the big users of pea beans, is interested in expanding the area of pea beans. At present price of pea beans is 25-30¢ per lb. to the grower. This year some of the growers have planted pea beans in South Dakota and obtained a yield of over 1200 lbs. of pea beans per acre. This amounts to about $300 per acre or a farmer has to have 150 bushels of corn or 60 bushels of soybeans to compete.

For the last two years the Department of Horticulture and Forestry has been conducting variety trial tests at the Agriculture Research and Extension Center, Beresford, South Dakota. Two years of data indicate that beans can be successfully grown in this area. The results indicate that a grower can expect 1200-1500 lbs. of pea beans on dry land during the average growing season. The yields are greater under irrigation. The Campbell Soup Co. is interested in having 5,000-10,000 acres of pea beans in this area. As soon as the company can get enough growers to grow pea beans they will locate a buying plant in the area. At present the buying plant is located at Olivia, Minnesota.

Fourteen varieties of beans were planted on May 21st. The varieties were replicated four times. Four rows of beans were planted in each replication. The middle two rows were harvested for yield purposes. The beans were harvested on August 30 and September 11. The data from the yield is listed in Table 32. All of the varieties grown are not suitable for South Dakota because some of these are too late for our growing conditions. Some of the varieties seem to be adapted very well for our conditions. There is no serious pest of pea beans which can not be easily controlled during the growing season with proper cultural purposes. None of the varieties were sprayed for any disease or insect control during the growing season.

Table 32. Dry Beans Variety Trial (under dry land), Centerville, South Dakota.

Entry Name	Date of Harvest	Yield (grams) Rep. 1	Rep. 2	Rep. 3	Rep. 4	Total	Average	Yield/acre lbs.
Sanilac	8-30-73	2370	2430	2377	2325	9502	2375.5	2281.6
Seafarer	8-30-73	2647	2696	2713	2642	10698	2674.5	2568.9
Gratiot	8-30-73	2535	2625	2608	2588	10356	2589.0	2487.2
Aurora	8-30-73	2385	2450	2313	2343	9491	2372.7	2278.7
Atlas	9-11-73	1493	1583	1591	1640	6307	1579.2	1516.9
Bonus	9-11-73	1833	2177	2192	1990	8192	2048.0	1967.5
Chief	9-11-73	1753	1673	1714	1785	6925	1731.2	1662.9
Capital	9-11-73	1787	1782	1823	1865	7257	1814.2	1742.7
W-5 (6R-395)	8-30-73	2628	2702	2868	2600	10798	2699.5	2592.9
W-6 (6R-320)	8-30-73	1439	1584	1503	1597	6123	1530.7	1469.8
W-10 (W-26)	8-30-73	2605	2510	2545	2544	10204	2551.0	2450.7
W-15 (W-34)	8-30-73	2828	2625	2705	2780	10938	2734.5	2626.5
W-25 (6R-295)	8-30-73	2180	1965	2090	1952	8187	2046.7	1965.6
SVC 1036	9-11-73	1307	1306	1294	1260	5167	1291.7	1240.2
Harvested area ft.^{2}		100.0	100.0	100.0	100.0			

Date of planting: 5-21-73 and 6-6-73

Number of rows per plot harvested for yield: 2

Length of row harvested for yield: 40 ft.

Row width: 30 inches

Any comments on environmental conditions during the growing season, diseases, etc.:

1. Variety SVC 1036 was planted on 6-6-73.

2. Rainfall and other growing conditions normal.

3. Variety Atlas, Bonus, Chief, Capital, SVC 1036 are too late for S.D. After harvest (after freeze) many plants were green and were dried in greenhouse before threshing. About 10-12% beans were moldy when threshed, of the late varieties.

SUNFLOWER RESEARCH

Harry A. Geise

Objectives of Research

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

Sunflower Variety Trial

The variety trial in 1973 consisted of both confectionery and oilseed types. It was planted on May 11 with all plots receiving both an insecticide and a herbicide treatment.

Harvesting was completed on September 10 in order to prevent larger yield errors from shattering and bird depredation. The harvested heads were immediately placed in a dryer and left until dry enough for threshing.

Field observations prior to harvest indicated considerable damage by birds and insects. The results of the study are shown in Tables 33 and 34.

Table 33. Estimates of Damage to Sunflower Varieties by Diseases, Insects, and Birds - Southeast South Dakota Experiment Farm, Beresford, S.D. - 1973.

Variety	Powdery* Mildew Infection	Percent Leaf Rust	Percent Sunflower Moth	Percent Stem Girdling	Percent Knotted Heads	Percent Bird Loss
CONFECTIONERY						
Sundak	S	tr	11	3	8	4
Commander	M	2.7	6	0	9	5
Arrowhead	M	3.2	0	0	16	8
Mingren	M	2.5	6	0	15	3
OILSEED						
Romsun HS-52	S	1.8	7	3	8	8
Sputnik	S	2.2	8	8	11	7
Peredovik 66	S	1.8	12	3	10	9
Luch	M	1.3	8	2	11	9
Record	M	1.7	12	8	12	11
VNIIMK 8931-66	S	2.3	12	6	11	8

*Mildew Infection Score: L-light, M-moderate, S-severe.

Table 34. Percent Stand, Plant Height, Seed Quality and Yield of Confectionery and Oilseed Type Sunflowers - Southeast Experiment Farm, Beresford, S.D. - 1973.

Variety	Percent Stand	Height Inches	Test Wt Lbs/Bu	Seed Yield Lbs/Acre
CONFECTIONERY TYPE				
Sundak	83	73	25.4	1352
Commander	78	70	26.5	1305
Arrowhead	74	64	30.0	1212
Mingren	79	72	26.6	1086
				Mean - 1239
OILSEED TYPE				
Romsun HS-52	87	75	29.0	1514
Sputnik	85	75	29.5	1493
Peredovik 66	95	78	31.1	1290
Luch	87	75	30.5	1272
Record	91	90	31.7	1233
VNIIMK 8931-66	91	78	30.6	1193
				Mean - 1332

Note: Yield differences are not statistically significant.

MOST PROFITABLE ROTATION 1973

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 grow a legume in rotation?
4. How much will commercial fertilizer increase net profits?

Methods and Procedures

Early wet soil conditions made the seeding of crops somewhat difficult and uneven emergence caused some problems in row crops. Planting dates were nearly normal for all crops.

Varieties Used:

Corn - Curry's SC 160
Oats - Kota
Alfalfa - Vernal
Soybeans - Corsoy
Grain sorghum - NK 222
Sweet clover - Madrid

Table 35. Effect of Cropping Sequence and Fertilizer on Crop Yield, 1973

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	--		42.0				
1 Continuous corn	Corn	6 + 11 + 10	70		104.0				
2 Corn-oats	--	0 + 0 + 0	--	29.0	39.0				
2 Corn-oats	Corn	6 + 11 + 10	70		76.0				
	Oats	30 + 7 + 0	--	45.0					
3 Corn-corn-oats+alf-alf hay	--	0 + 0 + 0	--	48.0	47.0	75.0			0.96
3 Corn-corn-oats+alf-alf hay	Corn	6 + 11 + 10	--		61.0				
	Corn	6 + 11 + 10	70			81.0			
	Oats	15 + 26 + 0	--	69.0					
	Alf residual	0 + 0 + 0	--						1.46
4 Oats+sweet clover-corn	--	0 + 0 + 0	--	46.0	59.0				
4 Oats+sweet clover-corn	Oats	30 + 7 + 0	--	57.0					
	Corn	6 + 11 + 10	--		51.0				
5 Corn-soybean oats	--	0 + 0 + 0	--	59.0	64.0		27.0		
5 Corn-soybeans-oats	Corn	6 + 11 + 10	70		71.0				
	Soybeans	6 + 11 + 10	--				26.0		
	Oats	30 + 7 + 0	--	81.0					
6 Corn-oats-soybeans	--	0 + 0 + 0	--	20.0	78.0		21.0		
6 Corn-oats-soybeans	Corn	6 + 11 + 10	55		104.0				
	Oats	20 + 7 + 0	--	55.0					
	Soybeans	6 + 11 + 10	--				27.0		
7 Continuous Grain Sorghum	--	0 + 0 + 0	--					44.0	
7 Continuous Grain Sorghum	Sorghum	6 + 11 + 10	70					73.0	

Table 36. Yield Increases Due to Commercial Fertilizer in Rotation Study

Rotation No.	Cropping Sequence	Corn 1st Year Bu/A	Corn 2 Year Bu/A	Oats Bu/A	Soy-beans Bu/A	Grain Sorghum Bu/A	Alfalfa Ton/A
1	Continuous corn	62	--	--	--	--	--
2	Corn-oats	37	--	16	--	--	--
3	Corn-corn-oats+alf-alf hay	14	6	21	--	--	0.5
4	Oats+sweet clover-corn	-8	--	11	--	--	--
5	Corn-soybeans-oats	7	--	22	-1	--	--
6	Corn-oats-soybeans	26	--	35	6	--	--
7	Continuous grain sorghum	--	--	--	--	29	--

Discussion and Interpretation of Tables 35 and 36

Notice the large increase in yield of corn in sequence number 1 due to commercial fertilizer. When nitrogen was provided by alfalfa and sweet clover (sequences 3 and 4) yield response to fertilizer by corn was less. We still have to pay for nitrogen whether it is cash-out-of-pocket or in terms of soil moisture reserves pumped out by the legume. With nitrogen at a nickel a pound, it was cheaper to buy it than grow it, but with the recent increases in price and possible shortages of commercial nitrogen, legume nitrogen is going to play a more important role.

Oats yields were not very high this year in some rotations. The response to fertilizer by oats was substantial.

Fertilizer increased yield of beans in the corn-oats-beans rotation.

Sorghum yields were increased by fertilizer in a year of midseason moisture stress.

EFFECT OF ENVIRONMENT AND FEEDING ANTIBACTERIAL COMPOUNDS DURING EARLY GROWTH ON PERFORMANCE OF GROWING-FINISHING PIGS

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

It has been recommended by the Food and Drug Administration Task Force that antimicrobial agents used in clinical medicine be prohibited from use as growth promotants in animals after December 31, 1973. They have asked for further research on the efficacy and safety of these compounds, particularly in the area of development of resistant organisms. Early research conducted at South Dakota and several other stations indicated that the greatest benefit in growth performance occurs when these compounds are included in rations of young pigs. It was also shown that removing an antibiotic from the feed at about 100 lb. live weight resulted in a loss of part of the increased gain by market weight.

The objectives of this experiment were to study the value of several antimicrobial agents as feed additives when included in the diet of young weaned pigs for approximately 5 weeks and to compare the performance of pigs fed in an enclosed confinement building with those fed in an outside, open-front building.

Experimental Procedure

Sixty-four crossbred pigs that averaged about 26 lb. were allotted to two replications of four treatments. Eight pigs, six barrows and two gilts, were assigned to each lot. One replicate of four pens was housed in concrete floored pens in a totally enclosed building, while the other replicate of four pens was housed in open-front, uninsulated buildings having concrete floored pens and outside feeding areas.

All pigs were fed the basal diets shown in Table 37. Antimicrobial compounds were added to the diets during the first 37 days of the experiment and then removed and all treatments were fed the unsupplemented basal diets to termination of the experiment at an average weight of about 185 pounds.

The experimental treatments for the first 37 days were as follows:

1. No additive (control)
2. 200 g furazolidone (Furox) per ton
3. 150 g furazolidone, 100 g oxytetracycline and 90 g arsanilic acid (FOA) per ton
4. 100 g chlortetracycline, 100 g sulfamethazine and 50 g penicillin (ASP-250) per ton.

Results

The effect of the various antimicrobial compounds on growth performance is shown in Table 38. There were significant differences in average daily gain and feed/gain for the 37-day period that antimicrobial compounds were included in the diet. Daily gains were increased 0.17, 0.30 and 0.42 lb. by feeding ASP-250, Furox and FOA, respectively. Feed efficiency was also improved from 6 to 12% when pigs were fed these growth promotant compounds.

The initial treatment during the first 37 days did not appear to have any effect on performance of the pigs during the subsequent 70-day period when all pigs were fed the basal diet. Gains, feed consumption and feed efficiency were similar for all treatments during this period. The advantage in increased gains observed during the first 37 days was essentially maintained for the remainder of the experiment. However, when considering the entire experiment, average daily gains for pigs fed the antimicrobial compounds were only slightly better than those of pigs fed the control diets. Daily gains were 1.42, 1.47, 1.55 and 1.48 for pigs fed the basal, Furox, FOA and ASP-250 diets, respectively. There were no differences in feed efficiency for the total experimental period.

The comparison of pigs housed in total confinement or in open-front buildings is summarized in Table 39. No significant differences were found in average daily gain. However, during the final 70-day feeding period pigs housed in the open-front buildings consumed significantly more feed than those housed in total confinement and they consumed approximately 10% more feed daily during the entire experiment.

Less feed was required per lb. of gain when pigs were confined indoors. As an average of the experiment, pigs fed in outside lots required 6% more feed per lb. of gain than those pigs fed in confinement. This experiment was conducted from November 1 to February 16 and the data indicate that pigs fed outside had to utilize a part of the energy of their diet for body heat. The pigs appeared to compensate for this by consuming more feed and maintaining their gains equal to those pigs fed in a building where temperature rarely fell below 50° F.

More feet and leg problems, tail biting and poor growth were encountered with pigs in the confinement house as indicated by the fact that nine pigs were removed from this group and only two pigs needed to be removed from the outside group. It is not possible to conclude whether these differences were totally due to housing conditions.

Summary

Sixty-four weanling pigs were used in an experiment to study the effects of feeding furazolidone, a furazolidone-oxytetracycline-arsanilic acid mixture and a chlortetracycline-sulfamethazine-penicillin mixture for 37 days. All of the antimicrobial compounds increased gains and improved feed efficiency during the 37-day period they were fed. These compounds did not have any carry-over effect on performance of pigs fed the basal diet for a subsequent 70-day period. Feeding the above compounds for the initial 37 days of the experiment resulted in overall increases in daily gain from 0.05 to 0.13 pound.

Pigs fed in total confinement required less feed per unit of gain than pigs housed in open-front buildings and fed in outside lots. Gains did not differ significantly among these treatments.

Table 37. Composition of Basal Diets (Percent)

	To 125 lb.	125 to 200 lb.
Ground yellow corn	79.4	89.8
Soybean meal (44%)	17.7	7.9
Dicalcium phosphate	1.7	1.1
Ground limestone	0.5	0.5
Trace mineral salt (0.8% zinc)	0.5	0.5
Vitamin premix[a]	0.2	0.2

[a]Provided per lb. of diet: vitamin A, 1500 IU; vitamin D, 200 IU; riboflavin, 1.25 mg; panthothenic acid, 5 mg; niacin, 10 mg; choline, 50 mg and vitamin B_{12}, 7.5 mcg.

Table 38. Effect of Feeding Antimicrobial Compounds for 37 Days on Performance of Growing-Finishing Pigs

	Control	Purox	FOA	ASP-250
		First 37 days		
Number of pigs	16	16	16	16
Avg. daily gain, lb.*	0.90	1.20	1.32	1.07
Avg. daily feed, lb.	2.47	3.04	3.20	2.79
Avg. feed/gain**	2.76	2.54	2.43	2.60
		From 37 days to termination		
Number of pigs[a]	13	13	12	15
Avg. daily gain, lb.	1.65	1.57	1.66	1.67
Avg. daily feed, lb.	5.67	5.58	6.05	5.75
Avg. feed/gain	3.44	3.54	3.64	3.44
		Complete trial		
Number of pigs[b]	13	13	12	15
Avg. daily gain, lb.	1.42	1.47	1.55	1.48
Avg. daily feed, lb.	4.62	4.85	5.11	4.74
Avg. feed/gain	3.24	3.30	3.28	3.20

[a] Eleven pigs were removed during this period because of tail biting, leg problems and failure to grow.
[b] Data adjusted to include only those pigs that completed the experiment.
* Significant treatment differences (P<.05).
** Significant treatment differences (P<.01).

Table 39. Effect of Type of Housing on Growth Performance

	Total confinement	Open-front
Number of pigs started	32	32
Number of pigs finished	23	30
Avg. initial wt., lb.	25.6	25.9
Avg. final wt., lb.	181.2	187.2
Avg. daily gain, lb.		
First 37 days	1.10	1.14
37 days to end	1.59	1.68
Complete trial	1.45	1.50
Avg. daily feed, lb.		
First 37 days	2.77	3.01
37 days to end**	5.17	6.04
Complete trial	4.54	5.03
Avg. feed/gain		
First 37 days*	2.52	2.64
37 days to end	3.25	3.60
Complete trial*	3.14	3.34

*Significant difference ($P<.05$).
**Significant difference ($P<.01$).

WHY ADD VITAMIN SUPPLEMENTS TO DIETS OF GROWING-FINISHING PIGS?

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

A great deal of variation appears to exist in the amount of supplemental vitamins that are added to diets for growing-finishing pigs. Many pigs are fed diets that do not contain any supplemental vitamins, others receive diets containing levels of vitamins that meet the recommendations of the National Research Council (NRC) and still others are fed diets containing levels of vitamins considerably higher than the NRC recommended levels. This experiment was conducted to determine the value, if any, of recommended and excess levels of vitamins in growing-finishing pig diets.

Experimental Procedure

Seventy-two crossbred pigs averaging about 35 lb. were allotted to three replications of three treatments on the basis of weight, sex and ancestry. Each lot was composed of four barrows and four gilts. The pigs were housed in a confinement, slotted floor building. The 5 x 16 foot pens of each replicate varied in slotted floor area. Floors were totally slotted in the pens of replicate 1, 25% slotted in pens of replicate 2 and 50% slotted in pens of replicate 3.

The compositions of the corn-soybean meal basal diets, which were self-fed, are shown in Table 40. The diets were changed from 15% protein to 12% protein when pigs averaged approximately 125 pounds.

The three treatments were as follows:

1. Basal diet, no added vitamins
2. Basal diet plus recommended levels of vitamins
3. Basal diet plus excess levels of vitamins.

The compositions of the vitamin supplements are shown in Table 41. The supplement used in treatment 2 supplied vitamins at levels near those recommended by the NRC, while the supplement used in treatment 3 supplied 20 times the levels of vitamins A and D and 5 times the levels of B vitamins that were added to treatment 2.

Results

Performance data for this experiment are shown in Table 42. Pigs in treatment 1 that were fed the basal diet without supplemental vitamins grew at a slower rate during both the growing and finishing phases than pigs fed supplemental vitamins. This slower growth was accompanied by a reduced feed intake and slightly increased feed requirement. Average daily gains up to an average pig weight of 125 lb. were 1.31 for pigs fed the unsupplemented diet and 1.51 and 1.48 lb. for pigs receiving the vitamin supplemented diets. However, after 125 lb. the difference in gains was greater as the unsupplemented pigs gained only 1.26 lb. per day compared to 1.63 and 1.57 lb. per day for pigs fed vitamin supplemented diets. This larger difference in gains is probably a reflection of the greater difference in feed consumption. During the growing phase, pigs fed supplemental vitamins consumed approximately 0.36 lb. more feed daily and during the finishing phase they consumed about 0.95 lb. more feed daily than pigs that were fed the diets without vitamin supplementation. There was a greater variation in performance of pigs in treatment 1 than in the other two treatments. This could indicate some difference in individual pig requirements for vitamins and it is also possible that these pigs were more susceptible to certain stress conditions. Four pigs had to be removed from this treatment compared to three pigs in treatment 2 and none in treatment 3.

There were no advantages in growth rate or feed/gain by increasing vitamins above the NRC recommended levels. Performance was similar for these two vitamin supplemented treatments during both the growing and finishing periods.

Summary

Seventy-two weanling pigs were used in an experiment to study the effect of supplemental vitamins added to a corn-soybean meal diet. Pigs fed supplemental vitamins gained about 18% faster and required 3% less feed than pigs that did not receive a vitamin supplement. Feed consumption was significantly lower for pigs fed the unsupplemented diets. There was no advantage of increasing the vitamin levels over NRC recommended levels.

Table 40. Composition of Basal Diet (Percent)

Ingredients	To 125 lb.	125 to 200 lb.
Ground yellow corn	79.4	89.8
Soybean meal (44%)	17.7	7.9
Dicalcium phosphate	1.7	1.1
Ground limestone	0.5	0.5
Trace mineral salt (0.8% zinc)	0.5	0.5
Premix	0.2	0.2

Table 41. Vitamins Added Per Pound of Diet

	Treatment		
	1	2	3
Vitamin A, IU	0	800	16,000
Vitamin D, IU	0	90	1,800
Vitamin E, IU	0	5	10
Riboflavin, mg	0	1.25	6.25
Pantothenic acid, mg	0	5	25
Niacin, mg	0	10	50
Choline, mg	0	50	250
Vitamin B_{12}, mcg	0	7.5	37.5

Table 42. Effect of Vitamin Supplementation on Performance of Growing-Finishing Pigs

	Treatment[a]		
	1	2	3
Number of pigs[b]	20[c]	21[c]	24
Avg. initial wt., lb.	35.4	35.6	35.3
Avg. final wt., lb.	174.2	199.2	198.2
Growing phase			
Avg. daily gain, lb.	1.31	1.51	1.48
Avg. daily feed, lb.	3.91	4.30	4.25
Feed/gain	3.04	2.89	2.86
Finishing phase			
Avg. daily gain, lb.	1.26	1.63	1.57
Avg. daily feed, lb.	5.24	6.20	6.17
Feed/gain	4.40	3.89	3.92
Growing and finishing			
Avg. daily gain, lb.	1.30	1.55	1.52
Avg. daily feed, lb.[d]	4.36	5.09	5.01
Feed/gain	3.41	3.32	3.29

[a]Treatment 1, no added vitamins; treatment 2, recommended levels and treatment 3, excess levels of vitamins.
[b]Three replicates of 8 pigs each per treatment.
[c]Two pigs died, three removed for rectal prolapse and two for leg weakness.
[d]Significant treatment differences (P<.05).

FEED ADDITIVES IN SWINE DIETS

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

The use of antibiotics and synthetic antibacterial compounds for therapy and prevention of bacterial diseases as well as their use for growth promotion of swine is well known. There is a constant search for new compounds, particularly those not used for humans, that will satisfy the needs of the swine producer. This past year a new synthetic antibacterial agent has been approved by the Food and Drug Administration. This compound is carbadox and is marketed under the trade name of Mecadox. This compound has a withdrawal time of 10 weeks; therefore, it is recommended to be fed only to a weight of 75 pounds.

An experiment was conducted at the Cornbelt Research and Extension Center near Beresford, South Dakota, to determine the effectiveness of Mecadox and other feed additives fed for a 5-week period, to study the effect of withdrawal of feed additives at this time on future growth performance and to study the effect of the antibiotic tylosin when fed during the finishing period.

Experimental Procedure

Ninety pigs were allotted to three replications of five treatments for the initial 5-week study. Each of the 15 lots consisted of three barrows and three gilts. Initial weights varied among replicates and were approximately 33, 25 and 19 lb. for replicates 1, 2 and 3, respectively. The pigs were housed in a total confinement building in pens 5 feet by 16 feet.

The pigs were self-fed the basal diet shown in Table 43. The feed additives that were included in the basal ration for the five treatments were as follows:

1. No additive (control)
2. 50 g Mecadox per ton
3. 100 g furazolidone (Furox) per ton
4. 100 g furazolidone, 100 g oxytetracycline and 90 g arsanilic acid (FOA) per ton)
5. 100 g chlortetracycline, 100 g sulfamethazine and 50 g penicillin (ASP-250) per ton.

After 5 weeks on the above diets the pigs were reallotted within treatments from the three replicate lots of six pigs to two replicate lots of eight pigs each. One barrow and one gilt were removed from each of the five treatments in order to equalize numbers in all replicates due to the loss of four pigs during the previous 5-week treatment period. One lot of pigs from each of the five previous treatments was fed the basal diet and the other lot received the basal diet supplemented with 20 g of tylosin per ton of diet. This part of the experiment was conducted for 84 days. The average final weight of pigs was approximately 185 pounds.

Results

Table 44 summarizes the growth performance of pigs during the initial 5-week period. The data are presented for each replicate to show differences observed due to differences in initial weights. There were significant ($P<.01$) differences in average daily gains. All of the pigs fed the various feed additives grew at a faster rate than those fed the basal diet. Increases in gain were 9, 20, 20 and 27% when pigs were fed Furox, Mecadox, FOA or ASP-250, respectively. A significant difference in rate of gain was also observed between replicates as the heavier pigs grew at the fastest rate. Rates of gain for the 5-week period were 1.31, 1.09 and 0.94 lb. per day for pigs having initial weights of 33, 25 and 19 lb., respectively.

An average of about 0.3 lb. more feed was consumed daily by pigs fed the various feed additives than was consumed by pigs fed the basal diet. There also was a significant ($P<.01$) difference in feed consumption between replicates. Feed/gain was not significantly different, although pigs fed FOA, ASP-250 or Mecadox were more efficient in feed conversion than those pigs fed the basal diet or the Furox-supplemented diet.

The results of the second phase of this experiment, involving feeding tylosin to pigs that had been fed the various feed additives for a 5-week period as discussed previously, is shown in Table 45. There were no significant differences in daily gains, although pigs fed tylosin gained 0.07 lb. per day faster than those fed

the basal diet. Pigs fed tylosin gained faster when they received a feed additive in their diet during the initial 5-week period than did pigs fed tylosin following a nonadditive diet. When the feed additive was removed from the diet after 5 weeks, there was no carry-over effect of the additive on rate of gain except for pigs that had received ASP-250 previously. These pigs gained about 0.15 lb. per day faster than the other pigs fed the basal diets from 66 to 186 pounds. Of the pigs receiving tylosin, the fastest gains were also by those pigs fed ASP-250 previously.

Previous treatment affected feed consumption during the final period. More feed was consumed daily by pigs that had previously been fed feed containing FOA or ASP-250. This might have been due, in part at least, to the fact that these pigs were heavier when placed on these diets and continued to gain faster. Thus, an increase in feed consumption would be expected. Significantly less feed per gain was required by pigs fed tylosin during the final 84-day period. Pigs fed tylosin required only 3.09 lb. of feed per lb. of gain compared to 3.33 lb. of feed for those pigs fed the basal diet.

Summary

Ninety weanling pigs were used in an experiment to study the effects of feeding furazolidone, Mecadox, a furazolidone-oxytetracycline-arsanilic acid (FOA) mixture and a chlortetracycline-sulfamethazine-penicillin (ASP-250) mixture for 5 weeks. Eighty of these pigs were then reallotted to study the effect of the previous treatment on the response of pigs to tylosin. The experiment was terminated after 84 days on these diets when the pigs averaged 186 pounds.

A significant improvement in gain was observed during the initial 5-week period when feed additives were included in the diet. Pigs fed the diets containing additives consumed more feed daily and were more efficient in feed conversion except for the pigs fed Furox.

Pigs fed tylosin gained slightly faster and required significantly less feed/gain than pigs fed the basal diet during the period from 66 to 186 pounds. Pigs fed ASP-250 during the initial 5-week period continued to gain faster during the final 84-day period even when fed the basal diet, indicating a carry-over effect of this additive.

Table 43. Composition of Basal Diets (Percent)

	First 5 weeks	5 wk. to 125 lb.	125 to 200 lb.
Ground yellow corn	76.5	82.5	88.7
Soybean meal (44%)	20.7	14.8	8.9
Dicalcium phosphate	1.6	1.5	1.2
Ground limestone	0.5	0.5	0.5
Trace mineral salt (0.8% zinc)	0.5	0.5	0.5
Vitamin premix[a]	0.2	0.2	0.2

[a]Provided per lb. of diet: vitamin A, 1500 IU; vitamin D, 200 IU; riboflavin, 1.25 mg; panthothenic acid, 5 mg; niacin, 10 mg; choline, 50 mg and vitamin B_{12}, 7.5 mcg.

Table 44. Growth Performance of Pigs Fed Feed Additives for a Five Week Period[a]

	Control	Mecadox	Furox	FOA	ASP-250	Replicate average
			Average daily gain, lb.[b]			
Rep 1	1.09	1.36	1.34	1.36	1.40	1.31
Rep 2	0.95	1.15	0.97	1.12	1.29	1.09
Rep 3	0.87	0.96	0.87	1.02	1.00	0.94
Avg.	0.97	1.16	1.06	1.16	1.23	
			Avg. daily feed consumed, lb.[c]			
Rep 1	2.95	3.22	3.38	3.28	3.18	3.20
Rep 2	2.39	3.03	2.47	2.80	2.92	2.72
Rep 3	2.08	2.07	2.45	2.16	2.33	2.22
Avg.	2.47	2.77	2.77	2.74	2.81	
			Feed/gain			
Rep 1	2.71	2.36	2.53	2.41	2.27	2.46
Rep 2	2.50	2.66	2.53	2.50	2.27	2.49
Rep 3	2.39	2.15	2.79	2.14	2.32	2.36
Avg.	2.53	2.39	2.62	2.35	2.29	

[a]Six pigs per lot, avg. initial wt., 33, 25 and 19 lb. for replicates 1, 2 and 3, respectively.
[b]Significant treatment and replicate differences (P<.01).
[c]Significant replicate differences (P<.01).

Table 45. Effect of Tylosin on Growth Performance of Pigs[a]

Previous treatment	Control	Mecadox	Furox	FOA	ASP-250	Replicate average
			Average daily gain, lb.			
Basal diet	1.36	1.35	1.33	1.40	1.53	1.39
Tylosin (20 g/ton)	1.38	1.46	1.43	1.50	1.54	1.46
Avg.	1.37	1.40	1.38	1.45	1.53	
			Avg. daily feed consumed, lb.[b]			
Basal diet	4.51	4.46	4.37	4.90	5.04	4.66
Tylosin (20 g/ton)	4.26	4.39	4.29	4.93	4.72	4.52
Avg.	4.38	4.45	4.33	4.92	4.88	
			Feed/gain[c]			
Basal diet	3.34	3.24	3.28	3.50	3.30	3.33
Tylosin (20 g/ton)	3.09	3.00	3.01	3.27	3.08	3.09
Avg.	3.20	3.17	3.15	3.39	3.19	

[a]Eight pigs per lot, avg. initial wt., 66 lb., avg. final wt., 186 lb.
[b]Significant (P<.01) difference due to previous treatment.
[c]Significant (P<.01) difference due to tylosin.

ALFALFA HAY-STRAW AND CORN SILAGE RATIONS FOR PREGNANT BEEF COWS

Richard M. Luther and Alan Vogel

A beef cow herd consisting of 30 Hereford x Angus heifers was established at the Experiment Farm in January, 1972. The heifers were bred A.I. to an Angus bull and calved their first calves from June 10 through July 20. Three heifers were not pregnant. An experiment was conducted the first year to study the value of alfalfa hay, haylage, straw and corn silage in gestation rations for pregnant heifers. The 140-day study covered the last part of the gestation period. Feedlot and reproductive performance for the trial was reported in the 1972 Annual Progress Report for the Southeast Experiment Farm.

Following calving the herd was maintained in dry lot through the summer, fall and early winter months. Mixtures of corn silage, alfalfa hay and corn grain were fed. One cow waa culled. The remaining 29 cows being exposed to a purebred Hereford bull for 65 days (October 16 to December 20, 1973). The calves were weaned February 1, 1973. Following weaning the cows were used in a second experiment to study the use of alfalfa hay, straw and corn silage in gestation rations.

Procedure

Twenty-nine cows were allotted to two pens with 15 and 14 cows per pen. The allotment was on the basis of body weight and 1972 ration treatments. Half of the cows from each of the 1972 treatments were allotted to the alfalfa-straw ration and half to the corn silage ration. One lot was fed alfalfa hay and straw which was chopped through a forage harvester. Straw was replaced with hay the last 37 days of the trial. Ground corn grain was fed at a rate of 1 lb. per cow per day the last half of the experiment. A second lot of cows was fed corn silage and 0.5 lb. of protein supplement. The supplement was formulated to contain 39% crude protein and contained the following ingredients: soybean meal, 85.2%; dicalcium phosphate, 10%; and vitamin A premix, 4.8%. The supplement contained 40,000 I.U. vitamin A per pound.

During a 57-day period, February 8 through April 5, both lots of cows were housed under shelter which allowed the cows access to outside lots. Feedbunks and automatic waterers were inside. From April 6 through June 29 the cows were kept in two outside lots without shelter. One cow was culled from the alfalfa hay-straw treatment when the cows were moved outside. The experiment was terminated on June 29. Three cows in each ration treatment were not pregnant and were removed. The remaining eleven cows in each ration treatment calved with the first calf being born July 17. Each cow and calf were weighed at calving. The calves were eartagged at birth. Measures of the effect of gestation rations on beef cows include rate of growth and feed consumption and reproductive performance.

Results - 1973 Experiment

Because the cows were moved from an indoor to an outdoor environment the results have been summarized in three parts. Table 46 shows the feed and gain data for the first 57 days when the cows were housed inside. Table 47 gives the

data for the last 84 days when the cows were kept in outside lots without shelter. The combined data for 141 days are presented in Table 48 along with results of the 1972 study.

Cows fed chopped alfalfa hay and chopped straw gained an average of 29 lb. per cow the first 57 days. However, these cows lost an average of 18 lb. per cow the last 84 days. The combined data show a net gain for the experiment of 11 lb. per cow. In contrast, the cows fed corn silage and protein supplement gained 66 and 61 lb. per cow, respectively, for the first and second period with an overall total gain of 127 lb. per cow.

Feed consumption varied some during the trial due to variability in quality and moisture content of the feeds. Mixing chopped straw with the hay did not eliminate sorting of hay from the mixture. Maximum dry matter consumption was achieved by replacing the straw with hay in the ration. Addition of a pound of corn grain per cow helped to maintain but did not increase cow weight. The average dry matter content of corn silage fed the first 57 days was 27% and 35% the last 84 days. This resulted in dry matter consumption for the cows fed silage of 11.7 and 17.9 lb., respectively, for the first and second phases of the study. In comparison, consumption of dry matter by cows fed the hay-straw ration was 14.8 and 16.9 lb., respectively. According to the National Research Council the daily dry matter requirement for a 1100 lb. cow is 16.7 lb. Since nutrients such as energy, protein, minerals and vitamins are contained in the dry matter it is important that adequate feed intakes be maintained. Nutrient inadequacies which may have occurred in this trial bear little, if any, relationship to the weight gains obtained.

The lowered weight gains the last 84 days of the trial appears to be related to climatic conditions, particularly to those which occurred the first 3 weeks the cows were kept outside without shelter. During this period average maximum and minimum temperatures were 59 and 35 degrees, respectively, with 1.5 inches of rainfall. The dirt floors of the pens were very wet with water accumulations in some areas. Cows fed the alfalfa hay-straw ration lost an average of 20 lb. per cow; cows fed corn silage lost 16 lb. per cow. The losses were recovered subsequently by cows fed silage but not by the cows fed the hay-straw ration.

Results - 1972 and 1973 Experiments

Gain and feed consumption data for two years of research are shown in Table 48. Reproductive performance is presented in Table 49.

The nutrient requirements of the beef cow are normally at a low point during early gestation. During the last 30 to 60 days before calving nutrients are used for fetal growth and development and for maintenance of the cow. Requirements are fairly well established for the beef cow that calves in the spring. In the present studies the gestation period covered the late winter and early spring months with calving during the summer months. The herd was maintained under dry lot conditions with liberal use of roughages in the feeding program. Under the conditions of this study several comparisons can be made.

In both trials the cows fed corn silage supplemented with protein, minerals and vitamin A made excellent gains and were in good to excellent condition at calving time. On the other hand, the cows fed alfalfa hay and a low quality roughage (cereal

straw) gained less weight and were in average condition (not thin) at calving time. The hay-straw ration required more feed bunk management than the corn silage ration. The cows tended to sort the hay from the mixture. No health problems were encountered with the herd.

Nutrition has been shown to have an important influence on reproductive performance of the cow. A summary of reproductive performance for the two trials is presented in Table 49.

The amount of weight lost through calving is a fair indication of the adequacy of the feeding program during gestation. It is also an indication of what the feeding program should be for the cow from calving through re-breeding. In the 1972 trial the cows which were fed alfalfa hay and straw with no additional energy or protein lost 13 lb. from final to post partum weight as compared to 50 lb. for cows fed corn silage and protein supplement. Likewise in 1973 cows fed the hay-straw ration with some additional energy from corn grain lost 64 lb. Cows fed corn silage lost 106 lb. through calving. Weight losses were not as severe in 1972 as they were in 1973. This appears to be due in part to the time post partum weights were taken and partly to the influence of shelter in the 1972 study. The losses in 1972 were rapidly re-gained between calving and breeding.

Of the 14 cows used on each treatment (1973) eleven gave birth to calves. Nine of the eleven calves from cows fed the hay-straw ration were alive at birth. All calves from cows fed the corn silage ration were born alive. The average birth weight of calves regardless of sex was 2.5 lb. heavier for calves from cows fed the hay-straw ration.

The range in calving dates in 1973 for cows fed alfalfa hay and straw was 62 days compared to 49 days for cows fed corn silage.

Summary

Under the conditions of these studies the results indicate that a mixture of alfalfa hay and a low quality roughage such as cereal straw will support adequate weight gains during the gestation period of beef cows. Corn silage supported gains somewhat in excess of those believed desirable for cows of this weight and condition.

Table 46. Gestation Rations for Cows Housed Indoors (February 8 to April 6, 1973 - 57 days)

	Rations	
	Alfalfa Hay-Straw	Corn Silage
No. cows	15	14
Av. initial wt., lb.	1070	1066
Av. final wt., lb.	1099	1132
Av. total gain, lb.	29	66
Av. daily gain, lb.	0.51	1.16
Av. feed consumption, lb.		
Alfalfa hay	9.78	1.69[1]
Straw	8.39	--
Corn silage	--	36.83
Protein supplement	--	0.50
Total (as fed)	18.17	39.02
Total (dry basis)	14.78	11.69

[1]Hay used first 2 weeks of adaptation to silage.

Table 47. Gestation Rations for Cows Kept Outdoors (April 6 to June 29, 1973 - 84 days)

	Rations	
	Alfalfa Hay-Straw	Corn Silage
No. cows	14[1]	14
Av. initial wt., lb.	1107	1132
Av. final wt., lb.	1089	1193
Av. total weight change, lb.	-18	61
Av. daily gain or loss, lb.	-0.21	0.73
Av. daily feed consumption, lb.		
Alfalfa hay	14.32	--
Straw	3.89	--
Corn silage	--	49.96
Corn grain	1.07	--
Protein supplement	--	0.49
Total (as fed)	19.28	50.45
Total (dry basis)	16.86	17.88

[1]One poor doing cow culled.

Table 48. Summary of 1972 and 1973 Experiments
Gain and Feed Consumption

Year	1973		1972	
Period	2-8 to 6-29		1-21 to 6-9	
Days	141		140	
Treatment	Alfalfa hay-straw	Corn silage	Alfalfa hay-straw	Corn silage
No. cows	14	14	15	15
Av. initial wt., lb.	1074	1066	864	864
Av. final wt., lb.	1089	1193	936	1024
Av. total gain, lb.	15	127	72	160
Av. daily gain, lb.	0.11	0.90	0.51	1.14
Av. daily feed consumption, lb.				
Alfalfa haylage	--	--	9.12	--
Alfalfa hay	12.49	0.68[1]	3.64	--
Corn silage	--	44.65	--	35.78
Straw	5.71	--	7.96	--
Corn grain	0.64	--	--	--
Protein supplement	--	0.50	--	0.50
Total (as fed)	18.84	45.83	20.72	36.28
Total (dry basis)	15.58	14.34	14.73	14.36

[1]Hay fed first 2 weeks of trial.

Table 49. Summary of 1972 and 1973 Experiments
Reproductive Performance

	1973		1972	
	Alfalfa hay-straw	Corn silage	Alfalfa hay-straw	Corn silage
No. cows	14	14	15	15
No. cows not pregnant	3	3	2	1
No. cows calving	11	11	13	14
Final cow wt., lb.[1]	1089	1193	936	1024
Av. cow wt., post partum, lb.[2]	1025	1087	923	974
Weight change, lb.	-64	-106	-13	-50
No. calves born[3]	11	11	14	16
No. calves lost[4]	2	0	3	3
No. live calves	9	11	11	13
Av. birth wt., lb.[5]	67.7	65.2	54.1	55.1
Range of calving dates	7/31 to 9/30	7/17 to 9/3[6]	6/10 to 7/23	6/15 to 7/20

[1]Weight at end of feeding experiment.
[2]Cows calving. Weight taken immediately after calving in 1973 and 2 days post partum in 1972.
[3]Twins born to 2 cows fed alfalfa hay-straw and 1 cow fed corn silage in 1972. No twins born in 1973.
[4]All dead at birth.
[5]Weights recorded 2 days post partum in 1972 and on same day in 1973.
[6]One cow calved November 4 not included.

BACKGROUNDING BEEF STEER CALVES FOR VARYING RATES OF GROWTH

Alan Vogel and Richard M. Luther

Backgrounding is not a new concept in beef cattle production. In a backgrounding operation beef calves are "grown out" from weights of 300 to 500 lb. to weights from 500 to 700 lb. Approximately 200 lb. of growth is put on a calf. Forages play an important role in backgrounding rations. However, some grain is usually required depending on how rapidly the cattle are to gain. The question then arises as to what level of gain is desirable in a backgrounding period when the cattle subsequently are taken to market weight on a high concentrate ration. Does backgrounding affect the overall gains and feed conversion? How do the cattle grade? What about carcass quality? All of these questions are frequently asked about the backgrounding of beef cattle.

To answer these questions an experiment was initiated at the Southeast Experiment Farm in 1972. Only the backgrounding phase was completed when the 1972 Annual Progress Report of the Southeast Experiment Farm was published. The purpose of this paper is to present results of the finishing phase and to summarize the overall results of the trial with regard to feedlot performance and carcass characteristics.

Procedures - Backgrounding and Finishing Phases

The methods and procedures used in this experiment are outlined in the 1972 Annual Progress Report of the Southeast Experiment Farm, pages 74-78.

Results - Backgrounding Phase

Table 50 shows the results of the 112-day backgrounding or growing experiment. A more detailed summary appears in the 1972 Annual Report.

Table 50. Backgrounding Steer Calves
(March 8 to June 28, 1972 - 112 days)

Expected daily gain, lb.	1.00	1.60	1.90	2.25
Number steers	13[1]	13[2]	14	14
Av. initial wt., lb.	496	496	498	498
Av. final wt., lb.	575	640	675	683
Total gain, lb.	79	144	177	185
Av. daily gain, lb.	0.71	1.29	1.58	1.65
Av. daily ration, lb.	14.32	14.96	15.32	15.25
Feed/cwt. gain, lb.	2017	1160	960	931

[1]Died of bloat.
[2]Chronic bloater removed.

Steer gains were generally lower than those projected for the trial. Differences in feed consumption were due to the feeding program. The amount of feed was increased with each 50 lb. increase in body weight. Therefore, the slower gaining cattle were held at a given feed intake for a longer period of time than the faster gaining cattle. Feed required per cwt. gain followed the trends in growth.

Results - Finishing Phese

The results of the finishing phase are presented in Table 51.

Table 51. Results of Finishing Phese

	Backgrounding gains, lb. per day			
	0.71	1.29	1.58	1.65
No. steers	13[1]	13[2]	14	14
Finishing period, days	230	194	194	173
Av. initial shrunk wt., lb.	575	640	675	683
Av. final shrunk wt., lb.	1158	1167	1137	1153
Av. total gain, lb.	583	527	462	470
Av. daily gain, lb.	2.53	2.72	2.38	2.72
Av. daily feed, lb.[3]				
Chopped alfalfa hay	2.66	2.49	2.36	2.30
Ground corn	17.62	17.61	17.59	17.39
Protein supplement	1.63	1.61	1.70	1.72
Vitamin A and Iodine premix	.05	.05	.05	.05
Total	21.96	21.76	21.70	21.46
Feed/cwt. gain, lb.[3]				
Chopped alfalfa hay	105	92	99	83
Ground corn	695	648	738	626
Protein supplement	64	59	71	63
Vitamin A and Iodine premix	2	2	2	2
Total	866	801	910	774

[1] Died of bloat.
[2] Chronic bloater removed.
[3] As fed basis.

The steers backgrounded at the lower rate of gain required 230 days to reach market weight. Steers backgrounded at the intermediate growth rates reached market weight at 194 days while the steers which were backgrounded at the higher level required 173 days to reach market weight. The lowest rate of gain was obtained with steers backgrounded for 1.58 lb. per day gain. Steers that gained 1.29 and 1.65 lb. per day made finishing gains of 2.72 lb. per day. With the lowest rate of backgrounding gain (0.71 lb./day) the steers gained over 2.5 lb. per day during the finishing period. Feed conversion data followed the trend where the faster gaining cattle required less feed and the slower gaining cattle required more feed per unit of gain.

Table 52 shows the overall performance of steers through both the backgrounding and finishing phases. Steers backgrounded at 1.29 lb. per day gained 13% faster on 13% less feed than steers backgrounded for 0.71 lb./day gain. Gains and feed efficiency were 8% greater and 7% less, respectively, for steers backgrounded at 1.58 lb./day compared to those of steers backgrounded at the lowest rate of gain. Steers backgrounded at the highest rate of gain, 1.65 lb. per day, gained 19% faster on 19% less feed than steers backgrounded at the slowest rate of growth.

Table 52. Backgrounding and Finishing

	Backgrounding gains, lb. per day			
Expected gain	1.00	1.60	1.90	2.25
Actual gains obtained	0.71	1.29	1.58	1.65
No. steers	13[1]	13[2]	14	14
Overall feeding per., days	342	306	306	285
Av. initial wt., lb.	496	496	498	498
Av. final wt., lb.	1158	1167	1137	1153
Av. total gain, lb.	662	671	639	655
Av. daily gain, lb.	1.94	2.19	2.09	2.30
Av. daily feed, lb.[3]				
Chopped alfalfa hay	6.44	5.40	4.62	3.79
Ground corn	11.85	12.77	13.58	14.12
Protein supplement	1.10	1.02	1.08	1.05
Vitamin A and Iodine premix	.03	.03	.03	.03
Total	19.42	19.22	19.31	18.99
Feed/cwt. gain, lb.[3]				
Chopped alfalfa hay	333	246	221	164
Ground corn	612	582	650	614
Protein supplement	57	47	52	46
Vitamin A and Iodine premix	1	1	1	1
Total	1004	876	934	816

[1]Died of bloat.
[2]Chronic bloater removed.
[3]As fed basis.

Carcass characteristics of steers backgrounded for various rates of growth are shown in Table 53. Several comparisons can be made with the various carcass measurements recorded. The steers backgrounded at the lowest level of growth and requiring the most days on feed had a lower dressing percent, slightly more marbling and graded higher than cattle backgrounded for higher rates of gain. Other characteristics noted for cattle backgrounded for the lowest gains as compared to cattle with higher rates of backgrounding growth were: generally lower percent kidney fat, greater fat thickness over the loin and slightly smaller loin eye areas.

Table 53. Carcass Characteristics of Backgrounded Steers

	Backgrounding gains, lb. per day			
Expected gain	1.00	1.60	1.90	2.25
Actual gains obtained	0.71	1.29	1.58	1.65
No. carcasses	13	13	14	14
Hot carcass wt., lb.	706	735	710	717
Dressing percent[1]	60.96	62.99	62.44	62.15
No. grading choice	11	5	9	7
Marbling[2]	5.38	5.31	4.71	5.23
Carcass grade[3]	19.08	18.77	18.29	18.57
Kidney fat, %	2.92	3.31	2.86	3.25
Maturity[4]	23.00	22.92	22.93	22.93
Fat thickness, cm[5]	2.00	1.81	1.69	1.85
Loin eye area	11.1	11.9	11.6	11.5
Abscessed livers	12	10	9	13

[1] Hot carcass ÷ final shrunk wt. x 100.
[2] Slight = 4; small = 5; modest = 6.
[3] USDA grade. Good = 17; Choice = 20 Graded to 1/3 grade.
[4] A+ maturity = 22; A maturity = 23 (higher number represents younger carcass).
[5] Fat thickness external to loin eye.

Carcasses of steers backgrounded at 1.58 lb. per day graded lower largely as a result of less marbling in the loin eye. These steers had the least kidney fat and external fat covering, also indicating a carcass with less finish. These factors appear to relate to the poorest gains (2.38) in the finishing phase.

Carcass characteristics of steers backgrounded at 1.29 and 1.65 lb. per day were noticeably similar. These cattle made similar finishing gains, 2.72 lb./day.

The number of abscessed livers was high in all treatments. This was expected since an antibiotic was not used in the experiment. Antibiotics fed at continuous feeding levels have been shown to reduce liver abscesses.

Summary

The gains obtained during the growing period failed to meet the gains expected from rations of this type. Two lots of steers fed for higher but different backgrounding gains grew at essentially the same rate. Finishing gains did not reflect compensatory gains usually associated with lower growing gains. Carcass characteristics appeared to be related more to performance during the finishing period than to growth rate during the backgrounding period.

More research is needed to answer the questions frequently raised about the backgrounding of beef cattle.

ANIMAL WASTE MANAGEMENT

Maurice L. Horton, Richard M. Luther, John L. Wiersma, Albert Dittman,
Alan Vogel and James L. Halbeisen[1]

The nearly 5 million head of cattle in South Dakota annually produce more than 6 million tons of waste for disposal. The disposal of animal wastes have generally been considered a problem; however, with pending shortages of commercial fertilizers the value of manure to the land for crop production may increase. The nitrogen contained in the approximately 6 million tons of cattle manure is almost 4 times the amount of commercial nitrogen sold in South Dakota last year.

Livestock producers are concerned with development of waste management systems that are environmentally acceptable and economically feasible. Some of the concerns that arise include maximum disposal rates, runoff pollution control, salt accumulation in the soil, and feasible disposal methods.

In an attempt to answer some of the waste management problems, the South Dakota Agricultural Experiment Station established an animal waste management research project. In order to supplement existing waste management research the Water Resources Institute in conjunction with the Departments of Animal Science, Agricultural Engineering, Plant Science, and Microbiology of the Agricultural Experiment Station prepared a research proposal for consideration by the Environmental Protection Agency. The research proposed was timely and of high priority which led to rapid approval and funding.

The Cornbelt Research and Extension Center was selected as the research site for the project "Animal Waste Management in the Northern Great Plains." Work began on the EPA project on June 1, 1973.

The Water Resources Institute and Agricultural Engineering personnel remodeled the existing barn at the Center to house approximately 90 animals and constructed 8 open outdoor concrete surfaced lots for approximately 90 additional experimental animals. Concrete feed bunks and automatic waterers were purchased for all lots by the Animal Science Department and installed by Water Resources Institute and Agricultural Engineering personnel. Upon completion of facilities in early August, 176 steers were purchased and the experiment got underway.

The major objectives of the research are:

(1) Evaluate the effects of roughage content and salt content of the ration upon amount and composition of wastes from beef cattle in confined feedlots.
(2) Evaluate the influence of covered versus open pens upon the chemical and physical properties of wastes to be removed from the pens.

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[1] Associate Professor of Plant Science, Professor of Animal Science, Director of WRI, Research Associate, Assistant in Animal Science, and Graduate Assistant, respectively.

(3) Determine the maximum application rates for disposal of wastes on the land compatible with maintaining reasonable levels of crop production with pollution control.
(4) Determine the concentration and movement of chemical and bacteriological waste components by surface runoff or leaching through the soil under the prevailing climatic conditions.

Personnel involved in the project include:

(1) Dr. Richard M. Luther and Center employees Alan Vogel, Howard Livingston and Donald Anderson.
---responsible for ration forumulation, feeding, waste handling, feedlot operations, and assisting with field plots.
(2) Dr. Maurice Horton, James Halbeisen (Graduate Research Assistant; Plant Science) and Albert Dittman (Agricultural Engineering Research Associate).
---responsible for field plots, waste disposal, runoff measurements, sample collection and laboratory analyses.
(3) Mr. Dan Ronning (Graduate Assistant in Animal Science).
---assisting with feed and waste analyses.
(4) Dr. Paul Middaugh, Microbiology Department.
---responsible for microbiological analyses.
(5) Dr. L. O. Fine and Mrs. Shirley Mittan, Water Quality Laboratory.
---responsible for soil, runoff, and waste laboratory analyses.

Dr. John L. Wiersma is the project officer, Dr. Maurice L. Horton is principal investigator, and Mr. Douglas Kreis is the Environmental Protection Agency contract officer.

The research progress to date is discussed under the following headings:

(1) Effect of Environment and Salt Levels in Rations for Growing Beef Steers (see page 89 of this report).
(2) Field Plots and Waste Disposal Rates.

Field Plots and Waste Disposal Rates

A total of 68 field plots, each 120 ft. by 20 ft., were established on the Research Farm as soon as the land became available. Prior to any waste application, all field plots were sampled to a depth of 5 ft. using a power driven probe. Three sub-samples were taken in each of four depth increments within each plot and the sub-samples combined for analyses.

Field application rates are 0, 20, 40, 60, and 80 tons of dry waste per acre. The high salt levels and low salt levels waste are combined to give two levels of salinity for wastes applied to field plots. Wastes are sampled at time of application for physical and chemical analyses.

Manure was applied to 40, 60, and 80 ton/acre plots prior to fall freeze-up. Wastes accumulating during winter months are periodically removed from the

pens and placed in plastic lined outside storage bins until weather will permit field spreading. Field applied wastes were encorporated into the soil following application using a chisel plow.

Complete feed, soil, and waste analyses are now in progress. Of particular attention will be the salinity hazard of the wastes, the accumulation of salts and nutrients in the soil, and the effect of wastes upon soil properties and crop production.

A key field observation will be the amount and composition of snowmelt or rainfall runoff from the waste disposal plots. Elevation contours for the field disposal site have been determined to aid in runoff planning (see Figure 4). Equipment is currently being assembled to instrument 17 runoff plots for sample collection, volume measurement and distribution of runoff determinations. Samples collected will be analyzed for solids content, chemical composition, and microbiological contamination.

Laboratory analyses are not completed so analytical results are not available at this time.

Livestock feeders are invited to visit the Center and to discuss waste management research progress with the project leader or research director.

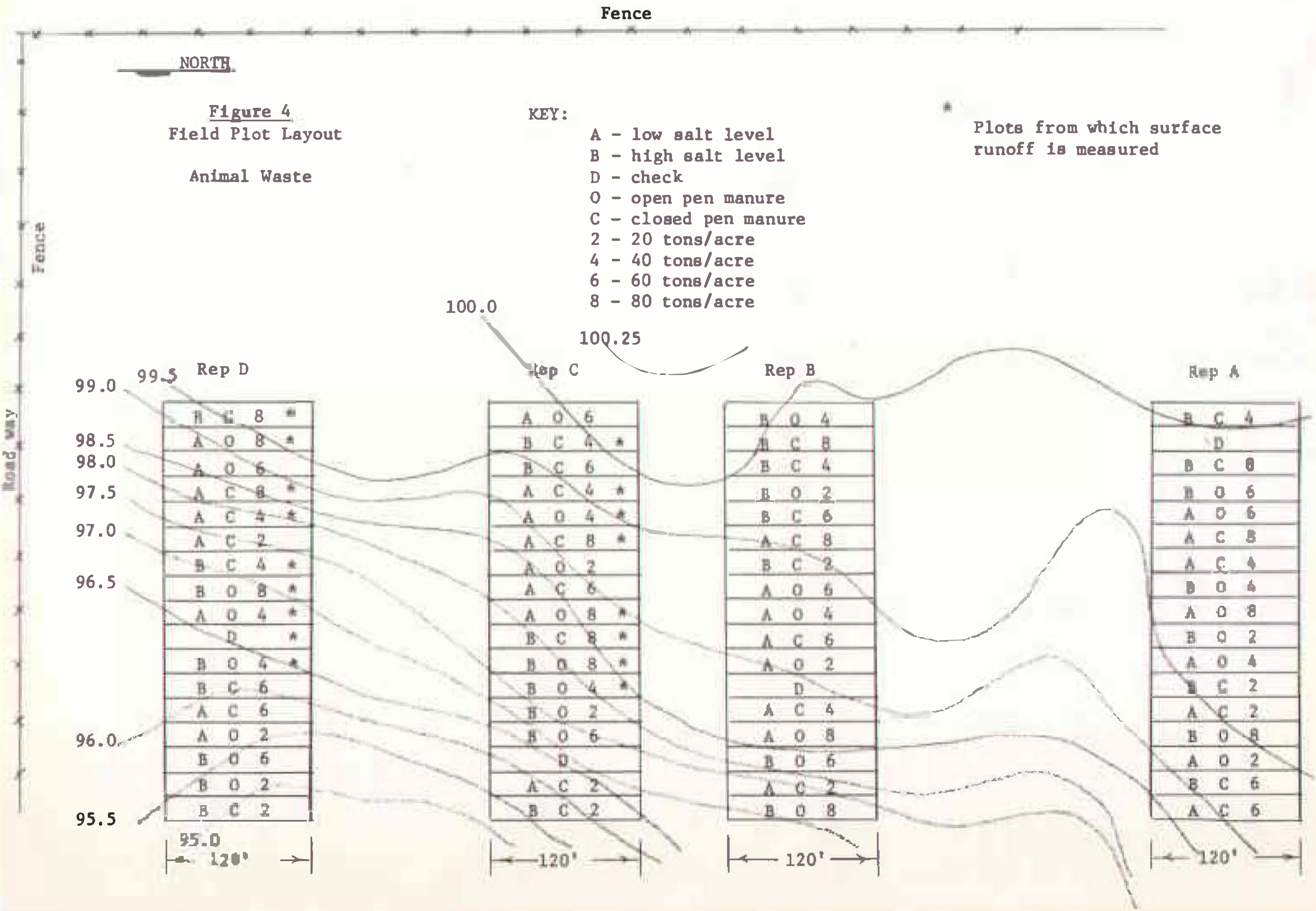

Figure 4
Field Plot Layout

Animal Waste

EFFECT OF ENVIRONMENT AND SALT LEVELS IN RATIONS FOR GROWING BEEF STEERS[1]

Richard M. Luther, Alan Vogel and Maurice L. Horton[2]

Salt is considered one of the lesser important nutrients in animal rations, however it plays an important role in body processes. It has been shown that salt has an important influence on feed consumption. The National Research Council suggests a level of 0.25% salt in the ration dry matter as being adequate to meet requirements of beef cattle. Continuing interest in returning animal wastes to the soil has prompted the study of the level of salt in the ration that would support adequate growth with minimum amounts appearing in animal wastes. Some soil types in low rainfall areas are sensitive to salt levels in feedlot manures. This report deals with the effects of various levels of salt in growing rations for beef cattle. The details of the project are reported in the previous paper.

Procedure

One hundred seventy six steer calves of mixed breeding were purchased by a local order buyer for use in the experiment. The steers, which were from several origins, were collected over a period of three weeks and held in drylot for allotment to the study. Following 15 hours without feed and water the steers were weighed, eartagged and implanted with Synovex S (200 mg. Progesterone and 20 mg. Estradiol Benzoate per steer). The cattle were allotted to 16 pens on the basis of weight and breeding with 11 steers per pen.

The design of the experiment was as follows:

	Environment							
	Shelter				No Shelter			
Replica-	Added Salt, %*				Added Salt, %*			
tion	0	0.25	0.50	0.75	0	0.25	0.50	0.75
	Steers/lot				Steers/lot			
I	11	11	11	11	11	11	11	11
II	11	11	11	11	11	11	11	11

*Percent of ration dry matter.

The pens were situated such that 8 lots were under shelter from a barn and 8 outdoors without shelter. The pens had concrete floors and were equipped with fence-line feed bunks and automatic waterers.

[1]This study is partially supported by a grant from the Environmental Protection Agency. The project is titled "Animal Waste Management in the Northern Great Plains."

[2]Professor of Animal Science, Assistant in Animal Science and Associate Professor of Plant Science, respectively.

The ration treatments were 0, 0.25, 0.50 and 0.75% salt added to the ration. Salt additions were based on dry matter content of the ration except for the first 16 days when salt was added on the basis of ration weight as fed. The major ingredient of the ration was corn silage from the 1972 and 1973 crops. A commercial liquid protein supplement (44% protein) was fed at the rate of 2 lb. per steer daily. An antibiotic premix was fed to provide 66 mg. chlortetracycline per steer daily. Feed grade salt (NaCl) was used to supply the added salt. The silage, supplement, antibiotic and salt were mixed in a horizontal batch mixer. The procedure was to mix a batch for two lots of cattle and then divide it proportionally depending upon the number of steers in the lots. Feed was distributed to each lot once daily using a mechanized feed cart attached to an IHC model 3200 front end loader.

Manure was removed from the pens periodically and spread on designated field plots or stored for spreading in the spring. No additional bedding was added to the pens.

Samples of the complete ration were collected weekly for moisture determinations. The salt level was adjusted periodically with changes in the dry matter content of the ration.

The experiment reported here started August 6 and was completed on December 18, 1973 for a total of 134 days. Filled weights were taken 29, 80 and 134 days from the start of the trial. Final shrunk weights were recorded after 15 hours without feed and water. The cattle will be continued on the same treatments in the same lots with a fattening ration containing ground corn grain, supplement and a limited amount of corn silage.

Results

The results of the growing trial are presented in Table 54.

The values are based on initial and final shrunk body weight and represent four lots of cattle fed each salt level. Because of relatively small differences in performance of inside and outside cattle these data were combined. The data have not been subjected to statistical analysis.

Average daily gains for the 0, 0.25, 0.50 and 0.75% levels of added salt were essentially the same. Gains were slightly lower and feed consumption higher for cattle fed 0.75% salt. More feed was required per unit gain for the cattle fed the higher level of salt.

The effect of environment is presented in Table 55. Average daily gains favored the cattle fed under shelter, however the difference was not large. The cattle outside without shelter consumed slightly more feed but required about 4½% more feed per unit gain than cattle under shelter. These results are consistent with previous studies at the Experiment Farm that show the benefits of shelter to be mainly in improved feed conversion.

The finishing phase of this study will be completed about mid-May, 1974. These results as well as results from other aspects of the project will be summarized as the project continues.

Table 54. Salt Levels for Growing Beef Calves
(August 6 to December 18, 1973 - 134 days)

	Added Salt to Ration			
	Percent of Ration Dry Matter			
	0	0.25	0.50	0.75
No. steers	42	44	43	42
Av. initial wt., lb.	442	442	445	443
Av. final wt., lb.	691	690	687	683
Av. daily gain, lb.	1.86	1.85	1.81	1.78
Av. daily ration, lb.[1]				
Corn silage	39.14	38.80	39.08	39.81
Alfalfa hay	0.23	0.23	0.23	0.23
Salt	—	0.04	0.08	0.12
Antibiotic premix[2]	0.05	0.05	0.05	0.05
Gr. limestone	0.03	0.03	0.03	0.03
Protein supplement	1.82	1.81	1.82	1.84
Total	41.27	40.96	41.29	42.08
Feed/cwt. gain, lb.[1]				
Corn silage	2104	2097	2159	2237
Alfalfa hay	12	12	13	13
Salt	—	2	4	7
Antibiotic premix[2]	3	3	3	3
Gr. limestone	2	2	2	2
Protein supplement	98	98	101	103
Total	2219	2214	2282	2365

[1]As fed basis.
[2]Provided 66 mg. chlortetracycline per steer daily.

Table 55. Effect of Environment on Growing Beef Calves
(August 6 to December 18, 1973 - 134 days)

	Environment	
	Shelter	No Shelter
No. steers	87	84
Av. initial wt., lb.	444	443
Av. final wt., lb.	692	684
Av. daily gain, lb.	1.85	1.80
Av. daily ration, lb.[1]		
Corn silage	38.88	39.53
Alfalfa hay	0.23	0.23
Salt	0.06	0.06
Antibiotic premix[2]	0.05	0.05
Gr. limestone	0.03	0.03
Protein supplement	1.81	1.84
Total	41.06	41.74
Feed/cwt. gain, lb.[1]		
Corn silage	2102	2196
Alfalfa hay	12	13
Salt	3	3
Antibiotic premix[2]	3	3
Gr. limestone	2	2
Protein supplement	98	102
Total	2220	2319

[1]As fed basis.
[2]Provided 66 mg. chlortetracycline per steer daily.

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