EIGHTH ANNUAL PROGRESS REPORT

DECEMBER 1968

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SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

NEAR CENTERVILLE, SOUTH DAKOTA

Agricultural Experiment Station
South Dakota State University
Brookings

EIGHTH ANNUAL PROGRESS REPORT
SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

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

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION
BROOKINGS, SOUTH DAKOTA 57006

Duane Acker, Director

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INTRODUCTION

— J. F. Fredrickson

This publication marks the completion of the eighth year of research work at S.E.S.D. Experiment Farm. At this time, attention can be directed to some of the changes that are taking place.

Some experiments are being discontinued because they have produced the answers that they were designed to produce. An example of this is minimum tillage. The basic principles of reduced tillage methods are now well known and have been well promoted by machinery manufacturers, who perform an excellent service in this field. New problems may arise from expanded and continued use of these methods.

The production of forage sorghum and sorghum related forages will be discontinued until such time when there is further need to establish their place in a cropping system. Meanwhile, the search for new varieties of sorghum that are hardy, disease resistant, and succulent will continue as rapidly as possible.

Comparisons of high rates of phosphorus and of potassium and their effects upon yields of corn will be discontinued. Results of these experiments have repeatedly verified factors already established. Research in other phases of fertility, such as rates of nitrogen and methods of application will be expanded as problems arise.

The effect of varying amounts of slotted floors on the rate of gain and feed efficiency of market hogs has been proven. Research in improved management methods and improvement of carcass quality is being expanded.

The economics of silage for the production of beef has taken a firm direction. A new look is being taken at corn fed as grain in combination with varying levels of roughage in the forms and amounts best suited for a given agricultural area.

These examples point out that there is continuous change in the field of research. This is not change for the sake of change, but change for the sake of providing needed information.

At this time it seems fitting to recognize the role that is being played at this experiment farm by the S.E.S.D Experiment Farm Association and its board of directors. This group continually shows its support by taking an active part in promoting field days, crop tours, and informative meetings. The board of directors acts in an advisory capacity in helping Experiment Station staff personnel determine what general types of research work should be pursued at this location.

This association has as its main income the land rental paid to them by the State University Experiment Station. A minimal amount of money is used in the business operations of the association, and the remainder of the income is used to support the research work by adding facilities and equipment.

The latest of these improvements is the installation of a 20 ton capacity wagon scale. Prior additions have been: material for a 50 ft. x 96 ft. pole type machine shed, concrete aprons for outside cattle feed lots, and feeders and waterers for the swine barn.

The overall effect of these activities is the promotion of a continuing local interest in the S.E.S.D. Experiment Farm. The association aids in directing research and in spreading the information compiled by staff members to those who can put it to use.

When research was started on this farm in 1961, the south quarter was plotted to contain all the agronomic experiment plots. Since 1962, the north quarter has been used for production of grain and forage to be used in livestock feeding trials. In the past few years, the expansion of research has brought about a need for larger experiment sites, and some agronomic studies have been moved to the north quarter. Surplus grain from all agronomy plots, as well as filler areas on the south quarter, is also used for livestock feed.

The crops grown on the north quarter in 1968 were: 25 acres of alfalfa and 125 acres of corn.

Production from the two quarters for the 1968 crop year was: (determined by sampling and field measurements)

Corn silage:	260 tons	Ear corn:	10,000 bu.
Alfalfa hay:	80 tons	Oats:	800 bu.

All corn acreage on the north quarter was fertilized. On 72 acres, 80 lbs. N and 18 lbs. P/acre were plowed down in the fall of 1967. The remaining 53 acres were side dressed with 100 lbs. of anhydrous ammonia.

The alfalfa was chopped and stored in a silo as haylage.

A field demonstration involving five different chemicals for the control of corn root worm was applied in cooperation with the Extension Service. The infestation of corn root worm was not extensive enough to produce visable differences between these treatments.

Table 1 is a summary of precipitation and temperature data recorded during 1968. This information is compiled at the research farm as the official weather observer location for this area.

Some pertinent observations can be made from these data. The early part of this growing season was quite dry. It can be called a continuation of the preceding season which left the subsoils of the general area depleted of a moisture reserve. Consequently, spring small grains in extreme south eastern South Dakota suffered from rainfall deficiency. Small grain yields reported in this publication reflect the deficiency.

More abundant mid-season and late season rainfall favored the production of later maturing crops and has left the sub-soil with an adequate moisture reserve for the coming year.

Large departures in average monthly temperatures from the normal were experienced only during the months of March and May. The average yearly temperature and the duration of frost free days were very nearly normal when compared to past records for this station.

Table 1. Precipitation and Temperature at the Southeast Farm, 1968

Month	Rainfall in Inches	1963-1968 16 Year Ave.	Departure	Ave. Temp. (F)	1953-1968 16 Year Ave.	Departure
Dec. 1967	.84	.62	+ .22	24.3	23.5	+ .8
Jan. 1968	.32	.38	- .06	18.3	17.5	+ .9
Feb.	.02	1.21	-1.19	21.1	24.9	- 3.8
March	.36	1.31	- .95	42.5	31.0	+11.5
April	3.16	2.73	+ .43	50.7	49.3	+ 1.4
May	.92	3.21	-2.29	55.7	60.9	- 5.2
June	4.62	4.43	+ .19	73.3	70.1	+ 3.2
July	6.43	3.14	+3.29	73.3	75.3	- 2.0
Aug.	2.16	2.89	- .73	73.5	70.0	+ 3.5
Sept.	3.92	2.95	+ .97	62.1	63.3	- 1.2
Oct.	5.57	1.43	+4.14	52.7	55.0	- 2.3
Nov.	.29	.91	- .62	35.8	36.6	- .8
Total	28.61	25.21	+3.40			
			Ave.	48.6	48.1	+ .5

Frost free days: May 20 to Oct. 3 - 136 days.

AGRONOMY, PLANT PATHOLOGY AND ENTOMOLOGY SECTION

Corn Populations and Row Spacing

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

Objectives of Experiment

1. What is the optimum spacing of corn rows for different plant populations with a short season hybrid and a full season hybrid?

2. Is there a greater need for narrow rows with higher plant populations?

3. Can moisture loss by evaporation be reduced by narrow rows?

4. 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?

5. Will an erect leaf hybrid perform better than an arched leaf hybrid at high populations and in narrow rows?

Methods and Procedures Used in Corn Row Spacing Experiment

Methods and procedures used for the corn row spacing were as follows:

Nov. 8, 1967 - fall fertilized with 120 lbs. N, 26 lbs. P and 25 lbs. K broadcast
Nov. 16, 1967 - approximately 15 tons of manure/acre applied
Nov. 26, 1967 - plowed
April 8, 1968 - harrowed with flextine harrow to break hard clods but not very sucessful
April 15 - tandem disked plot
April 22-26 - disked and harrowed plot
May 3 - started planting
Root worm control - Bux ten applied in band at planting
June 4 - cultivated
June 7 - sprayed with 1.56 lbs. atrazine 80 W plus 1 gallon of oil per acre to get weeds not controlled by cultivator
June 10 - thinned to desired populations
June 28 - cultivated
Oct. 3 - hand picked

Discussion and Interpretation of Figures 1 through 7

The full season hybrid yielded more than the short season hybrid at all populations this year. In other years, yields from short season hybrid compared more favorably with the bigger later variety when populations were increased.

Yields from the full season hybrid were not so sensitive to changes in populations this year. This was a bigger, later maturing hybrid than the full season hybrid used in previous years. It appears that the bigger later hybrids have a greater "flex-range" in ear size which can compensate fairly well for variations in stand. Consequently populations are not such an important consideration for the late hybrids as for the smaller earlier varieties.

Figure 1. Effect of Row Spacing on Yield of Short Season and Full Season Hybrid at 10,000 Plants per Acre.

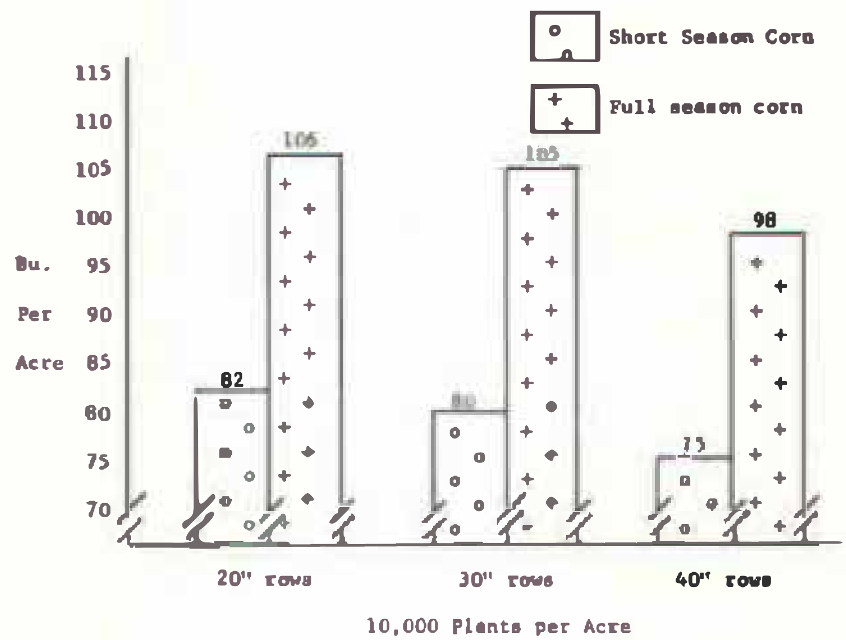

Figure 2. Effect of Row Spacing on Yield of Short Season and Full Season Hybrid at 12,000 Plants per Acre.

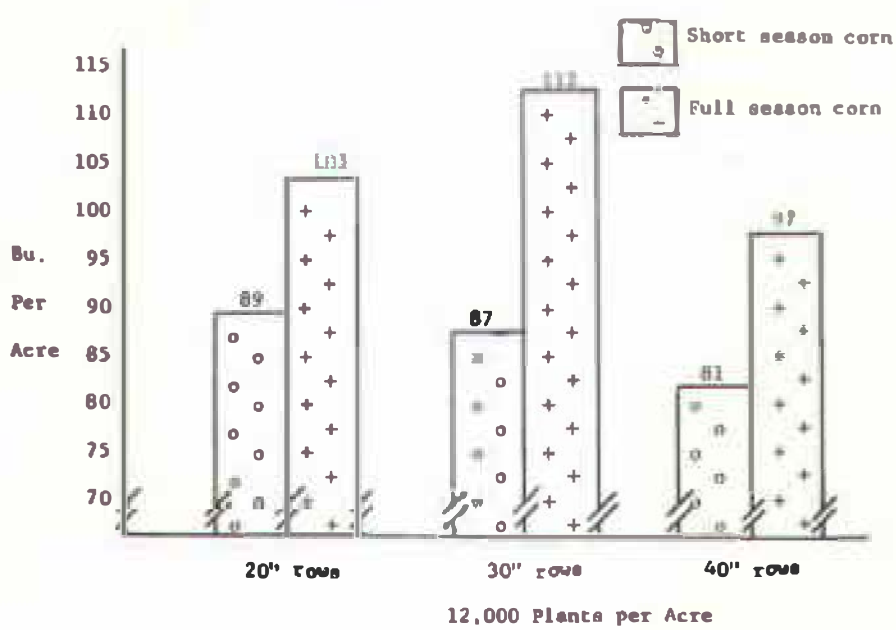

Figure 3. Effect of Row Spacing on Yield of Short Season and Full Season Hybrid at 14,000 Plants per Acre.

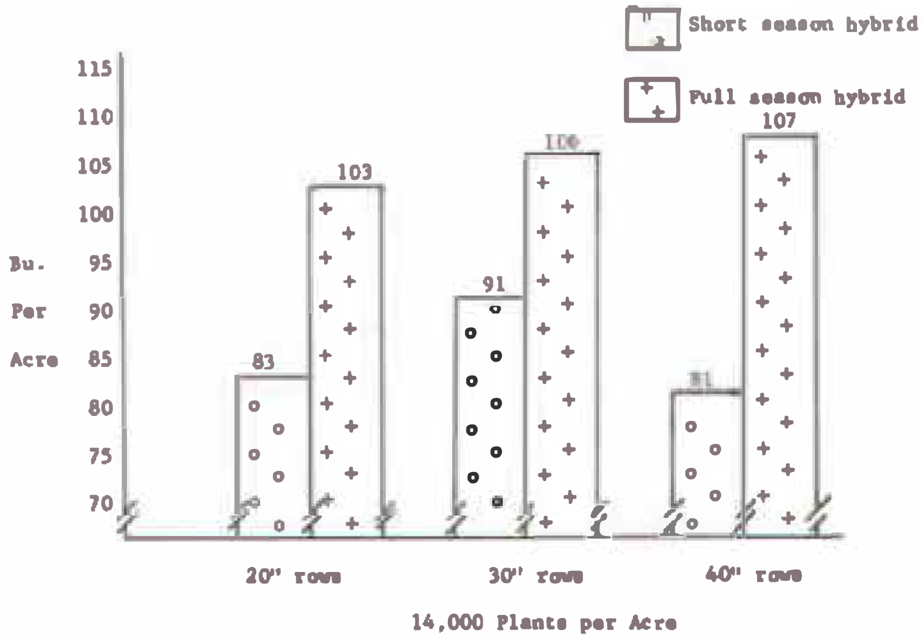

Figure 4. Effect of Row Spacing on Yield of Short Season and Full Season Hybrid at 16,000 Plants per Acre.

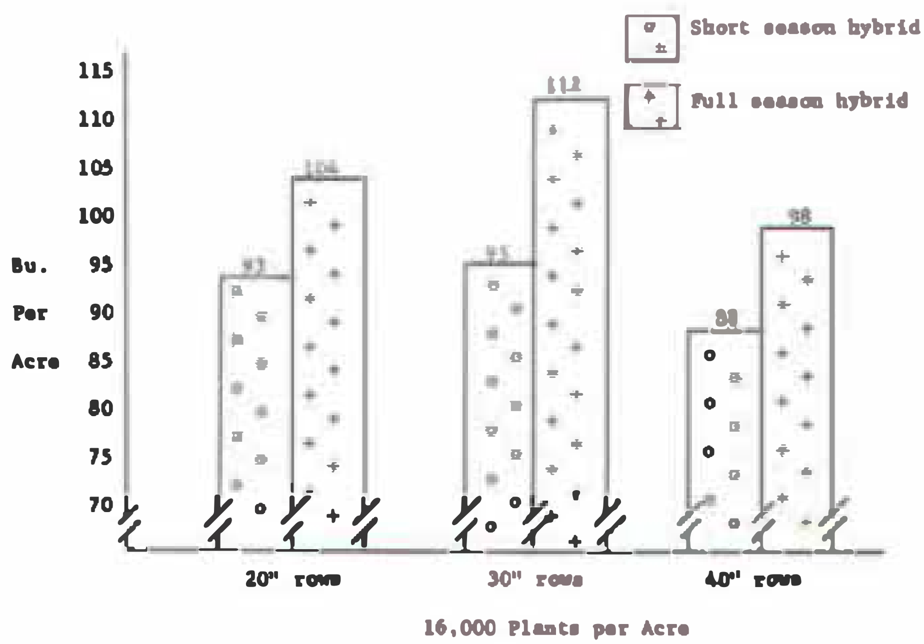

Figure 5. Effect of Row Spacing on Yield of Short Season and Full Season Hybrid at 18,000 Plants per Acre.

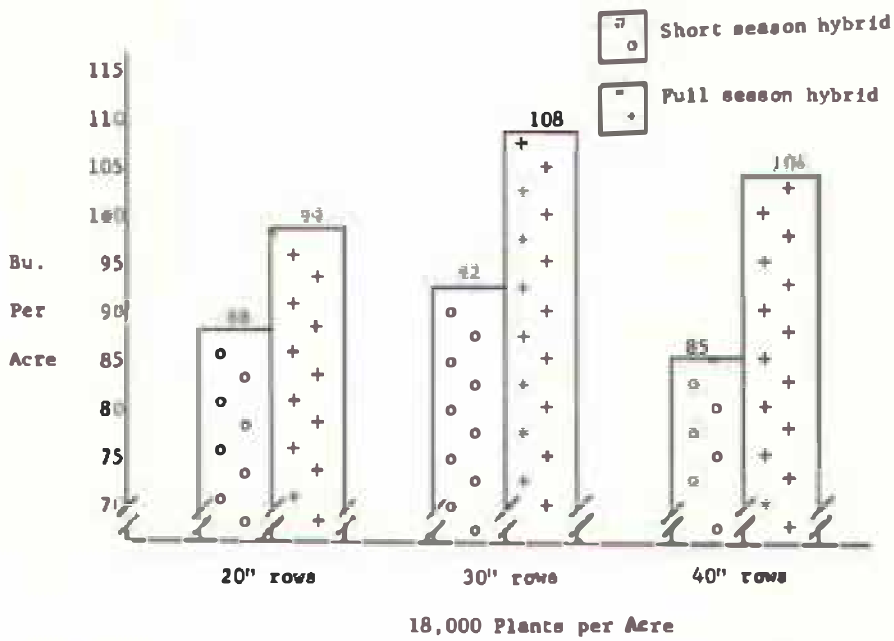

Figure 6. Effect of Plant Populations on Yield of Corn (Average of 3 row spacings included for each population).

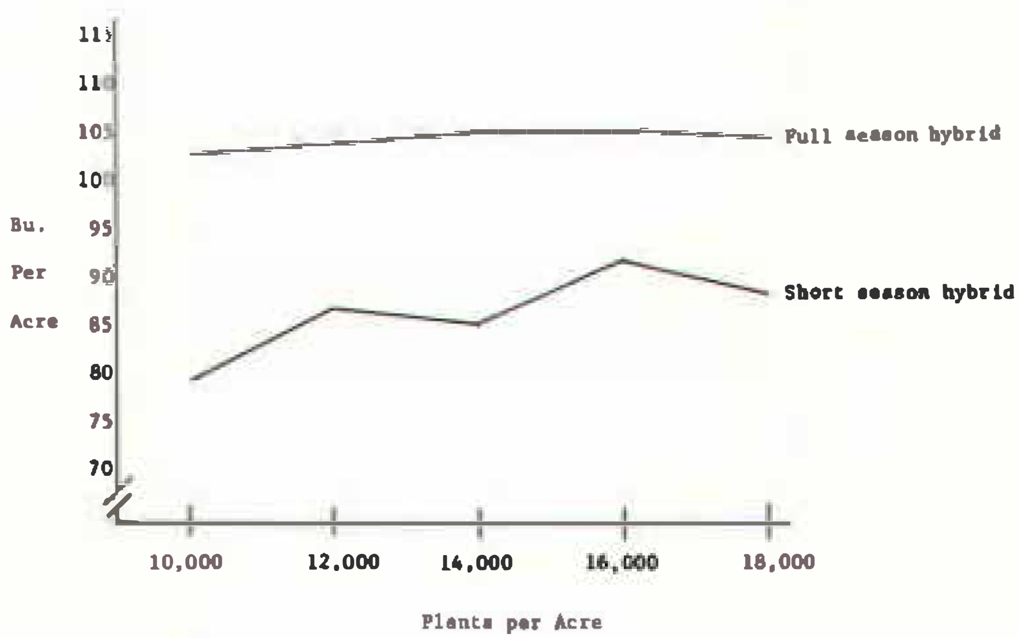

Figure 7. Effect of Row Spacings on Yield of Corn (Average of 5 populations included for each row spacing).

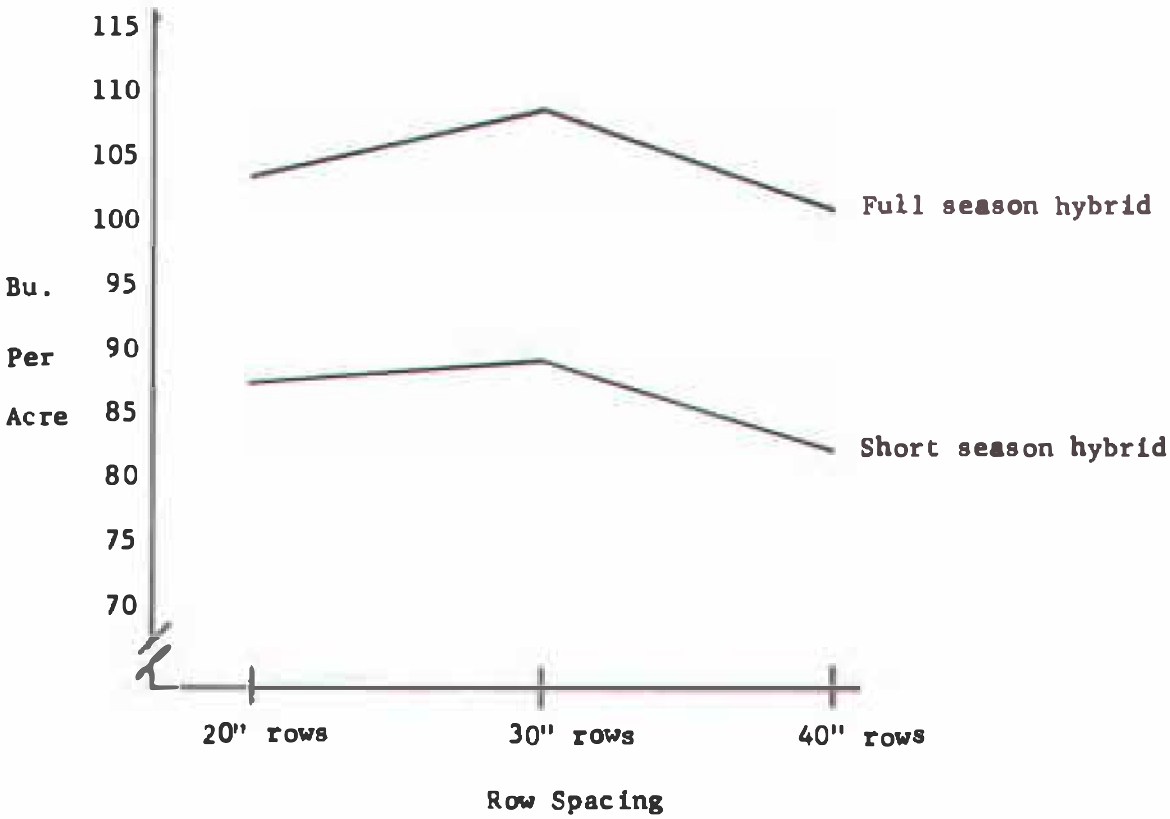

Table 2. Effect of Short Season Hybrid and Full Season Hybrid on Leaf Area* Index (Leaf Area to Ground Area** Ratio) at Different Population Densities

	Leaf Area Index	
Plants Per Acre	Short Season Corn S.D. 407A	Full Season Corn Pioneer 3505
10,000	1.8	2.7
12,000	2.0	2.8
14,000	2.2	2.9
16,000	2.3	3.3
18,000	2.5	3.4

* Calculated by summing the products of length x width of each leaf x 0.73.
** All 3 row spacings were included in the average for each population.

Discussion and Interpretation of Table 2

The short season corn had a typical inverted U shaped leaf curvature. The full season corn had leaves extending in a more erect or vertical direction. One of the reasons for selecting this corn with vertical leaves was the possibility that it may perform better than curved leaf hybrids at high populations densities. With high populations, vertical leaves may allow more direct sunlight to fall on leaves and reduce shading effect of upper leaves on lower leaves.

Laboratory and computer data from the University of California* indicate that more carbohydrates would be produced with erect leaves than with curved leaves if populations were dense enough to give a leaf area about three times greater than the ground area. As the leaf area to ground area ratio increased from 3 to 8, the advantage for erect leavea also increased.

In the S.E. Farm experiment, leaf area was measured under field conditions. Full season corn had greater leaf area than short season corn at corresponding population denaitiea (Table 2). As populations were increased, leaf area also increased but the leaf area to ground area ratio did not exceed 3.4. From the California data* it appears that with the 2 hybrids used in this experiment, populations greater than 18,000 would be necessary to take maximum advantage of the erect leaf principle.

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* Loomis, R. S. Color it Green. Plant Food Review Vol. 13. No. 2. 1967. pp 2-4.

Table 3. Effect of Row Spacing and Hybrid on Leaf Area Index (Leaf Area* to Ground Area** Ratio)

Row Spacing	Leaf Area Index: Short Season Corn S.D. 407 A	Leaf Area Index: Full Season Corn Pioneer 3505
20 inch	2.3	3.1
30 inch	2.3	3.1
40 inch	1.8	2.9

* Calculated by summing the products of length x width of each leaf x 0.73.
** All 5 populations were included in the average for each row spacing.

Discussion and Interpretation of Table 3

When leaf area to ground area ratio was rounded off to the nearest 1/10 there was no difference between 20 and 30 inch rows for either hybrid. For 40 inch rows, the ratio was lower than for the 2 narrow row apacings. Perhaps the more equal spacing arrangement provided in narrow rows allowed a greater development of leaves.

Table 4. Effect of Plant Populations* on Ear Moisture and Lodged Stalks

Plants Per Acre	% Ear Moisture at Harvest	% Broken and Lodged Stalks
10,000	39.0	2.7
12,000	37.5	1.8
14,000	37.2	1.8
16,000	38.9	2.1
18,000	39.1	3.4

* Average from 3 row spacings and 2 hybrids for each plant population.

Table 5. Effect of Row Spacings* on Ear Moisture and Lodged Stalks

Row Spacing	% Ear Moisture At Harvest	% Broken and Lodged Stalks
20 inch	37.0	2.5
30 inch	38.3	2.1
40 inch	38.3	1.8

* Average from 5 populations and 2 hybrids for each row spacing.

Discussion and Interpretation of Tables 4 and 5

There were only minor differences in ear moisture at harvest due to plant populations and row spacings.

Percentages of broken and lodged stalks were not influenced very much by populations or row spacing this year. Corn was picked October 3. With a later picking date, more broken and lodged stalks would be expected.

Discussion and Interpretation of Figures 8, 9, and 10

In previous years, soil temperatures were measured once a day at 1:00 p.m. In 1968, soil temperatures were measured and recorded electrically every hour, day and night. Thermocouples were used to measure soil temperature. They were placed 3 inches below the soil surface. Four thermocouples were located at 4 different points in 10 linear feet of one row in each plot. These 4 thermocouples were connected in parallel to a common lead. This produced an average of the 4 temperatures which was recorded every hour. Temperature readings were averaged for the time intervals given on the horizonal axes in figures 8, 9 and 10.

Figure 8. Effect of Corn Row Spacing on Soil Temperatures between Rows with Plant Populations of 18,000.

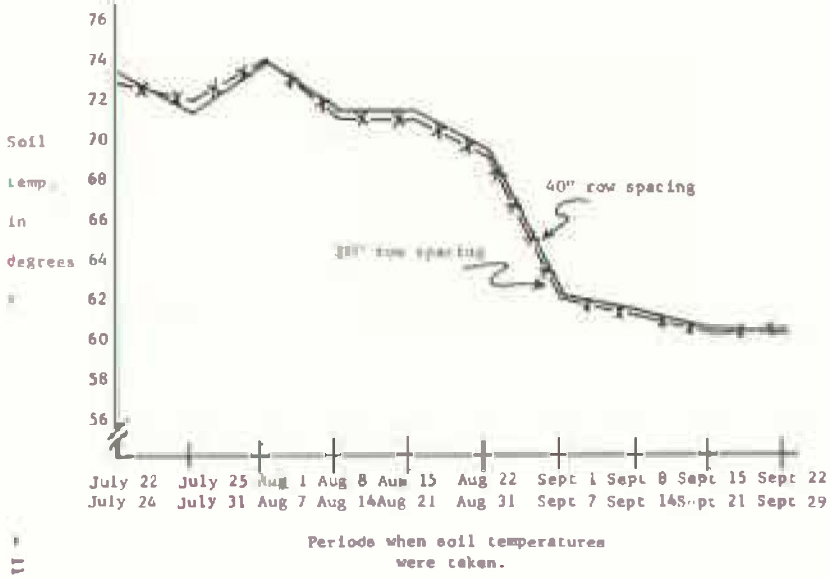


Figure 9. Effect of Plant Populations on Soil Temperatures between 40" Rows

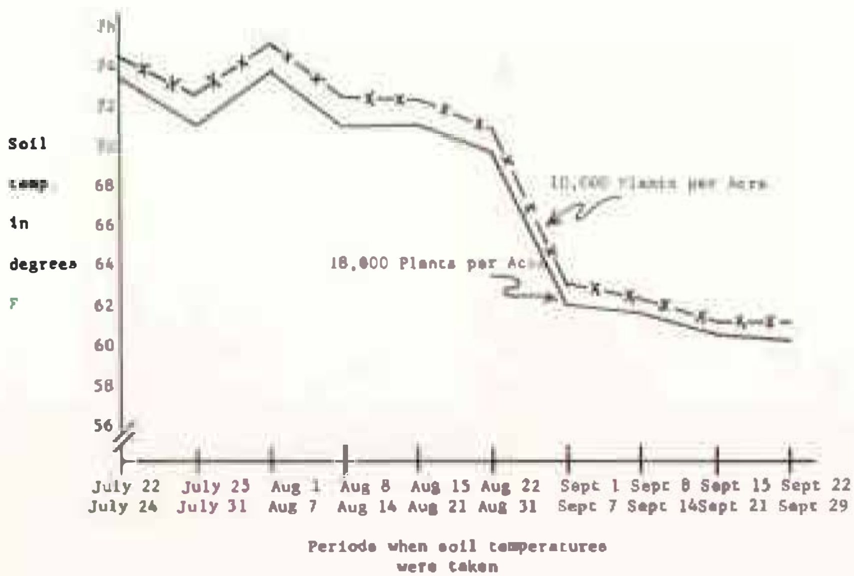


Figure 10. Comparison of Soil Temperatures in the Row and between the Row with 18,000 Plants per Acre and 40" Row Spacing.

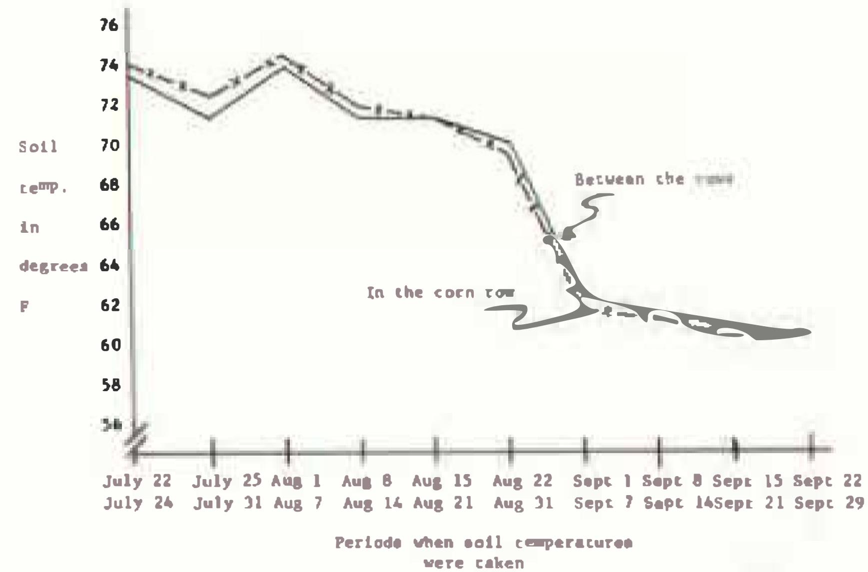


Figure 8 shows effect of 2 row spacings on soil temperatures with a population of 18,000 plants per acre. When measured between rows, there were only small differences in soil temperature due to row spacings. However, twenty inch row spacings usually had cooler soil temperatures than 40 inch rows. It should be remembered that both day and night temperatures were recorded.

Figure 9 illustrates effect of plant populations on temperature. In the middle of the row with 18,000 plants per acre, soil temperatures were cooler than with 10,000 plants per acre. These results are consistent with previous work of 1967. The denser leaf canopy in higher plant populations is probably responsible for cooler soil temperatures. These results suggest that with high plant populations and narrow rows, less of the sun's energy infiltrates through the leaf canopy to reach the soil. The energy that reaches the soil is used to evaporate water, if present, and to heat the soil.

In Figure 10, a comparison is made of soil temperatures in the corn rows to that in the middle between corn rows. Population was 18,000 in 40 inch rows planted east and west. Prior to August 15, soil temperatures between rows were slightly cooler than in the rows. After August 15 soil temperatures were usually slightly cooler in the corn row. However, these differences were extremely small.

STARTER AND POP-UP FERTILIZER FOR CORN

-- F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Will a starter fertilizer high in phosphorus increase corn yields in a soil with medium to low phosphorus supplying ability?

2. Is the practice of including a small amount of potassium in the starter fertilizer worth while "insurance" against possible potassium dificiencies in borderline response soils?

3. Is it best to forget about starter fertilizer and to broadcast all fertilizer before planting, either disking it in or plowing it under?

4. What can we expect from "pop-up" fertilizer? Pop-up refers to small amounts of fertilizer placed with the seed at planting.

Methods and Procedures Used in Starter and Pop-up Experiment

The following procedures were used in this experiment:

Previous corn crop was unfertilized.
Previous corn crop was removed for silage.
April 30 - applied broadcast fertilizer.
April 30 - plowed and disked.
May 13 - disked, harrowed and planted.
Variety - Pioneer 3414
Corn root worm control - Bux Ten in band at planting.

Row spacing - 30 inches.
Population - 14,000
May 17 - harrowed with spike tooth harrow.
June 5 - first cultivation.
June 30 - second cultivation.
June 21 - sprayed with 1½ lb. Atrazine 80 W plus 1 gallon of oil for weed control.
July 3 - sidedressed nitrogen.
July 5 - cultivated plots.
Sept. 25 - hand picked.

Table 6. Effect of Starter Fertilizer, Pop-Up Fertilizer, Supplemental Nitrogen and Method of Application on Corn Yield

Treatment No.	Starter and Pop-up Fertilizer Lbs. per acre N	P	K		Additional Nitrogen, Lbs. per acre	% Water in Ears at Harvest	Bu. of #2 Corn per acre
1.	0	0	0		none	45.3	70
2.	12	23	0	in band 2 x 2	none	46.3	78
3.	12	23	17	in band 2 x 2	none	45.1	77
4.	0	0	0		80 sidedress	46.2	88
5.	12	23	0	in band 2 x 2	80 sidedress	46.5	92
6.	12	23	17	in band 2 x 2	80 sidedress	48.2	88
7.	12	23	17	+ zinc in band 2 x 2	80 sidedress	45.2	86
8.	12	23	17	disked in	80 disked in	46.2	88
9.	12	23	17	plowed down	80 plowed down	48.7	91
10.	3	6	5	pop-up	80 plowed down	46.6	94
11.	3	6	5	pop-up + 9-17-12 plowed down	80 plowed down	45.5	100
L.S.D. at 5%							12.9

Discussion and Interpretation of Table 6

In band treatments, fertilizer was placed approximately 2 inches to the side and 2 inches below the seed. Pop-up refers to a small amount of fertilizer placed in contact with the seed. In broadcast treatments, fertilizer was broadcast and then either disked in or plowed down.

Soil test information of 0 to 4 inch soil depth at this plot site is given below:

Organic matter % = 2.6 medium
Bray No. 1 phosphorus (lbs/acre) = 14 medium to low
Exchangeable potassium (lbs/acre) = 401 high
Soil pH (1:1 dilution) = 6.2
Soluble salts (mmho/cm) = 0.50 low
Zinc 0.1 N HCl (parts per million) = 8.2 high
Calcium 0.1 N HCl (me/100 grams) = 19.5 adequate
Magnesium 0.1 N HCl (me/100 grams) = 6.8 adequate

Fertilizer increased corn yields 7 to 30 bushels per acre this year. Starter fertilizer without additional nitrogen appeared to give a seven bushel increase in yield over the check plot but this difference was not statistically significant. The greatest yield increases occurred in plots that received supplemental nitrogen. May was 5.2 degrees cooler than average (Table 1). In previous years, cool temperatures in the spring have resulted in yield responses to starter fertilizer.

When all the fertilizer was plowed down (treatment No. 9) the yield was 91 bushels. When all fertilizer was disked in (treatment No. 8) yield was 3 bushels less. This was not significant but the trend was similar to results in 1967.

Zinc did not increase yield of corn this year.

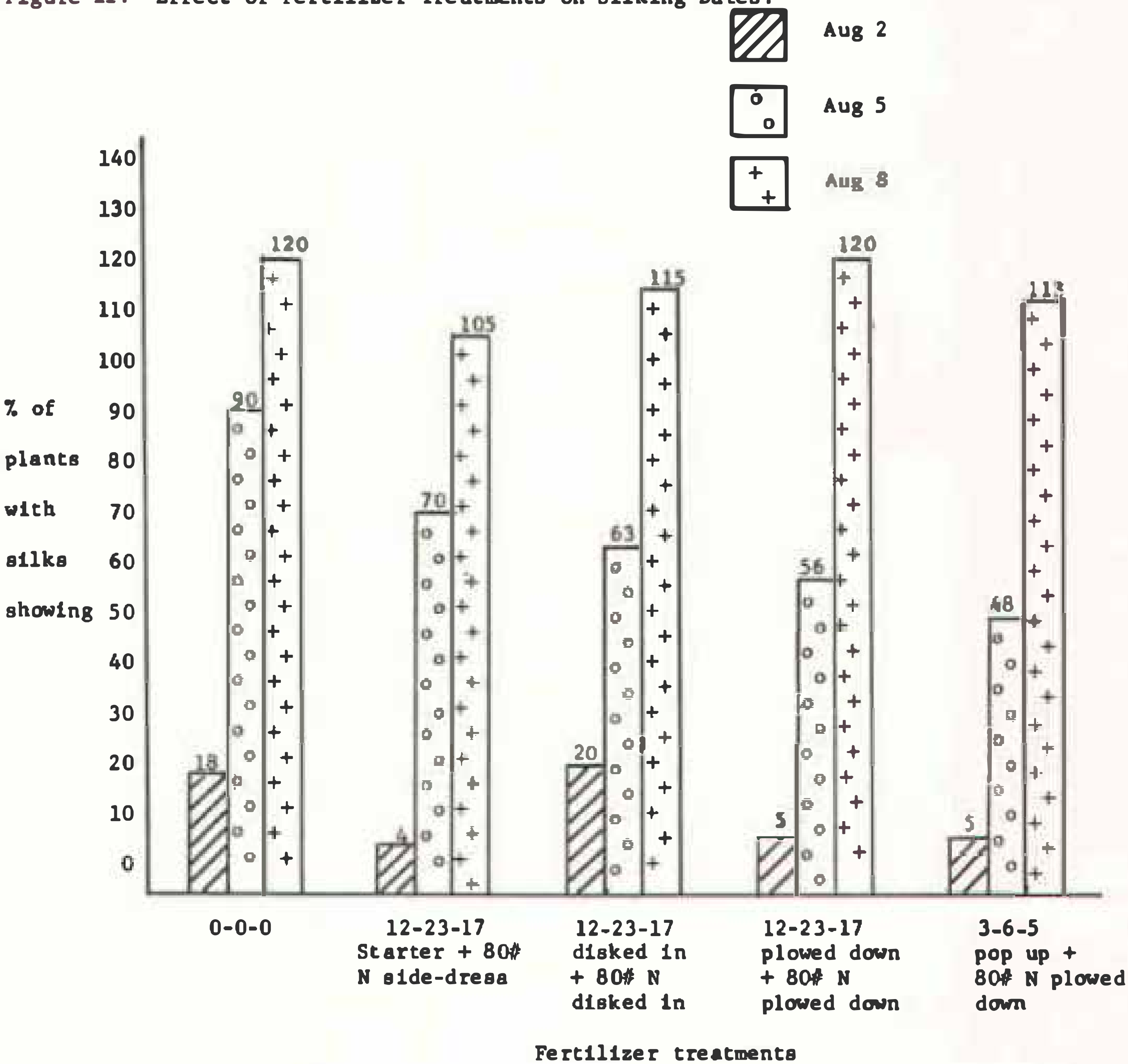
Another interesting comparison is between treatment No. 9, where all fertilizer was plowed down and treatment No. 6 where the same amount of fertilizer was split into a starter application and a sidedressed application. The plow down treatments averaged 3 bushels higher and this difference was not statistically significant, but the trend was similar to results in 1967.

Results for pop-up are also similar to those obtained in 1967. The highest yielding plot in the experiment both years received a small amount of fertilizer as a pop-up in addition to the other supplemental treatments. However, the yield advantage in favor of pop-up was not statistically significant in either year.

Potassium did not increase yields at this site in 1968.

Starter fertilizer was not very effective in speeding up maturity measured by % ear moisture when harvested at this early stage. Effect of pop-up fertilizer on maturity was about the same as starter placed in a band 2 x 2.

Figure 11. Effect of Fertilizer Treatments on Silking Dates.

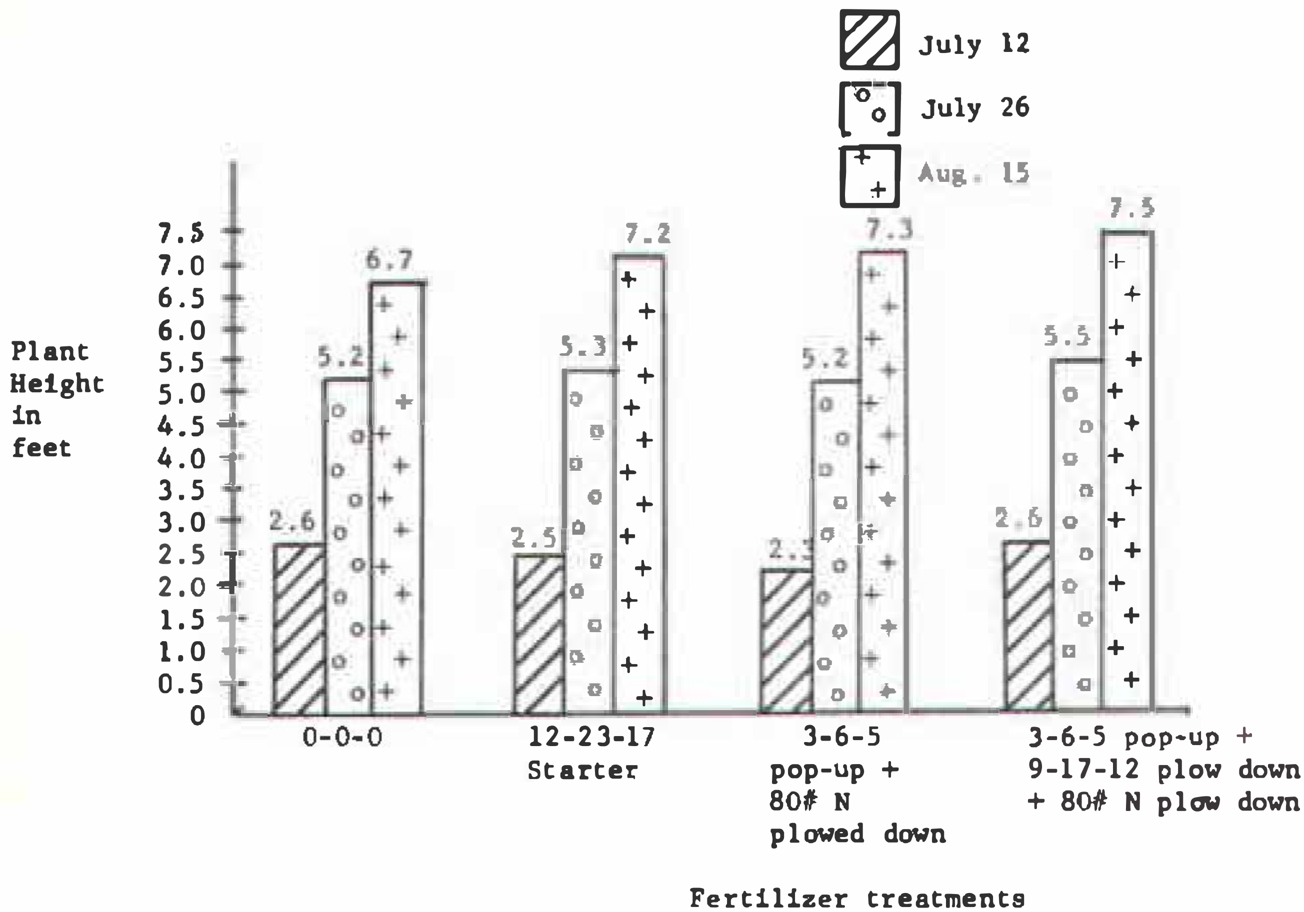


Discussion and Interpretation of Figure 11

Silking data were obtained by counting the number of ears showing silks in 20 plants and expressing this as a percent. Notice that the percentage figures on August 8 were over 100. The reason for this is that 5 to 20% of the stalks had more than one ear with silks showing.

None of the fertilizer treatments advanced silking dates over that of the check plots.

Figure 12 Effect of Fertilizer Treatments on Corn Height



Discussion and Interpretation of Figure 12

There was little difference in plant height due to fertilizer treatments on July 12 and July 26. On August 15, fertilized corn was 0.5 to 0.8 foot taller than the check plot.

On this medium fertility soil, pop-up fertilizer did not stimulate early growth as the name would suggest. The greatest height differential occurred when corn was 7 feet tall.

In this era when we are thinking about "shorty" wheats and smaller corn, it is interesting to note the relationship of corn height to yield of this variety (Table 6). The taller the corn on August 15, the greater was the yield.

DATES OF PLANTING AND RATES OF NITROGEN

-- F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Will planting dates influence response to fertilizer?

2. How high should we go with rates of nitrogen with a soil testing medium in organic matter?

3. Will unusually high rates of nitrogen influence disease or insect damage?

4. Will soil temperature serve as a dependable guide to tell us the optimum time to plant?

Methods and Procedures

Time of plowing - In fall.
Cropping history - Continuous corn for 4 years.
Population - 16,000 planted.
Previous fertility treatment - No fertilizer used in 4 previous years.
April 24 - Tandem disked plots twice.
April 25 - Applied broadcast fertilizer for the first planting.
April 26 - Area for first planting tandem disked, harrowed and planted.
April 29 - Broadcast fertilizer for other 3 planting dates and disked in the same day.
May 8 and 9 - Area for second planting date disked, harrowed and planted.
April 26 - Rotary hoed first planting.
May 20 - Area for third planting date tandem disked, flextined and planted.
May 20 - First planting cultivated.
June 1 - Second planting cultivated.
June 3 - Area for fourth planting date tandem disked, flextined and planted.
June 7 - First 3 plantings sprayed with atrazine and oil (1.56 lbs of atrazine 80 W + 1 gallon oil/acre) for weed control.
June 13 - Cultivated first and second planting.
June 17-20 - Cultivated plots.
June 21 - Sprayed 4th planting for weed control using atrazine and oil.
July 3 - Cultivated plots as needed.
July 29 - Corn borer eggs attached on leaf whorl.
Variety - South Dakota SK 70.
Insecticide - Bux Ten.
September 27 - Hand picked .

Table 7. Soil Test Values for Time of Planting and Nitrogen Rate Study - Determined By South Dakota State University Soil Testing Lab

Location	Soil Sampling Depth in Inches	Organic Matter %	Bray No. 1 Phosphorus lbs./A	Exchangeable Potassium lbs./A	pH 1.1 dilution	Soluble salts mmho/cm	Zn 0.1 N HCl ppm	Ca 0.1 N HCl me/100 grams	Mg 0.1 N HCl me/100 grams
Replicate I Range 2	0-4	3.0 M	5 between L and very L	327 H	6.8	0.40 L	8.9 H	21.4 ad.	9.7 ad.
Replicate II Range 4	0-4	2.6 M	6 L	321 H	6.4	0.40 L	8.4 H	19.5 ad.	8.7 ad.
Replicate III Range 6	0-4	2.8 M	7 L	369 H	6.4	0.38 L	8.9 H	19.5 ad.	9.5 ad.
Replicate IV Range 8	0-4	2.7 M	9 L	390 H	6.4	0.95 L	10.6 H	23.4 ad.	12.4 ad.

H = high
M = medium
L = low
Ad = adequate

Discussion and Interpretation of Figure 13

Lines plotting yields and rates of nitrogen for different planting dates appear to be divided into two pairs. The extremely early and late planting dates constitute 1 pair and the 2 medium planting dates make up the other pair. Highest yielding pair occurred with the medium or moderately early planting dates.

The first 80 lb. increment of nitrogen gave the biggest yield increase. The yield curve line for rates of nitrogen was not perfectly smooth because of minor variations in soil characteristics and plot technique. But it appeared that the curve leveled off in the vicinity of 160 lbs. of nitrogen per acre for the May 9 and May 20 planting date on this soil of medium organic matter content (see table 7).

One of the most outstanding results of this experiment was the response to commercial fertilizer. Increases well over 30 bushels per acre were obtained. Note that the cropping history had been continuous corn for 4 years with no fertilizer applied.

Results from Illinois* indicated that early planting (May 4 in Illinois) resulted in a greater response to nitrogen than medium or late planting dates at the heavier nitrogen application (160 lbs/A). In the South Dakota S.E. Farm experiment, the earliest planting date was about a week earlier than in the Illinois experiment. Profitable yield increases were obtained from 80 lbs. of nitrogen with all dates of planting. The low yield for the unfertilized plots of the earliest planting, emphasized the need for fertilizer if corn is planted very early.

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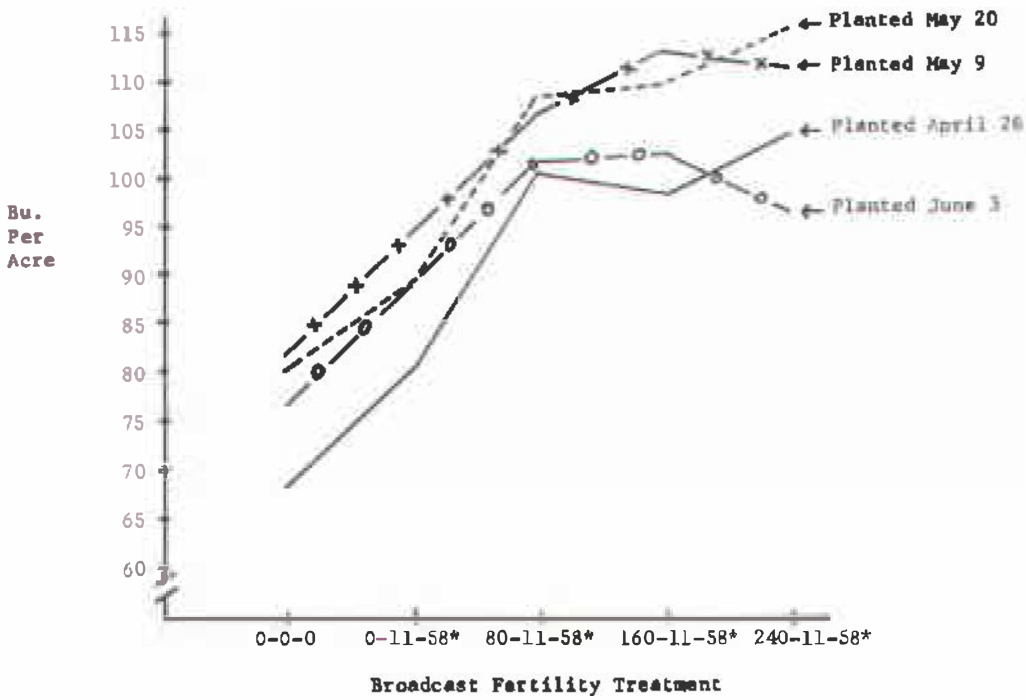
* Better Crops With Plant Food. Winter 1967. Pages 16-17.

Discussion and Interpretation of Figure 14

Figure 14 shows effect on silking dates of the very early and very late planting.

It was interesting that the interval in planting dates was 38 days but the interval between 100% silking dates of the early planting and 100% silking of the late planting was only 9-10 days.

Figure 13. Effect of Fertilizer and Planting Date on Yield of Corn.



* Received 50 lbs per acre of 8-14-13 (N-P-K) starter placed 2 x 2 in addition to the broadcast treatment.

Figure 14. Effect of Planting Dates on Time of Silking.

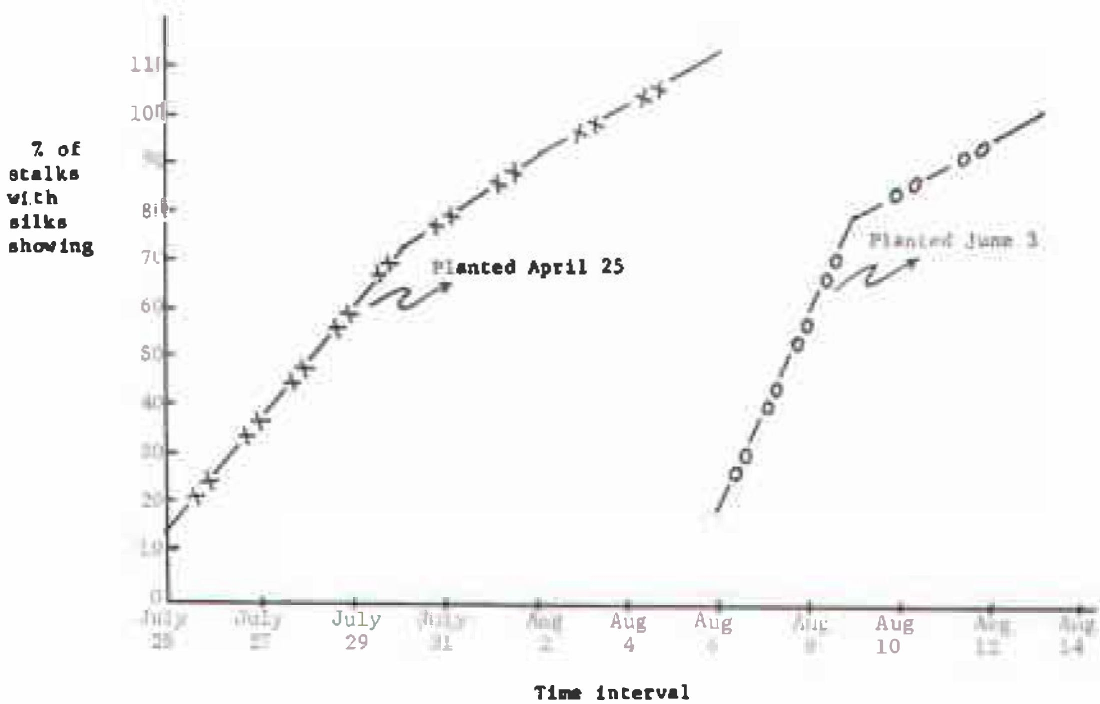


Table 8. EFFECT OF PLANTING DATES AND FERTILIZER TREATMENTS ON % EAR MOISTURE AT HARVEST

Planting Dates	% Ear Moisture	Broadcast Fertilizer Treatments lbs./A N	P	K	% Ear Moisture
April 26	39.1	0	0	0	43.0
May 9	40.7	0	11	58*	42.4
May 20	42.0	80	11	58*	42.4
June 3	46.6	160	11	58*	41.8
--	--	240	11	58*	41.7

* Received 50 lbs. per acre of 8-14-13 as a starter placed 2" x 2".

Discussion and Interpretation of Table 8

Ear moisture for each planting date included the average for five fertility treatments.

With an interval of 38 days between the first and last planting dates, the difference in ear moisture between these extremes in planting dates was only 7½%.

Fertilized plots had less ear moisture at harvest than the unfertilized plot.

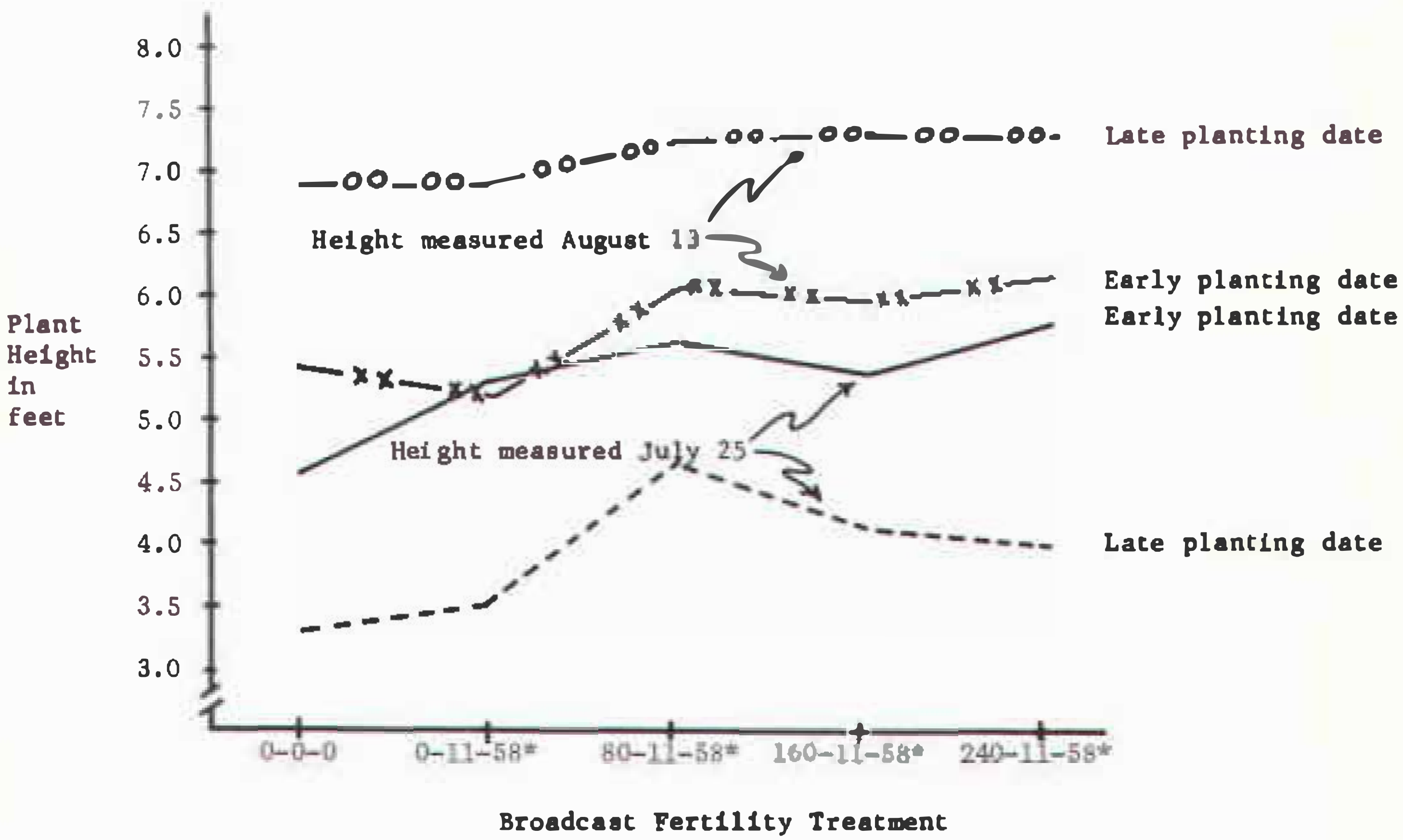
Discussion and Interpretation of Figure 15

Figure 15 shows corn height measurements for only the first planting date (April 26) and the last planting date (June 3). Height measurements were taken on July 25 and August 13 for both the early and late planted corn.

On July 25, late planted corn was not as tall as early planted corn. On August 13, note how the late planted corn towered above the early plantings by approximately 1 to 2 feet. Planting dates had a strong influence on plant height in 1968.

Rates of nitrogen had less effect on plant height than planting dates but nitrogen did add a little height to the corn plants. On July 25 with late planted corn, height decreased as nitrogen was increased from 80 to 160 to 240 lbs. This was probably due to a slowing effect of nitrogen on growth rather than a permanent restrictive effect because 19 days later, corn plants in these same high nitrogen plots were the tallest of all those measured.

Figure 15. Effect of Planting Dates and Fertilizer on Corn Height.



* Received 50 lbs per acre of 8-14-13 (N-P-K) starter placed 2 x 2 in addition to the broadcast treatment.

Table 9. Effect of Planting Date on Leaf Area Index

Planting Dates	Leaf Area Index*
April 26	1.0
May 9	1.3
May 20	1.3
June 3	1.4

* Determined by multiplying and summing the products of length and width of each leaf per plant x 0.73 and dividing by soil surface area per plant.

Discussion and Interpretation of Table 9

Leaf area index, as calculated in Table 9, gave additional evidence of the profound effect date of planting had on certain plant characteristics. Each index number represents an average from 5 fertilizer treatments for each date of planting.

Corn planted June 3 had nearly half again as much leaf area per unit of ground area as the very early planting. This is due to poorer stand (Table 10) and shorter plants (Fig. 15) in early plantings. For very early planting we may have to use heavier populations and bigger varieties to get the full complement of leaf factories working for us.

Table 10. Effect of Planting Dates on Tillering, Lodging and Final Stand*

Date of planting	% of stalks with tillers	% lodged stalks	Final stand in plants per acre (rounded off to nearest thousand)
April 26	15	0.7	13,000
May 9	64	0.4	14,000
May 20	31	0.6	15,000
June 3	36	0.3	15,000

* Each number represents an average from 5 fertilizer treatments for each date of planting.

Discussion and Interpretation of Table 10

It is interesting to see that the earliest planting date had the fewest tillers and also the fewest plants per acre. All plots were planted with the same corn planter, with the same plates and sprocket settings and at the same speed. Therefore any differences in stand should be due primarily to planting dates and associated environmental conditions. This experiment was located in the eastern, lower lying area of the farm. The lower elevation may have influenced frost damage because the earlier planted corn was damaged by frost on at least 2 different occasions. It was somewhat surprising to end up with a stand as high as 13,000 plants per acre.

The number of lodged plants at harvest was not influenced by planting dates. In most plots, the number of stalks lodged was about ½ of 1% or less.

Table 11. Effect of Nitrogen Fertilizer Rates on Tillering, Lodging and Final Stand

Broadcast Fertilizer treatment, lbs./acre N	P	K	% of stalks with tillers	% of lodged stalks	Final stand in plants per acre (rounded off to the nearest hundred)
0	0	0	4	0.3	13,900
0	11	58*	38	0.3	14,200
80	11	58*	38	0.8	14,300
160	11	58*	28	0.8	14,300
240	11	58*	39	0.4	14,100

* Received 50 lbs per acre of 8-14-13 (N-P-K) starter placed 2 x 2 in addition to the broadcast treatment.

Discussion and Interpretation of Table 11

This information was included in the report because some farmers believe that high rates of nitrogen have an undesirable affect on lodging and on stands. All broadcast fertilizer treatments (except 0-0-0) received 50 lbs. per acre of 8-14-13 (NPK) in a band as a starter.

Rates of nitrogen as high as 240 lbs. of actual N per acre had little or no effect on lodged stalks. Soil organic matter was in the low end of the medium range. Rates of nitrogen had little effect on final stand.

Notice the increase in tillering over that in the check plot when 11 lbs. P and 58 lbs. K plus starter were applied. Additional increments of nitrogen beyond that in the starter did not increase tillering. From these results and results from previous experiments, it appears that phosphorus has more influence on tillering than nitrogen.

Table 12. Effect of Fertilizer on Leaf Composition at First Silking**
April 26 Planting Date

Broadcast Fertilizer treatment, lbs. per acre N P K	Composition of Dry Leaves N %	P %	K %	Ca %	Mg %	Mn %	Fe ppm	B ppm	Cu ppm	Zn ppm
0-0-0	1.25	0.18	2.74	0.17	0.26	51	182	10	9	51
0-11-58*	3.10	0.14	2.44	0.22	0.14	27	60	6	6	20
80-11-58*	3.50	0.23	2.24	0.31	0.23	41	139	9	19	35
160-11-58*	3.55	0.33	2.56	0.47	0.29	77	188	12	14	41
240-11-58*	3.65	0.31	2.43	0.45	0.24	89	179	11	29	46

* Received 50 lbs/acre of 8-14-13 (N-P-K) starter placed 2 x 2 in addition to the broadcast treatment.

** Leaf analysis made by Plant Analysis Laboratory at Ohio Agricultural Research and Development Center, Wooster, Ohio.

Table 13. Sufficiency Levels to Evaluate Leaf Analysis for Corn as Determined by Ohio Research and Development Center Standards

Element	% of element in leaves Minimum	Maximum
N %	2.76	3.50
P %	0.25	0.40
K %	1.71	2.25
Ca %	0.21	0.50
Mg %	0.21	0.40
Mn ppm	20.0	150.0
Fe ppm	21.0	250.0
B ppm	6.0	25.0
Cu ppm	6.0	20.0
Zn ppm	20.0	70.0

Discussion and Interpretation of Tables 12 and 13

In Table 12, all broadcast treatments (except 0-0-0) received 50 lbs. per acre of 8-14-13 (N-P-K) in a band as a starter.

Percent nitrogen in leaves in the unfertilized plot was very low (Table 12). It was below the minimum desired levels by the Ohio Standards (Table 13). A small amount of starter with the 0-11-58 broadcast treatment brought % leaf nitrogen above minimum levels. Plots receiving 160 and 240 lbs. of N per acre had % leaf N above the maximum level.

Percent leaf phosphorus was below the minimum levels in those plots where no N or small amounts of N were applied. This occurred even though 11 lbs/acre of P were broadcast and 7 lbs P per acre were applied in a band near the seed at planting. This indicated the value of nitrogen as an aid to the plants in their uptake of phosphorus.

Percent calcium was a little low in leaves from the check plot and corn leaves from the second treatment were lower in magnesium than the minimum sufficiency level. Other than this there was a sufficiency of those elements that were analyzed.

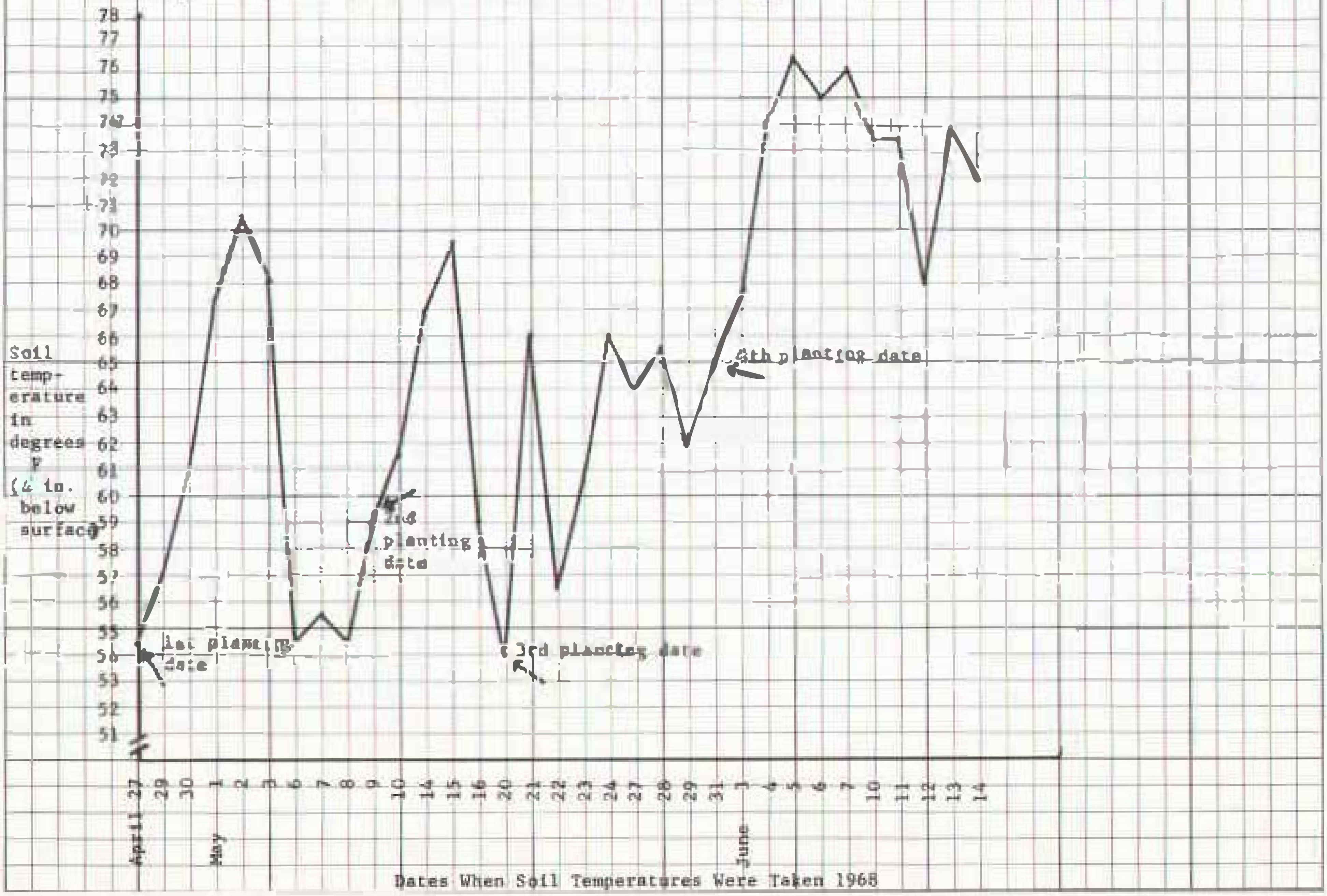
Discussion and Interpretation of Figure 16

This was an attempt to relate optimum planting date to soil temperature. Note in Figure 16 that soil temperature was not measured every day. Notice the wide variations in soil temperatures in the early part of the season until about May 22. A period of warm soil temperature followed each of the 4 planting dates in 1968.

Soil temperatures at 1:00 p.m. on each day measured, were above the minimum needed by corn to germinate. The lowest soil temperature which corn will germinate is approximately 50 degrees F.

The May 9 planting was able to survive fairly well. Final stand was only about 1,000 plants per acre less than the May 20 and June 3 planting dates (Table 10). By the time this corn emerged, most of the severely low soil temperatures were past.

Figure 16. Relation of Soil Temperature to Planting Date.



Summary of Dates of Planting and Rates of Nitrogen

It looks as though our earliest planting date (April 26) was a little too early for the conditions of 1968. Yields were not increased by this extra early planting date. Increases in yield from fertilizer were about as much as with later plantings. The lowest yield in the entire experiment was with the very early planting where no fertilizer was applied. On the basis of one years results this suggests that if you are going to plant very early additional attention should be given to your fertility program.

Date of planting had a profound influence on several plant characteristics. Plant height and leaf area index were especially influenced by extremes in planting dates. Plant survival and number of tillers were also affected. Judging by the low yield and low nitrogen content in leaves of the unfertilized April 26 planting, perhaps nitrogen uptake was also affected by date of planting.

Agronomy Project - Rates of N on Corn

-- P. A. Jones, Entomology-Zoology Dept.
South Dakota State University

Entomology - Sub-project

Relationship between high rates of N on corn and the establishment and development of European corn borer, *Ostrinia nubilalis* (Hubner).

Since the purpose of the project was to determine if high rates of N would effect corn borer establishment, either positively or negatively, a population of corn borers had to be assured on the corn plot at Centerville. The natural corn borer infestation was minimal when the plot was checked in mid-July, so through the cooperation of the USDA Corn Borer Laboratory at Ankeny, Iowa, corn borer eggs were obtained for artificially infesting the corn. Eggs were from ten different batches, collected July 23 and 24. The parent stock had been reared for 20 generations on artificial diet. Eggs were received in Brookings July 25 and then immediately incubated at the Northern Grain Insects Research Laboratory at optimum temperatures (room temperature to 80 F.) at 85% humidity so that development of the eggs from the various batches could be synchronized at hatching time. On July 28, 20 plants in each replicate of the June 3 corn planting had one egg mass of 20 - 30 eggs deposited in the upper whorl of the corn plants. The majority of the eggs at this time were in the black head stage. Corn plants used for infesting were in the second and fifth row of the replicates with every fifth plant infested until the total of 20 plants was reached. Approximately four weeks later the stalks and cobs were dissected and the corn borers counted. Data from replicate one to three were obtained August 22 and 25, and data on relicate four on August 26. The results of the corn borer count are summarized in Table 14.

Results of the first year of a five year test indicated that under conditions operative in 1968 the high rates of N did not increase or decrease corn borer establishment. Although there was variability between replicates and within replicates, the overall average number of larvae per replicate were within a remarkably small range of 34 to 37.75 larvae. The average infestation per replicate held close to the 75% level. From these results it would appear that the techniques used had only a small degree of error. One other fact rather prominently displayed by the results is that although there was little variation

due to treatment, there was a variation between replicates on number of larvae and number of infested plants from replicate one at the north end of the field to replicate four at the south end of the field. This variation could possibly be explained by an increasing amount of available water in the soil which may make the corn plant more suitable for corn borer establishment, by changing the thickness of the rind or pith core density or by dilution of the glucoside fraction which contains the corn borer larvae inhibitor (2,4-dihydroxy-7-methoxy benzoxizin-3-one) in corn stalk tissue. However, this is strictly conjecture.

Results of studies in Iowa, Illinois, and Ohio on relationship between high N and corn borer populations can not be easily equated with South Dakota results since conditions are not similar and studies were dissimilar. In one study (Zuber and Dicke) the highest rate of N used was 80 lbs. per acre in a side dress treatment. In another experiment (Canon and Ortega) the tests were done mostly as a greenhouse trial rather than a field trial, so fertilizer applications were different. In some cases there have been positive correlations with both high and low rates of nitrogen depending on whether the corn had been selected as a resistant or susceptible variety. In most cases in studies done elsewhere, high rates of N have been implicated in higher rates of corn borer establishment. It would appear that definite conclusions for the South Dakota tests should be delayed until at least one more years data has been obtained.

Canon, W. N. and A. Ortega. 1966. Studies of Ostrinia nubilalis larvae (Lepidoptera, Pyraustidae) on corn plants supplied with various amounts of nitrogen and phosphorus. I. Survival. Ann. Entomol. Soc. Am. 59:631-38.

Offerman, G. P., A. J. Poppelis, and J. P. Vavra. 1967. Effects of mulching and nitrogen on corn borer susceptibility in corn. Phytopathol. 57:(10): 1031-33.

Zuber, M. S. and F. F. Dicke. 1964. Interrelationships of European corn borer, plant populations, nitrogen levels, and hybrids on stalk quality of corn. Ajron. J. 56:401-2.

Table 14. Establishment of European Corn Borer on Corn Treated with Various Rates of N at Centerville, South Dakota 1968

Broadcast Fertilizer Treatments, lbs./Acre N-P-K	Starter Fertilizer Treatments, lbs./Acre N-P-K	Average larvae per replicate	Average plants infested/replicate
0-0-0	none	34.25	16
0-25-70	8-14-13	34.0	14.25
80-25-70	8-14-13	37.75	15
160-25-70	8-14-13	34.25	15.25
240-25-70	8-14-13	35.0	15.25

20 plants per replicate artificially infested VII - 28 - 68 with 1 egg mass per plant.
Larvae counted Rep. 1 to 3 - August 22, 25
Larvae counted Rap. 4 - August 26

Corn Tillering

-- F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Does fertilizer stimulate formation of tillers?

2. Do tillers depress yields?

3. Is tillering a function of total nitrogen and phosphorus applied or of methods by which they were applied?

4. Do number of plants per acre or method of planting corn influence tillers formation?

Methods and Procedures Used in Tillering Study

May 1 - Broadcast fertilizer and plowed
May 15 - Tandem disked and harrowed plots. Planted same day.
May 24 - Harrowed all plots with flextine harrow.
June 7 - Cultivated first time.
June 21 - Cultivated second time.
June 21 - Sprayed with atrazine and oil (1½ lbs. atrazine 80 W and 1 gallon of oil) to control weeds in row.
July 3 - Cultivated 3rd time.
July 16 - Removed tillers in plots so designated.
Aug. 12 - Tiller count made and tillers removed in designated plots.
Oct. 11 - Hand picked
Variety - Pioneer 3558
Insecticide - Bux Ten

Soil test information is listed below:

Organic matter %	2.7	medium
Phosphorus lbs/A	28	medium
Exchangeable K lbs/A	514	high
pH 1:1 dilution	6.5	
Soluble salts mmho/cm	0.37	low
Zn 0.1 N HCl ppm	9.8	high
Ca 0.1 N HCl me/100 grams	19.5	adequate
Mg 0.1 N HCl me/100 grams	9.9	adequate

Table 15. Effect of Fertilizer and Method of Application on Number of Tillers and Yield of Ear Corn

Treatment No.	Treatment N-P-K	Method of Application	Plants per Acre	Method of Planting	Tillers	% Stalks with tillers	Bu. per Acre
1	0-0-0	none	13,275	drilled	left	16	93
2	6-11-11	starter	13,275	drilled	left	32	102
3	6-11-11	starter	13,275	checked	left	2	105
4	100-18-0	plowed down	13,275	drilled	left	16	117
5	100-18-0	plowed down	13,275	checked	left	1	113
6	100-18-0	plowed down	19,000	drilled	left	18	122
7	100-18-0	plowed down	13,275	drilled	removed	0	116
8	6-11-11 100-18-0	starter + plowed down	13,275	drilled	left	26	119

Discussion and Interpretation of Table 15

Starter fertilizer was banded 2 inches below the seed and about 2 inches to one side. The rest of the fertilizer was broadcast and plowed down.

Method of planting affected tillering in 1968 similar to results in 1967. Checked corn had fewer tillers than drilled corn. Increasing populations to 19,000 did not decrease % of tillers compared to a population of 13,275 when corn was drilled and fertilizer broadcast (Treatments 6 and 4).

In drilled corn, starter alone doubled the number of tillers. This was similar to previous results. In drilled corn, plots with plow down fertilizer had about as many tillers as the check plot (Treatment 4 and 1). The plow down method did not stimulate tiller formation as much as the banded starter treatment this year.

A small amount of starter alone appeared to increase yield of ear corn, but this was not statistically significant at the 5% confidence level. Application of starter in addition to plow down fertilizer did not increase yield of corn very much (Treatment 8 and 4).

Removing tillers did not increase corn yield this year (Treatment 7 and 4).

Increasing plant populations to 19,000 appeared to cause a small improvement in yield (Treatment 6 and 4).

Organic Soil Conditioner for Corn and Oats

-- F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Compare effects of organic speciality fertilizer or soil conditioner to chemical fertilizer effects on bushels per acre, protein in grain and moisture in grain at harvest.

Methods and Procedures Used in Soil Conditions Study

The following methods and procedures were used for corn:

- Preceding crop - Soybeans.
- Plowed - In fall.
- May 7 - Applied broadcast chemical fertilizer (60-13-0). Disked all plots and harrowed the same day.
- May 8 - Banded 200 lbs. of soil conditioner with planter attachment approximately 3 inches to the side and 2 inches below seed.
- May 7 and 8 - Planted corn.
- Variety - Pioneer 3715.
- Insecticide - Bux Ten.
- May 27 - Cultivated all plots.
- June 12 - Second cultivation.
- July 3 - Third cultivation.
- Sept. 25 - Hand picked.

The following methods and procedures were used for oats:

- Preceding crop - Soybeans
- Plowed - In fall.
- April 9 - Broadcast chemical fertilizer and soil conditioner. Disked and harrowed same day. Amount applied: 200 lbs. per acre of soil conditioner; 60-13-0 of N,P,K chemical fertilizer.
- April 10 - Drilled Holden oats at 2½ bushels per acre.
- Aug. 8 - Harvested all plots.

Soil test information and protein analyses were provided by South Dakota State University Soil Testing Laboratory. Soil test information is listed below.

Organic matter %	2.9	medium
Bray No. 1 phosphorus lbs/A	13	low
Exchangeable potassium, lbs/A	359	high
pH 1:1 dilution	6.4	
Soluble salts mmho/cm	0.38	low
Zinc ppm	9.5	high
Calcium me/100 grams	14.1	adequate
Magnesium me/100 grams	6.5	adequate

Table 16. Effect of Commercial Fertilizer and Soil Conditioner on Yield of Corn, Ear Moisture at Harvest and % Protein in Grain

Fertilizer treatment	% ear moisture at harvest	% protein in grain	Bu/A of No. 2 corn
none	40.2	6.97	108
60 lb. N + 13 lb. P/acre	40.1	8.65	115
200 lb/A soil conditioner	41.5	7.63	109

Table 17. Effect of Commercial Fertilizer and Soil Conditioner on Yield of Oats, % Moisture in Grain at Harvest, Screenings and % Protein

Fertility treatment	% moisture in grain at harvest	Amount of screenings* in lbs/acre	% protein in grain	Bu/A of cleaned grain**
none	12.2	198	14.72	22
60 lb. N + 13 lb. P/acre	15.2	238	14.23	20
200 lb/A soil conditioner	12.8	172	15.12	22

* Screenings include weedseeds, chaff and outer glumes with light kernels or infertile florets that were blown out while cleaning.

** Calculated on air dry weight.

Discussion and Interpretation of Tables 16 & 17

No conclusions can be made at this time.

Soybean Populations and Row Spacing

-- F. Shubeck and B. Lawrensen

Objectives of Experiment

1. Study effect of row spacings and plant populations on yield.

Methods and Procedures Used in Soybean Population and Row Spacing

Methods and procedures used in the soybean row spacing experiment were as follows:

Nov. 10 - Broadcast 150 lbs. N and 22 lbs. P per acre and disked in.
Plowed - Late November.
May 16 - Tandem disked plots.
May 21 - Sprayed plots with 1½ pints per acre of Treflan and disked immediately.
May 22 - Harrowed plots with spike tooth harrow.
May 22, 23 - Planted beans.
Variety - Amsoy
June 24 - 1st cultivation.
July 11 - 2nd cultivation.
Oct. 21 - Harvested.

Table 18. Relation of Distances Between Soybean Plants in the Row and Row Spacings to Plants per Acre

Soybean plants/acre	Row spacing in inches	Plants/ft. of row	Linear inches between plants in the row
75,000	20	2.86	4.2
75,000	30	4.30	2.8
75,000	40	5.74	2.1
100,000	20	3.83	3.1
100,000	30	5.74	2.1
100,000	40	7.65	1.6
125,000	20	4.78	2.5
125,000	30	7.17	1.7
125,000	40	9.57	1.3
150,000	20	5.74	2.1
150,000	30	8.61	1.4
150,000	40	11.48	1.0
175,000	20	6.70	1.8
175,000	30	10.04	1.2
175,000	40	13.39	0.9
200,000	20	7.65	1.6
200,000	30	11.48	1.0
200,000	40	15.30	0.8

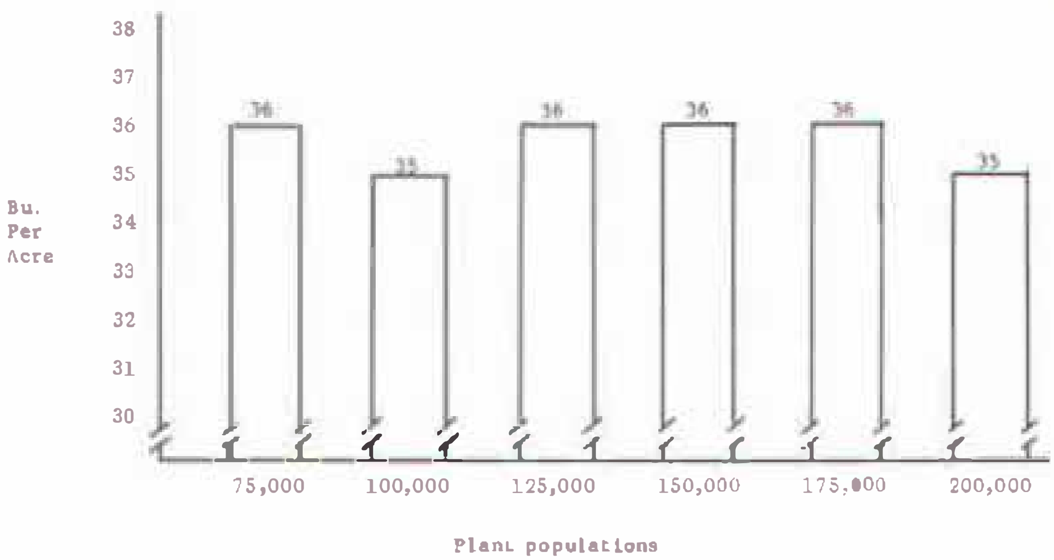
Discussion and Interpretation of Table 18 and Figures 17 and 18

Table 18 shows distances between plants necessary to achieve the final stands indicated for each row spacing.

Effect of plant populations on yield is illustrated in Figure 17. A wider range in populations was used in 1968 because results in 1967 indicated that narrow rows may have been a little more beneficial for increasing yield at higher plant populations. However, results in 1968 showed no clear cut yield advantage for any of the populations used.

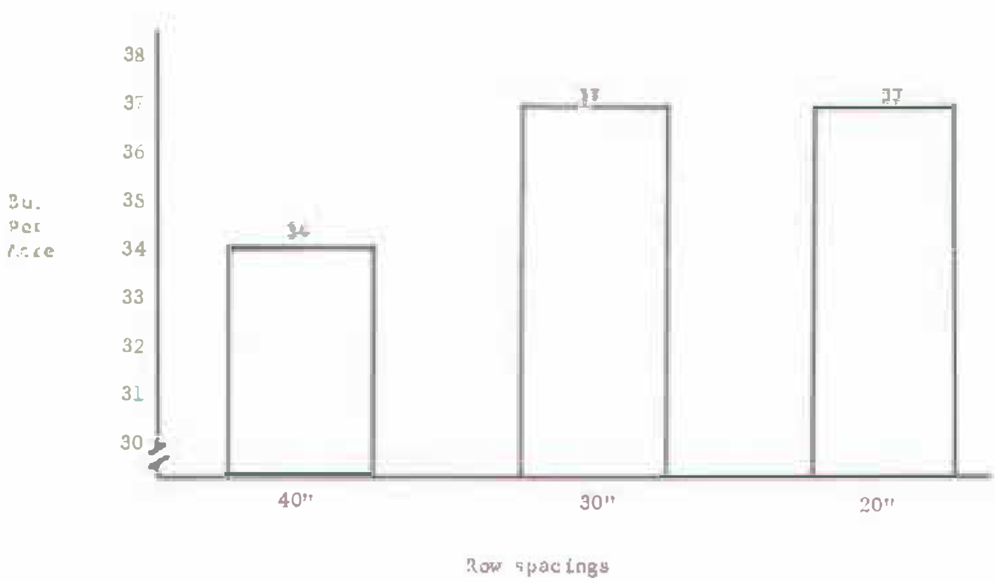
Figure 18 shows effect of row spacings on soybean yields. Results were very similar to those of 1967. Yields for 20 inch rows were the same as for 30 inch rows in 1968 and also in 1967. In both years, yields from narrow rows averaged more than yields from 40 inch row spacing.

Figure 17. Effect of Soybean Populations* on Yield.



* Yields for 3 row spacings were included in the average for each population.

Figure 18. Effect of Row Spacings* on Soybean Yield.



* Yields for 6 populations were included in the average for each row spacing.

Moat Profitable Rotation

-- B. Lawrensen and F. Shubeck

Objectives of Experiment

1. How much will commercial fertilizer increase net profita?

2. Which rotation or cropping sequence will bring the greateat cash return?

3. Ia it more profitable to add nitrogen from a commercial eource or to grow a legume in the rotation?

4. How great is effect of previous crop on available soil moiature during a growing season?

Methods and Procedures Used in Rotation Study

Seven different rotations or cropping sequences were investigated. The longest sequence had 2 years of corn, one year of oats and one year of alfalfa hay.

Varieties used were as follows:

Corn - Northrup-King PX 610	Soybeans - Amsoy
Oats - Holden	Grain sorghum - Northrup-King 227
Alfalfa - Common	Sweet Clover - Madrid

Fertility applications were based on soil test recommendations.

Table 19. Effect of Cropping Sequence and Fertility on Crop Yield

Cropping Sequence	Crop Receiving N-P-K Fertilizer	Fertilizer lbs/acre N+P+K	N Side Dress Lb/A	Oats Bu/A	1st Yr. Corn Bu/A	2nd Yr. Corn Bu/A	Soy-beans Bu/A	Sorg-hum Bu/A	Hay Tons/Acre
1 Cont. Corn		0 + 0 + 0	-	-	60	-	-	-	-
1 Cont. Corn	Corn	6 + 11 + 10	70	-	85	-	-	-	-
2 Corn-Oats	-	0 + 0 + 0	-	14	64	-	-	-	-
2 Corn-Oats	Corn	6 + 11 + 10	70	-	109	-	-	-	-
	Oats	30 + 7 + 0	-	18	-	-	-	-	-
3 Corn-Corn-Oats + Alf.-Alf. hay	-	0 + 0 + 0	-	18	98	56	-	-	2.6
3 Corn-Corn-Oats + Alf.-Alf. hay	Corn	6 + 11 + 10	0		108	-	-	-	-
	Corn	6 + 11 + 10	70	-	-	98	-	-	-
	Oats	15 + 26 + 0	-	21	-	-	-	-	-
	Alfalfa	residual	-	-	-	-	-	-	3.2
4 Oats + Sw. Clover-Corn	-	0 + 0 + 0	-	17	77	-	-	-	-
4 Oats + Sw. Clover-Corn	Oats	30 + 7 + 0	-	23	-	-	-	-	-
	Corn	6 + 11 + 10	-	-	108	-	-	-	-
5 Corn-Oats-S. beans	-	0 + 0 + 0	-	22	67	-	30	-	-
5 Corn-Oats-S. beans	Corn	6 + 11 + 10	70	-	119	-	-	-	-
	Oats	20 + 7 + 0	-	26	-	-	-	-	-
	Beans	6 + 11 + 10	-	-	-	-	33	-	-
6 Corn-S. beans-Oats	-	0 + 0 + 0	-	17	64	-	35	-	-
6 Corn-S. beans-Oats	Corn	6 + 11 + 10	55	-	105	-	-	-	-
	Beans	6 + 11 + 10	-	-	-	-	37	-	-
	Oats	30 + 7 + 10	-	22	-	-	-	-	-
7 Cont. Grain Sorghum	-	0 + 0 + 0	-	-	-	-	-	29	-
7 Cont. Grain Sorghum		6 + 11 + 10	70	-	-	-	-	34	-

Discussion and Interpretation of Table 19

Oats yields were very low this year due to low rainfall in May. Fertilizer increased oats yields 3 to 6 bushels per acre.

Corn yields responded very favorably both to commercial fertilizer and to legumes in the rotation. When corn followed soybeans (a legume) in a corn-oats-beans sequence (No. 5, Table 19) corn yields appeared to be a little higher for both fertilized and unfertilized plots than for corresponding fertilizer treatments when corn followed oats in a corn-bean-oats sequence (No. 6).

The highest yielding unfertilized corn plot in the entire experiment was in sequence 3 with 1st year corn after alfalfa. Yield increase due to fertilizer in this sequence was only about 10 bushel per acre. In non-legume rotations, fertilizer increased corn yield much more. A sweet clover catch crop also increased corn yields this year (compare 0-0-0 treatments in sequence four -77 bu- to sequence two - 64 bu). When fertilizer was applied to corn in these 2 sequences, yields were about the same (108 bu to 109 bu).

With second year corn and no fertilizer applied in the alfalfa rotation (No. 3) corn yield fell off sharply compared to first year corn after alfalfa.

Starter fertilizer banded 2 x 2 increased yield of soybeans 2 to 3 bushels per acre (sequence 5 and 6). This small increase in bean yield for starter fertilizer has been fairly consistent in most years.

Maximum Forage Production

-- B. Lawrensen, F. Shubeck of Agronomy Dept.
& G. Gastler of Station Biochemistry

Objectives of Experiment

1. Compare yield potential of 5 forage types (hybrid sorghum-sudan, true sudan hybrid, hybrid forage sorghum, open pollinated sorghum, and hybrid corn.
2. Compare multiple cuttings with full season growth using two types of forage (hybrid sorghum-sudan, and true sudan hybrid).
3. Compare nutritive values of different forage types and cuttings.
4. Compare results from 20" and 40" rows.

Methods and Procedures Used in Maximum Forage Study

Nov. 18, 1967 - Broadcast 190 lbs. N, 26 lbs. P and 42 lbs. K per acre and disked in.
Nov. 21 - Plowed in fall.
May 17 - Tandem disked plots.
May 28 - Tandem disked and flextine harrowed plots.
May 29-31 - Planted all varieties. For 20 inch rows, tool bar planters were moved in to 20 inch spacings and no changes were made in sprockets or plates from 40 inch row plantings. This amounted to double seeding in 20 inch rows.

June 14 - 1st cultivation.
July 24 - 2nd cultivation.
July 24 - 1st cutting of forage made in multiple cutting plots.
Aug. 30 - 2nd cutting of forage made in multiple cutting plots.
Oct. 4 - Forage cut in plots where only a single cutting was made.

Table 20. Effect of Forage Types, Row Spacings and Number of Cuttings on Forage Yield and Plant Composition*

Type	Variety	** No. of Cuttings	Row Sp.	Ton/Acre @ 70% Water	% Crude Fat	% Crude Fiber	% Crude *** Protein	% Nitrogen Free Extract	% Ash
@	(Frontier	1	20"	14.8	1.23	31.86	5.89	47.18	8.94
	(Hydan 38	1	40"	12.7	1.64	29.06	7.91	47.31	8.58
	(	2	20"	8.6	3.10	24.93	15.19	41.57	10.03
	(	2	40"	7.1	2.74	25.95	14.25	40.92	10.62
	(DeKalb	1	20"	15.3	1.57	30.37	6.31	48.35	8.49
	(SX-11	1	40"	13.8	1.74	28.16	7.66	49.34	8.05
	(	2	20"	8.8	3.15	25.26	15.74	39.54	10.39
	(	2	40"	7.5	3.14	22.48	16.44	41.77	10.64
@@	(Northrup	1	20"	11.3	1.96	28.23	7.65	49.27	7.96
	(King	1	40"	9.9	1.86	32.29	7.49	45.19	8.41
	(Trudan	2	20"	8.8	2.83	25.95	15.21	39.23	11.10
	(	2	40"	7.3	2.51	24.08	15.49	43.30	9.13
@@@	(Frontier	1	20"	18.2	2.38	24.65	7.22	54.05	6.71
	(FS 210	1	40"	14.6	2.29	24.86	6.91	53.92	6.73
	(Pioneer	1	20"	22.5	1.74	28.35	7.17	51.56	6.15
	(931	1	40"	20.5	1.79	33.16	7.69	46.24	6.11
@@@@	(Rox	1	20"	18.2	2.58	24.86	7.91	52.37	6.77
	(Orange	1	40"	13.3	2.07	27.66	8.24	49.37	6.87
@@@@@	(Pioneer	1	20"	15.5	1.60	28.20	7.72	51.12	5.54
	(3291	1	40"	12.6	2.08	22.22	8.16	56.64	5.67

* % Plant composition analysis reported on basis of moisture free material.
** one cutting - plants were allowed to grow until frost. Two cuttings - plants were cut each time they reached approximately 40" in height.
*** Determined by multiplying nitrogen by 6.25.

@ = Hybrid Sorghum Sudan
@@ = True Sudan Hybrid
@@@ = Hybrid Forage Sorghum
@@@@ = Open Pollinated Sorghum
@@@@@ = Hybrid Corn

Discussion and Interpretation of Table 20

With those varieties that had both single and multiple cuttings, yields of forage from single cuttings were greater than from multiple cuttings. Quality of forage, measured by low content of fiber and higher protein, was in favor of the multiple cuttings. These results were very similar to those of 1967. In every comparison, double planting in 20 inch rows yielded more forage than 40 inch rows.

Pioneer 931 forage sorghum again came through with the highest yields of total forage.

High Phosphorus Experiment

— Raymond C. Ward

An experiment was established in 1964 to study the effects of various rates of phosphorus (P) fertilizer on the yield of corn. The various rates of P were also used to determine the influence of P fertilizer on the zinc (Zn) uptake by corn plants. In the four previous years, four rates of P (10, 20, 40, and 80 lbs. P/Acre) had been broadcast and plowed down annually. In 1968 P was not broadcast. Each of the broadcast P treatments were divided into thirds with one third receiving 10 pounds of P as a starter fertilizer annually, one third receiving a Zn application in 1964 and 1965, and one third receiving no extra P or Zn.

The entire experimental area received 80-100 pounds of nitrogen (N) and 30-35 pounds of potassium (K) per acre per year. An insecticide was applied to control western corn rootworms. Pioneer 3414 was planted May 12, 1968 in 30" rows at 16,000 kernels per acre.

Results and Discussion

The corn yields for the various residual P treatments are shown in Table 21. Portions of the experimental plot area was affected with stalk rot disease. This caused considerable yield variability among the replications and therefore a large experimental error. However, it appears that the residual P treatments increased corn yields 8 to 10 bushels per acre. Starter P and residual Zn did not influence the yields appreciably.

The residual P treatments produced considerably drier corn than the check or P plots. The moisture content of the ear corn was 4 to 5 percent less where P was adequate. (See Table 22)

Soil samples were taken from the plots in August of 1968. The P soil test results are shown in Table 23. Where P had not been applied, the soil test values were in the low range. Where 23 pounds of P_2O_5 or 10 lbs. had been applied per year (40 lbs. of total P, Table 21) the P soil test was medium-high (Table 23). The other P soil tests were high to extremely high. The corn yields did not increase above the 40 pounds of P treatment which indicates that a soil test of about 35 lbs. P/Acre is high enough to produce top corn yields.

The zinc soil tests are shown in Table 24. The tests are essentially the same for the broadcast P and starter P treatments. The test almost doubled where 20 pounds of Zn had been applied per acre. The increasing rates of applied P did not have any influence on the zinc soil test.

Table 21. Influence of Various Rates of Residual Broadcast P and the Additional Influence of Starter P and Residual Zn on Yield of Ear Corn.

	No additional P or Zn	10 lbs. of P/A as starter	20 lbs. of Residual Zn/A	Average
Total lbs. of P Broadcast/A (1964-1967)	Ear Corn in Bushels Per Acre[1]			
0	76	70	75	74
40	84	84	83	83
80	83	79	78	80
160	83	86	86	85
320	87	82	81	83
Average	82	80	80	

[1] Yields corrected to 15.5% moisture in ear corn.

Table 22. Influence of Various Rates of Residual Broadcast P on Ear Corn Moisture

Total lbs. of P broadcast/A (1964-1967)	Ear corn[1] moisture
0	28.2
40	24.6
80	22.5
160	24.4
320	23.5

[1] Ear corn was harvested October 25, 1968.

Table 23. Influence of Residual Broadcast P, Additional Starter P, and Residual Zn on the Phosphorus Soil Tests

	No additional P or Zn	10 lbs. of P/A as starter	20 lbs. of Residual Zn/A
Total lbs. of P Broadcast/A (1964-1967)	Bray No. 1	P soil test, lbs. P/A	
0	13	20	11
40	37	55	34
80	57	84	62
160	95	108	88
320	140+	140+	140+

Table 24. Influence of Residual Broadcast P, Additional Starter P, and Residual Zn on the Zinc Soil Test

	No additional P or Zn	10 lbs. of P/A as starter	20 lbs. of Residual Zn/A
Total lbs. of P Broadcast/A (1964-1967)	Zinc soil test, ppm Zn*		
0	8.7	9.6	16.4
40	10.5	10.7	17.8
80	9.0	9.6	19.3
160	8.6	8.2	17.2
320	11.8	10.1	17.6

* .1 N HCL Extractant, 1:25 dilution.

Lime Experiment

— Raymond Ward and Douglas Koth

A lime experiment was initiated in 1968. The experiment consisted of four treatments repeated four times. The treatments were:

(1) Check plot
(2) Lime plot (four tons of limestone per acre)
(3) Phosphate plot (60 pounds of P_2O_5 per acre)
(4) Lime plus phosphorus plot

The treatments were broadcast on corn stalk ground in April and then plowed under. Corn was planted the middle of May and harvested October 25, 1968.

Most soils in South Dakota do not need lime, however, in the eastern part of South Dakota the pH of some soils warrants an investigation such as this to determine if lime will give a yield response or not. The soil testing laboratories at Iowa State University, the University of Minnesota, and the University of Nebraska recommend the addition of lime when the soil reaches a pH of 6.2. The soils on the Southeast Farm have a pH ranging from about 6.1 to 7.3 with most of them being around 6.4 or 6.5. The pH of the soil where the lime plot is located is 6.2.

One of the most important aspects of liming is its effect on the availability of phosphorus. As the pH approaches 6.0 and below, the availability of phosphorus is reduced because the phosphorus begins to be tied up as aluminum and iron phosphates.

Liming is a long term investment in that the benefits of lime will not be reaped in one crop year but rather over a period of several years, therefore, a cost return factor can be determined. If a favorable cost return factor evolves from this study, the soil testing laboratory in South Dakota will begin to make lime recommendations where the pH would indicate the need for lime.

Results and Discussion

Ear corn yields and moisture content from the lime experiment are shown in Table 25. The response to lime was small and variable depending on whether it was applied alone or with phosphorus. When yields from the two lime treatments were averaged and compared to the yields from the no lime treatments there was no yield increase. There was a small yield increase from P_2O_5. There was essentially no difference in moisture content of the ear corn.

Table 25. The Effects of Added Lime and Phosphorus on the Yield and Moisture Content of Ear Corn Grown at the S. E. Farm in 1968

	Ear Corn	
Treatments	Yield bu/A	Mositure %
Check	90.0	30.9
Lime (4 ton/A)	93.5	29.3
0 + 60 + 0	98.6	29.5
Lime 0 + 60 + 0	95.2	28.6

Soil Potassium of the Southeast Farm

— Dwight Hovland

The 1968 study was a continuation of the same plots used 1965-67. Earlier results and descriptions of the plots were included in previous annual progress reports for the southeast farm.

These plots compared three potassium fertilizer treatments. The same fertilizer treatments were used on the same plots each spring 1965, 1966, 1967, and 1968. Treatments were: (a) no potassium, (b) 500 pounds of potassium per acre broadcast and disked into surface soil, and (c) 12 to 17 pounds potassium per acre banded alongside and just below the seed. Nitrogen and phosphorus fertilizers were broadcast uniformly over all plots. Pioneer 3510 corn was planted in 30-inch rows on May 17. Good insect and weed control was maintained throughout the season. However, there was a severe shortage of soil moisture during the early part of the season as a result of low rainfall and high temperatures. The first helpful rain came on June 23. Some seedlings were just emerging on June 22 when plant height and density observations were made. This slow start of the corn was mainifested in late progress throughout the season.

The 1968 corn grain yields and June 22 seedling heights and seedling densities were recorded in Table 26. Statistical analysis showed all differences associated with fertilizer treatments were significant.

Table 26. Influence of Potassium Fertilizer on 1968 Corn Grain Yields and June 22 Seedling Heights and Densities on Some Moderately Well Drained Soils of the Southeast Farm.

Lb. 0-0-60/ac./yr. 1965, 1966, 1967 & 1968	Seedling ht. (in.)	Seedling Density (thousands/ac.)	Grain Yield (bu./ac.)
0	10	16	89
1,000	6	15	70
30	11	18	105

Flight Activity of Insect Predators of Cereal Aphids

— Robert W. Kieckhefer
ARS - USDA
Ent. Res. Div.

Objectives

1. To determine whether insect predators of cereal aphids move between small grains, corn, and alfalfa in South Dakota and to describe the nature of these movements.

2. To determine which environmental factors may be associatied with flight of predators from one crop to another.

Discussion and Interpretation of Figures

Problems connected with widespread application of insecticides have renewed interest in use of insect predators as an alternative or supplementary method of regulating populations of insect pests. A detailed knowledge of the field biology of predators and pest populations is prerequisite to management of predator populations or to making predictions about their effectiveness as pest control agents. Lady beetles, lacewings, and damsel bugs are known to be the most prevalent groups of insect predators in South Dakota small grain fields (Kieckhefer and Miller 1967).

They are also present in corn and alfalfa but information about size and timing of their movements between these crops is lacking. Cylindrical adhesive traps, mounted on poles 12 feet in height, and placed between principal crops at the Southeast Experiment Station, yielded data on size of airborne populations of predators, seasonal timing of flight, height of flight, and direction of flight. In combination with other research on insect predators and their prey, these flight trap studies have enabled us to draw some preliminary conclusions about flight activity of the 3 groups of predators mentioned.

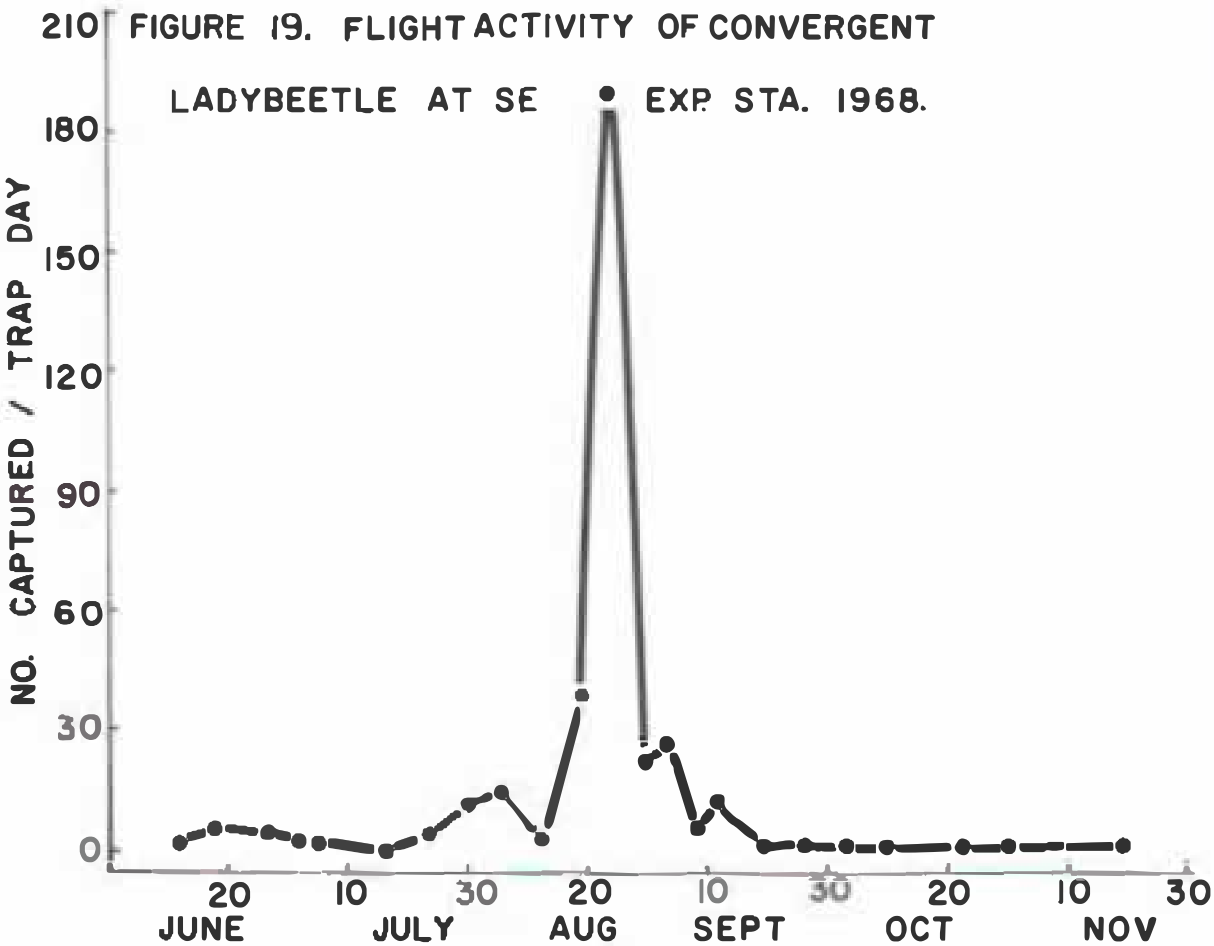
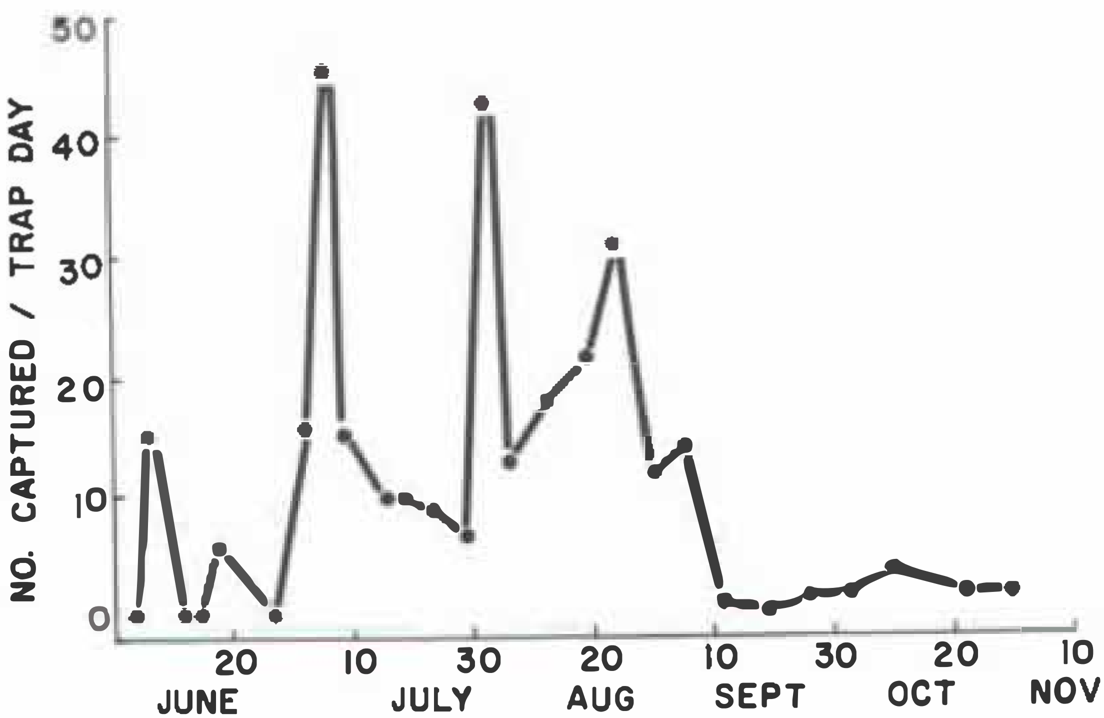


FIGURE 19. FLIGHT ACTIVITY OF CONVERGENT LADYBEETLE AT SE EXP. STA. 1968.

FIGURE 20. FLIGHT ACTIVITY OF GREEN LACEWINGS AT SE EXP. STA. 1968.



Seven species of ladybeetles were frequently captured in flight above small grains, alfalfa, and corn. Although 2 of the 7 species were captured in flight above all these crops, they were found searching for prey only in corn. A third species searched for prey only in small grains. A fourth species occurred in all crops but did not become numerically important until early autumn. Three of the 7 species were resident in the 3 crops throughout the growing season. One of these 3 species, the convergent ladybeetle, was the most numerous ladybeetle. Trap catches showed constant flight activity for the convergent ladybeetle during the growing season (Figure 19) but the major flight peak for the year occurred during the 3rd week of August. This flight peak coincided with a precipitous drop (119 beetles/200 net sweeps to 5 beetles/200 net sweeps) in convergent ladybeetles populations in alfalfa between August 19 and August 30. We concluded that the flight peak reflected an exodus of ladybeetles from alfalfa and a movement into corn.

Flight activity of green lacewings (Figure 20) flucuated more widely during the growing season than ladybeetles activity did. One species of lacewing predominated and was resident in all 3 crops. Flight activity peaks generally corresponded with declines in lacewing populations in alfalfa so that alfalfa appeared to be the principal origin of lacewing flights. Damselbugs were captured in only negligible numbers and evidently were not strong or frequent fliers.

In summary, it appears from these preliminary data that alfalfa fields may be a primary reservoir for insect predator populations. Clipping schedules and spray programs in alfalfa, particularly early in the season, may profoundly influence predator population levels in the entire cropping system.

With accumulation of additional information in the future, we may be able to devise systematic managment programs that will enable us to conserve and manipulate predator populations for very specific pest control objectives.

Literature Cited

Kieckhefer, R. W. and E. L. Miller. 1967. Trends of populations of aphid predators in South Dakota cereal crops - 1963-65. Ann. Ent. Soc. Amer. 60(3):516-518.

Water Storage Capacities of Various Surface Conditions and Geometric Shapes*

-- C. A. Onstad and P. E. Stegenga

Objectives of Experiment

1. To determine the geometric shapes of bedding, conventional tillage, listing and listing superimposed on bedding.
2. To detemine the surface water storage capacities for these types of tillage operations.
3. To determine the effects of these tillage operations on soil moisture, crop yield, and terrace spacing.

1968 Practices and Observations

All plots were planted on May 13, 1968, with Pioneer 3414MF at the rate of 14,000 plants/acre and fertilized with 200 lbs/acre of 22-22-0. Because May was very dry, the stand was poor and had to be replanted July 1. The plots were sidedressed on July 9 with 33.5-0-0 at the rate of 450 lbs/acre.

Throughout the growing season the plots suffered from the late start. In addition, volunteer corn was noticed in the listed plots before the first cultivation and was removed. It may have influenced yield (Table 27). One or two late summer thunderstorms produced row breakover and a general eroded condition on the conventional and listed plots without bedding. The bedded plots did quite well in protecting the soil surface from erosion.

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* This study was conducted by the Soil and Water Conservation Research Division, Agricultural Research Service. Project No. SWC2-W7 for 1968.

No soil moisture or surface storage measurements were made during 1968. These characteristics as affected by the different tillage practices are discussed in detail in an M.S. Thesis by Coy W. Doty.*

Summary of Experiment, 1966-1968

Table 27 summarizes the corn yield on the plots for 1966-1968 and indicates the averages. There is some variation in the corn yield averages but the averages are not significantly different. The average yields year by year are also not significantly different.

To evaluate the effect of these six different tillage treatments on potential surface water storage throughout the year; Doty, in his thesis, introduced the potential surface water storage index. This index utilizes the amount of available storage on the different geometric shapes and the percent of mean annual precipitation between each cultural operation. Table 28 shows the index and the storage increase over conventional contouring for each of the five other tillage practices on a 4% slope. Doty goes on to say that even though the 4-row bedding treatments increase potential storage most, 8-row bedding is nearly as good and is the most versatile of the shapes studied. Eight-row beds are easily constructed during normal plowing operations and the maintenance program is simple. Furthermore, 8-row beds are more conducive to the large field equipment presently being used by farmers.

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* Doty, Coy W. "Potential Surface Water Storage Capacity of Various Contoured Geometric Shapes." M.S. Thesis in Agricultural Engineering. South Dakota State University, 1968.

The increase in surface water storage by bedding reduces the potential amount of runoff and soil erosion so that no terraces are needed to maintain a tolerable soil loss on the soils of eastern South Dakota. So in addition to conserving moisture, they also reduce erosion.

Soil moisture data for the year 1966 at this and two other locations where this experiment was conducted indicated that there was no significant difference in soil moisture under average conditions. However, under very dry conditions there were apparent differences in soil moisture among the treatments. It was observed during periods of drought that the soil moisture beneath conventional tillage practices was least, grading up to the highest in the more drastic tillage methods. This increase in soil moisture increased the yields but not significantly.

In conclusion, it can be said that different geometric shapes of tillage increased the surface water storage potential but did not necessarily increase soil moisture or corn yield over the years tested. On the other hand, it did not necessarily decrease soil moisture or corn yield either. In addition the increase in surface storage potential through bedding practices eliminates the need for further erosion control measures on mildly sloping fields planted to corn in eastern South Dakota.

Table 27. Effect of Different Geometric Shapes on Corn Yield

Treatment	1966	1967	1968	Average
Conventional Contouring	135.0	103.1	91.0	109.7
Contour Listing	123.6	95.7	61.9	93.7
Contoured 4-row bedding - Conv. Planting	129.1	94.6	97.9	107.2
" " " - Lister Planting	114.3	80.9	87.0	94.1
" 8-row " - Conv. Planting	124.6	90.0	97.3	104.0
" " " - Lister Planting	129.4	81.3	92.3	101.0

Table 28. Increase of Potential Surface Water Storage Capacity Index Over Conventional Contouring on a 4% Slope

Treatment	Index	Percent Increase
Conventional Contouring	0.4	0
Contour Listing	1.2	200
Contoured 8-row bedding with		
conventional planting	1.9	375
lister planting	2.4	500
Contoured 4-row bedding with		
conventional planting	2.5	525
lister planting	2.8	600

Western Corn Rootworm Control - 1968

— B. H. Kantack, W. L. Berndt & J. F. Fredrikson

Western corn rootworm larval populations and larval damage was lower in 1968, as compared with previous years. Infestations were spotted in nature and somewhat less in intensity. Five demonstration plots were planted and treated in 1968, and only two developed light rootworm infestations. The infestations were not of sufficient magnitude to cause plant lodging. Injury was less noticeable for several reasons. (1) The rootworm hatch was late and prolonged over a several week period so that maximum numbers of larvae feeding at any one time was somewhat lower than other years. (2) Good growing conditions masked a lot of the rootworm injury as the plants made fast recovery.

Adult rootworm beetle populations were fairly general in all major corn growing areas of the State during August, September and October. Counts of two to three beetles per plant were common in most fields. These beetle numbers are considered of sufficient intensity to produce enough eggs for serious rootworm infestations to develop next year. We are recommending crop rotation to break the corn-on-corn sequence wherever possible in South Dakota. Where corn is planted following corn we recommend the following insecticide treatments to be applied at planting time (see Table 29).

Table 29. RECOMMENDATION FOR CORN ROOTWORM CONTROL IN 1969

Insecticide	Dosage
Bux Ten	0.75 lbs./A
Dasanit	1.0 lbs./A
Thimet	1.0 lbs./A
Dyfonate	0.75 lbs./A
Diazinon	1.0 lbs./A
Diazinon is recommended north of Highway 16 only in South Dakota	
Furadan*	0.75 lbs./A
Landrin*	1.0 lbs./A

* Will be recommended if they receive USDA registration by corn planting time in 1968.

As a result of the discovery of apparent resistance to Diazinon and the possibility that resistance to Diazinon may be present in the field, we are changing our control recommendations in South Dakota for 1969.

We are <u>removing</u> Diazinon from our recommended list of chemicals for corn rootworm control in all corn growing areas <u>South</u> of Highway 16.

It is possible that Diazinon may perform satisfactorily next year in affording corn rootworm control south of Highway 16. However, in view of findings in Nebraska of increased adult beetle tolerance to Diazinon in a region of close proximity to our major corn growing area, there is a good chance that failures could occur on Diazinon treated fields in adjoining areas in South Dakota in 1969. Thus, to protect our corn growers in southern South Dakota we are removing Diazinon from the recommended list of chemicals for control of corn rootworm larvae in this designated area for 1969.

Caution: Poison

All insecticides used for rootworm control are poisonous both to man and animals. This is especially true of most organic phosphate and carbamate formulations. They are safe to use in granular form when all safety precautions prescribed on the labels are followed strictly.

All insecticides recommended for corn rootworm control are toxic and, therefore, dangerous when not handled according to directions. This is true also of Aldrin, Heptachlor, and Chlordane which are used to control other soil insects.

The first rule in working with any of these materials is to read the label until it is understood completely. Secondly, follow the manufacturer's safety precautions to the letter.

Wear protective equipment when opening containers and filling insecticide hoppers - rubber gloves, long-sleeved shirt or coveralls, goggles, hat, and a proper respirator if working in the wind.

Remove protective clothing as soon as possible after use. If any insecticide is spilled accidentally on clothing or parts of the body, remove clothing and wash any parts of the body that the insecticide may have contacted.

Always stand upwind and away from the insecticide hoppers when filling. Never breathe dust or fumes. Do not haul containers in your automobile since fumes often are inhaled. Store all insecticides or contaminated equipment away from children and pets. Be sure to burn containers immediately after they are emptied. Bury unused or spilled granules.

Never attempt to sift or break-up lumpy, granular insecticides - the personal hazard is too great! If you find lumps or excessive amounts of fine powder in the granular formulation, return the insecticide to your dealer for replacement or refund.

If there is any chance you may have been poisoned accidentally, consult your doctor. Insecticides can gain entry into a human body in a number of ways - absorption through the skin; inhalation of vapors, or dust; smoking while hands or face are contaminated with dust; or entry into the eyes.

Take all precautions to avoid accidental poisoning.

Standard Variety Small Grain Trials

-- J. J. Bonnemman

Variety trials of spring and winter wheats, rye, oats and barley were harvested at the SE Farm in 1968. Data included in this report are bushel yield, test weight and five-year averages where available.

The winter grains were seeded on September 22, 1967 and adequate cover developed before fall growth stopped. Stands were variable, some because of winterkill and some for mechanical reasons. Yields were good though quality could have been better.

The spring seeding was done April 9, 1968. Growth was slow and somewhat limited as dry weather prevailed until early July and the plants were too far along to take advantage of the moisture.

Further discussion on the small grain trials will be found in Circular 194, 1968 Small Grain Variety Trials, South Dakota Experiment Station.

TABLE 30. STANDARD VARIETY SPRING-SEEDED WHEAT TRIALS, SOUTHEAST RESEARCH FARM BERESFORD, 1964-1968

Variety	1968 Test Wt. lb/bu	Average Yield, Bu/A 1968	Average Yield, Bu/A 1964-68
Waldron*	60.0	37.5	
Crim*	61.5	35.7	29.0
Shorty*	59.0	34.0	
Wells †	61.2	33.9	
Chris*	60.0	32.1	32.1
Tobari 66 ‡	61.2	31.9	
Rushmore*	60.5	31.7	27.3
Thatcher	60.5	30.4	24.4
Manitou*	61.0	30.3	
Polk*	61.2	29.5	
Sheridan*	61.0	29.1	29.2
Justin*	59.7	28.8	25.0
Leeds †	61.0	28.5	
Red River 68 §	61.0	28.2	
Fortuna*	59.2	23.3	
	Mean Yield	31.0	
	LSD (.05)	5.2	

*hard red spring † durum ‡ Mexico § World Seeds, Inc.

TABLE 31. STANDARD VARIETY BARLEY TRIALS, SOUTHEAST RESEARCH FARM, BERESFORD, 1964-68

Variety	1968 Test Wt. lb/bu	Average Yields, Bu/A 1968	1964-68
Dickson	47.0	32.6	
CI 11864	47.5	31.6	
Primus	49.0	30.2	
Conquest	46.0	28.5	
Paragon	47.5	28.2	
Firlbecks III	49.0	28.1	
Larker	49.0	27.2	45.2
Galt	47.0	26.0	
Centennial	50.0	25.8	
Liberty	46.0	25.7	47.1
Mich. 308	50.0	23.3	
Trophy	47.0	21.4	45.5
	Mean Yield	27.4	
	LSD (.05)	5.1	

TABLE 32. STANDARD VARIETY WINTER WHEAT TRIALS, SOUTHEAST RESEARCH FARM, BERESFORD, 1963-1968

Variety	1968 Test Wt. lb/bu	Average Yields, Bu/A 1968	1964-68
Winalta	58.0	44.6	
Trapper	58.5	43.9	
Ottawa	59.0	43.5	33.3
Minter	59.5	41.4	29.3
Lancer	58.5	40.7	34.1
Scout 66	58.5	38.7	
Gage	59.0	38.7	
Scout	58.5	37.7	
Winoka (CI 14000)	61.0	37.1	
Trader	57.0	37.0	
Shoshoni	59.0	36.8	
Guide	58.0	36.5	
Nebred	58.0	33.4	28.2
Hume	58.5	31.6	31.0
	Mean Yield	38.7	
		N.S.	

TABLE 33. STANDARD VARIETY OAT TRIALS, SOUTHEAST RESEARCH FARM, BERESFORD, 1964-1968

Variety	1968 Test Wt. lb/bu	Average Yields, Bu/A 1968	1964-68
Kelsey	34.0	45.2	
Kota	33.0	44.5	
Lodi	32.5	43.9	62.0
Santee	33.0	43.2	57.9
Multiline E 68	36.5	43.0	
Jaycee	36.0	42.8	
Wyndmere	33.0	42.8	
Clintland 64	32.0	42.7	65.0
Rodney	34.0	41.1	55.5
Burnett	33.0	39.9	58.8
Brave	32.0	39.2	59.2
Dawn	33.5	39.0	
Portal	30.0	37.8	
Pettis	36.0	37.6	
Tippecanoe	34.0	37.2	59.6
Sioux	31.0	37.1	
Dupree	34.0	35.9	62.7
O'Brien	35.0	35.8	
Clintford	32.0	33.4	59.8
Multiline M 68	32.0	33.3	
Coachman	30.0	30.2	55.5
Tyler	32.0	29.9	55.4
Holden	31.0	28.8	64.1
Garland	34.0	28.3	59.2
Orbit	30.0	24.9	
	Mean Yield	37.4	
	LSD (.05)	6.1	

TABLE 34. STANDARD VARIETY RYE TRIALS, SOUTHEAST RESEARCH FARM, BERESFORD, 1964-68

Variety	1968 Teat Wt. lb/bu	Average Yields, Bu/A 1968	1964-68
Zelder	55.5	67.1	
Von Lochow	55.5	58.3	
Dominant	55.0	57.6	
Antelope	54.5	57.6	51.2
Guelzower	54.0	55.6	
Frontier	55.0	55.5	
Elk	54.0	50.9	44.5
Toiva	52.5	50.5	
7276	55.5	50.1	
Pierre	55.5	49.5	45.2
Pearl	53.0	47.4	
Petkus	54.0	47.1	
Elbon	55.5	46.9	
Caribou	54.5	45.5	47.0
Dakold	55.5	44.7	
Adams	53.5	43.4	
Sangaste	53.0	42.1	
N.F. #7	55.5	40.3	
Bonel	55.5	37.1	
Tetra Petkus	50.0	27.1	
	Mean Yield	48.7	
	LSD (.5)	12.0	

Grain Sorghum Performance Trails

-- J. J. Bonnemann

Grain Sorghum Performance Trials have been conducted at the SE Farm since 1962. The material included has been the choice of the entering producers. Check entries are included by the Agricultural Experiment Station.

The grain sorghum trial was seeded May 21 and harvested October 7. Cool temperatures prevailed throughout much of the growing season. Excessive precipitation occurred during June. Conditions were not favorable for sorghum growth. Yields were higher and of better quality than could be expected with the handicaps imposed by the 1968 growing season.

Yields are reported in pounds per acre. Quality was generally good. Because of the cool season, ripening was slow and moisture at sampling time was high. The crop was physiologically mature because test weights were good for most entries.

Results of the Grain Sorghum Performance Trials appear in Table 35. Complete results and further discussion will appear in Circular 195, 1968 Grain Sorghum Performance Trials, South Dakota Agricultural Experiment Station.

TABLE 35. 1968 GRAIN SORGHUM PERFORMANCE TRIAL, SOUTHEAST RESEARCH FARM, BERESFORD

Variety	Height, inches	Percent Moisture 9/26/68	Test Wt. lb/bu	Yield lb/A
Pioneer 866	53	30.6	58.5	7160
DeKalb E-55	51	34.0	55.0	6860
Asgrow Rico	52	29.9	55.0	6710
Asgrow Flare	58	33.0	54.0	6600
RS 610	53	30.3	57.0	6510
Curry M-530	47	24.4	58.0	6340
ACCO R 102	50	28.9	57.0	6300
NK 265	52	29.9	58.0	6230
Pioneer 875	49	31.8	56.0	6140
Pioneer 883	47	25.7	55.0	6120
DeKalb DD-50	46	33.5	57.0	6110
Advance AMAK R-10	49	23.0	56.0	6090
Advance 14	50	27.6	56.0	6050
Sokota 510	51	35.1+	57.0	6050
Frontier GX 410	40	24.1	55.0	5850
Pioneer 889	42	28.6	57.0	5810
NK 222	43	31.7	58.0	5780
SD 503	58	24.4	56.0	5760
Asgrow Rocket B	50	23.0	58.0	5720
Frontier 388a	45	24.9	58.0	5680
ACCO R 1050	47	28.2	58.0	5630
Pioneer 885	45	22.8	57.0	5540
Frontier Grassy Grain I	49	19.6	57.0	5480
SD 451	52	19.8	56.0	5140
ACCO R 94	50	26.3	58.0	4830
T-E 44c	47	24.2	57.5	4670
SD 441	56	17.4	55.0	4200
			Mean	5900

C.V. = 6.8% LSD (.05) 660

Corn Performance Trials

-- J. J. Bonnemann

The entries included in the trial were those selected by the participating commercial seed producers and varieties developed by the Experiment Stations in the area. Fifty-four entries were included in the 1968 trials.

The corn was drilled in rows on May 10. It was harvested with a picker-sheller on October 31. The plant population desired was 16,080 plants per acre. Fifty-six kernels were seeded with the intention of thinning to 48 in a 39 foot row. Growing conditions in the early part of the year caused some severe stand losses. All plots were overplanted 15%. In some plots stand losses were greater than 15%.

Even with delayed ripening, yields were excellent in 1968. Yields ranged from 150 to 185 bushels per acre. Moisture was high in many entries at harvest. This was typical of many areas this past fall. Many entries were physiologically mature but the fall season was not favorable for rapid drying of grain on the stalk after plants had reached maturity. (Table 36, page 56)

Additional information may be found in Circular 196, 1968 Corn Performance Trials, South Dakota Agricultural Experiment Station.

Oat Breeding

-- R. S. Albrechtsen

A total of 133 entries were tested in 4 oat yield nurseries at the Southeast Experiment Farm in 1968 as a part of the Oat Breeding and Regional Testing Program of the South Dakota Agricultural Experiment Station. Approximately two-thirds of the entries in these nurseries were strains orginating from our own breeding program and are in the early stages of yield-testing. The majority of these strains will eventually be discarded after further testing and only the most promising few will be retained for advanced testing. The best new strains available from state experiment stations are entered in Uniform Regional Nurseries which are grown throughout the North Central Region of the U.S. and in Canada. These nurseries provide data for final discusion on the release of new varieties. Yield data are presented in this report for selected entries in the two Regional Nurseries only. Entries are arranged in descending order of 1968 yield values.

Data on selected high yielding experimental strains and accompanying check varieties in the 1968 Uniform Early Oat Performance Nursery are shown in Table 37. Entries in this nursery are primarily of the early maturity class, being equal to or earlier than the Clintland type oats. Jaycee was the highest yielding entry in this nursery in 1968 but Clintland 64 had the highest 2-year average yield. Long-time averages generally give a better measure of the true potential of a variety since it reduces the magnitude of seasonal variation upon entries.

Table 38 shows yield and bushel weight information on selected high yielding experimental entries, recently released varieties and long-time checks in the Uniform Midseason Oat Performance Nursery. Entries in this nursery are primarily of the midseason to late maturity class. The highest yielding entry in 1968 was an unreleased experimental strain. Kota, a 1969 release of the South Dakota

Table 36. 1968 CORN PERFORMANCE TRIAL, AREA E, SOUTHEAST RESEARCH FARM

Variety	Percent RL	Percent SB	Performance Score	Percent Moisture	Yield, B/A
Pioneer 3510 (2x)	0	5	10	32.5	150.3
Pioneer 3333 (M2x)	1	3	7	31.6	150.1
Curry TC-358	0	4	4	27.4	146.7
Asgrow ATC 79 (3x)	1	6	3	26.5	145.9
Asgrow ASX 58 (2x)	3	7	1	24.0	144.6
Northrup-King PX 50 (2x)	2	8	2	24.3	144.0
McCurdy 2 x 4 (2x)	2	4	9	24.6	141.7
Pioneer 3545 (2x)	0	2	11	26.2	141.5
Northrup-King PX 580 (3x)	2	9	8	23.7	140.7
Northrup-King PX 556 (3x)	1	10	5	23.7	140.2
United-Hagie 6G7 (2x)	4	12	6	21.8	138.9
Pioneer 3505 (2x)	0	7	16	28.9	138.6
McCurdy HP 4 (3x)	2	12	12	35.7	138.4
Northrup-King PX 621 (3x)	3	12	15	27.3	137.6
SDAES Exp. 67 (3x)	2	42	21	30.3	136.0
Pioneer 3570 (2x)	0	1	14	25.1	135.8
Pioneer 3365 (2x)	1	3	23	30.2	135.4
United-Hagie 6S370	1	2	17	27.0	135.2
Northrup-King PX 610 (3x)	8	8	13	25.7	134.5
Nebr. 501G (4x)	20	13	24	31.0	134.5
McCurdy 3 x 6 (2x)	1	10	20	28.1	133.7
Pioneer 3390 (2x)	1	3	26	31.3	133.7
McCurdy 112 M (4x)	6	12	22	28.5	133.5
Asgrow ASC 91 (2x)	0	2	27	30.0	132.2
Pioneer 3567 (2x)	0	3	25	30.0	132.2
Asgrow ATC 75 (3x)	0	10	19	26.0	131.4
Curry SC-142 (2x)	11	11	18	24.5	130.6
Sokota SK-70	7	2	28	29.0	130.3
Pioneer 3291 (4x)	1	12	32	30.0	129.2
Disco 112-A (4x)	1	8	33	28.4	127.0
SDAES Exp. 69 (4x)	3	23	38	31.3	126.8
Northrup-King PX 63 (2x)	6	7	29	26.8	126.6
United-Hagie 5S495 (2x)	2	3	39	32.2	125.7
Pioneer 3715 (3x)	0	20	30	25.7	124.9
McCurdy HP 5 (3x)	0	10	34	27.1	124.7
United-Hagie 23G3 (3x)	2	3	36	27.8	124.3
Minn. 417 (4x)	1	12	31	25.3	123.8
SDAES PP 67403 (4x)	0	16	35	26.3	123.4
Green Acres 401 (4x)	4	9	37	27.3	123.4
Curry SC-166 (3x)	0	2	44	32.4	119.0
Sokota 645A (4x)	1	7	41	28.6	118.6
Northrup-King PX52 (2x)	2	3	42	25.6	115.1
SDAES Exp. 68 (3x)	1	16	47	33.5	114.7
Sokota 623 (4x)	4	5	43	28.2	114.6
SD 604 (4x)	4	8	45	29.0	113.4
SDAES PP 67401 (4x)	4	14	40	23.5	113.3
SDAES PP 67402 (4x)	0	4	46	26.7	107.8
Curry TC-360 (3x)	6	4	49	34.4	107.4
SD 420 (4x)	4	11	48	25.9	102.9
SDAES PP 67405 (4x)	2	5	50	28.6	96.8
SDAES PP 67404 (4x)	1	11	51	29.3	95.8
Disco SX-29 (2x)	1	4	52	28.7	91.9
SDAES PP 67406 (4x)	2	4	53	27.9	88.6
SD 622 (4x)	1	7	54	29.0	85.4
				LSD (.05)	11.9

Agricultural Experiment Station, had the highest 2-year average yield. Kota is a product of our oat breeding program at South Dakota State. Kota seed is being released by the South Dakota Foundation Seed Stock Division to County Crop Improvement Associations for registered and certified seed production in 1969.

Table 37. PERFORMANCE OF SELECTED EXPERIMENTAL OAT STRAINS AND CHECK VARIETIES IN THE CENTERVILLE UNIFORM EARLY OAT PERFORMANCE NURSERY; 1967-1968.

C.I. Number	Variety or Selection	Bushel Weight 1968	Bushel Weight 67-68	Yield 1968	Yield 67-68
		lbs./bushel		bushels/acre	
7971	Jaycee	38.0	36.5	52.4	55.8
4170	Andrew	33.0	33.4	51.6	58.8
7698	Ab-60-1079	35.5	34.8	49.6	59.3
--	0498	38.0	37.0	49.2	58.0
8304	II-54-109	35.0	*	47.4	*
--	05291	34.0	34.5	46.8	56.4
7639	Clintland 64	35.0	36.0	46.6	68.0
8166	62-1453	34.0	35.4	46.5	61.0
--	E-69	39.0	37.6**	44.5	63.5**
8063	61-1632	33.0	34.1	42.2	57.1
7463	Clintford	34.5	36.4	42.1	59.6

* 1968 was first year of testing in the Uniform Early Oat Performance Nursery
** E-68 values used for 1967 data.

Table 38. PERFORMANCE OF SELECTED EXPERIMENTAL OAT STRAINS AND CHECK VARIETIES IN THE CENTERVILLE UNIFORM MIDSEASON OAT PERFORMANCE NURSERY; 1967-68

C.I. Number	Variety or Selection	Bushel Weight 1968	Bushel Weight 67-68	Yield 1968	Yield 67-68
		lbs./bushel		bushels/acre	
--	1181-2	34.0	*	54.1	*
7561	Lodi	31.5	31.8	51.6	60.8
--	995-4-1	32.5	*	50.7	*
--	469	33.6	*	50.0	*
8178	Kota (new)	33.0	36.0	49.4	70.0
4170	Andrew	33.0	34.1	48.3	51.0
--	955	33.0	*	47.9	*
7971	Jaycee	35.5	35.2	46.8	58.0
--	1137-5	33.0	*	45.9	*
--	1541	32.0	*	45.5	*
8304	II-54-109	33.0	33.0	44.7	64.0
8040	Portal	31.0	34.2	44.4	67.1
7453	Garland	31.5	34.0	43.9	51.5
7639	Clintland 64	34.0	36.4	42.2	63.5

* 1968 was first year of testing in the Uniform Midseason Oat Performance Nursery.

Weed Control in Corn

-- J. F. Stritzke and C. E. Stymiest

Objective

To compare effectiveness of new herbicides with some of the recommended herbicide treatments.

Materials and Methods

Plot and Planting Information: Plots were 10 ft. by 30 ft. and were replicated 3 times in a randomized complete block design. Corn was grown in 30-inch rows. Corn plant population at harvest was approximately 15,000 plants/A. Area was fertilized at rate of (130-48-0 #/A) and fall plowed. Corn (Sokota 625) was planted May 2, 1968.

Spray Applications: Herbicide treatments were applied with a tractor type sprayer applying 20 gallons spray per acre. Preplant incorporated treatments were incorporated by a tandem disk immediately after spraying. Preplant treatments were applied May 2 and Preemergence treatments May 9. Postemergence treatments were applied when grasses were in the 7-leaf stage.

Preemergence treatments of application had to be delayed one week after planting because of winds. The front half of each plot was flextined after spraying. The no herbicide plots were cultivated 3 times and the herbicide plots were cultivated once.

Results

Flextining one week after planting resulted in some weed control. Very little rainfall was received after spraying and only two treatments gave satisfactory weed control. They were 2.5 #/A of atrazine incorporated and a new compound, BAS 2902. An estimate of weeds indicated that many of the plots had 1000 #/A of weedy grasses at harvest (Table 39). Late post emergence treatments were not effective. Corn yields from the atrazine incorporated plots cultivated once were 12 bushels better than check. One cultivation on check plots (cultivated 3 times) with some treatments and less than check plots with other treatments (see Table 39).

Table 39. THE PERFORMANCE OF HERBICIDES AND RESULTING CORN YIELDS AT THE SOUTHEAST RESEARCH FARM IN 1968.

Treatment Common Name	Trade Name	Rate/Acre lb. actual	% Control Grasses[1] Flextined	Not Flextined	Avg. Estimate lbs/A Weeds	Avg. Yield bu/A Corn
Preplant Inc.						
Atrazine	AAtrex	2.5	92	87	93	139
R-1910	Sutan	4	67	50	800	132
Preemergence						
BASF 2902	BASF	6	88	65	356	129
CP 50144	Lasso	2	63	47	930	128
GS 14260	Geigy	2.5	50	48	466	123
C-6313	Maloran	4	47	43	1000	118
Atrazine	AAtrex	2.5	51	43	630	131
NC 4780	Fisons	1.5	43	18	926	132
Propachlor	Ramrod 65w	4	73	38	866	113
SD 15418	Shell	2.5	38	17	890	120
VCS 438	Velsicol	4	50	51	1000	136
Preemergence Combinations						
Atr. + Prometryne	Primaze	2.5	42	40	763	125
Ramrod + Atrazine		2 + 1	72	51	1000	130
CP 50144 + Atrazine		1 + 1	60	40	866	130
Ramrod + Linuron	Londax	2 + 1	67	47	906	127
Atrazine + Liruron		1 + 1	53	50	853	126
Post Emergence (Late 7-leaf stage)						
Atrazine + Oil + Dalapon		1 + 1 + 6 oz.			800	114
Atrazine + Oil		1 + 1			710	119
Atrazine + Detergent		1 + .5%			966	121
SD 15418 + Oil		1 + 1			1000	119
No Herbicide (3 cultivations)			32	0	1000	127

[1] Grasses are primarily yellow and green foxtail. Some barnyardgrass. Notes were taken June 13, 1968.

Effects of Chloroxuron (Tenoran)
on Soybeans

-- J. F. Stritzke and C. E. Stymiest

Objective

To determine the effect of chloroxuron on soybean yields.

Materials and Methods

Plot size and Cultural Information: Amsoy soybeans were planted May 27 in 30-inch rows. Plots were 2 rows wide and 30 ft. long. All plots were cultivated twice. Treatments were replicated 3 times in a randomized complete block design.

Spraying Information: The early treatments of chloroxuron were applied when the soybeans were in the early trifoliolate state of growth (June 17, 1968). At the time of spraying, the soil was dry and the air temperature was 75° F. The late treatments of chloroxuron were applied when the soybeans were in the early blossom stage of development. Growing conditions were good at this stage of growth and the air temperature was 80° F.

Cultivation: All plots were cultivated 2 times and at harvest no weeds were present in any of the plots.

Results:

Only fair grass control resulted from the early treatments with chloroxuron. All early treatments gave foliage injury. Severe burning of unifoliate and 1st trifoliolate leaves resulted when 1 gallon of oil was used with 2 lb/A of chloroxuron. This injury was also reflected in the height measurements taken July 12 (Table 40). Late treatments also cause leaf burning of the beans. Although some fairly severe leaf burning was noted in a number of treated plots, the soybeans recovered and resulting yields were satisfactory with all treatments.

Table 40. THE EFFECT OF CHLOROXURON ON SOYBEAN HEIGHT AND SOYBEAN YIELDS WITH VARIOUS METHODS OF APPLICATION.

Treatment	Rate lbs/A lb. actual	Average Height (cm) July 12	Average Yield bu/A
Early			
Chloroxuron + adjuvant	2 + .5%	28.3	30.1
" "	3 + .5%	27.0	31.7
Chloroxuron + oil	1 + 1 gal.	25.0	27.9
" "	2 + 1 gal.	23.0	33.2
Late			
Chloroxuron + adjuvant	2 + .5%		34.9
" "	3 + .5%		30.9
Chloroxuron + oil	1 + 1 gal.		30.0
" "	2 + 1 gal.		30.3
No Herbicide	--	32.0	32.1

Weed Control in Soybeans

-- J. F. Stritzke and C. E. Stymiest

Objective

To compare effectiveness of new herbicides with some of the recommended herbicide treatments.

Materials and Methods

Plot and Planting Information: Plots were 10 ft. x 30 ft. and were replicated 3 times in a randomized complete block design. Corsoy soybeans were planted May 27. Soybean plant population at harvest was approximately 154,000 plants/A. Soybeans were grown in 30-inch rows.

Spray Applications: Herbicide treatments were applied with a tractor type sprayer applying 20 gal. spray solution per acre. Preplant incorporation treatments were sprayed on May 27 and were immediately incorporated by a tandem disk. Preemergence treatments were applied immediately after planting.

Mechanical Practices: Plots receiving no herbicide were cultivated 2 times and all herbicide treated plots were cultivated once.

Results:

Weeds were not a problem in soybeans under the conditions that existed during this year's study. DCPA and U.C. 22460 treatments did not give satisfactory weed control based on early estimates, but yields of weeds from these two treatments were less than 75 lb/A (Table 41). Also the weed yield from check plot was only 72 lb/A. Soybean yields in the trifluralin plots were lower than soybean yields from plots not sprayed.

Table 41. ESTIMATE OF EARLY WEED CONTROL AND SOYBEAN YIELDS FROM VARIOUS HERBICIDE TREATMENTS

Treatment: Common Name	Treatment: Trade Name	Rate/A lb. actual	Average % Weed Control	Yield Bu/A
Preplant Inc.				
DCPA	Dacthal	10	57	40.4
Nitralin	Planavin	1.5	52	37.1
Trifluralin	Treflan	1	77	27.1
Vernolate	Vernam	3	93	34.8
Preemergence				
VCS-438	Velsicol*	4	65	35.0
BAS-2902	BASF*	4	95	30.9
Amiben	Amiden	3	85	31.4
CP-52665	Monsanto*	2	91	32.1
CP-50144	Lasso	2	83	35.8
C-6989	Praforan	4	92	30.7
Metobrmuron	Patoran	4	73	30.5
NC-4780	Fision*	1.5	65	32.6
U.C.-22463	Sirmate	6	55	33.2
Propachlor	Ramrod	4	96	29.9
Linuron	Lorox	2.5	67	32.6
SD-15129	Shell*	2	75	30.7
Mixtures				
Norea + Amiben		1.2 + 1.5	73	31.1
Propachlor + Linuron	Londax	2 + 1	75	34.4
CP-50144 + Linuron		1 + 1	78	36.4
No Herbicide		0	0	37.2

Treatment	Rate of herbicide lb/A	Weed Yields dry matter lb/A
No Herbicide	0	72
U.C. 22460	6	47
Dacthal	10	75

* No trade name.

Weed Control in Sorghum

-- J. F. Stritzke and C. E. Stymiest

Objective:

To compare effectiveness of new herbicides with some of the recommended herbicides.

Materials and Methods:

Plot and Planting Information: Plots were 10 ft. by 30 ft. and were replicated 3 times in a randomized complete block design. Sorghum was grown in 30-inch rows. Sorghum (NK-133) was planted May 27 at the rate of 100,000 plants/A.

Spray Applications: Herbicide treatments were applied with a tractor type sprayer applying 20 gallons spray solution per acre. Preemergence treatments were applied just after planting and early postemergence treatments were applied when weedy grasses were in the 2-4 leaf stage (1 1/2 inches tall).

Cultivation: The no herbicide plots were cultivated twice and all herbicide plots were cultivated once.

Results:

Two cultivations in the no herbicide plots were effective in controlling weeds. At the time of planting, growing conditions were dry and weeds did not germinate until a rain was received. Propachlor (Ramrod) and various combinations of Ramrod were the only preemergence treatments that gave good weed control (Table 42). All of the postemergence treatments gave mostly satisfactory grassy weed control. Sorghum yields from control plots and the better herbicide treatments were about 6000 pounds/A. Yields of Sorghum from plots treated with R 11913 were lower due to unsatisfactory weed control. A treatment of SD 15418 + oil caused injury to sorghum and only fair weed control. Fair weed control was obtained with a SD 15418 + oil treatment but some burning and injury to the sorghum was noted.

Table 42. THE PERFORMANCE OF HERBICIDES AND RESULTING SORGHUM YIELDS AT THE S.E. RESEARCH FARM IN 1968

	July 25 Average	

Table 44. PERFORMANCE OF SOYBEAN BLENDS IN 1968

Variety or Blend	Yield (Bu/A)
Chippewa	35.8
Hark	36.6
Corsoy	42.3
Amsoy	36.5
Hawkeye	35.2
Wayne	40.1
Chippewa-Hark	35.8
Chippewa-Corsoy	35.9
Chippewa-Amsoy	35.8
Chippewa-Hawkeye	36.5
Chippewa-Wayne	36.8
Hark-Corsoy	39.9
Hark-Amsoy	37.3
Hark-Hawkeye	33.6
Hark-Wayne	40.4
Corsoy-Amsoy	41.5
Corsoy-Hawkeye	38.3
Corsoy-Wayne	41.7
Amsoy-Hawkeye	37.4
Amsoy-Wayne	39.9
Hawkeye-Wayne	38.4

Sorghum Breeding and Regional Grain Sorghum

-- A. O. Lunden

Sorghum testing included regional grain sorghum yield tests and preliminary yield tests of both grain and forage type experimental hybrids. Grain sorghum yields ranged to about 65 hundredweight or 115 bushels per acre in 1968. The lower than average temperature was unfavorable for sorghum development but moisture was generally favorable. Harvest conditions were very poor and excessive lodging was found in most entries.

Two extra leafy type forage sorghums and their pollinators will probably be released for seed production in 1969. They produced more than 5 tons dry matter per acre of good quality silage in the 1968 tests. The main desirable features of these new hybrids are high forage quality from both leaves and seed, good yield, ease of harvest due to short plant height, and ability of the plant to hold its leaves and resist lodging after frost.

Disease Damage, 1968 Corn Crop

-- C. M. Nagel

Since September 1 corn stalk rot and root rot have caused much stalk lodging and stalk breakage in South Dakota.

Losses were estimated at 15-20% in South Dakota. Although the disease damage varied somewhat from field to field, the average damage was estimated to be 18%. In addition to stalk breakage and lodging the diseased ear shanks also became weak, rotten and brittle, and ear drop was expected to increase. Yield reductions caused by these two diseases were due to shorter ears, poor kernel filling, and poorly filled kernels towards the ear tips.

Corn production based on November 1 conditions were estimated by the South Dakota Crop Reporting Service as 119.8 million bushels. If this estimate is realized with final corn in the crib, this will be 29% above 1967 and 9% above the 1962-66 average production. Thus as a whole, 1968 was a good year for corn production. However, with excellent moisture during the last half of the season, and no stalk or root rot diseases, yields could have averaged 18% higher. A loss estimate of 18% from the total corn production estimate for 1968 of 119.8 million bushels would indicate a loss of $21,420,000. These figures do not take into consideration possible loss from insects.

The losses from these two diseases in the heart of the South Dakota corn belt in 1967 was estimated at 21%. These figures were based on extensive sampling of field experiments. Thousands of corn stalks were split and examined and grain yields were obtained to determine the severity of stalk rot and yield losses. Therefore, the estimate of damage due to this disease was based on scientific techniques. Although stalk lodging and breakage has been more severe during the last two seasons, serious losses, usually 8-12%, have been attributable to these diseases every year.

Stalk and root rot losses reported by pathologists in Minnesota, Iowa, Indiana, Nebraska, and Illinois were nearly as high as those in South Dakota for 1968. Stalk and root rot are perhaps the two most important disease hazards to corn production in South Dakota as well as in the corn belt of the nation. Rot damage is especially important because it usually affects most plants in the field even though there is some variation in severity within the field. It does not appear as a spotty condition as some other crop hazards do. This accounts for the high average level of damage to the crop.

As was evident to most growers this past season, most hybrids showed little advantage over one another for rot and stalk breakage. This was easily observed while traveling through the corn growing sections this past fall.

The Plant Pathology Department of South Dakota Agricultural Experiment Station, at Brookings, has been working on this program for a number of years and has produced what appears to be some promising parental corn lines with disease resistance to stalk and root rot. Particularily in 1967, in experiments conducted in the heart of the South Dakota corn belt at the Southeast Research Farm where the disease was severe, yield and stand performance trials with these new experimental hybrids compared exceptionally well with a broad spectrum of commercial hybrids. Additional testing is still needed.

These new experimental hybrids are considered promising for eliminating some of the disease losses in the future. In addition to the disease resistance

to stalk and root rot, these parental lines possess other desirable characteristics as upright foliage, which is believed by some to be very important should narrow row planting and high plant populations prove to be effective and economical on a commercial basis. It is thought that upright leaf characteristics shade lower leaves less and permit a greater amount of sunlight to strike a larger leaf area per plant than present hybrids that have a drooping type of leaf. The drooping leaf type is characteristic of perhaps 98% of present day hybrids. There are many things to take into consideration before growers launch into high population levels to increase bushel per acre production. Preliminary experimental evidence indicates at this time that close planting may intensify certain diseases. Extremely high fertility rates needed to produce high anticipated yields may also increase disease severity in the crop. Stress from dense populations and drought also increase severity of stalk rot and root rot damage.

ANIMAL SCIENCE SECTION

Alfalfa and Corn Grain vs. Corn Silage and Protein Supplement for Growing and Finishing Beef Cattle, With and Without Shelter

-- L. B. Embry, H. G. Young and J. F. Fredrikson

This experiment was conducted to compare rations of alfalfa and a limited amount of corn grain with rations of corn silage and protein supplement for growing and finishing beef cattle. Each kind of ration was fed to two pens of cattle with shelter and two pens without shelter.

Procedure:

The shelter consisted of an east-west oriented shed, 38 ft. x 100 ft., divided into four pens with 25 ft. x 50 ft. outside pens to the north and south. The cattle were fed in a common divided manger in the center of the shed. Adequate space was provided for the cattle either inside or outside the shed. Both inside and outside areas were paved with concrete. The cattle were allowed choice to inside and outside loafing and bedding areas. The inside area was bedded with straw as needed.

The outside pens measured 56 ft. x 64 ft. Each had a 10 ft. concrete apron adjacent to a fence-line feed bunk and a concrete walkway from this apron to an electrically heated automatic waterer. A bedding mound was used in each outside pen. Corn cobs and straw were used for bedding.

Two inside pens and two outside pens were fed a ration of corn silage (about 57% moisture) with 2 lb. daily of a 40% protein supplement. Another two pens of each were fed a ration of reconstituted alfalfa haylage (about 30% moisture) and corn grain at a ratio of 2 parts haylage to 1 part corn grain with 2 lb. per head daily of a supplement. The supplement was composed of corn grain with the same level of additives as in the supplement fed with corn silage.

Results:

Steers fed alfalfa haylage and corn grain at the ratio of 2 parts haylage to 1 part grain gained at a faster rate than those fed corn silage and protein supplement. The difference amounted to an average of 0.16 lb. daily for inside and outside groups.

Alfalfa is a high protein roughage but somewhat lower in energy than corn silage. Therefore, alfalfa and grain should be used to replace corn silage and protein supplement if similar feedlot performance is expected. On basis of feed per 100 lb. of gain from this experiment, 100 lb. of corn silage (about 37% moisture) and 8 lb. of protein supplement (40% protein) was equal to 51 lb. of alfalfa haylage (about 30% moisture) and 32 lb. of grain. Results of the experiment would indicate the corn silage and protein supplement to be the more favorable ration on an basis of usual feed costs and yields for corn (as grain or silage) and alfalfa.

Cattle fed either the rations of alfalfa and corn grain or corn silage and protein supplement gained faster when provided with shelter and fed inside. The value for shelter with inside feeding appeared to be greater for the corn silage and protein supplement ration than for alfalfa and corn grain. The improvement in gain and feed efficiency amounted to 6.1 and 7.0% for the ration with alfalfa and corn grain and 8.5 and 14.3% for the one with corn silage and protein supplement. At typical current feed prices, the savings on basis of feed efficiency in this experiment would amount to about $1.00 and $1.45 per 100 lb. of gain, or about $4.10 and $5.60 per head over the 196 days of the experiment, for the alfalfa and corn ration and the one with corn silage and protein supplement.

Summary

Steers fed rations of reconstituted alfalfa haylage (2 parts) and corn grain (1 part) gained at a slightly faster rate than those full-fed corn silage and 2 lb. daily of a 40% protein supplement. On the basis of feed per 100 lb. of gain, 100 lb. of corn silage (about 57% moisture) and 8 lb. of the protein supplement was about equal to 51 lb. of the haylage (about 30% moisture) and 32 lb. of grain.

Steers having access to a shed with inside feeding (inside and outside paved areas) gained faster with less feed than those fed in open pens but with a concrete apron at the feed bunk and a concrete walkway from the feed bunk to water. Improvement in gain and feed efficiency amounted to 6.1 and 7.0% when fed a ration of alfalfa haylage and corn grain. When fed a ration of corn silage and protein supplement, the improvement amounted to 8.5 and 14.3% for weight gain and feed efficiency, respectively. Value of the shelter with inside feeding would amount to about $4.10 and 5.60 per head in feed saved over a 198-day experiment (December - June) using typical current feed prices.

Table 45. ALFALFA OR CORN SILAGE RATIONS, WITH AND WITHOUT SHELTER (DECEMBER 15 to JUNE 28, 1968 -- 196 days)

	Alfalfa		Corn Silage	
	Inside	Outside	Inside	Outside
Number of steers	30	29	30	30
Init. shrunk wt., lb.	440	439	441	440
Final shrunk wt., lb.	858	831	832	797
Av. daily gain, lb.	2.13	2.00	1.99	1.82
Av. daily ration, lb.				
Alfalfa haylage	14.0	14.2		
Corn silage			24.7	26.5
Corn grain	7.0	7.1		
Prot. supplement	1.9	1.9	2.0	2.0
Feed per 100 lb. gain, lb.				
Alfalfa haylage	658	708		
Corn silage			1239	1452
Corn grain	331	356		
Prot. supplement	88	94	99	109

Roughage Levels in Beef Cattle Finishing Rations and Value of Shelter

-- L. B. Embry, H. G. Young and J. F. Fredrikson

Upon termination of the experiment to compare rations with alfalfa or corn silage, the cattle were allotted to this experiment. The objective was to determine the value of various levels of roughage in finishing rations.

Procedure:

Pen facilities were the same as for the experiment comparing rations with alfalfa or corn silage. Inside and outside pens of cattle were fed each type of ration The alfalfa was the current crop, wilted to about 50% moisture and stored in a concrete stave silo. The amount of a 40% protein supplement was varied depending on the level of haylage fed (Table 46).

Results:

Results of this experiment are shown in Table 46. The cattle fed rations with 4 lb. of alfalfa haylage gained at a faster rate than those fed the all concentrate ration. Haylage at this level did not appear to reduce intake of ground shelled corn. Gains were reduced at the higher levels of haylage.

Up to 8 lbs. of haylage per head daily, 100 lb. of haylage saved about 30 lb. of corn and protein supplement on basis of feed per 100 lb. of gain. When fed at 16 lb. per head daily, cattle gained at a lower rate and consumed some less corn. However, the haylage at this level of feeding had only about one-half the value in replacement for concentrates as when fed at the lower levels.

There was no consistent effect of shelter on rate of gain. The average for all rations was about the same for those fed inside or outside. The cattle fed outside consumed more feed in most comparisons and had higher feed

requirements. They required an average of 5.6% more feed per unit of gain for the four rations which is slightly less than the improvement obtained during the winter period.

Summary:

Steers fed 4 lbs. of alfalfa haylage gained at a faster rate than those fed a ration of corn grain and supplement with no added roughage. Levels of 8 and 16 lb. daily of the haylage reduced rate of gain.

On basis of feed efficiency, haylage at 4 or 8 lb. per head daily saved about 30 lb. of corn and supplement per 100 lb. of haylage. At 16 lb. per head daily, the concentrate replacement value was only about one-half as much as at the lower levels.

Shelter during this experiment (June - November) did not appear to influence rate of gain. However, cattle fed outside required an average of 5.6% more feed than those with shelter and fed inside.

Table 46. RATIOS OF CORN GRAIN TO ALFALFA HAYLAGE, WITH AND WITHOUT SHELTER (JUNE 28 TO NOVEMBER 6, 1968 -- 131 days)

	Inside				Outside			
Level of haylage, lb.	0	4	8	16	0	4	8	16
Number of steers	14	14	15	15	14	14	14	15
Init. shrunk wt., lb.	842	837	847	845	811	798	826	815
Final shrunk wt., lb.	1154	1177	1142	1103	1110	1112	1141	1075
Av. daily gain, lb.	2.38	2.59	2.26	1.97	2.28	2.40	2.41	1.98
Av. daily ration, lb.								
Alfalfa haylage	--	4.5	8.0	15.1	--	4.6	8.1	15.1
Corn grain	15.9	16.8	14.2	12.7	16.8	16.6	17.1	13.6
Protein supplement	2.0	1.3	0.4	--	2.0	1.3	0.4	--
Feed per 100 lb. gain, lb.								
Alfalfa haylage	--	174	353	764	--	190	338	762
Corn grain	670	650	629	644	730	693	709	684
Protein Supplement	84	51	16	--	87	55	14	--
Dressing Percent	61.1	60.4	61.4	60.7	60.9	61.7	60.8	60.4
Marbling	4.9	5.6	5.3	5.3	4.9	4.9	5.2	4.1
Carcass Grade	18.4	19.6	19.3	19.1	18.6	18.7	18.9	18.4
Ribeye Area	11.17	12.56	12.56	12.17	12.45	12.40	12.58	12.11
Fat Thickness	0.63	0.68	0.63	0.59	0.52	0.61	0.60	0.49
Concentrate saved per 100 lb. haylage	--	30	31	14	--	36	29	17

Effect of a Controlled Environment on the Performance of (1) Heavy and Light Weight Pigs and (2) Barrows and Gilts

— Richard C. Wahlstrom and J. F. Fredrikson

The trend in swine housing during recent years has been toward controlled environment buildings. These buildings generally contain slotted or partially slotted floors. Labor requirements in structures of this type are apt to be less than with conventional type buildings. Also of concern to the pork producer is the performance of growing-finishing pigs in these buildings compared to the performance in less costly structures.

The purpose of the experiment reported herein was to study the performance of heavy and light weight pigs and also of barrows and gilts allotted separately when housed in different environmental conditions during December, January, and February.

Experimental Procedure

One hundred forty-four crossbred SPF pigs were assigned on December 18, 1967 to two replicates of four groups. One replicate was housed in an insulated, ventilated, controlled environment house while the other replicate was housed in an open front house with adjoining outside concrete pens where feed and water were available. The four groups in each house were: heavy weight pigs, light weight pigs, barrows and gilts. The heavy weight pigs averaged 110 pounds initially compared to 39 pounds for the light weight pigs. The complete ground mixed rations used in this trial are shown in Table 47. A 16% protein ration was fed up to a weight of approximately 110 pounds and a 12% protein ration was fed from then to the end of the trial.

Results

Results of this trial are summarized in Table 48. Several comparisons can be made in this data. The heavy weight pigs gained faster but required considerably more feed than the light weight pigs as might be expected, especially since the lighter pigs were fed from weights of about 40 to 150 pounds compared to the heavy pigs from 110 to 210 pounds. These groups contained a combination of barrows and gilts. The groups of barrows gained faster than the gilts when both were fed separately and also gained faster than the heavy weight pigs although averaging 45 to 50 pounds lighter initially. There did not appear to be any real difference in the feed efficiency of barrows or gilts when fed over a similar weight period.

The data of all 72 pigs fed in each type of house was combined in order to compare the two types of housing. Pigs housed in the controlled environment house had an average daily gain of 1.65 pounds per day and required 3.42 pounds of feed per pound of gain compared to a daily gain of 1.70 and feed efficiency of 3.46 for the pigs in the uninsulated, open front house. These data support previous research which also indicated pigs housed in the open front type building gained equally as well as those in a more controlled environment. However, in previous work considerably more feed has been required by pigs in the open front house. The winter of 1967-68 was much milder than normal with almost complete absence of snow during this period which may account for the better performance this past winter.

Summary

Pigs from 110 to 210 pounds gained about 7% faster but required 24% more feed per unit of gain than pigs from 40 to 150 pounds. Barrows gained about 9% faster than gilts with essentially the same feed efficiency. The performance of pigs housed in a controlled environment building was similar to that of pigs housed in an uninsulated, open front building with outside feeding area.

Table 47. Composition of Rations, Percent (Winter 1967-68)

	To 110 lb.	110 to market
Ground yellow corn	76.8	87.2
Soybean meal, 44%	20.0	10.0
Dicalcium phosphate	1.5	1.0
Ground limestone	0.7	0.8
Trace mineral salt	0.5	0.5
Vitamin-antibiotic mix[a]	0.5	0.5

[a] Provided 1500 I.U. vitamin A, 150 I.U. vitamin D, 1 mg. riboflavin, 2.5 mg. calcium pantothenate, 7.5 mg. niacin, 50 mg. choline, 5 mcg. vitamin B_{12} and 5 mg. oxytetracycline per pound of ration.

Table 48. Results of Winter Trial (1967-68)

	Heavy Pigs	Light Pigs	Barrows	Gilts
Controlled Environment House				
No. of pigs	18	18	18	18
Av. initial wt., lb.	109.5	39.4	59.2	68.1
Av. final wt., lb.	207.3	149.3	182.3	183.1
Av. daily gain, lb.	1.69	1.55	1.73	1.62
Av. daily feed, lb.	6.37	4.83	5.89	5.50
Av. feed par lb. gain, lb.	3.78	3.12	3.40	3.39
Uninsulated House				
No. of pigs	18	18	18	18
Av. initial wt., lb.	110.4	38.1	64.6	66.3
Av. final wt., lb.	210.3	154.3	193.2	182.8
Av. daily gain, lb.	1.72	1.64	1.81	1.64
Av. daily feed, lb.	6.62	4.84	6.49	5.68
Av. feed per lb. gain, lb.	3.84	2.95	3.59	3.46

Feeding Hormones to Finishing Swine

— R. C. Wahlstrom and J. F. Fredrikson

Diethylstilbestrol has become a rather common additive in beef cattle rations but has not been effective as a growth promotant in swine rations. Recent research has shown that combining the female hormone diethylstilbestrol (DES) with the male hormone methyltestosterone (MT) improves feed efficiency of pigs fed these rations from a weight of about 120 pounds to market. This experiment was conducted to obtain information on the effect of these hormones on growth, feed efficiency and carcass characteristics of finishing swine.

Procedure

Forty-eight female and forty-two castrated male pigs were divided into two replicates on the basis of weight and sex. Pigs were then allotted into 6 lots of 15 pigs each with each lot containing 8 gilts and 7 barrows. Average initial weight of the pigs was 119 and 98 pounds for replicates 1 and 2, respectively. Two lots, one from each replicate, received each of the ration treatments which were:

Basal ration
Basal ration + 2 grams DES and 2 grams MT per ton
Basal ration + 2 grams DES, 2 grams MT and 10 grams Tylosin per ton
The composition of the basal ration is shown in Table 49.

The pigs were weighed off of the experiment when they reached an individual weight of 205 pounds or more on the weekly weigh day. They were removed from the test pens and fed the control ration for 72 hours before being marketed.

Carcass data obtained after carcasses had been cooled for approximately 24 hours were carcass length, backfat, percent ham and loin and percent of lean cuts (ham, loin, picnic shoulder and Boston Butt).

Results

Growth performance data are summarized in Table 50 and carcass data in Table 51. The gains of pigs on all treatments were similar. Pigs in replicate 1 gained 1.83, 1.84 and 1.84 pounds per day and in replicate 2 gains were 1.90, 1.95, and 1.92 pounds per day for pigs fed the basal ration, DES + MT and DES + MT + tylosin, respectively. Pigs receiving the rations containing the hormones consumed less feed daily and required less feed per unit of gain than did the pigs fed the basal ration. Approximately 8 percent less feed was required by the pigs fed the supplemented rations in replicate 1 and in replicate 2 pigs fed DES + MT required 4.5 percent less feed and those fed this combination of hormones plus the antibiotic tylosin required 10 percent less feed.

DES + MT decreased carcass backfat significantly ($P < .05$) when fed alone and highly significantly ($P < .01$) when fed in combination with tylosin. Although other carcass measurements did not differ significantly there was a trend for leaner carcasses from the pigs fed the hormone containing rations. Ham and loin increased from 40.4 to 40.8 and 41.3 percent and lean cuts increased from 56.5 to 57.4 and 58.3 percent when pigs were fed the basal ration, DES + MT and DES + MT + Tylosin, respectively.

Summary

Ninety finishing pigs were used in an experiment to study the effect of a dietary combination of diethylstilbestrol (DES) and methyltestosterone (MT) and a combination of DES, MT and tylosin.

Feed efficiency was improved from 4.5 to 10 percent when DES + MT or DES + MT + tylosin were included in the ration. Carcass backfat was also significantly reduced when these additives were fed.

Table 49. Composition of Ration, Percent (Summer 1968)

	Control
Ground yellow corn	80.00
Soybean meal, 44%	9.47
Dehy. alfalfa meal, 17%	1.00
Meat meal, 50%	4.00
Wheat middlings	3.00
Fish solubles	1.00
Calcium carbonate	0.60
Dicalcium phosphate	0.30
Salt	0.50
Trace mineral mix	0.08
Vitamin premix	0.05

Table 50. Growth Performance Data of Pigs Fed Hormones (Summer 1968)

	Control	DES & MT	DES & MT + Tylan
		Rep. I.	
No. of pigs	15	15	15
Av. initial wt., lb.	118.9	118.9	118.9
Av. final wt., lb.	211.3	211.6	210.1
Av. daily gain, lb.	1.83	1.84	1.84
Av. daily feed, lb.	6.51	6.01	5.99
Av. feed per lb. gain, lb.	3.56	3.27	3.25
		Rep. II.	
No. of pigs	15	15	15
Av. initial wt., lb.	98.1	98.0	98.1
Av. final wt., lb.	208.7	211.5	211.2
Av. daily gain, lb.	1.90	1.95	1.92
Av. daily feed, lb.	6.24	6.11	5.70
Av. feed per lb. gain, lb.	3.29	3.14	2.96

Table 51. Effect of Hormones on Carcass Characteristics of Swine

	Control	DES + MT	DES + MT + Tylan
Pigs per treatment	30	30	30
Cold carcass wt., lb.	155.2	157.1	157.0
Av. carcass length, in.	30.6	30.7	30.8
Av. carcass backfat, in.	1.49	1.40*	1.36**
Av. % ham and loin	40.4	40.8	41.3
Av. % lean cuts	56.5	57.4	58.3

** Significantly less than controls (P < .01)
* Significantly less than controls (P < .05)

* * *

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