Table 1 (cont.). Average harvest grain moisture, grain yield @ 15.5% moisture, N in corn grain (dry basis) and total N removed by grain per acre from annually fertilized Webster loam with NH_4NO_3 or urea. (4 replications).

Treatment[1/] (lbs N/A)	% Dry matter at harvest	Bu/A @ 15.5% moisture I	II	III	IV	Ave.	Ave. % N in grain	lbs N/A removed	Annual fert. N (lbs/A)	Soil N status (lbs/A)
80 N(NH_4NO_3) sidedress	72.4	119.1	106.9	100.4	111.3	109.4bcde	1.52fg	78.5efgh	94	+15.5
80 N(urea) sidedress	71.8	144.3	125.6	120.7	103.5	124.0e	1.46ef	85.2fgh	94	+ 8.8
160 N(NH_4NO_3) sidedress	69.4	119.9	136.2	115.4	97.0	117.1cde	1.65gh	90.9gh	174	+83.1

1/ All plots received an additional 14 lbs N/A in starter.

2/ P.D. = plowed down.

Table 2. Yields of ear corn during 14 years on a tiled Webster loam near Lamberton with annual applications of NH_4NO_3 or urea nitrogen at different rates, times, and placement.

(Average of 4 replications)

N applied annually in lbs/A[1]	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	14 year average
	Ear corn yield in bushels per acre														
Check	49.5	88.2	26.1	132.6	72.9	33.1	11.1	53.4	102.4	92.8	85.7	40.8	75.6	69.2	66.7a
40 NH_4NO_3-fpd[2]	42.3	87.5	30.9	148.6	88.3	34.9	26.8	75.7	131.6	109.3	96.3	88.7	113.6	92.0	83.3ab
40 Urea - fpd	55.1	78.2	29.1	148.8	100.3	38.8	19.8	86.9	132.5	124.5	120.4	100.7	113.9	101.5	89.3bc
40 NH_4NO_3-fps[3]	49.0	96.7	29.6	140.1	101.5	45.6	24.3	75.1	135.2	124.6	122.5	81.5	109.9	93.0	87.8bc
40 Urea - fps	62.3	101.3	37.0	140.7	84.1	57.4	30.9	87.2	134.0	136.1	121.2	82.4	106.7	97.8	91.4cd
80 NH_4NO_3-fpd	67.4	97.9	43.6	149.6	100.8	63.4	47.3	114.3	131.2	146.8	134.7	108.0	143.1	121.7	105.0fg
80 Urea - fpd	61.7	76.9	36.7	154.5	104.9	73.0	37.8	117.2	142.6	144.3	141.4	107.8	140.1	117.9	104.0fg
160 NH_4NO_3-fpd	69.8	97.9	46.7	147.7	100.9	70.8	38.5	127.4	140.2	158.7	141.7	120.2	147.6	121.0	109.2g
160 Urea - fpd	79.4	112.5	43.5	152.8	112.4	73.5	37.7	121.3	149.9	161.0	140.4	110.6	151.7	114.9	111.5g
40 NH_4NO_3-std[4]	66.2	92.0	45.4	152.2	99.8	63.4	23.7	99.8	128.0	142.0	125.6	84.0	117.0	104.0	96.0cde
40 Urea - std	45.4	91.1	31.4	147.6	100.6	59.8	33.8	95.0	140.5	143.4	118.9	94.6	116.5	97.1	94.0cde
80 NH_4NO_3-std	59.3	90.0	32.7	149.2	112.5	74.2	49.0	128.3	144.7	159.5	140.4	122.7	142.7	118.0	108.8g
80 Urea - std	57.7	99.1	40.5	149.3	115.7	84.4	41.8	128.6	138.7	155.9	146.2	116.0	142.1	117.6	109.5g
40 NH_4NO_3-sd[5]	63.6	92.6	39.5	148.6	90.4	54.8	38.6	96.8	133.4	142.3	127.1	104.5	136.0	99.1	97.7def
40 Urea - sd	57.7	95.6	24.9	142.3	94.1	48.4	50.4	86.1	132.2	143.3	117.7	100.5	133.9	103.9	95.1cde
80 NH_4NO_3-sd	50.4	98.4	46.7	140.7	113.0	68.1	43.8	101.6	137.7	140.3	127.7	97.6	124.7	109.4	100.0ef
80 Urea - sd	76.9	86.4	48.2	143.8	121.4	64.7	47.3	117.0	146.9	166.2	140.5	124.4	149.8	124.0	111.3g
160 NH_4NO_3-sd	40.7	97.4	77.7	151.7	109.5	77.6	51.4	120.2	141.5	148.3	136.9	104.2	150.0	117.1	109.9g
Ave. annual corn yield in bu/a	58.6	93.3	39.4	147.5	101.3	60.3	37.8	101.8	135.7	140.9	127.0	99.4	128.6	97.4	

[1]The entire area received an additional 14 lbs N/A as starter fertilizer annually (8-24-12 @ 175 #/A)

[2]fpd -- fall plow down [3]fps -- fall plow surface [4]std -- spring topdress [5]sd -- sidedress

40 #N fall plowdown are less effective than 40 #N spring topdressed or 40 #N sidedressed

15 year ave.

86.3

89.6

104.5

110

95

69

120.9

96

115.5

LIME PLOTS, LAMBERTON, 1972 - 73

J. Grava, W.W. Nelson, D.S. Fairchild

A field experiment was established in 1965 to study the effects of liming on crop yields, chemical composition of plant tissue, and chemical properties of soils. The crops grown were: (a) Vernal alfalfa in series four, and (b) in series five, corn (1966, 1968, 1970, 1972) and soybeans (1967, 1969, 1971) in a sequence. Data on crop yields, soil and plant analyses were reported in the departmental "Bluebooks."

Since this experiment was discontinued in 1973, soil samples were collected from the alfalfa series in August of 1972 and from the corn-soybean series in October of 1973. The effect of various dolomitic limestone applications on soil pH is shown in Tables 1 and 2. Table 1 shows that limestone applied as a split application on alfalfa increased the soil pH in the 0-9 inch depth from an initial level of 5.9 to 6.3 and 6.8 with a total of 7 and 16 tons/A. Soil pH's were increased from 6.2 to 6.6 and 7.0 with 0.6 and 12 tons limestone per acre applied to the corn-soybean series (Table 2).

Data reported in Table 3 and 4 show no consistent interaction between soil test levels of phosphorus and potassium and varying limestone treatments.

Table 1. Effect of liming on soil pH, alfalfa area (series 4), Lamberton, 1972.

Depth Inches	Lime Treatment Tons/Acre 0	7*	16**
0-3	5.9	6.3	6.9
3-6	5.7	6.4	6.8
6-9	5.9	6.3	6.6
9-12	6.1	6.2	6.4
12-18	6.5	6.5	6.4

* 3 tons/A applied in fall of 1965 and 4 tons/A applied in spring of 1968.
** 6 tons/A applied in fall of 1965 and 10 tons/A applied in spring of 1968.

Table 2. Effect of liming on soil pH, corn-soybean area Lamberton, 1973.

Depth Inches	Lime Treatments Tons/Acre 0	6*	12*
		soil pH	
0-9	6.2	6.6	7.0
9-12	6.6	6.7	6.9
12-18	7.2	6.9	7.1

* 3 or 6 tons/A applied in fall of 1965 and again in spring of 1968.

Table 3. Phosphorus and potassium soil tests, alfalfa area, Lamberton lime plots, 1972.

Depth Inches	Lime rate, Tons/Acre 0	7	16	0	7	16
	Extractable P pp 2 m			Exchangeable K, pp 2 m		
0-3	55	44	50	350	270	330
3-6	52	62	45	240	240	240
6-9	23	25	19	240	240	260
9-12	11	5	6	250	240	240
12-18	5	3	3	230	230	220

Table 4. Phosphorus and potassium soil test, corn-soybean area, Lamberton lime plots, 1973.

Depth inches	Lime rates tons/acre 0	6	12	Lime rates tons/acre 0	6	12
	Extractable P, pp 2 m			Exchangeable K, pp 2 m		
0-9	59	54	56	332	338	344
9-12	20	22	11	272	274	270
12-18	4	6	3	254	228	264

SOIL FERTILITY MATERIALS

G. D. Holcomb, W. W. Nelson and C. J. Overdahl

In 1971, field trials were established at the Southwest Experiment Station to compare conventional fertilizer with three other soil fertility materials. The products selected were:

Wonder Life: An inorganic soil conditioner. Examples of other products which may be considered in this grouping include Planters, Nu-Age, Life for the Soil, and Procal.

Shur-Gro: A specialty fertilizer labeled as an organic soil builder. Other products which may be considered in this grouping of organic soil conditioners and/or specialty fertilizers include Super-Gro, Bio-Act, Fertilaid, and Fertidyne.

Na-Churs: A liquid fertilizer advertised for application with the seed, on the crop foliage and for deep placement. Examples of other products are Pure and Westroc.

The initial soil tests showed a medium level of organic matter and a low phosphorus level. The potassium level was medium to high.

All treatments were replicated four times with and without broadcast applications of phosphate and potash. This provides comparisons under medium to high as well as under low soil phosphorus conditions. Each year, all plots received herbicides and two cultivations.

TREATMENTS APPLIED PER ACRE FOR CORN.

1. Check.

2. Na-Churs 9-18-9: Seed plus
   1971 and '72--4 gal. with seed plus 4 gal. on foliage (2 applications at 2 gal. rate). 45 lbs. (42 lbs. in 1971) nitrogen, preplant.
   1973-- 3 3/4 gal. with seed plus 5 gal. placed deep, both at planting. 95 lbs. N preplant.

3. Na-Churs 9-18-9: Seed
   1971 & '72--Same treatments as listed for Number 2 except no foliage application. 1973-- 3 3/4 gal. with seed. 85 lbs. N preplant.

4. Wonder Life: 1971 & 1972--250 lbs. broadcast before planting. 1973--150 lbs. with planter. No pesticide applied.

5. Shur-Gro 6-2-1: 300 lbs. broadcast with establishment of plots. 200 lbs. each year with planter. No pesticide applied.

6. Conventional fertilizer: 1971 & '72--180 lbs. 8-24-12 with planter. 1973--125 lbs. 8-24-12 with planter. 100 lbs. nitrogen, preplant each year.

Corn yield, percent moisture at harvest and percent protein content of the grain are shown in the following tables.

Table 1. Bushels of corn per acre at 15½% moisture

	No Broadcast				0+90+45 Broadcast (71&72)			
	1971	1972	1973	Ave.	1971	1972	1973	Ave.
Check	64	80	74	73	71	85	92	83
Na-Churs: Seed Plus	76	93	85	85	79	109	99	96
Na-Churs: Seed	79	104	80	87	78	114	98	97
Wonder Life	49	74	64	63	39	73	76	63
Shur-Gro	53	89	61	68	45	99	75	73
Conventional Fertilizer	83	96	92	90	93	110	103	102

Table 2. Moisture Percent of Grain at Harvest

	No Broadcast				0+90+45 Broadcast (71&72)			
	1971	1972	1973	Ave.	1971	1972	1973	Ave.
Check	41.0	31.4	37.2	36.6	38.5	29.7	32.9	33.7
Na-Churs: Seed Plus	38.7	29.4	31.8	33.3	36.4	29.5	30.7	32.2
Na-Churs: Seed	39.6	28.8	30.9	33.1	36.6	28.9	29.9	31.8
Wonder Life	41.6	30.6	38.2	36.8	39.9	29.8	36.7	35.5
Shur-Gro	42.9	30.0	39.1	37.3	38.3	29.5	37.4	35.1
Conventional Fertilizer	37.7	30.0	29.4	32.4	35.2	29.2	31.0	31.8

Table 3. Protein Percent of Corn Grain

	No Broadcast				0+90+45 Broadcast (71&72)			
	1971	1972	1973	Ave.	1971	1972	1973	Ave.
Check	7.4	9.0	7.7	7.99	7.6	8.3	7.4	7.76
Na-Churs: Seed Plus	9.3	8.7	10.3	9.44	8.6	9.5	10.4	9.50
Na-Churs: Seed	9.1	9.3	9.4	9.28	8.3	9.0	10.2	9.15
Wonder Life	7.8	8.8	7.9	8.20	6.7	8.1	7.3	7.36
Shur-Gro	7.6	8.9	8.3	8.26	6.6	8.6	6.8	7.32
Conventional Fertilizer	10.1	9.5	10.2	9.95	10.1	9.4	10.5	10.00

TREATMENTS AND YIELD RESULTS FOR SOYBEANS

Trials with soybeans were commenced in 1972 on the site of the 1971 plots. Corn and soybeans are being rotated on two sets of plots. The treatments are:

1. Check

2. Na-Churs 3-18-18: Seed plus
   1971 - 2 gal. in contact with seed plus 2 gal. on foliage.
   1972 - 3 gal. in contact with seed.

3. Na-Churs 3-18-18: Seed
   1971 - 2 gal. in contact with seed
   1972 - 2 gal. in contact with seed

4. Wonder Life: 150 lbs. applied each year with planter. No herbicide applied.

5. Shur-Gro 0-1-7: 150 lbs. applied each year with planter. No herbicide applied.

6. Residual from conventional fertilizer: No fertilizer was applied for soybeans. Applications to corn in 1971 and 1972 are described under treatments for corn. Herbicide applied.

Table 4. Bushels per Acre, Soybeans, Lamberton.

	No Broadcast				0+90+45 Broadcast (1972 & 1973)		
	1972	1973	Ave.		1972	1973	Ave.
Check	24	30	27	:	28	31	30
Na-Churs: Seed plus	28	30	29	:	30	31	30
Na-Churs: Seed	29	30	30	:	29	32	31
Wonder Life	25	29	27	:	28	28	28
Shur-Gro	25	30	27	:	29	28	29
Residual (Conv. Fert.)	29	32	30	:	28	33	30

NUTRIENT MOVEMENT PLOTS
SOUTHWEST EXPERIMENT STATION, LAMBERTON, MINN.

Robert Gast and Wallace Nelson

Plans were developed and the first eight of a total of 16 nutrient movements plots were installed on the Southwest Experiment Station during August-September, 1972. Plots 9-12 were installed during July and August, 1973 with installation of plots 13-18 being delayed until performance of the first 12 plots can be evaluated. Treatments for the various plots are as follows:

	Plot No.		
Treatment	I	II	III
0# N	4	8	9
100# N	1	6	10
200# N	3	7	12
400# N	2	5	11
True Check	13	16	17
Organic 200# N	14	15	18

The plots, which are 45 x 50 ft. in size, were isolated to a depth of six ft. by trenching and installation of heavy gauge plastic. Tile lines run parallel along the 45 ft. width of each plot providing for drainage conditions representative of 90-95 ft. tile spacing. Tile lines from each of two plots are extended to a vertically positioned metal culvert where flow rates can be measured and tile drainage samples collected for analysis.

The plots provide a facility for studying water, salt and plant nutrient balance, movement and loss through tile drainage under carefully controlled conditions. Several such studies are planned involving investigators from the Southwest Experiment Station, the Department of Soil Science and the ARS Laboratory at Morris, Minnesota.

The first treatments, which are for continuous corn, were applied May 9, 1972 on all plots, including plots 13-18 yet to be installed. The tile drains for plots 1-8 flow during the period between April 12 through June 25, 1973. Flow rates were determined and samples were collected and analyzed for NO_3-N, Cl^-, SO_4-S and PO_4-P. The available results must be considered preliminary and therefore are not given in detail here.

While there was some variation between plots, the NO_3-N concentrations were in the range of 20 ppm when the tile first began to flow and decreased to about 10 ppm by June 25, 1973 when flow stopped. The tile did not flow during the remainder of 1973. Chloride concentrations were in the range of 2-4 ppm, SO_4-S ranged from 20-80 ppm and PO_4-P ranged from <.001 to .003 ppm. Even though NO_3-N concentration were in excess of 10 ppm during the period of flow (April-June, 1973), total N loss was only about five lbs per acre during this period due to relatively low tile flow rates.

TILLAGE FOR SOYBEANS - LAMBERTON, 1973

W.W. Nelson

The basic tillage trial for soybean production initiated in the fall of 1971 on a tiled Nicollet Webster soil. The crop prior to soybean production was corn and the stalks were chopped. Treatments were fall plow, fall chisel, spring disc and spring chisel. After the treatments were completed and just prior to planting, all treatments are tandem disked again. Soybeans are grown and a broadcast application of Amiben is applied. The experiment in 1973 was replicated four times.

Soybean Tillage

Primary tillage	Bu/A
Fall plow	32.0
Fall chisel	30.9
Spring chisel	32.3
Spring disc	30.2
LSD 5%	N.S.

No difference in growth or weed control was evident during the season. Yields were obtained using a 4-row combine, and all plots were in 30-inch. Planting was accomplished using a standard 6-row 30-inch planter.

WEST CENTRAL EXPERIMENT STATION - MORRIS

WEATHER SUMMARY - 1973

Month	Period	Precipitation 1973	Precipitation 84-yr. av.	Precipitation Dev. from av.	Air Temperature 1973	Air Temperature 84-yr. av.	Air Temperature Dev. from av.	Soil (10 cm) Temperature 1973	Soil (10 cm) Temperature 6-yr. av.
January	1-31	.17	.66	- .49	11.9	8.6	+3.3	29.0	24.2
February	1-28	.47	.65	- .18	17.1	12.8	+4.3	27.9	25.5
March	1-31	1.81	1.04	+ .77	36.4	26.8	+9.6	35.1	30.3
April	1-10	.07	.60	- .53	39.0	38.3	+0.7	40.9	
	11-20	.78	.63	+ .15	45.7	44.3	+1.4	44.1	
	21-30	.24	1.10	- .86	43.7	48.4	-4.7	47.8	
Total or Av.		1.09	2.33	-1.24	42.8	43.7	-0.9	44.4	41.4
May	1-10	1.24	.81	+ .43	51.8	52.1	-0.3	51.0	
	11-20	.04	1.01	- .97	52.3	55.6	-3.3	56.6	
	21-31	2.52	1.18	+1.34	59.6	60.0	-0.4	61.0	
Total or Av.		3.80	3.00	+ .80	54.6	56.0	-1.4	56.3	56.0
June	1-10	.44	1.34	- .90	68.1	62.9	+5.2	71.4	
	11-20	.19	1.16	- .97	68.3	66.6	+1.7	75.2	
	21-30	.35	1.41	-1.06	65.8	68.2	-2.4	73.7	
Total or Av.		.98	3.91	-2.93	67.4	65.9	+1.5	73.4	69.6
July	1-10	.98	1.57	- .59	73.4	69.9	+3.5	78.2	
	11-20	1.00	1.06	- .06	70.0	71.4	-1.4	78.0	
	21-31	3.57	.94	+2.63	66.6	71.7	-5.1	72.1	
Total or Av.		5.55	3.57	+1.98	69.9	71.0	-1.1	76.0	75.0
August	1-10	.79	1.10	- .31	71.2	70.6	+0.6	76.4	
	11-20	.31	.91	- .60	71.8	69.1	+2.7	78.6	
	21-31	.66	.96	- .30	70.5	66.8	+3.7	72.5	
Total or Av.		1.76	2.97	-1.21	71.2	68.8	+2.4	75.7	74.7
September	1-30	2.26	2.26	0	56.7	59.3	-2.6	61.1	61.9
October	1-31	1.79	1.52	+ .27	51.4	47.5	+3.9	53.2	48.3
November	1-30	.95	.88	+ .07	30.9	29.9	+1.0	33.5	34.3
December	1-31	.63	.69	- .06	12.5	15.8	-3.3	23.2	26.5
April-August Growing Season		13.18	15.78	-2.60	61.2	61.2	0	65.2	63.4
January-December Annual		21.26	23.47	-2.21	43.7	42.2	+1.5	49.1	47.4

CONTINUOUS CORN SILAGE

West Central Experiment Station - Morris

Samuel D. Evans

I. In 1965 an experiment was initiated on McIntosh silt loam to determine the effect of removal of continuous corn silage and fertilizer application on corn grain and corn silage yields. Rates of fertilizer used were 74 + 48 + 48 ($N + P_2O_5 + K_2O$) and 148 + 96 + 96. All plots received a broadcast application of 10 lbs./acre of zinc as zinc sulfate in the fall of 1965.

II. In 1973 the variety used was Pioneer 3932. Furadan was applied at 1 lb./acre (active ingredient) at planting on May 4. Lasso at 2 1/2 lbs./acre was applied broadcast on May 7. Silage yields were taken on September 14 and grain yields on October 3.

III. Silage yields - Dry matter; tons/acre.

A. On plots harvested as grain 1965-73:

	1973 Yield	1966-73 Yield
Low fertility (74 + 48 + 48)	6.19	5.40
High fertility (148 + 96 + 96)	7.00	5.83

B. On plots harvested as silage 1965-73:

Low fertility (74 + 48 + 48)	6.45	5.49
High fertility (148 + 96 + 96)	6.78	5.90

IV. Grain yields - Bushels/acre @ 15.5% moisture.
On plots harvested as grain 1965-73:

	1973	1965-73
Low fertility (74 + 48 + 48)	116.96	88.81
High fertility (148 + 96 + 96)	132.90	96.08

V. Yields on an additional unfertilized, unreplicated check adjacent to the experimental area:

	1973	1966-73 Average
Grain (0 + 0 + 0)	65.10 Bu/A	56.82 Bu/A
Silage (0 + 0 + 0)	4.64 tons/A	4.03 tons/A

VI. DISCUSSION

A. In 1973 silage yields were increased by fertilization on areas that had been harvested for grain and for silage for 8 years. There was no significant reduction in yield due to growing continuous corn silage. Grain yields were also increased slightly with additional fertilizer. Yields on the check plots were substantially lower than on fertilized plots.

B. The 8-year average yields again show no reduction in silage yields from growing continuous corn silage and show a response to additional fertilizer.

FERTILIZER MATERIALS PLOTS

West Central Experiment Station - Morris

S. D. Evans, O. Gunderson, G. Holcomb, and C. Overdahl

I. EXPERIMENT DESIGN

An investigation of the effect of soil conditioners, organic fertilizers, and liquid fertilizers was commenced on field corn in the spring of 1971 at Morris. The experiment was established on a site consiting of Tara and McIntosh silt loams.

The experiment was set up in a split block design of four replications. Main blocks were (1) no broadcast fertilizer and (2) 80 lbs./acre P_2O_5 broadcast in the spring of 1971 and 100 lbs./acre P_2O_5 broadcast in the spring of 1973. Ten individual fertilizer treatments were superimposed across each main block pair. The 1973 individual treatments are described in Table 1. Ten pounds/acre of zinc as zinc sulfate was broadcast over the entire area in the fall of 1971.

II. 1973 OPERATIONS

On April 27 soil samples were taken to an 8-inch depth in each plot and the samples from all reps were combined. The results of these tests are in Table 2. The broadcast fertilizer treatments were applied May 14. Treatments 2 and 3 were planted with a planter from the Lamberton Station on May 16 and the remainder of the treatments on May 17 with the 2-row planter from the Morris Station. The hybrid used was Pioneer 3956A. Lasso was applied to the appropriate plots on May 19. The plots were harvested on October 22. Soil samples were taken again in each plot to an 8-inch depth.

III. LEAF ANALYSIS RESULTS

The broadcast phosphorus significantly decreased the content of N and Zn in the leaves at silking and significantly increased the P, Ca, Mg, and B contents of the leaves (Table 3). The 10 individual fertilizer treatments brought about changes in many of the elements. Those significantly affected were N, P, Ca, Mg, Cu, Mn, B, Al, Fe, and Zn (Table 4). Many elements were also significantly affected by the interaction between the broadcast and individual row treatments.

IV. PLANT MEASUREMENTS

The broadcast phosphorus did not significantly affect any of the general plant measurements including yield. On the other hand, the different fertilizer materials significantly affected most of the plant measurements made in 1973 (Table 5).

A. Plant height in late June was the greatest on treatments 2, 3, 6, 9, and 10, or those where substantial amounts of nitrogen were applied. These included the Nachurs, conventional, conventional liquid, and the high rate of conventional fertilizer.

B. Pollen shed and silking - Dates of these events occurred earliest on the same treatments as in A. above.

C. Broken stalks at harvest - The only treatment which was significantly higher was the high rate of conventional fertilizer; 14.2% vs 5.8% with the regular conventional fertilizer.

D. Stalks root lodged - Treatments 4 and 5, Wonderlife and Shurgro without pesticides, were much higher showing primarily the effect of corn rootworms.

E. Plant height at maturity - Again the tallest plants were on the same treatments as in A. above.

F. Ear size and/or shape - Treatments 1, 4, 5, and 7 produced a lot of small ears which were misshapen and unfilled.

G. Ear moisture at harvest - There was no significant effect of any of the fertilizer materials.

H. Yield - The highest yielding treatments were Nachurs, conventional, conventional liquid, and the high rate of conventional fertilizer. Intermediate in yield were the check, and Wonderlife and Shurgro with pesticides. Lowest in yield were the Wonderlife and Shurgro without pesticides.

I. Percent protein in the grain - There were significant effects of the materials on percent protein with Nachurs, conventional, conventional liquid, and the high rate of conventional fertilizer being over 10% protein.

Table 1. 1973 Treatment Descriptions[1]

Treatment	Description
1	Check (0 + 0 + 0 total applied).
2	This set of plots received Nachurs seed plus foliar applications in 1971 and 1972. In 1973 these plots were treated with the same materials as Treatment 3 and are not included in the Treatment 3 averages (98 + 7 + 3 total applied).
3	Nachurs liquid 9-18-9[2]: Seed placement only; 3 3/4 gal/A with the seed at planting; 95 lbs/A of N as ammonium nitrate broadcast before planting (98 + 7 + 3 total applied).
4	Wonderlife (soil conditioner): 150 lbs/A with the planter (0 + 0 + 0 total applied).
5	Shurgro (organic fertilizer 6-2-1): 200 lbs/A with the planter (12 + 4 + 2 total applied).
6	Conventional fertilizer: 80 lbs/A of N as ammonium nitrate broadcast before planting plus 111 lbs/A of 9-36-18 with the planter (90 + 40 + 20 total applied).
7	Wonderlife (soil conditioner) plus pesticides: Same as Treatment 4 plus insecticide and herbicide (0 + 0 + 0 total applied).
8	Shurgro (organic fertilizer 6-2-1) plus pesticides: Same as Treatment 5 plus insecticide and herbicide (12 + 4 + 2 total applied).
9	Conventional liquid 7-21-7: Seed placement only; 4 gal/A with seed at planting; 95 lbs/A of N as ammonium nitrate broadcast before planting (98 + 9 + 3 total applied).
10	High rate of conventional fertilizer: Same as Treatment 6 except an additional 100 lbs/A of N and 100 lbs/A of K_2O broadcast before planting (190 + 40 + 120 total applied).

[1] All treatments were treated with Furadan @ 1 lb/A and Lasso (Broadcast) @ 2 1/2 lbs/A except 4 and 5.

[2] Also contained sulfur, iron, and zinc.

Table 2. Soil Test Results, Spring 1973.

Treatment	No Broadcast				Broadcast			
	pH	Organic Matter	P[1] Phosphorus (lbs/A)	K Potassium (lbs/A)	pH	Organic Matter	P Phosphorus (lbs/A)	K Potassium (lbs/A)
1	7.9	M	8(20)	320	7.9	H	7(18)	270
2	7.9	H	11(20)	320	7.5	H	9(18)	260
3	7.9	H	5(10)	250	8.0	H	4(8)	250
4	7.8	H	7(13)	270	7.9	H	9(15)	270
5	7.7	H	5(8)	260	7.6	H	13(18)	290
6	7.9	H	4(5)	230	7.8	H	29(48)	280
7	8.0	H	4(8)	240	8.0	H	11(23)	250
8	7.8	H	5(5)	280	7.5	H	11(15)	270
9	7.9	H	6(10)	270	7.6	H	12(23)	250
10	8.0	H	8(15)	270	7.9	H	13(23)	280

[1] First value is for a Bray P_1 test 1:10, soil:solution ratio; the figure in parenthesis is for a Bray P_1 test 1:50, soil:solution ratio.

Table 3. Effect of Broadcast Phosphorus on Plant Measurements.

	No Broadcast	P Broadcast	Significance[1]
Extended leaf height (June 29), in.	33.7	34.1	NS
Date 50% plants shedding pollen	7-23	7-23	NS
Date 50% plants silked	7-26	7-27	NS
Leaf Analysis (at silking):			
N, %	2.37	2.26	*
P, %	.237	.293	*
K, %	1.95	1.88	NS
Ca, %	.721	.772	*
Mg, %	.766	.810	*
Na, %	.307	.344	NS
Cu, ppm	12.9	11.8	NS
Mn, ppm	91	92	NS
B, ppm	5.8	6.1	**
Al, ppm	97.0	99.6	NS
Fe, ppm	198	196	NS
Zn, ppm	33.2	27.4	**
Harvest measurements:			
Number plants/acre	16,019	15,758	NS
Broken stalks, %	4.3	4.8	NS
Stalks root lodged, %	7.0	8.4	NS
Height to base of tassel, in.	73.3	71.6	NS
Ears normal in size and/or shape, %	77	73	NS
Ear moisture at harvest, %	22.8	22.3	NS
Yield in bu/A @ 15.5% moisture	82.8	85.5	NS
Protein in corn grain, %	8.9 1.4%N	8.8	NS

[1] Significance: ** = 99% level; * = 95% level; + = 90% level; NS = not significant at the 90% level.

Table 4. Effect of Fertilizer Materials on Leaf Analysis (Leaves Sampled at Silking).

Treatment	N	P	K	Ca	Mg	Na	Cu	Mn	B	Al	Fe	Zn
	%						ppm					
1	1.89	.223	2.21	.629	.664	.320	7.9	59	5.7	113.2	201	26.8
2	2.61	.285	2.05	.802	.836	.294	15.5	116	6.1	89.2	203	32.4
3	2.78	.269	1.88	.794	.818	.321	19.4	118	5.5	90.4	202	35.5
4	1.28	.252	1.90	.584	.622	.358	4.2	40	5.6	97.2	166	25.3
5	1.46	.218	1.80	.638	.672	.322	8.8	44	5.8	99.6	169	26.6
6	3.10	.300	1.61	.830	.972	.355	15.8	131	6.4	85.1	195	29.1
7	2.05	.253	1.93	.761	.765	.339	9.1	78	5.8	129.4	227	29.8
8	2.19	.249	1.94	.833	.760	.272	13.2	81	5.4	114.2	214	31.2
9	2.78	.290	1.62	.853	.952	.307	14.7	114	6.1	90.4	203	31.0
10	3.02	.312	2.26	.743	.823	.370	14.8	133	6.7	74.2	192	35.1
Significance	**	**	NS	**	**	NS	**	**	**	**	**	**
BLSD[1] .10	.31	.025	- -	.068	.127	- -	3.7	16	.5	11.8	16	4.0
.05	.37	.029	- -	.080	.153	- -	4.4	18	.6	13.8	19	4.8
.01	.49	.038	- -	.106	.207	- -	5.9	24	.9	18.4	26	6.5
Significance of Interaction	NS	**	**	**	+	NS	**	+	NS	NS	NS	NS

[1] Bayes LSD

Table 5. Effect of Fertilizer Materials on Plant Measurements.

Treatment	Extended Leaf Ht. June 29 inches	Date 50% Plants Shedding Pollen	Date 50% Plants Silked	Number Plants/ Acre	Broken Stalks %	Stalks Root Lodged %	Height to Base of Tassel inches	Ears Normal in Size and/or Shape,%	Ear Moisture at Harvest %	Yield in bu/A @ 15.5% Moisture	Protein in Corn Grain %
1	32.2	7-23.8	7-27.9	16281	3.0	1.3	69.6	80	23.8	69.6	7.1
2	39.0	7-19.0	7-23.2	15464	3.9	0.0	77.2	94	22.2	118.2	10.5
3	35.9	7-19.5	7-23.8	15518	4.2	0.4	78.4	95	22.3	110.9	10.1
4	26.9	7-29.4	8-2.9	15736	2.2	39.3	59.0	15	23.5	26.1	6.9
5	26.8	7-28.4	8-2.9	16226	1.3	30.2	60.2	13	21.8	26.4	6.9
6	36.3	7-19.5	7-23.5	16008	5.8	0.7	78.5	91	22.1	119.6	10.6
7	30.2	7-24.9	7-28.5	15573	3.7	2.9	67.2	73	24.7	61.5	7.3
8	33.7	7-21.8	7-25.2	16172	2.4	1.4	73.4	94	22.7	79.3	7.8
9	37.5	7-19.5	7-23.5	15736	4.8	0.0	78.2	96	20.7	113.1	10.5
10	35.4	7-20.2	7-24.0	16172	14.2	0.7	82.6	97	21.5	116.7	10.6
Significance:	**	**	**	NS	**	**	**	**	NS	**	**
BLSD[1] .10	3.1	1.3	1.4	- -	3.6	14.1	3.9	10	- -	7.1	1.6
.05	3.6	1.5	1.7	- -	4.2	16.6	4.5	12	- -	8.3	1.9
.01	4.8	2.0	2.2	- -	5.6	22.3	6.0	15	- -	10.9	2.5
Significance of Interaction	NS	**	**	**	NS	NS	NS	NS	NS	+	NS

[1] Bayes LSD

PHOSPHORUS FERTILIZATION OF CONTINUOUS CORN

West Central Experiment Station - Morris

Samuel D. Evans

I. GENERAL DESCRIPTION

A phosphorus fertilization experiment in 1965 on continuous corn was set up on Forman clay loam to determine (1) the interaction of row and broadcast levels of phosphorus on corn yeilds, and (2) the effect of high rates of phosphorus on the zinc content of corn leaves on corn yields.

II. 1973 YIELDS

The plots were planted to Pioneer 3956A on May 18, 1973. All plots had received 110 lbs./acre of N in the fall of 1972. Starter was applied to all plots to provide 10 + 0 + 20 ($N + P_2O_5 + K_2O$). The 1973 yields shown in Table 1 show significant effects of broadcast P, row fertilizer, and the interaction of the two. There was a significant reduction in yields with the added broadcast P. This was particularly apparent at 30 P and 45 P. Row P fertilizer brought about a reduction in yield.

III. EARLY PLANT SAMPLES

Ten plants were collected from all plots on June 20, 1973. The samples were thoroughly dried before submitting for analysis. The results are summarized in Table 2. The phosphorus level in the plants was increased with higher levels of phosphorus and decreased by the addition of zinc. There was a slight effect of the treatments on magnesium content. Zinc content of the plants was lowered by the addition of row P and increased by the addition of zinc. There were also slight effects of the row treatments on copper, manganese, and boron.

IV. LEAF SAMPLES AT SILKING

Ten leaves were collected from each plot at silking. The results in Table 3 again show significant effects on phosphorus and zinc. Iron and copper were affected by row treatments, but the effects were small. The manganese content of the leaves was increased by row P and decreased by the row zinc.

V. SOIL TESTS

The plots were thoroughly sampled in the fall of 1973. The soil test phosphorus levels in the plow layer are given in Table 4. The plots which received 90 P/year (45 P row + 45 P broadcast) each year since 1965 were sampled to a depth of 5 feet. High test levels show up in only the top foot (Table 5). The soil test zinc levels for 3 reps are given in Table 6.

Table 1. Corn Yield in Bu/Ac at 15.5% Moisture - 1973.

Row Fertilizer - lbs/Ac -	No Broadcast	45 P Broadcast (lbs/Ac)	Average
	- Bu/Ac -		
0	111.5	109.4	110.4
15 P	106.6	109.9	108.2
30 P	115.5	105.8	110.6
45 P	107.8	98.4	103.2
45 P + 10 Zn	101.7	109.8	105.8
Average	108.6	106.6	

Variable	Level of Significance
Broadcast P	**
Row Fertilizer	+
Interaction	**

Bayes LSD for Row Fertilizer Means

.10 - 5.7

Table 2. Analysis of Whole Plants - 1973.

Treatment	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%				ppm				
0	.544	4.71	.50	.43	280	47.0	11.2	75	8.5
15 P	.573	4.75	.48	.42	290	31.5	9.5	68	8.1
30 P	.598	4.84	.50	.42	291	34.2	9.5	74	8.0
45 P	.641	4.95	.53	.44	286	34.6	9.1	80	8.9
45 P + 10 Z	.588	4.75	.50	.38	257	73.2	7.8	63	8.6
Level of signif.[1]	**	NS	NS	+	NS	**	+	+	+
BLSD[2] .10	.023	--	--	.04	--	19.6	2.2	12	0.7
.05	.026	--	--	--	--	23.0	--	--	--
.01	.035	--	--	--	--	31.1	--	--	--
- Broadcast P	.54	4.81	.49	.41	269	49.8	9.6	73	8.5
+ Broadcast P	.64	4.80	.52	.43	293	38.4	9.3	71	8.4
Level of signif.	**	NS	NS	+	NS	NS	NS	NS	NS
Interaction Level of signif.	NS	NS	NS	+	**	NS	NS	NS	NS

[1] Significance: ** = 99% level; * = 95% level; + = 90% level; NS = not significant at the 90% level.

[2] Bayes LSD.

Table 3. Analysis of Corn Leaves at Silking - 1973.

Treatment	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%				ppm				
0	.314	2.39	.60	.43	122	20.7	13.4	53	3.2
15 P	.334	2.42	.59	.46	133	20.0	13.4	48	3.1
30 P	.367	2.40	.64	.48	137	16.7	14.5	56	3.3
45 P	.384	2.42	.62	.45	126	15.7	11.8	56	3.2
45 P + 10 Z	.318	2.49	.64	.43	122	37.4	11.5	35	3.0
Level of signif.[1]	**	NS	NS	NS	*	**	*	**	NS
BLSD[2] .10	.016	--	--	--	10	2.4	1.9	6	--
.05	.018	--	--	--	12	2.8	2.2	8	--
.01	.025	--	--	--	--	3.7	--	10	--
- Broadcast P	.32	2.49	.61	.43	126	25.4	13.7	49	3.1
+ Broadcast P	.37	2.36	.63	.47	130	18.8	12.1	50	3.3
Level of signif.	**	**	NS	*	NS	**	NS	NS	NS
Interaction Level of signif.	+	NS	NS	NS	NS	NS	NS	+	NS

[1] Significance: ** = 99% level; * = 95% level; + = 90% level; NS = not significant at the 90% level.

[2] Bayes LSD.

Table 4. Soil Test Levels of Phosphorus[1]

Row Fert.	Broadcast P	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
0	0	11(15)	22(30)	37	20	12(25)	60(120)
15 P	0	32(48)	41	47	47	36	46
30 P	0	34(93)	73	73	63	38	47
45 P	0	146(240)	91	83	124	93	48
45 P + 10 Z	0	72(128	102	120	122	72(120)	100
0	45	101(175)	78(130)	118	82	123	75(145)
15	45	121	103	104	100	95	90(170)
30	45	138(230)	139(270)	133	125	108	142
45	45	160	200+(340)	200	180	146	150
45 P + 10 Z	45	200+(360)	172	182	150	141	152

[1] Bray P_1 test with a 1:10, soil:solution ratio. Values in parentheses are samples where the pH was above 7.4 and are with a 1:50 soil:solution ratio.

Table 5. Soil Test Levels of Phosphorus[1] on Plots that Received 90 lbs./acre of Phosphorus Each Year.

Depth Increment (ft.)	Plot 10	Plot 15	Plot 29	Plot 33	Plot 42	Plot 58
0 - 1/2	180	190	192	162	94	181
1/2 - 1	133	22	120	63	70	168
1 - 2	9(5)	4(8)	6	5	8	6(23)
2 - 3	5(3)	1(5)	4(20)	4(30)	5(40)	4(10)
3 - 4	3(5)	1(15)	3(5)	6(15)	6(10)	4(5)
4 - 5	4(8)	1(15)	3(10)	4(50)	5(15)	4(15)

[1] Bray P_1 test with a 1:10, soil:solution ratio. Values in parentheses are samples where the pH was above 7.4 and are with a 1:50, soil:solution ratio.

Table 6. Soil Test Levels of Zinc.

Row Fertilizer	Broadcast P	Rep 1	Rep 2	Rep 3	Average
0	0	10.4	3.4	10.4	8.1
15 P	0	- -	5.3	5.3	5.3
30 P	0	2.2	2.4	4.3	3.0
45 P	0	12.4	5.1	2.2	6.6
45 P + 10 Z	0	24.0	20.8	22.4	22.4
0	45	5.7	1.3	1.2	2.7
15 P	45	1.8	2.2	4.2	2.7
30 P	45	5.2	1.8	3.0	3.3
45 P	45	4.1	3.2	6.0	4.4
45 P + 10 Z	45	30.4	20.8	23.6	24.9

ZINC FERTILIZATION OF CONTINUOUS CORN

West Central Experiment Station - Morris

Samuel D. Evans

I. GENERAL DESCRIPTION

In the spring of 1965 an experiment was initiated involving the use of zinc fertilizer on continuous corn. The plots were set up on Forman clay loam. Corn grown previously on this soil had not shown zinc deficiency, even though leaf samples indicated the zinc content was below 20 ppm zinc.

II. TREATMENT DESCRIPTION AND 1973 YIELDS

The individual treatments are described in Table 1. Yields in 1973 were very good due to the favorable weather, but there was no significant treatment effect.

III. EARLY PLANT SAMPLES

Ten whole plant samples were taken on June 20 in each plot. They were dried before submitting for chemical analysis. The results are presented in Table 2. The phosphorus content of the plants was highest where 45P had been broadcast each year. The lowest levels were where 20 lbs. of zinc as zinc sulfate was used in 1965 and where 10 lbs. of zinc as zinc sulfate was used every year. There were small differences in the content of potassium, but there was no definite pattern. Plant content of zinc was directly related to the amount of zinc applied. Even the rates applied in 1965 only were still showing an effect.

IV. LEAF SAMPLES AT SILKING

Ten leaves were collected from each plot when the majority of the plots were in silk. The results of the chemical analysis of these leaves is given in Table 3. The phosphorus content was again highest on those plots receiving 45P each year. There were some significant differences in iron content but no definite pattern. The leaf content of zinc again was closely related to amount of zinc applied.

V. SOIL TESTS

Ten soil samples of the plow layer were taken after harvest in the fall of 1973. The phosphorus and zinc soil tests are presented in Tables 4 and 5.

Table 1. Treatment Descriptions and 1973 Yields.

Treatment[1] (lbs./acre)	When Applied	Yield in Bu/Ac at 15.5% Moisture
1. Check	- -	116.1
2. 5 lbs. zinc as zinc sulfate	1965	109.3
3. 10 lbs. zinc as zinc sulfate	1965	111.7
4. 20 lbs. zinc as zinc sulfate	1965	116.0
5. 45 lbs. P broadcast	yearly	110.8
6. 45 lbs. P broadcast + 10 lbs. zinc as zinc sulfate	yearly 1965	109.8
7. 0.5 lbs. zinc as Zn chelate	yearly	107.8
8. 10 lbs. zinc as zinc sulfate	yearly	114.9

[1] All plots received a uniform application of 110 lbs. of N in the fall of 1972 and 125 lbs. of 8-32-16 starter.

Table 2. Analysis of Whole Plants - 1973.

Treatment	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%				ppm				
Check	.53	5.18	.50	.43	389	26.5	7.7	84	17.5
5 Zn	.53	4.93	.51	.43	398	30.0	7.7	74	17.0
10 Zn	.51	4.98	.49	.41	299	34.6	7.0	70	19.0
20 Zn	.48	4.59	.52	.40	266	37.7	7.7	71	17.7
45 P	.58	5.03	.54	.44	332	25.2	8.6	85	16.6
45 P + 10 Zn	.55	4.77	.51	.43	290	32.1	7.5	72	16.2
1/2 chelate yearly	.51	4.81	.51	.43	325	31.4	8.0	76	17.6
10 Zn yearly	.50	4.76	.53	.42	305	72.0	7.5	67	21.0
Level of signif.[1]	**	*	NS	NS	NS	**	NS	NS	NS
BLSD[2] .10	.029	.32	--	--	--	5.3	--	--	--
.05	.033	.38	--	--	--	6.2	--	--	--
.01	.047	--	--	--	--	8.2	--	--	--

1 Significance: ** = 99% level; * = 95% level; + = 90% level; NS = not significant at the 90% level.

2 Bayes LSD.

Table 3. Analysis of Corn Leaves at Silking - 1973.

Treatment	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%				ppm				
Check	.34	2.66	.63	.45	139	18.4	13.0	70	4.1
5 Zn	.34	2.48	.66	.46	148	23.0	14.8	69	3.6
10 Zn	.33	2.56	.64	.46	149	24.1	13.0	68	4.0
20 Zn	.32	2.30	.69	.48	139	27.4	14.8	65	3.4
45 P	.40	2.52	.71	.48	157	15.5	13.6	83	3.8
45 P + 10 Zn	.37	2.49	.74	.49	144	19.2	13.0	68	3.4
0.5 chelate yearly	.34	2.47	.69	.47	145	22.8	13.7	73	3.8
10 Zn yearly	.32	2.39	.70	.47	138	45.2	13.5	58	3.8
Level of signif.[1]	**	NS	NS	NS	*	**	NS	NS	NS
BLSD[2] .10	.015	--	--	--	12	4.0	--	--	--
.05	.018	--	--	--	14	4.7	--	--	--
.01	.023	--	--	--	--	6.2	--	--	--

1 Significance: ** = 99% level; * = 95% level; + = 90% level; NS = not significant at the 90% level.

2 Bayes LSD.

Table 4. Soil Test Levels of Phosphorus[1]

Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6
			- lbs./acre -			
Check	41	38	31	50	74	58(170)
5 Zn	42	35	29(60)	55	62	30
10 Zn	41	26	32(78)	70	47	27(78)
20 Zn	33	43(90)	21	43	37	23(60)
45 P	128	86	120	88(155)	77	86
45 P + 10 Z	127	90	130(210)	121	120	62
0.5 chelate yearly	39	63	52	70	54	53(105)
10 Zn yearly	41	52(80)	51	58	62	32(63)

[1] Bray P_1 test with a 1:10, soil:solution ration. Values in parenthesis are samples where the pH was above 7.4 and are with a 1:50, soil:solution ratio.

Table 5. Soil Test Levels of Zinc.

Treatment	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Average
Check	5.5	2.4	2.8	4.1	3.7	4.3	3.8
5 Zn	4.1	5.8	5.1	2.4	4.4	4.3	4.4
10 Zn	5.8	4.3	1.7	4.5	4.6	4.2	4.2
20 Zn	4.3	9.2	4.3	5.9	9.2	5.1	6.3
45 P	3.2	2.7	5.2	5.8	3.0	3.3	3.9
45 P + 10 Z	3.1	3.6	9.2	4.5	5.0	13.2	6.4
0.5 chelate yearly	5.0	4.4	4.9	5.3	6.0	3.4	4.8
10 Zn yearly	27.0	10.8	23.2	14.4	20.8	17.6	19.0

THE RESIDUAL EFFECT OF HEAVY APPLICATIONS OF ANIMAL MANURES ON CORN GROWTH AND YIELD AND ON SOIL PROPERTIES

West Central Experiment Station - Morris

S. D. Evans, J. M. MacGregor, R. C. Munter, and P. R. Goodrich

I. EXPERIMENTAL DESIGN

Main treatments were arranged in three replications of a complete randomized block design. Each plot was split into two parts for sub-plot treatments.

II. TREATMENTS

A. Main Plots

1. No manure or fertilizer (2 such plots per rep).

2. Recommended amounts of inorganic fertilizer each year (120 N + 40 P_2O_5 + 40 K_2O).

3. Solid manure from a conventional beef feeding facility (manure + straw) at 100 tons/acre (wet weight) in the fall of 1970 and again in the fall of 1971.

4. Liquid beef manure from a slatted floor beef feeding barn at 284 tons/acre (wet weight) in the fall of 1970 and again in the fall of 1971.

5. Liquid hog manure from a slatted floor hog finishing barn at 284 tons/acre (wet weight) in the fall of 1970 and again in the fall of 1971.

B. Sub-plots

1. Corn treated at planting with insecticide (Furadan) for corn rootworm control.

2. No rootworm control.

C. The plots were planted to Pioneer 3956A on May 10, 1973. Furadan at 10 lbs./acre (1 lb./acre active ingredient) was applied to the east 14 rows of each plot and the west 6 rows were left untreated. Starter fertilizer was used only on the fertilized treatment. Lasso was applied broadcast @ 2 1/2 lbs./acre on May 13; 2,4-D amine @ 1/2 lb./acre was applied as a postemergence spray on June 5; 2,4-D ester @ 1/3 lb./acre was applied on June 22.

III. MANURE ANALYSIS AND APPLICATION

Manure was applied each fall for 2 years as mentioned in II. above. Samples were taken at time of application and were analyzed by Animal Waste Laboratory in the Department of Agricultural Engineering. The chemical properties of the manures are given in Table 1. Some of these values were given in Soil Series 88 and 89 in previous years on a wet weight basis. In Table 1 they are given on a dry weight basis and some values which were in error have been corrected.

Listed in Tables 2 and 3 are the nutrient applications in lbs./acre. Manure has not been applied since 1971.

IV. SOIL SAMPLING AND ANALYSIS

A. The soils in each plot were sampled to a depth of 10 ft. in the fall of 1970 prior to manure application. Samples were taken again each fall prior to manure application. In the fall of 1971 the plots were sampled only to a depth of 4 ft. and the results are given on page 129, Soil Series 88. In 1972 the plots were sampled to a depth of 10 ft. and the results are given in Table 4. The soils were sampled in the fall of 1973 to a depth of 12 ft. but the results are not yet available.

1. NH_4-N levels were all quite low and levels in soils which were treated with manure were no higher than on check and fertilized soils.

2. NO_2-N levels were also very low and there were no increases due to manure applications.

3. NO_3-N levels were drastically changed by manure applications. The NO_3-N in the top foot of the liquid beef manure plots was 20 times higher than on the fertilized plot. Levels on solid beef and liquid hog manure were also very high. With all manures there was some movement of NO_3-N into the 9-10 ft. zone.

4. Conductivity of a soil:water mixture was increased by all manure applications. The increase was substantial in the upper soil horizons and was apparent down to the 8-9 ft. zone.

B. Bulk density measurements were made in September of 1972. The measurements are given in Table 5. Bulk density was significantly reduced by the solid beef and liquid beef manures in the 0-6 in. layer and by the solid beef manure in the 6-12 in. layer.

C. Electrical conductivity of the upper 4 ft. of one rep was determined on samples taken on June 11, 1973. The manure treatments in past years still resulted in substantially higher E.C.'s in all depth increments (Table 6). However, none of the values appeared high enough to affect plant growth.

Table 1. Chemical Properties of Animal Manures Applied at Morris in 1970 and 1971[1].

Properties	Units (Dry Matter Basis)	Solid Beef Manure (SB) 1970	Solid Beef Manure (SB) 1971	Liquid Beef Manure (LB) 1970	Liquid Beef Manure (LB) 1971	Liquid Hog Manure (LH) 1970	Liquid Hog Manure (LH) 1971
Total Solids	%	31.35	52.51	10.82	10.58	1.24	3.68
Total Volatile Solids	%	- -	82.69	- -	8.27	- -	63.78
COD	mg/l (wet basis)	46,695	- -	124,800	147,700	26,400	79,000
Conductivity	umho's/cm	- -	1550	- -	3470	- -	5570
Total N	%	3.58	2.48	7.46	7.62	18.84	9.77
Org - N	%	- -	1.44	- -	2.58	- -	2.54
NH_4 - N	%	- -	1.13	- -	5.20	- -	7.62
NO_2 - N	%	- -	.0155	- -	N.M.A.	- -	N.M.A.
NO_3 - N	%	Trace	.1835	Trace	N.M.A.	Trace	N.M.A.
Phosphates (PO_4-P)	%	0.68	0.59	0.44	1.39	0.75	1.63
Chlorides	%	- -	2.56	- -	4.12	- -	4.42
Emission Spectrograph							
P	%	- -	0.69	- -	2.32	- -	2.78
K	%	- -	1.48	- -	2.36	- -	3.31
Ca	%	- -	0.89	- -	3.48	- -	3.52
Mg	%	- -	0.44	- -	1.09	- -	1.36
Na	%	- -	0.76	- -	1.56	- -	2.01
Fe	ppm	- -	523	- -	897	- -	1723
Al	ppm	- -	351	- -	514	- -	766
Mn	ppm	- -	78	- -	224	- -	380
Zn	ppm	- -	96	- -	198	- -	1125
Cu	ppm	- -	18	- -	28	- -	114
B	ppm	- -	18	- -	25	- -	78

[1] Values based on one sample of each manure in 1970 and two samples of solid beef, 6 samples of liquid beef and 5 samples of liquid hog manure in 1971.

N.M.A. = no measurable amount.

Table 2. Nutrient Amounts Applied in 1970 for the 1971 Crop Year.

Element	SB	LB	LH
	lbs./acre		
Total N	2245	4584	1327
PO_4-P	426	270	53

Table 3. Nutrient Amounts Applied in 1971 for the 1972 Crop Year.

Element	Solid Beef SB	Liquid Beef LB	Liquid Hog LH
	lbs./acre		
Total N	2604	4579	2042
Org - N	1512	1550	531
NH_4 - N	1187	3125	1593
NO_2 - N	16	N.M.A.	N.M.A.
NO_3 - N	193	N.M.A.	N.M.A.
PO_4 - P	620	835	341
Cl	2689	2476	924
P	725	1394	581
K	1554	1418	692
Ca	935	2091	736
Mg	462	655	284
Na	798	937	420
Fe	55	54	36
Al	37	31	16
Mn	8.2	13.5	7.9
Zn	10.1	11.9	23.5
Cu	1.9	1.7	2.4
B	1.9	1.5	1.6

N.M.A. = no measurable amount.

Table 4. Effect of High Rates of Manure and Commercial Fertilizer Two Years after Application on the NH_4-N, NO_2-N, NO_3-N, and Conductivity of a Tara-Doland Soil Profile.

Depth	Initial[1]	CK	TREATMENT FE	SB	LB	LH
			NH_4-N (ppm)			
0-1'	4.6	7.2	5.0	5.9	8.8	6.0
1-2'	3.2	4.7	2.6	2.7	4.8	2.7
2-3'	- -	3.8	2.1	2.0	3.2	2.6
3-4'	2.4	3.4	2.0	3.1	2.9	2.5
4-5'	- -	3.6	1.9	2.8	3.4	3.1
5-6'	- -	4.0	2.5	4.6	4.1	4.4
6-7'	- -	4.4	2.4	4.0	3.9	4.4
7-8'	- -	4.2	2.2	3.6	4.6	3.9
8-9'	- -	4.5	2.9	5.0	4.6	3.6
9-10'	3.7	5.3	4.1	4.6	3.6	3.7
			NO_2-N (ppm)			
0-1'	1.3	0.5	0.2	0.3	0.2	0.4
1-2'	0.5	0.3	0.2	0.2	0.3	0.4
2-3'	0.4	0.3	0.2	0.2	0.2	0.3
3-4'	0.4	0.2	0.1	0.2	0.1	0.2
4-5'	0.3	0.2	0.1	0.1	0.1	0.2
5-6'	0.3	0.2	0.1	0.2	0.1	0.2
6-7'	0.3	0.2	0.1	0.2	0.1	0.3
7-8'	0.3	0.2	0.2	0.2	0.2	0.3
8-9'	0.3	0.2	0.2	0.4	0.3	0.3
9-10'	0.3	0.2	0.3	0.3	0.2	0.3
			NO_3-N (ppm)			
0-1'	15.2	4.4	12.2	139.6	243.7	100.7
1-2'	13.9	3.4	22.0	67.6	88.1	40.5
2-3'	12.5	7.4	28.6	45.5	90.0	29.8
3-4'	6.2	10.6	19.9	37.2	108.7	41.2
4-5'	4.2	13.2	7.2	29.5	80.7	33.3
5-6'	3.5	10.4	4.3	23.0	50.3	20.0
6-7'	3.6	7.0	3.4	17.7	28.3	13.6
7-8'	3.6	5.0	2.6	9.0	18.1	9.3
8-9'	3.4	4.2	2.5	6.9	13.9	5.3
9-10'	3.0	3.4	2.5	5.3	10.6	4.5
			Conductivity (mmhos/cm)[2]			
0-1'	.175	.158	.167	.667	1.040	.460
1-2'	.177	.182	.232	.475	.473	.290
2-3'	.191	.172	.287	.368	.443	.230
3-4'	.178	.215	.253	.320	.510	.265
4-5'	.156	.211	.202	.297	.413	.263
5-6'	.154	.192	.175	.282	.325	.228
6-7'	.150	.179	.176	.238	.248	.220
7-8'	.153	.148	.167	.212	.232	.188
8-9'	.155	.173	.172	.192	.203	.182
9-10'	.151	.174	.188	.184	.192	.187

[1] Samples taken in the fall of 1970 before manure application; 0-6" and 6-12" samples were analyzed separately and averaged for the initial analysis values.
[2] Conductivity is on a sample consisting of 20 g. air dried soil + 50 ml. H_2O.

Table 5. Bulk Density, September 14, 1972.

Treatment		Depth Increment 0-6"	6-12"
CK		1.12	1.30
FE		1.12	1.28
SB		.96	1.14
LB		1.02	1.21
LH		1.12	1.30
Level of Significance[1]		**	*
BLSD[2]	.10	.06	.10
	.05	.08	.12
	.01	.11	- -

[1] Significance: ** = 99% level; * = 95% level; + = 90% level; NS = not significant at the 90% level.

[2] Bayes LSD.

Table 6. Electrical Conductivity of Soil Samples Taken on June 11, 1973.

Treatment	Depth	Saturation Extract	1:2.5[1] Extract
		- mmhos/cm -	
CK	0-1'	.600	.180
	1-2'	.470	.144
	2-3'	.860	.206
	3-4'	1.130	.238
FE	0-1'	.940	.260
	1-2'	.890	.270
	2-3'	1.180	.260
	3-4'	.880	.195
SB	0-1'	1.650	.400
	1-2'	2.400	.500
	2-3'	3.000	.510
	3-4'	2.800	.440
LB	0-1'	1.900	.500
	1-2'	2.950	.680
	2-3'	3.100	.580
	3-4'	2.100	.540
LH	0-1'	1.500	.370
	1-2'	1.650	.350
	2-3'	2.000	.350
	3-4'	1.600	.340

[1] E.C. determined on a 1:2.5, soil:water mixture.