Table 3. Yield of Corn, Lamberton Lime Plots, 1972.

Rate of Lime	Yield
Tons/Acre	Bu/Acre
0	134
6*	143
12*	135
Significance	NS**
CV,%	11

* 3 or 6 Tons/Acre applied in the fall of 1965 and again in the spring of 1968.

** NS - Treatment means not significantly different at the 5% level.

Table 4. Chemical Composition of Sixth Corn Leaf at Tasselling, Lamberton Lime Plots, 1972.

Lime Treatment	N	P	K	Ca	Mg	Zn	Cu	Mn	B	Fe	Al
Tons/Acre	---------Percent in Dry Matter----------					------Parts Per Million in Dry Matter------					
0	2.26	.30	1.67	.66	.46	25	11	36	10	147	53
6	2.30	.30	1.67	.71	.46	23	10	32	10	154	56
12	2.38	.30	1.63	.69	.48	20	11	37	10	161	57
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV, %	6	5	11	13	14	21	12	16	11	14	27

SOIL FERTILITY MATERIALS PLOTS

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

In the spring of 1971, field trials were established at the Southwest Experiment Station, Lamberton, to compare various soil fertility products with a conventional fertilizer program. Because it is not feasible to test all products which may be purchased as fertilizers or related materials, a soil conditioner, an organic soil builder and a liquid fertilizer (advertised for both foliar and soil applications) were selected. The liquid fertilizer is labelled as Super to identify it as a material claimed to be superior to commonly available fertilizers.

On June 2, 1972, soybeans were seeded in the 1971 plot area and treatments were applied as shown in Table 1.

Table 1. Treatments (soybean crop)

1. Check
2. Super: Seed plus Foliar

   2 gal. (3-18-18) in contact with seed.

   2 gal. (3-18-18) foliar application, 7/24.
3. Super: Seed

   2 gal. (3-18-18) in contact with seed.
4. Soil Conditioner.

   150 lbs. to the side and below seed.
5. Organic.

   150 lbs. (0-1-7) to the side and below seed.
6. Residual from Conventional Fertilizer

   For corn 114+43+22 was applied in spring, 1971.

An additional set of plots, established in 1972, was planted to corn, May 26. This will allow a corn-soybean rotation with results obtained from each crop annually. The treatments for the plots where corn was seeded in 1972 are shown in Table 2.

Table 2. Treatments (corn crop).

1. Check.
2. Super: seed + Foliar.

   4 gal. (9-18-9) in contact with seed.

   4 gal. (9-18-9) over foliage. (2 gal. two times).

   135 lbs. 33.5-0-0 broadcast and worked in.
3. Super: seed.

   4 gal. (9-18-9) in contact with seed.

   135 lbs. 33.5-0-0 broadcast and worked in.
4. Soil Conditioner.

   250 lbs. broadcast and worked in.
5. Organic.

   300 lbs. (6-2-1) broadcast and worked in.

   200 lbs. (6-2-1) to the side and below seed.
6. Conventional Fertilizer.

   300 lbs. 33.5-0-0 broadcast and worked in.

   180 lbs. 8-24-12 to the side and below seed.

All treatments were replicated four times with and four times without broadcast applications of phosphate and potash. The purpose of the broadcast application is to have comparisons under medium to high P and K soil conditions as well as under low P soil conditions. The rate applied was 0+90+45. Those receiving broadcast phosphate and potash were referred to as medium + fertility trials; those not receiving it are the low fertility trials. Except for treatments 4 and 5, all plots received a herbicide (Amiben in soybeans,

Ramrod in corn). All plots were cultivated two times. Weeds were a moderate problem in treatments 4 and 5.

1972 Results. 1972 Corn and Soybean Yields are reported in Table 3. Plant measurements available are shown in Table 4.

Table 3. Effect of Fertility Materials on Plant Measurements, 1972.

Treatment		Soybeans Bu/A	Corn Bu/A	Corn % Moist	Corn Date 50% Plts. Silked
Low fertility	1	24.0 a[1]	80 a	31.4	Aug. 1
(0+0+0 B.C.)	2	28.4 b	93 a	29.4	July 30
	3	28.9 b	104 a	28.8	July 30
	4	24.6 a	74 a	30.6	Aug. 1
	5	24.5 a	89 a	30.0	Aug. 1
	6	28.5 b	96 a	30.0	July 29
Med. + Fert.	1	28.0 a	85 a	29.7	July 31
(0+90+45 B.B.)	2	30.0 b	109 a	29.5	July 29
	3	29.4 b	114 a	28.9	July 29
	4	28.3 b	73 a	29.8	July 31
	5	29.2 b	99 a	29.5	July 30
	6	28.0 b	110 a	29.2	July 29
Significance		*	N.S.	--	--

[1] Numbers followed by the same letter are not significantly different at the 5.0% level.

Table 4. Leaf Analysis. Fertility Materials Plots, Lamberton, 1972.

	Treatment	P %	K %	Ca %	Mg %	Al ppm	Fe ppm	Zn ppm	Cu ppm	Mn ppm	B ppm
Corn 0+0+0 broadcast	1	.22	2.14	.34	.22 ab	(1)29	124	27	12	44	8
	2	.26	1.78	.38	.25 bc	43	131	28	13	46	6
	3	.25	1.89	.40	.28 de	38	138	32	15	51	9
	4	.18	1.89	.31	.20 a	32	108	22	9	40	7
	5	.21	2.10	.34	.24 bc	30	119	26	11	41	8
	6	.25	1.69	.46	.34 f	29	125	33	14	61	9
Corn 0+90+45 broadcast	1	.22	2.08	.38	.24 bc	34	117	24	10	43	9
	2	.30	1.84	.42	.27 cd	36	123	28	11	44	7
	3	.26	1.83	.48	.28 de	33	122	29	12	48	7
	4	.22	2.02	.39	.25 bc	37	118	25	10	44	8
	5	.22	2.03	.44	.28 de	42	131	24	11	44	8
	6	.26	1.76	.44	.31 ef	35	126	28	12	50	8
Significance		N.S.	N.S.	N.S.	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Soybeans 0+0+0 broadcast	1	.37	2.13	.99 bc	.39	37	172	53	17	69	50
	2	.44	2.16	1.04 c	.41	39	185	57	19	65	52
	3	.39	2.10	.98 abc	.38	34	169	54	17	64	50
	4	.33	2.13	1.01 bc	.37	40	178	54	18	60	50
	5	.39	2.23	1.00 bc	.38	39	170	55	17	68	48
	6	.44	2.22	.93 a	.37	29	166	54	17	62	51

Table 4. (continued)--

	Treatment	P %	K %	Ca %	Mg %	Al ppm	Fe ppm	Zn ppm	Cu ppm	Mn ppm	B ppm
Soybeans	1	.56	2.30	1.00 bc[1]	.39	31	161	55	16	60	51
	2	.53	2.30	1.00 bc	.37	33	171	52	14	66	51
	3	.55	2.31	.93 ab	.34	24	166	53	14	58	51
0+90+45	4	.43	2.25	1.13 d	.38	40	168	54	16	60	51
broadcast	5	.57	2.31	.94 ab	.39	27	165	56	17	62	51
	6	.54	2.39	1.00 bc	.37	29	163	53	15	61	52
Significance		N.S.	N.S.	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

(1) Numbers followed by different letters are significantly different at the 5.0% level.

SMALL GRAIN FERTILIZATION

SOUTHWEST EXPERIMENT STATION - LAMBERTON

W. W. Nelson and S. D. Evans

Field experiments were established at the Southwest Experiment Station in the spring of 1970 to study the response of wheat, oats, and barley to nitrogen fertilization. A second objective was to determine the need for starter fertilizer on these crops. Three varieties of each crop were grown at three applied nitrogen levels. The nitrate nitrogen level in the soil in 1971 and 1972 was determined by the University of Minnesota Soil Testing Laboratory. In 1970 the tests were by the North Dakota Soil Testing Laboratory.

A. Oats

Main plots - Varieties (1) Lodi, (2) Otter, (3) Diana.

Sub plots - No starter vs. starter (100 lbs of 10-20-20).

Sub-sub plots - Nitrogen levels of 0, 30, 60 and 90 lbs. of actual nitrogen.

Seeding dates - April 15, 1971 and May 5, 1972

Nitrate-nitrogen soil test - 1971 - 101 lbs/A

1972 - 70 lbs/A.

Table 1. Lodging (1-5 scale), Oat Fertility Study, Lamberton, 197[illegible].

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-lodging score-		
Lodi	0	2.0	2.3	2.2
	30	3.7	3.0	3.3
	60	4.3	3.7	4.0
	90	4.0	3.3	3.7
Variety Average		3.5	3.1	3.3
Otter	0	3.0	2.3	2.7
	30	3.3	3.3	3.3
	60	3.3	3.3	3.3
	90	4.0	3.7	3.8
Variety Average		3.4	3.2	3.3
Diana	0	2.0	3.0	2.5
	30	2.3	2.3	2.3
	60	4.0	4.0	4.0
	90	3.7	3.0	3.3
Variety Average		3.0	3.1	3.0
Overall average		3.3	3.1	

Table 2. Yield, Oat Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Bu/acre		
Lodi	0	75.7	88.2	81.9
	30	81.2	66.1	73.6
	60	66.6	81.1	73.8
	90	66.5	71.4	69.0
Variety Average		72.5	76.7	74.6
Otter	0	78.2	63.5	70.8
	30	70.7	77.2	74.0
	60	69.5	68.5	69.0
	90	74.1	70.6	72.3
Variety Average		73.1	70.0	71.5
Diana	0	75.8	71.8	73.8
	30	77.4	72.0	74.7
	60	87.7	79.7	83.7
	90	72.2	84.8	78.5
Variety Average		78.3	77.1	77.7
Overall Average		74.6	74.6	

Table 3. Groat Percentage, Oat Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Groat %-		
Lodi	0	74	76	75
	30	75	72	73
	60	73	74	74
	90	72	75	74
Variety Average		74	74	74
Otter	0	76	76	76
	30	76	76	76
	60	76	76	76
	90	76	75	75
Variety Average		76	76	76
Diana	0	74	75	74
	30	73	73	73
	60	73	75	74
	90	73	75	74
Variety Average		73	74	74
Overall Average		75	75	

Table 4. Analysis of Variance, Oat Fertility Study, Lamberton, 1977.

Source of Variation	Lodging	Bu/Acre	Groat %
Reps	*	NS	NS
Varieties (V)	NS	NS	**
Starter (S)	NS	NS	NS
V x S	NS	NS	NS
Nitrogen (N)	**	NS	NS
N x V	*	NS	NS
N x S	NS	NS	*
N x V x S	NS	*	NS
C.V. (%)	19.2	11.7	1.7

Table 5. Yield, Oat Fertility Study, Lamberton, 1972.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Bu/acre-		
Lodi	0	70.2	54.0	62.1
	30	73.3	59.5	66.4
	60	75.5	63.7	69.6
	90	69.7	61.5	65.6
Variety Average		72.2	59.7	65.9
Otter	0	72.5	80.2	76.3
	30	75.2	74.7	74.9
	60	82.3	90.0	86.2
	90	89.5	88.7	89.1
Variety Average		79.9	83.4	81.6
Diana	0	65.5	61.7	63.6
	30	78.5	73.7	76.1
	60	80.5	71.7	76.1
	90	76.5	76.5	76.5
Variety Average		75.2	70.9	73.1
Overall Average		75.8	71.3	

Table 6. Groat Percentage, Oat Fertility Study, Lamberton, 1972.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Groat %-		
Lodi	0	65	62	64
	30	67	64	66
	60	63	56	60
	90	62	65	64
Variety Average		64	62	63
Otter	0	68	70	69
	30	68	71	69
	60	67	69	68
	90	72	66	69
Variety Average		69	69	69
Diana	0	66	66	66
	30	68	66	67
	60	65	68	66
	90	61	70	66
Variety Average		65	68	66
Overall Average		66	66	

The statistical analysis of the 1972 data has not been done.

B. Barley

Main plots - Varieties (1) Dickson, (2) Larker, (3) 64-76 in 1971 and 65-220 in 1972.

Sub plots - No starter vs. starter (100 lbs. 10-20-20).

Sub-sub plots - Nitrogen levels of 0, 30, 60 and 90 lbs. of actual nitrogen.

Planting dates - April 15, 1971 and May 5, 1972.

Nitrate nitrogen soil test - 1971 - 117 lbs/A

1972 - 70 lbs/A

Table 7. Lodging (1-5 scale), Barley Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-lodging-		
Dickson	0	1.0	1.3	1.2
	30	2.0	1.7	1.8
	60	1.7	2.0	1.8
	90	2.0	3.0	2.5
Variety Average		1.7	2.0	1.8
Larker	0	1.7	3.3	2.5
	30	2.7	3.0	2.8
	60	2.7	3.0	2.8
	90	4.3	2.7	3.5
Variety Average		2.8	3.0	2.9
64-76	0	1.0	1.0	1.0
	30	1.0	1.0	1.0
	60	1.0	1.0	1.0
	90	1.0	1.0	1.0
Variety Average		1.0	1.0	1.0
Overall Average		1.8	2.0	

Table 8. Yield, Barley Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Bu/acre-		
Dickson	0	58.5	53.6	56.1
	30	58.6	56.5	57.5
	60	60.6	58.4	59.5
	90	57.0	50.6	53.8
Variety Average		58.7	54.8	56.7
Larker	0	57.7	64.9	61.3
	30	64.7	60.9	62.8
	60	58.7	60.2	59.4
	90	51.6	64.1	57.9
Variety Average		58.2	62.5	60.4
64-76	0	56.8	56.6	56.7
	30	63.2	55.6	59.4
	60	56.3	62.5	59.4
	90	61.0	56.0	58.5
Variety Average		59.3	57.7	58.5
Overall Average		58.7	58.3	

Table 9. Percent Protein in Grain, Barley Fertility Trial, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		- % Protein -		
Dickson	0	13.6	13.0	13.3
	30	13.4	14.3	13.9
	60	13.8	14.0	13.9
	90	14.5	14.2	14.4
Variety Average		13.8	13.9	13.9
Larker	0	13.6	14.8	14.2
	30	14.4	14.8	14.6
	60	15.0	14.8	14.9
	90	14.0	15.4	14.7
Variety Average		14.2	15.0	14.6
64-76	0	12.5	13.9	13.2
	30	12.6	13.6	13.1
	60	13.7	13.5	13.6
	90	13.7	13.9	13.8
Variety Average		13.1	13.7	13.4
Overall Average		13.7	14.2	

Table 10. Yield, Barley Fertility Study, Lamberton, 1972.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Bu/acre-		
Dickson	0	30.0	35.6	32.8
	30	47.1	54.2	50.7
	60	56.1	48.6	52.3
	90	52.3	44.8	48.6
Variety Average		46.4	45.8	46.1
Larker	0	40.3	42.2	41.2
	30	46.0	42.8	44.4
	60	49.3	50.4	49.8
	90	53.4	50.2	51.8
Variety Average		47.2	46.4	46.8
65-220	0	42.8	41.4	42.1
	30	55.5	46.8	51.2
	60	45.5	48.3	46.9
	90	48.8	46.5	47.6
Variety Average		48.2	45.7	47.0
Overall Average		47.3	46.0	

Table 11. Analysis of Variance, Barley Fertility Study, Lamberton, 1971 and 1972.

Source of Variation	1971 Lodging	1971 Bu/Acre	1971 % Protein	1972 Bu/Acre
Reps	NS	NS	NS	NS
Varieties (V)	*	NS	*	NS
Starter (S)	NS	NS	NS	NS
V x S	NS	NS	NS	NS
Nitrogen (N)	**	NS	NS	**
N x V	NS	NS	NS	NS
N x S	NS	NS	NS	NS
N x V x S	**	NS	NS	NS
C.V. (%)	32.2	9.2	5.7	21.5

C. Wheat

Main plots - Varieties (1) Chris, (2) Era, (3) Ciano 67.

Sub plots - No starter vs. starter (100 lbs. of 10-20-20).

Sub-sub plots - Nitrogen levels of 0, 40, 80, and 120 lbs. of actual nitrogen.

Seeding dates - April 27, 1970 and April 15, 1971.

Nitrate nitrogen soil test - 1970 - 101 lbs/A

1971 - 87 lbs/A.

Table 12. Yield, Wheat Fertility Trial, Lamberton, 1970.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-Bu/acre-		
Chris	0	32.3	31.5	31.9
	40	31.8	30.6	31.2
	80	31.4	30.0	30.7
	120	29.2	31.3	30.2
Variety Average		31.2	30.8	31.0
Era	0	41.7	37.2	39.4
	40	46.3	46.6	46.4
	80	42.5	44.0	43.2
	120	40.2	50.5	45.3
Variety Average		42.7	44.6	43.6
Ciano 67	0	33.0	27.9	30.4
	40	33.4	33.4	33.4
	80	30.7	31.2	30.9
	120	30.8	29.7	30.2
Variety Average		32.0	30.5	31.3
Overall Average		35.3	35.3	

Table 13. Lodging (1-5 scale), Wheat Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-lodging-		
Chris	0	1.0	1.0	1.0
	40	1.7	1.0	1.3
	80	1.7	1.7	1.7
	120	2.3	1.7	2.0
Variety Average		1.7	1.3	1.5
Era	0	1.0	1.0	1.0
	40	1.0	1.0	1.0
	80	1.0	1.0	1.0
	120	1.0	1.0	1.0
Variety Average		1.0	1.0	1.0
Ciano 67	0	1.0	1.0	1.0
	40	1.0	1.0	1.0
	80	1.0	1.0	1.0
	120	1.0	1.0	1.0
Variety Average		1.0	1.0	1.0
Overall Average		1.2	1.1	

Table 14. Yield, Wheat Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		- Bu/acre-		
Chris	0	36.6	36.8	36.7
	40	38.1	40.5	39.3
	80	33.8	37.9	35.8
	120	30.6	32.4	31.5
Variety Average		34.8	36.9	35.8
Era	0	37.2	35.4	36.3
	40	41.2	40.7	41.0
	80	42.6	35.8	39.2
	120	37.8	32.8	35.3
Variety Average		39.7	36.2	37.9
Ciano 67	0	33.3	32.5	32.9
	40	35.5	38.7	37.1
	80	30.4	33.5	32.0
	120	31.1	31.9	31.5
Variety Average		32.6	34.2	33.4
Overall average		35.7	35.8	

Table 15. Percent Protein in Grain, Wheat Fertility Study, Lamberton, 1971.

Variety	Nitrogen Applied lbs/acre	No Starter	Starter	Average
		-% protein-		
Chris	0	16.7	16.4	16.6
	40	15.9	16.8	16.4
	80	17.2	17.0	17.1
	120	17.1	17.4	17.3
Variety Average		16.8	16.9	16.9
Era	0	14.0	14.6	14.3
	40	14.4	14.4	14.4
	80	14.9	15.0	14.9
	120	15.4	15.8	15.2
Variety Average		14.2	15.0	14.7
Ciano 67	0	15.0	15.7	15.4
	40	15.5	15.8	15.6
	80	16.1	16.1	16.1
	120	16.5	16.4	16.5
Variety Average		15.8	16.0	15.9
Overall Average		15.7	16.0	

Table 16. Analysis of Variance, Wheat Fertility Study, 1970 and 1971.

Source of Variation	1970 Bu/Acre	1971 Lodging	1971 Bu/Acre
Reps	NS	NS	NS
Varieties (V)	**	NS	*
Starter (S)	NS	NS	NS
V x S	NS	NS	*
Nitrogen (N)	NS	**	**
N x V	NS	**	NS
N x S	NS	NS	NS
N x V x S	NS	NS	NS
C.V. (%)	16.3	20.2	10.8

The 1972 wheat data was not available at the time of printing.

This work was done in cooperation with the following staff of the Department of Agronomy and Plant Genetics:

Oats - D. D. Stuthman

Barley - D. C. Rasmusson

Wheat - R. E. Heiner.

Statistical analysis was done by Dean Fairchild, Department of Soil Science.

Thirteen Years of Field Experiments with Nitrogen Source, Placement and Time of Application to a Webster Loam at Lamberton from 1960 through 1972.

John MacGregor, Wallace Nelson, and Robert Munter

The annual results of this experiment have been previously reported and described in Soil Series 74 to 88 inclusive and need not be repeated here.

The entire area is fall plowed following the harvesting of the ear corn, stalk cutting, and application of the NH_4NO_3-N or the urea-N at the 40, 80, and 160 lb/A rate. Surface applications of two forms of N at the 40 lb/A rate are then broadcast with no further fall working of the soil. The four replications of each of the 18 treatments are plots 20' x 77.5' arranged in a randomized block. Starter fertilizer at planting is 8-24-12 at the rate of 175 lbs/A, supplying 14 lbs of N/A to all plots in addition to the broadcast N treatments. Plant population, using hybrid seed adapted to the area, are slightly in excess of 20,000 plants per acre. Yields, leaf N, dry matter and N content of grain at harvest, and soil N status are shown in Table 1.

Nitrogen concentrations in the 6th (index) corn leaf were much more affected by rate of N fertilization than by time of fertilization. Nitrogen concentrations in the index leaf were significantly higher with the 40 lb/A spring sidedressing than where similar rates of N were applied at planting, but not significantly greater than two of the fall 40 lb applications. The 80 lb. rate increased leaf N, but there was only a trace of more leaf N with later N fertilization. The 160 lb. N rate increased leaf N further, with no significance between fall and late June

sidedressed N.

Grain dry matter at harvest had a narrow range from 64.5 to 69.9 with no consistent trend from N treatment.

Grain yields (15.5% moisture basis) on the 72 plots averaged 128.6 bu/A, ranging from 67.2 to a maximum of 161.6 bushels; the four starter fertilizer plots averaging only 75.6 bu/A. At the 40 lb N rate, June sidedressing produced significantly more grain than equivalent amounts of N either plowed down or left overwinter on the plowed surface. The same rate applied in the spring produced an intermediate yield increase not significantly different than from the fall or sidedressed 40 lb N yields. Eighty pounds of N/A significantly increased grain yields in 5 of the 6 treatments above the 40 lb/A rate, with no effect of application time. This was also true of the corn yields on the 160 lb N/A rate plots.

The 80 lb N rate significantly raised N content of the corn grain, with no effect of either lower or higher N rate.

All three rates of N fertilization increased amounts of N removed in the grain, the lowest N rate being most effective from the June sidedressing. Higher N fertilization rates further increased N removal, but time of fertilization was then less effective.

Where starter alone was used (14 lbs N/A) or the 40 lb rates of N were used (a total of 54 lbs of N/A), more N was removed in the grain than was applied in fertilizer. The 80 lb N rate and starter N (a total of 94 lbs N/A) resulted in a near added fertilizer N- soil N removal balance, whereas the 160 lb rate (174 lb N/A annual total) supplied considerably more N than was removed in the corn grain.

Table 1. Percentage N in Sixth Corn Leaf, Yield of Ear Corn (15.5% H_2O basis), Percentage N in Grain (dry basis) and N Removal in Corn Grain per Acre From NH_4NO_3 or Urea Fertilized Continuous Corn Grown on Webster Loam near Lamberton in 1972 (Four replications).

Treatment[1] (lbs N/A)	% N ~~in~~ 6th leaf	~~Ave.~~ % grain DM ~~at harvest~~	Grain yield in bu/A @ 15.5% H_2O I	II	III	IV	Ave.	Ave.% N in grain	#/A of N removed	Annual N fert. #/A.	Soil N status (#/A)
check	1.40a	67.2	67.2	85.1	71.9	78.2	75.6a	1.21abc	42.6a	14	-28.6
40N-fall plow down	1.80b	67.4	91.8	107.8	129.5	125.4	113.6b	1.17ab	61.9b	54	-7.0
40 Urea N-fall plow down	1.93bc	64.5	121.5	108.7	91.8	133.7	113.9b	1.27abcde	66.6bc	54	-12.6
40N-fall plow surface	1.97bcd	67.0	124.0	103.8	95.0	116.6	109.9b	1.14a	58.0b	54	-4.0
40 Urea N-fall plow surface	1.86b	68.5	97.6	102.8	88.9	137.4	106.7b	1.23abc	60.9b	54	-6.9
80N-fall plow down	2.07cde	69.9	133.7	155.0	142.5	141.3	143.1e	1.47fgh	97.0efg	94	3.0
80 Urea N-fall plow down	2.10cde	68.8	120.9	135.7	152.7	151.1	140.1e	1.42efgh	92.4efg	94	-1.6
160N-fall plow down	2.28ef	69.0	139.9	145.1	151.4	153.9	147.6e	1.50gh	102.1fg	174	71.9
160 Urea N-fall plow down	2.30ef	69.5	145.3	146.3	161.6	153.5	151.7e	1.51gh	106.0g	174	68.0
40 N-spring	1.76b	68.6	106.5	142.4	101.0	118.1	117.0bc	1.32bcdef	72.0bcd	54	-18.0
40 Urea N-spring	1.78b	69.0	101.2	124.8	102.5	137.6	116.5bc	1.25abcd	67.6bc	54	-13.6
80 N-spring	2.27def	68.6	137.7	140.1	140.5	152.4	142.7e	1.32bcdef	86.7defg	94	7.3
80 Urea N-spring	2.19cdef	67.7	135.9	135.4	145.6	151.3	142.1e	1.43efgh	93.9efg	94	0.1
40 N-sidedress	2.10cde	68.3	126.1	137.3	141.6	138.9	136.0cd	1.36cdefgh	85.3def	54	-31.3
40 Urea N-sidedress	2.13cde	68.6	130.1	128.0	145.2	132.3	133.9cd	1.31bcdef	80.7cde	54	-26.7
80N-sidedress	2.39f	67.6	90.2	109.5	144.9	154.1	124.7b	1.39defgh	80.5cde	94	13.5
80 Urea N-sidedress	2.23def	67.9	139.9	142.6	157.2	159.3	149.8e	1.43efgh	98.9efg	94	-4.9
160 N-sidedress	2.46f	69.0	141.[illegible]	154.7	146.3	156.3	150.0e	1.56h	107.6g	174	66.4

Table 1. (continued)

Treatment[1] (lbs N/A)	% N in 6th leaf	Ave. % grain DM at harvest	Grain yield in bu/A @ 15.5% H_2O I	II	III	IV	Ave.	Ave.% N in grain	#/A of N removed	Annual N fert. #/A.	Soil N status (#/A)
Significance											
Replicates	NS						**	NS	**		
Treatments	**						**	**	**		
C.V.	7.7						9.5	7.4	12.0		

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

Thirteen Year Averages

Grain yields harvested over the 13 year period are shown in Table 2.

Where N has been broadcast at the 40 lb/A rate in each of the 13 years, average corn yields have been much the same with the two forms of N, whether plowed down or left on the soil surface. There was also no significant difference for time of N fertilization, but a trend toward greater N efficiency from fall to spring (87.4 to 94.5 bu/A) and from spring to late June sidedressing (94.5 to 96.0 bu/A). Each average is based on 52 plot yields over the 13 year period-the fall averages totalling 104 individual plot yields.

Fall applied N at the 80 lb. rate increased average grain yields to 103.4 bu.- a 16 bushel increase over the 40 lb. rate. Spring fertilization at the higher rate resulted in 108.5 bu - or 5.1 bushels more than fall fertilization and 14 more bushels than the spring 40 lb. rate. Late June sidedressing with 80 lbs. of N showed a yield decrease to 104.8 bushels compared to 95.9 bushels sidedressed at the 40 lb. rate.

The 160 lb N/A rate plowed under each fall has averaged 109.8 bu, and 108.2 as a June sidedressing. These yields are only slightly larger than those obtained with the 80 lb. broadcast treatment rate.

General Conclusions

Urea N is comparable to N as ammonium nitrate, and where continuous corn is grown, annual N applications at the approximate rate of 100 lbs/A are desirable. This supplies ample N for the growing corn with little or no excess which might contribute to unnecessary pollution of soils and/or to surface or subterranean waters.

Table 2. Yields of ear corn during 13 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	13 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	75.0	66.5a
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	113.0	82.6b
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	88.4bcd
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	87.4bc
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	90.9bcde
80 NH_4NO_3-fpd	67.4	97.9	43.6	149.6	100.8	63.4	47.3	114.8	131.2	146.8	134.7	108.0	143.1	103.7fgh
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	103.0fgh
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	108.3gh
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	111.3h
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	95.3cdef
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	93.7cdef
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	108.1gh
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	108.9gh
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	97.5defg
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	94.4cdef
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	99.3efgh
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	110.3h
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	108.2gh
Ave. annual corn yield in bu/A	58.6	93.3	39.4	147.7	101.3	60.3	36.3	101.8	135.7	140.9	127.0	99.4	128.6	

[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

Tillage for Soybeans - Lamberton, 1972

W. W. Nelson

A basic tillage trial for soybean production was initiated in the fall of 1971 on a tiled Nicollet-Webster soil. The crop in 1971 was corn and the stalks were chopped. The treatments were fall plow, fall chisel, spring chisel and spring disc. After the treatments were completed and just prior to planting all were disced again. Corsoy soybeans were grown and a broadcast application of Amiben applied. The experiment was replicated five times.

Soybean Tillage

Primary tillage	Bu/A
Fall plow	47.1
Fall chisel	45.1
Spring chisel	42.7
Spring disc	43.7
LSD 5%	3.1

No difference in growth or weed control were evident during the season. Yields were obtained by hand harvesting.

Winter Versus Spring Fertilization of a Webster Clay Loam Near Lamberton on 1968-72 Corn Yields.

W. W. Nelson and J. M. MacGregor

This experiment has now been conducted for each of five years on the nearly level Webster clay loam. Grain yields have been reported annually with the exception of 1969 when only silage corn was harvested. The experimental design and procedures have been previously described in Soil Series 84, 86, 87, and 88. The N, P_2O_5 and N+P_2O_5 (40+0+0, 0+40+0, and 40+40+0) have been broadcast each January or in April on the same plot areas. The relatively low rates of N application are known to be insufficient for optimum corn production. This is desirable since even minor losses of applied N or P_2O_5 should be reflected by reduced corn yields. Analyses of 1972 corn leaves showed 6th leaf N concentrations of 1.35% in the unfertilized area, the leaves from corn plants receiving 0-40-0 contained 1.30% N, whereas both the 40+0+0 and the 40+40+0 plot corn plant leaves were significantly higher with 1.61% N. All of these values are much below the 2.5% leaf N values usually considered desirable for optimum corn production. Grain or silage corn yields for each of the five years with the different treatments and times of application are shown in the following table.

Yields of Corn Grain or of Silage During a Five Year Period (1968-72) with Nitrogen, Phosphate, or Combination, Broadcast in January or in April on a Level Webster Clay Loam near Lamberton.

		Yields @ 15.5% moisture				
Time of Fertilization	Treatment (lbs/A)	1968 grain bu/A	1969 silage T/A	1970 grain bu/A	1971 grain bu/A	1972 grain bu/A
-----	none	93.8a	7.89ab	64.2a	26.8ab	57.6a
January	40+0+0	110.5b	9.46bc	90.6b	52.1c	78.8b
April	40+0+0	116.7b	11.17c	94.9b	66.0de	82.8b
January	0+40+0	101.6ab	8.33ab	69.5a	37.7b	59.9a
April	0+40+0	93.2a	7.23a	66.5a	22.5a	55.0a
January	40+40+0	114.7b	9.54bc	103.0c	54.4cd	81.2b
April	40+40+0	111.5b	9.19b	105.3c	73.0e	87.0b

Nitrogen and nitrogen + phosphate treatments have both significantly increased corn grain yields in each of the four years that grain yields were recorded with the phosphate fertilization producing no yield increase. The 1969 fertilizer effect on corn silage yields is less evident. It is apparent, however, that time of fertilizer application has not influenced grain yields in 3 of the 4 years of the study (1968, 1970, and 1972), but 1971 spring fertilization was significantly more effective on corn yields than the N + P_2O_5 applied three months earlier.

The five year study shows that winter fertilization occasionally may result in partial losses of some of the applied fertility in comparison to spring fertilization.

WEST CENTRAL EXPERIMENT STATION - MORRIS
WEATHER SUMMARY - 1972

Month	Period	Precipitation 1972	Precipitation 84-yr. av.	Precipitation Dev. from av.	Air Temperature 1972	Air Temperature 84-yr. av.	Air Temperature Dev. from av.	Soil (10 cm) Temperature 1972	Soil (10 cm) Temperature 5-yr. av.
January	1-31	.72	.66	+.06	3.2	8.6	-5.4	30.4	23.2
February	1-29	.86	.65	+.21	5.3	12.8	-7.5	28.0	25.0
March	1-31	1.31	1.04	+.27	24.5	26.8	-2.3	30.9	29.2
April	1-10	.36	.60	-.24	30.9	38.3	-7.4	33.6	
	11-20	1.12	.63	+.49	43.6	44.3	-0.7	41.3	
	21-30	1.13	1.10	+.03	44.7	48.4	-3.7	44.2	
Total or Average		2.61	2.33	+.28	39.7	43.7	-4.0	39.7	40.8
May	1-10	.34	.81	-.47	46.8	52.1	-5.3	47.9	
	11-20	1.02	1.01	+.01	63.8	55.6	+8.2	59.4	
	21-31	3.04	1.18	+1.86	64.8	60.0	+4.8	64.7	
Total or Average		4.40	3.00	+1.40	58.6	56.0	+2.6	57.6	55.9

WEST CENTRAL EXPERIMENT STATION - MORRIS. WEATHER SUMMARY - 1972 (continued) --

Month	Period	Precipitation 1972	Precipitation 84-yr. av.	Precipitation Dev. from av.	Air Temperature 1972	Air Temperature 84-yr. av.	Air Temperature Dev. from av.	Soil (10 cm) Temperature 1972	Soil (10 cm) Temperature 5-yr. av.
June	1-10	0	1.34	-1.34	68.9	62.9	+6.0	72.9	
	11-20	1.95	1.16	+ .79	63.3	66.6	-3.3	69.4	
	21-30	.25	1.41	-1.16	66.0	68.2	-2.2	70.0	
Total or Average		2.20	3.91	-1.71	66.1	65.9	-0.4	70.7	68.8
July	1-10	.15	1.57	-1.42	65.5	69.9	-4.4	73.2	
	11-20	2.42	1.06	+1.36	69.9	71.4	-1.5	74.7	
	21-31	3.71	.94	+2.77	70.3	71.7	-1.4	75.1	
Total or Average		6.28	3.57	+2.71	68.6	71.0	-2.4	74.3	75.5
August	1-10	.79	1.10	-.31	61.5	70.6	-9.1	70.7	
	11-20	.01	.91	-.90	77.4	69.1	+8.3	78.6	
	21-31	.92	.96	-.04	68.3	66.8	+1.5	70.7	
Total or Average		1.72	2.97	-1.25	69.1	68.8	+0.3	73.4	74.5
September	1-30	.38	2.26	-1.88	56.3	59.3	-3.0	63.3	62.1
October	1-31	1.81	1.52	+.29	42.3	47.5	-5.2	47.1	47.3
November	1-30	1.43	0.88	+.55	28.7	29.9	-1.2	34.5	34.4
December	1-31	1.74	0.69	+1.05	6.6	15.8	-9.2	30.4	27.3
April-August Growing Season		17.21	15.78	+1.43	60.4	61.2	-0.8	63.1	63.1
Jan.-Dec. Annual		25.47	23.46	+2.01	39.1	42.2	-3.1	48.4	47.0

Continuous Corn Silage

West Central Experiment Station-Morris

Samuel D. Evans

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 silage yields. Rates of fertilizer were 74+48+48 and 148+96+96. All plots received a broadcast application of 10 lbs. of zinc as zinc sulfate in the fall of 1965.

In 1972 the variety used was Pioneer 3932 and the corn was planted on June 8.

Silage Yields

Dry Matter, tons/acre

	1972 Yield	1966-72 Av. Yield
On plots harvested as grain 1965-72:		
Low fertility (74+48+48)	4.15	5.29
High fertility (148+96+96)	5.60	5.66
On plots harvested as silage 1965-72:		
Low fertility (74+48+48)	4.65	5.36
High fertility (148+96+96)	4.88	5.77

Grain Yields

Bushels/acre @ 15.5% moisture

On plots harvested as grain 1965-72:

	1972	1966-72
Low fertility (74+48+48)	63.74	84.79
High fertility (148+96+96)	83.81	90.83

In addition an unfertilized, unreplicated check adjacent to the experimental area yielded as follows:

Grain (0+0+0)	66.16 bu/A	55.64 bu/A
Silage (0+0+0)	3.62 tons/A	3.94 tons/A

Due to the wet fall in 1971 and wet spring the experiment was planted quite late. The results in 1972 follow those of previous years. There is still no significant reduction in yield after growing eight years of continuous corn silage. Higher fertility increased both silage and grain yields.

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

The experimental design and treatment descriptions are given on page 118, Soil Series 88, March 1972 (A Report on Field Research in Soils).

Field Operations (1972 Season)

May 2- Took pictures of all plots - observed a difference in soil drying.

May 15- Tried to take neutron probe readings - water in most of the tubes; some almost full.

May 18- Decided to remove all neutron access tubes due to the water in them - removed tubes.

May 18- Went thru all plots with Graham Home digger to enhance soil drying - disk liquid beef plot No. 4 to try to level it up - liquid beef plots very wet - tractor mired down in all liquid beef plots.

June 1- Dug all manure plots with large field cultivator - dragged plots to level them and to prepare a better seedbed.

June 1- Planted plots in 30-inch rows with Pioneer 3956A (N) @ 20,000 seeds/acre. West six rows of each plot was left without insecticide. Remaining 14 rows received 10 lbs./A of Furadan (10% granule). Plots of the treatment receiving fertilizer got 7-28-28 as a starter (10 + 40 + 40). None of the other treatments received any fertilizer.

June 2- Sprayed all plots with 2 1/2 lb./A of Lasso broadcast.

June 6- Sampled soil in plots 2, 3, 4, and 5 to a 2-foot depth for conductivity analyses.

June 7- Observed the corn 50% emerged on most plots - some skips in solid beef due to manure plugging in front of planter shoe and pushing out seed - some skips in liquid beef due to unevenness and wet conditions at planting.

June 12(Afternoon)- observed some plants wilted in liquid beef plots - took pictures of all treatments.

June 13- put neutron access tubes and porous cup tubes in plots 1 thru 4.

June 16- Finished putting access tubes in plots 5 and 6 - put porous cup tubes in plots 5 thru 12.

June 21- Evacuated porous cups to 0.7 ATM - took stand count in center 2 rows of each plot.

June 22- Took water samples from the porous cups.

June 22-23- Tried to take neutron probe readings again - water in many tubes and probe acting erratically.

June 26- Cultivated all plots for first time.

June 28 (AM)- Evacuated porous cups to 0.7 ATM.

June 30 (PM)- Took moisture samples from porous cups.

June 29 & 30- Plots were handweeded - solid beef plots were the weediest.

July 3- Cultivated all plots for the second time.

July 5- Handweeded plots.

July 7- Took soil samples in plots 1 thru 5 to a 3-foot depth for conductivity analysis.

July 14- Took plant heights on all plots and also took pictures.

July 25- Put up corn rootworm frames and cages.

July 31- Took first rootworm counts in each cage - continued these counts on Monday, Wednesday and Friday of each week.

August 1- Took soil samples in plots 1 thru 5 to a 3-foot depth for conductivity analysis - also evacuated porous cups in the

AM to 0.7 ATM.

August 3- (PM)- Took moisture samples from porous cups.

July 31 thru August 10- Took notes on pollen shedding and silking. On the day the plots silked leaf samples were taken from all sub-plots.

August 16- Took heights on all plots to the top of the tassel.

Mid-August- Installed deep wells (about 20 ft.) on the NW corner of plot 12 and 30 feet east of the center of plot 7.

August 24- Pumped water from deep wells.

August 31- Took samples from deep wells. Water from the west well had a foul odor.

September 14- Took bulk densities on plots.

September 28- Took ear, silage and root samples for analysis.

September 29- Staked standard lengths in each plot for harvest and made plant counts.

October 3- Pulled all pipes out of plots - about 1/2 of the porous cups came off.

October 6- Removed all cages from plots.

October 16- Harvested plots obtaining grain and silage yields.

October 19- Harvested the bulk of the experimental area as shelled corn.

October 23 & 24- Took soil samples to a 10-ft. depth in all plots (3 sub-samples per plot).

October 24- Sampled the three fertilizer plots for routine soil tests.

October 26- Applied 34-0-0 to fertilized plots to provide 110 lbs. of N/Acre.

October 26- Disked and plowed all plots.

Table 1. Manure Analyses (Fall 1970) - Correction of Table 1 on page 119, Soil Series 88, March 1972.

	Solid Beef	Liquid Beef	Liquid Hog
Total Solids	31.35%	10.82%	1.24%
Total Volatile Solids	78.30%	8.43%	99.51%
(from total solids)			
B.O.D.	4,066 mg/l	124,800 mg/l	11,340 mg/l
C.O.D.	46,695 mg/l	62,960 mg/l	26,400 mg/l
Total N	1.120%	0.202%	0.234%
NO_3-N	.282%	0.016%	0.014%
PO_4	.288%	0.063%	0.012%

Table 2. Exchangeable Ammonium in Soil Samples (Fall 1972)

Depth (ft.)	Exchangeable Ammonium (NH_4^+-N) ppm in Soil									
	A	B	A	B	A	B	A	B	A	B
0-1/2	5.2	4.9	5.4	8.3	4.9	9.1	5.7	11.7	5.8	12.5
1/2-1	3.9	5.1	4.0	9.0	8.0	8.0	4.8	10.6	4.5	8.4
1-2	2.9	2.8	3.8	6.9	3.3	3.9	2.8	6.9	4.5	4.0
3-4	2.2	2.5	2.8	5.1	1.8	3.8	2.5	2.2	3.3	4.2
	Check		Fertilized		Solid Beef		Liquid Beef		Liquid Hog	

NOTE: A - Readings taken on soil samples taken in the fall of 1970 before manure application.

B - Readings on Soil Samples taken in the fall of 1971 before manure application.

Table 3. Manure Analyses (Fall 1971)*

	Solid Beef	Liquid Beef	Liquid Hog
Total Solids (%)	52.51	10.59	3.59
Total Volatile Solids (%)	--	8.27	2.32
(from total solids)			
C.O.D. (mg/l)	--	147,700	79,000
Total N (%)	1.30	.81	.37
Org. N (%)	.76	.27	.09
NH_4^+-N (%)	.59	.55	.29
NO_3^--N (%)	.0970	< .0035	<.0020
NO_2^--N (%)	.0081	< .0002	<.00005
PO_4 (%)	.975	.451	.172
pH range	7.8-8.0	7.6-8.2	7.8-8.1
Chlorides (%)	1.34	.44	.15
Conductivity mho's	1500	3670	5570

* Average of 2 samples of solid beef, 6 samples of liquid beef, and 6 samples of liquid hog manure.

Table 4. Average Chemical Analyses of Water Collected from Porous Cups on June 22, June 30 and August 3, 1972.

Treatment	Porous cup depth (ft.)	NH_4-N ppm	NO_3-N ppm	NO_2-N ppm	PO_4-P ppm	Electrical Conduc. µmhos/cm
Check	2	.3	25	.2	.014	550
	4	.3	53	.9	.011	884
	6	.3	42	.2	.032	841
Fertilized	2	.3	42	.1	.026	785
	4	.4	149	.7	.049	1633
	6	.3	39	.8	.011	1147
Solid Beef	2	.5	246	.2	.010	2930
	4	.9	316	.3	.048	3470
	6	.5	44	.3	.099	1150
Liquid Beef	2	2.8	277	.5	.308	3317
	4	5.4	226	.9	.192	2950
	6	2.0	53	.4	.209	1174
Liquid Hog	2	.4	134	.3	.365	1832
	4	.8	364	.4	.475	3100
	6	.5	188	.5	.052	1913

Table 4. Electrical Conductivity* of Soil Samples Taken on June 6, July 7, and August 1, 1972.

Treatment	Depth Increment (ft.)	June 6	July 7	August 1
			-mmhos/cm-	
Check	0-1/2	--	.47	.52
	1/2-1	--	.57	.53
	1-2	--	.50	.45
	2-3	--	.92	.83
Fertilized	0-1/2	.82	.68	.45
	1/2-1	.80	.59	.33
	1-2	.80	.56	.52
	2-3	--	.81	.57
Solid Beef	0-1/2	1.90	2.50	1.28
	1/2-1	1.84	2.55	1.46
	1-2	1.82	2.90	1.12
	2-3	--	1.90	1.79
Liquid Beef	0-1/2	3.90	4.40	1.62
	1/2-1	3.60	2.55	1.46
	1-2	2.40	2.85	1.80
	2-3	--	2.20	1.84
Liquid Hog	0-1/2	2.25	2.90	1.25
	1/2-1	1.80	2.45	1.53
	1-2	1.70	1.85	1.30
	2-3	--	1.35	1.06

* Determined on a saturation extract.

Table 5. Plant Measurements Taken During the 1972 Season.

Treatment	Sub Plot Insecticide	July 14 Height of Ext. Leaf -(in)-	Aug. 16 Height Top of Tassel(in)	Date 50% Plants Shedding Pollen	Date 50% Plants Silked	Stalks on 9/29 Broken Below Ear,%	Stalks on 9/29 Broken Above Ear,%	GRAIN % Ear Moisture at Harv.	GRAIN Yield Bu/A @ 15.5% M.	SILAGE % Dry Matter at Harv.	SILAGE Yield #/A Dry Matter	SILAGE Ears as % of Total
Check	W	44	96	8-4	8-8	16.4	2.4	33.6	73.4	58.2	9800	52.7
	W/O	--	--	8-4	8-8	22.8	3.6	32.0	71.1	56.0	7900	56.8
Fertilized	W	53	107	8-2	8-6	15.2	4.1	32.6	102.8	53.7	11700	55.4
	W/O	--	--	8-2	8-6	27.7	8.0	30.8	93.5	53.8	11300	56.1
Solid Beef	W	61	113	7-31	8-4	11.1	6.7	34.3	120.7	38.3	13000	58.6
	W/O	--	--	7-31	8-4	30.8	17.5	31.7	106.2	43.7	12700	53.7
Liquid Beef	W	44	110	8-1	8-5	21.4	7.9	35.7	109.1	41.0	10900	57.6
	W/O	--	--	8-1	8-5	24.2	18.7	33.5	102.2	44.1	12500	53.9
Liquid Hog	W	61	112	7-31	8-4	9.7	7.1	31.5	123.7	44.2	13000	57.7
	W/O	--	--	7-31	8-4	30.5	22.6	32.4	103.8	41.1	10700	56.3

Table 6. Main Plot, Sub Plot, and Interaction Averages and Levels of Significance.

	On Sept. 29		GRAIN		SILAGE		
	Stalks Broken Below Ear %	Stalks Broken Above Ear %	% Ear Moisture at Harv.	Yield Bu/A @ 15.5% M	% Dry Matter at Harvest	Yield Lbs/Ac of Dry Matter	Ears as a % of the Total
Check	20.8	3.0 A	32.8	72.2 AB	57.1 C	8800 A	54.7
Fertilized	21.4	6.1 AB	31.7	98.2 BC	53.7 BC	11500 BC	55.8
Solid Beef	21.0	12.1 BC	33.0	113.4 C	41.0 A	12800 C	56.2
Liquid Beef	22.8	13.3 C	34.6	105.6 BC	42.6 AB	11700 C	55.8
Liquid Hog	20.0	14.8 C	32.0	113.8 C	42.6 AB	11900 C	57.0
Level of Significance	NS	**	NS	**	**	*	NS
+ Insecticide	15.8	5.1	33.5	100.5	48.9	11400	55.8
- Insecticide	26.5	12.4	32.0	91.3	49.1	10500	55.6
Level of Significance	**	**	*	*	NS	NS	NS
Interaction - Level of Significance	NS	**	NS	NS	NS	NS	NS

Table 7. Summary of Analysis of Corn Leaves at Silking.

	N %	P %	K %	Ca %	Mg %	Al ppm	Fe ppm	Zn ppm	Cu ppm	Mn ppm	B ppm
Check	1.56 A	.198 A	1.94 A	.64 B	.40 B	58 B	127 A	14.2 A	7.6	62 A	5.8 A
Fertilized	2.51 B	.286 A	2.00 A	.66 B	.40 B	44 AB	134 A	23.9 BC	9.0	56 A	5.9 A
Solid Beef	2.84 B	.572 B	2.85 B	.53 A	.21 A	32 A	136 A	16.8 AB	8.2	74 A	6.2 A
Liquid Beef	2.93 B	.549 B	2.22 B	.68 B	.20 A	48 AB	164 B	34.4 D	8.1	244 B	8.4 C
Liquid Hog	3.03 B	.510 B	2.45 AB	.70 B	.23 A	34 A	138 A	27.2 CD	9.1	97 A	6.9 B
Level of Significance	**	**	**	*	**	**	**	**	NS	**	**
+ Insecticide	2.47	.395	2.25	.66	.31	43	138	22.8	8.1	111	6.6
- Insecticide	2.34	.378	2.22	.63	.31	48	137	20.8	8.4	88	6.4
Level of Significance	(+)10%	NS	NS	NS	NS	NS	NS	*	NS	*	NS
Interaction-Level of Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS

Table 8. Chemical Analysis of Water from Deep Wells on August 31.

Well Location	NH_4-N ppm	NO_3-N ppm	NO_2-N ppm	PO_4-P ppm	Elec. Cond. umhos/cm
NW Corner of Plot #12 (F)	.5	18	0	0	645
30 ft. east of center of Plot #7 (LB)	.4	5	.1	0	500

Table 9. Soil Tests* Taken on Fertilized Plots in the Fall of 1972 (Oct. 24).

Rep	pH	Organic matter	P lbs/A	K lbs/A	Zn ppm	Soluble Salts mmhos
1	7.2	H	27	250	4.1	0.5
2	6.9	H	47	350	11.0	0.6
3	7.0	H	13	280	10.8	0.5

* Analysis of the University of Minnesota Soil Testing Laboratory.

EFFECT OF RATES OF SOLID BEEF MANURE ON CORN GROWTH AND YIELD

West Central Experiment Station - Morris

S. D. Evans

Solid beef manure was applied to plots at 33 1/3, 66 2/3, and 100 tons/acre (wet weight) and the plots were planted to corn in 1972. The growth and yield on these plots was compared to that on plots receiving fertilizer at recommended rates.

Field Operations (1971-72)

October 15, 1971- Applied solid beef manure to 33 1/3 and 66 2/3 tons/acre plots. Ran out of manure when we had applied only 33 1/3 T/A to 100 T/acre plots.

Applied zinc sulfate at 30 lbs./acre to the fertilizer plots.

Plowed all plots.

May 16, 1972- Finished applying solid beef manure to 100 T/acre plots and replowed these plots only.

May 18- Put 34-0-0 on to provide 110 lbs. of actual N per acre on fertilizer plots. Disk 100 T/A plots.

Dug all plots twice to incorporate manure.

June 1 - Dug all plots with large field cultivator.

Disked all plots.

Dragged plots.

June 1-2 - Planted plots in 30-inch rows with Pioneer 3956 A(N) @ 20,000 seeds/acre. Each main plot was split and one-half received Furadan (10% granule) at 10 lbs/acre and the other half received no insecticide.

The fertilized plots received 7-28-28 to provide 10 + 40 + 40.

June 2- Sprayed all plots with 2 1/2 lb/A of Lasso broadcast.

June 7- Corn 50% emerged - No problems.

June 21- Sprayed all plots with Banvel-D @ 1/4 lb/A broadcast to

control thistle.

June 21- Took a stand count.

June 26- Cultivated all plots for the first time.

July 3- Cultivated all plots for the second time.

July 14- Took plant heights on all plots.

August 2 thru 7 - Took notes on pollen shedding and silking. On the day the plots silked leaf samples were taken from all sub-plots.

August 16- Took plant heights on all plots.

October 17- Harvested all plots obtaining grain yields only.

October 20- Applied 34-0-0 to fertilizer plots to provide 110 lbs. of N/Acre.

October 24- Sampled the three fertilizer plots for routine soil tests.

October 26- Disked and plowed all plots.

Table 1. Manure Analyses*

		Fall 1971	Spring 1972
Total Solids	(%)	52.51	24.54
C.O.D.	(mg/l)	---	84310
Total N	(%)	1.30	.46
Org. N	(%)	.76	.23
NH_4+N	(%)	.59	.23
NO_3-N	(%)	.0970	N.M.A.
NO_2-N	(%)	.0081	N.M.A.
PO_4	(%)	.975	.136
pH range		7.8-8.0	7.0-7.5
Chloride	(%)	1.34	.44
Conductivity	mho's	1500	2650

N.M.A. - No measurable amount.

* Average of two samples on each date.

Table 2. Summary of Plant Measurements during the 1972 Season.

Treatment	% Ear Moisture at Harvest	Yield Bu/Acre @15.5% Moisture
Fertilized	32.6	101.0
Solid Beef @ 33 1/3 T/A	32.6	103.3
Solid Beef @ 66 2/3 T/A	31.4	109.0
Solid Beef @ 100 T/A	30.5	110.8
Level of Significance	NS	(+) 10% level
+ Insecticide	32.2	111.0
- Insecticide	31.2	101.0
Level of Significance	(+) 10% level	**
Interaction -		
Level of Significance	NS	NS

Table 3. Summary of Analyses of Corn Leaves at Silking.

	N %	P %	K %	Ca %	Mg %	Al ppm	Fe ppm	Zn ppm	Cu ppm	Mn ppm	B ppm
Fertilized	2.62	.296A	1.82A	.64	.43C	38	128	24.2B	10.1	72	6.8
Solid Beef @ 33 1/3 T/A	2.60	.407AB	2.30B	.62	.31B	44	142	14.2A	10.7	79	6.5
Solid Beef @ 66 2/3 T/A	2.51	.466B	2.51B	.58	.28AB	43	135	13.6A	8.7	79	6.4
Solid Beef @ 100 T/A	2.60	.420AB	2.36B	.55	.26A	41	131	15.8A	9.0	73	6.5
Level of Significance	NS	*	**	NS	**	NS	NS	**	NS	NS	NS
+ Insecticide	2.61	.407	2.24	.64	.32	40	134	17.4	10.2	77	6.6
- Insecticide	2.56	.388	2.25	.62	.32	43	134	16.6	9.0	75	6.5
Level of Significance	NS	NS	NS	NS	NS	(+)10%	NS	NS	*	NS	NS
Interaction -											
Level of Significance	NS	(+) 10% level	**	NS	NS	*	NS	NS	NS	NS	NS

Fertilizer Materials Plots

West Central Experiment Station-Morris

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

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 set up on a site consisting 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. Ten individual fertilizer treatments were superimposed across each main block pair. The individual treatments are described in Table 1. Ten lbs/acre of zinc as zinc sulfate was broadcast over the entire area in the fall of 1971. In 1972 the treatments were on the same plots as in 1971.

1972 Schedule of Operations

May 18- Ran Graham Home cultivator over entire area in an attempt to dry soil.

June 1- Ran field cultivator over area.

June 2- Ran field cultivator thru all plots and dragged for planting.

June 2- Planted all plots with hybrid Pioneer 3956 A. Used Furadan @ 1 lb/acre on all treatments but D & F (3 seeds/hill).

June 3- Sprayed all treatments but D & F with Lasso broadcast @ 2-1/2 lbs/acre.

1972 Schedule of Operations (cont.)--

June 29- Thinned all plots to two plants/hill.

July 7 (5:30-5:45 p.m.)- Applied first foliar treatment to B plots; very little wind, temp. 75-80°, mostly cloudy; 22 inch extended leaf height, 6th leaf coming out (not counting bottom two leaves).

August 3 (6:30-7:00 p.m.)- Applied second foliar treatment to B plots; no wind, temp. 64°, completely overcast; 10th leaf to tassels emerging.

October 19- Harvested reps 1 and 2 only (reps 3 and 4 were severely stunted due to wet soil conditions).

1972 Results.

There was very little effect of the broadcast phosphorus in 1972 (Table 2). The % P in the leaf was increased by .023% which was significant at the 10% level. The amount of aluminum in the leaves at silking was also increased from 92.2 ppm to 94.8 ppm by the addition of phosphorus in 1971. This was significant at the 1% level.

There was a spread of some seven days in pollen shedding (Table 3). The earliest plots were those receiving conventional fertilizer or conventional plus extra N and K. The latest were the organic and soil conditioner which had no pesticide applications. The date at which the plots silked followed the same pattern.

Harvest measurements were all significantly affected by fertilizer materials as shown in Table 3. The greatest percentage of normal ears were from treatments B, C, H, J, and K. Percent moisture in the ears at harvest was significantly higher on treatments D and F than on all other treatments. The highest yields were on treatments H and J. Treatment K followed closely and was not significantly lower. Treatments B and C were 69.8 and 68.2 bu/ac respectively and were

significantly lower than H, J, and K. The lowest yielding treatments were D and F. These two treatments were even lower yielding than the check, A, due to weed competition for moisture and nutrients. The use of pesticides with treatments D and F significantly increased yields by 23.2 and 25.8 bu/ac respectively.

Leaf samples were taken on the date the plants were 50% silked and the results are given in Table 4. Nutrient leaves significantly affected at the 5% level were Ca and Zn. Both elements were the highest on the so-called conventional treatments. N, P, Cu, and Mn were all changed by fertilizer materials and were different at the 1% level. These were all highest on the conventional treatments. B and Al were significant at the 1% level and were lowest on the conventional treatments.

The only measurements where the interaction between phosphorus and fertilizer materials was significant was in grain yield. Here the interaction was significant at the 5% level. The individual yields are given in Table 5.

Table 1. 1972 Morris Fertilizer Materials Trial

Treatment Letter	Treatment Description	Herbicide	Insecticide
A	check	yes	yes
B	120 lbs/acre of ammonium nitrate (40#N) broadcast before planting + 4 gal/acre of liquid 9-18-9* with seed at planting + 2 foliar treatments of 9-18-9x of 2 gal/acre on 7-7 and 3 gal/acre on 8-3.	yes	yes
C	Same as B but no foliar treatments	yes	yes
D	Wonderlife (0-0-0), a soil conditioner, at 250 lbs/acre broadcast before planting.	no	no
E	Same as D	yes	yes
F	Shurgro (6-2-1), an organic fertilizer, at 200 lbs/acre with planter	no	no
G	Same as F	yes	yes
H	313 lbs/acre of ammonium nitrate (105#N) broadcast before planting + 190 lbs/acre of 8-32-16 at planting.	yes	yes
J	Same as H but an addition of 299 lbs/acre of ammonium nitrate (100#N) and 100 lbs/acre of K_2O as 0-0-60 broadcast before planting.	yes	yes
K	120 lbs/acre of ammonium nitrate (40#N) broadcast before planting + 4 gal/acre of liquid 7-21-7 with seed at planting.	yes	yes

* Also contained 1% sulfur and 1/4 pint/acre Sequestrene Liquid Zinc (6.0% Zn).

x Also contained 1% sulfur.

Table 2. Effect of Broadcast Phosphorus on Plant Measurements.

	No P	B'cst P	Significance
Date 50% plants shedding pollen	8-10	8-10	NS
Date 50% plants silked	8-14	8-14	NS
Leaf Analysis:			
N, %	1.62	1.61	NS
P, %	.201	.224	+ (10%)
K, %	1.94	1.88	NS
Ca, %	.629	.666	NS
Mg, %	.431	.464	NS
Cu, ppm	7.3	6.6	NS
Mn, ppm	65	63	NS
B, ppm	7.2	7.3	NS
Al, ppm	92.2	94.8	**
Fe, ppm	176	174	NS
Zn, ppm	20.7	20.6	NS
Harvest Measurements:			
% ears normal in size and/or shape	73	75	NS
% ear moisture at harvest	37.2	36.9	NS
Yield in Bu/Ac 15.5% moisture	62.5	62.8	NS

Table 3. Effect of fertilizer materials on plant measurements.

Treatment Letter	Date 50% plants shedding pollen	Date 50% plants silked	%, ears normal in size and/or shape	% ear moisture at harvest	Yield Bu/Ac @ 15.5% M.
A	8-12 BC(1)	8-15 CD	66.5 C	36.6 A	45.2 BC
B	8-9 AB	8-14 BC	90.5 E	35.2 A	69.8 DE
C	8-9 AB	8-14 BC	85.0 DE	34.8 A	68.2 DE
D	8-14 C	8-17 D	22.5 A	43.0 C	20.4 A
E	8-12 BC	8-15 CD	67.5 C	38.4 AB	43.6 BC
F	8-14 C	8-17 D	39.8 B	41.6 BC	26.0 AB
G	8-10 ABC	8-14 BC	76.5 CD	36.6 A	51.8 CD
H	8-7 A	8-11 A	96.8 E	33.5 A	106.8 F
J	8-7 A	8-11 A	97.0 E	36.5 A	109.6 F
K	8-8 AB	8-12 AB	96.0 E	34.4 A	84.8 F
Significance	**	**	**	*	**

(1) Letters following values indicate significant differences by the Duncan test at the level indicated at the bottom of the column (either 5% or 1%).

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

Treatment Letter	N %	P %	K %	Ca %	Mg %	Cu ppm	Mn ppm	B ppm	Al ppm	Fe ppm	Zn ppm
	(1)										
A	1.04 A	.164 A	2.16	.478 A	.381	3.8 A	45 A	7.0 A	98.2 BCDE	166	17.0 AB
B	1.62 C	.213 B	1.98	.699 BCD	.431	7.3 BCD	66 ABC	6.5 A	101.1 BCDE	184	20.2 ABC
C	1.60 C	.194 AB	1.99	.698 BCD	.432	8.0 CD	71 ABCD	7.4 AB	87.0 ABCD	169	20.9 ABC
D	1.16 AB	.202 AB	1.88	.550 AB	.362	3.8 A	49 AB	8.6 B	119.4 DE	193	18.0 AB
E	1.13 A	.173 AB	1.86	.660 BCD	.456	5.5 AB	55 ABC	7.7 AB	104.4 CDE	168	20.4 ABC
F	1.12 A	.182 AB	2.04	.562 ABC	.393	3.7 A	48 AB	8.8 B	130.4 E	214	16.3 A
G	1.35 B	.187 AB	1.80	.698 BCD	.456	6.4 BC	72 BCD	6.6 A	104.7 CDE	184	21.4 BCD
H	2.66 E	.310 C	1.75	.759 D	.571	11.7 F	90 D	6.9 A	54.6 A	157	24.6 CD
J	2.64 E	.288 C	1.93	.651 BCD	.467	10.6 EF	79 CD	6.2 A	61.1 AB	161	26.0 D
K	1.86 D	.215 B	1.74	.722 CD	.525	8.6 DE	68 ABCD	6.5 A	73.8 ABC	156	21.7 BCD
Significance	**	**	NS	*	NS	**	**	**	**	NS	*

(1) Letters following values indicate significant differences by the Duncan test at the level indicated at the bottom of the column (either 5% or 1%).

Table 5. Yield of corn grain @ 15.5% moisture with and without broadcast phosphorus.

Treatment Letter	with Broadcast P	without Broadcast P
	---Bu/Ac---	
A	52.7	37.6
B	66.7	72.9
C	66.6	69.8
D	22.5	18.3
E	45.1	42.1
F	24.6	27.4
G	51.4	52.2
H	106.9	106.6
J	108.3	110.9
K	79.8	89.8

NITRATE NITROGEN CONTENT OF AN UNTILLED BARNES LOAM AFTER FIFTEEN YEARS OF NITROGEN FERTILIZATION FOR CONTINUOUS CORN CROPPING (1957-71)

J. M. MacGregor, S. D. Evans and G. R. Blake

A long term fertilizer-soil structure study with annual corn cropping was commenced in the spring of 1957 on an experimental field of Barnes loam on the West Central Experiment Station at Morris. Phosphate and potash were broadcast at the rate of 40 lbs/A each spring at planting with nitrogen at rates of 0, 40, 80 and 240 lbs/A, one of the 40 lbs N rates being plowed down each fall. Five soil structure treatments were included in three replications making a total of 75 individual 25' x 35' plots arranged in a Latin square design.

During the first ten years of the experiment, five different methods of seedbed preparation were included in the study and the desired plant population of 16,000 to 18,000 plants per acre was not uniformly obtained each year on all experimental plots. This seedbed preparation study was discontinued in 1967, and corn yields were somewhat improved with more uniform plant populations during the last five years of the study. During the last three years (1969-71) all of the phosphate, potash, and an additional 10 lbs of nitrogen per acre was applied in the row as a starter fertilizer in an effort to produce fertilizer yield increases.

Annual precipitation during the 15 year period averaged 25.18", which was somewhat greater than the long term average of 22.58". However, uneven precipitation distribution in this area, frequently limited corn production and the average annual yields obtained from the different fertilizer treatments were relatively low due to soil moisture limitation. Total annual precipitation, grain yields, and nitrogen removal in the corn grain per acre are shown in Table 1.