Table 2. Forage and grain yields, protein levels and total nitrogen removed by Froker oats, Crookston, Minnesota - 1974.

Lbs. N/A	Grain Bu/A	Grain % protein	Forage Tons/A	Forage % protein	Forage N removed
0	51	12.3	2.88	5.5	48
60	64	17.7	4.13	7.0	98
90	64	18.2	4.08	9.2	118
120	66	18.9	4.28	8.6	125
Significance	ns	**	**	ns	*
BLSD		2.3	0.8		35

Table 3. Forage and grain yields, protein levels and total nitrogen removed by Cree barley, Crookston, Minnesota - 1974.

Lbs. N/A	Grain Bu/A	Grain % protein	Forage Tons/A	Forage % protein	Forage N removed
0	48	10.7	1.93	9.0	68
60	78	13.5	2.48	9.2	72
90	79	13.6	2.55	9.6	77
120	75	13.4	2.63	10.5	94
Significance	*	*	*	ns	ns
BLSD	23	1.4	0.54		

EFFECT OF INOCULATING SOYBEANS WITH *RHIZOBIUM JAPONICUM* AT CROOKSTON

G.E. Ham and L.J. Smith

Rhizobium japonicum strains were applied as normal seed inoculants both individually and in combination to measure their effect on seed yield and protein content. Strains 5036, 5084 and 5099 are isolates obtained from soybean nodules at Waseca in 1973 and the other strains are highly effective N_2 fixing strains obtained from other sources. In addition, strain 110 and 138 were prepared as granular-based-humus inoculants and applied at rates of 250, 500 and 1000 times the normal seed rate. The soil contained few rhizobia and the uninoculated controls were not nodulated. Seed yields were increased significantly by all rhizobia strains. The seed yield was increased with increasing amounts of 110 inoculum (250X, 500X, 1000X) but not with 138 inoculum. Seed protein percentage was increased by all treatments except strains 5036, 5084, 6 and 61 applied as seed inoculants.

Table 1. Effect of inoculating soybeans on seed yield and protein percentage at Crookston.

Inoculum treatment	Rhizobia strain	Seed yield	Seed protein*
		bu/acre	%
Control	0	26.6	36.4
Seed	5036	31.3	36.5
Seed	5084	33.3	37.1
Seed	5099	30.7	37.6*
Seed	6	33.6	37.3
Seed	33	33.4	38.1*
Seed	59	32.9	38.6*
Seed	61	32.2	36.7
Seed	122	32.7	38.0*
Seed	139	31.8	37.6*
Seed	122+139	35.5	38.0*
Seed	138+139	34.2	37.6*
Seed	110+138	34.9	38.8*
250X	110+138	34.7	39.4*
500X	110+138	34.1	39.7*
1000X	110+138	36.2	39.6*
Seed, P	110	35.1	37.7*
250X, P	110	35.2	39.1*
500X, P	110	35.4	40.3*
1000X, P	110	32.4	40.0*
Seed, G	110	33.3	38.1*
250X, G	110	35.6	38.9*
500X, G	110	35.0	39.5*
1000X, G	110	34.9	39.5*
Seed, P	138	30.9	37.6*
250X, P	138	34.3	38.9*
500X, P	138	35.4	39.6*
1000X, P	138	38.1	39.4*
Seed, G	138	30.8	37.7*
250X, G	138	33.4	38.3*
500X, G	138	35.8	39.3*
1000X, G	138	40.0	39.2*

* Protein percentage significantly greater than control.

FERTILIZER TRIALS ON ALFALFA - ELK RIVER 1974

C. J. Overdahl and C. P. Klint[1/]

The alfalfa plots were reseeded in the spring of 1971 and the design modified. The 1972 results are reported in Soil Series 89 (bluebook). In the fall of 1972, the plot treatments were again modified when all potash treatments were reduced by one half. These were reduced from 240 lbs. K_2O per acre in October, 240 lbs. K_2O per acre in June and 240 lbs. of K_2O applied both October and June.

Alfalfa yields (4 cuttings in 1973, 3 in 1974), soil test K and percent K in plant tissue for irrigated vs. unirrigated plots were as follows:

	Rates of K_2O/acre and Time of Application				
	0	0 Oct. 120 June	120 Oct. 0 June	120 Oct. 120 June	
Irrigated (avg. pH 7.1)					
Yield T/A 1973	3.7a	6.3bc	5.9b	6.7c	
1974	2.3a	4.2b	4.1b	4.4b	
Soil Test K (Sept. 73)	60	160	130	535	
1974	40	170	85	360	
Avg. soil P 1974, 106					
% K Tissue					Avg. % P tissue
1st cut	.97	2.49	2.23	4.55	.55
2nd cut	1.08	2.01	1.84	2.33	.37
3rd cut	.86	1.85	1.54	2.39	.34
Non-irrigated (avg. pH 6.7)					
Yield T/A 1973	2.8a	4.4b	4.1b	4.5b	
1974	2.0a	2.9b	2.8b	3.1c	
Soil Test K (Sept. 73)	70	260	180	600+	
1974	65	255	210	600+	
Avg. soil P 1974, 136					
% K Tissue					
1st cut	1.21	2.76	3.28	4.14	.48
2nd cut	1.08	1.86	1.90	2.72	.29
3rd cut	.99	2.05	2.10	2.60	.29

[1/] Acknowledgment is made of the considerable effort put into these plots by Bob Schoper, Jerry Lensing and Glenn Titrud.

POTATO FERTILIZATION ON IRRIGATED LOAMY SANDS - ELK RIVER 1974

C. J. Overdahl and C. P. Klint[1/]

Fertilizer rates of 0, 150 and 500 pounds per acre of K_2O have been applied annually for potatoes since 1968. Also a rate of 50 pounds of magnesium on these various potassium rates have been compared to the same K treatments without magnesium.

Potato yields, soil test levels, and petiole analysis have been used to study the effect of these treatments. Soil test K was initially high (280 pounds exchangeable K). No yield response due to high broadcast potash applications have been observed. Significant responses were obtained from row treatments in 1972, 1973 and 1974.

There has been no significant effect of added magnesium at any time. It has been observed that high rates of potash considerably reduce petiole magnesium. No plant or soil analyses were made in 1974.

Chieftan was the variety used in 1973 and 1974. Norland was used for each of the years preceding 1973.

Tuber yields by years were as follows:

Potassium-magnesium effect	Yield, CWT/acre					
$N + P_2O_5 + K_2O + Mg$	1968	1969	1970	1972	1973	1974
200 + 150 + 0 + 0	158	270	267	210	340	226
200 + 150 + 150 + 0	170	288	268	320	461	344
200 + 150 + 500 + 0	189	286	287	339	493	372
200 + 150 + 0 + 50	195	286	237	207	311	243
200 + 150 + 150 + 50	199	327	294	334	479	362
200 + 150 + 500 + 50	183	305	263	284	446	389

1974 Magnesium Treatment Effect

Mg	Avg. Yield/CWT
0	323
75	331

No soil tests were made in 1971, 1972, and 1974, petiole samples were not taken in 1970 and 1974. Rye was grown on the plot in 1971 instead of potatoes.

[1/] Efforts of Bob Schoper, Jerry Lensing, Glenn Titrud and others are gratefully acknowledged.

UREA VS. AMMONIUM NITRATE TRIAL ON POTATOES
ELK RIVER SAND PLAIN EXPERIMENT STATION - 1974

Abelardo Castro-M., C. J. Overdahl, R. P. Schoper, J. M. MacGregor*

Field studies on the effect of two sources of fertilizer nitrogen on potato yield were started in 1974 at the Elk River experimental field.

Four rates of nitrogen (treatments): 0, 50, 100, 200 lbs. N/A were broadcast in the spring on Russet Burbank potatoes in the form of urea and ammonium nitrate (sub-treatments). A split plot design with 9 replicates was used. Total irrigation of 11.45 inches was provided to supplement rainfall.

The nitrogen level significantly increased the yield of potatoes at P = 0.01 (Table 1). Ammonium nitrate showed to be significantly better (P = 0.05) than the urea source of nitrogen (Table 1). The interaction between level x source of nitrogen was not significant at P = 0.05 (Table 1). The C.V. = 22.7% is considered high, and the potato yields are low. The potatoes showed bad pits from scab. The soil pH of 6.1, as shown in Table 2, allows considerable scab growth.

The significant difference (P = 0.05) between replicates could be explained as an effect of the wind break on the south side of the experimental field.

Although one year's data cannot be considered as conclusive, interesting questions are raised and would warrant further investigations as to the effectiveness of various nitrogen carriers.

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* Continuation of Dr. MacGregor's work.

Table 1. Effect of nitrogen level, nitrogen source, and level x nitrogen source on Russet Burbank potato yield - Elk River, 1974.

Treatments N - lbs/A	Yield CWT/A	Level of Significance Between Treatments
0	68 a	
50	98 a	**
100	139 b	
200	193 c	
Source of Nitrogen		
Ammonium nitrate	132 b	
Urea	117 a	*
Level x Source of Nitrogen		
0 x AN	69	
0 x Urea	67	
50 x AN	104	
50 x Urea	92	
100 x AN	151	NS
100 x Urea	127	
200 x AN	203	
200 x Urea	184	

Level of Significance Between Replicates *

C.V. % 22.7

Table 2. Soil test.

Texture	pH	O.M.	P_2O_5 (lbs/A)	K_2O (lbs/A)	NO_3-N (lbs/A per 2 ft.)
LS	6.1	M	200+	310	19

ASPHALT BARRIERS

CROP YIELDS 1974 1/

Blake, Schoper, Lensing

	No Asphalt	750 gal/A	950 gal/A	1500 gal/A
Elk River Experimental Field				
Field Corn, bu/A	36			30
Sweet Corn				
Ears/A marketable	13346			12935
lbs/A marketable	6477			6170
Ears/A total	22034			22506
lbs/A	9229			9150
Ave wt. marketable ears	0.49			0.48
Potatoes, cwt/A				
A	125			139
B	31			33
Total	156			172
Elk River Satellite Field				
Pinto beans, lbs/A	765a	1282b	1260b	1273b
Onions, lbs/A				
Jumbo >3" dia.	0	46.3	13.5	0
No 1 2-3"	1718	956	1296	1625
No 2 1-2"	3839	3950	3463	3730
Culls	281	251	316	288
Total	5837	5203	5089	5646
Marketable	5556	4952	4773	5356

1/ Plots were not irrigated in 1974.

FIFTEEN YEARS OF FIELD EXPERIMENTATION WITH NITROGEN SOURCE, PLACEMENT, AND TIME OF APPLICATION TO A WEBSTER LOAM NEAR LAMBERTON (1960-1974)

John MacGregor, Gary Malzer, Wallace Nelson and Robert Munter

(Annual reports of this experiment have been reported in Soil Series 74 through 91 - and some of this information will not be included here).

The fertilizer treatments have not been annually applied to the same plot areas for 15 years. After ear corn removal and stalk cutting, the fall plowdown N treatments are broadcast on their respective plots and the entire area is then plowed to an approximate 12 inch depth. The fall surface N treatments are then broadcast, with no further working of the plowed area. Each plot is 20' x 77.5' and the 4 treatment replications are arranged in a randomized block.

Spring N treatments are broadcast before seedbed preparation late in April or in early May. The corn is drilled in 30" rows to produce approximately 20,000 plants/A, using a banded starter fertilizer of 8-24-12 at the rate of 175 lbs. over the entire experimental area, thus supplying an additional 14 lbs. N/acre to all plots. Herbicides and insecticides are also annually applied. Nitrogen sidedressing treatments are broadcast in June. Nitrogen concentrations present in the sixth or "index" leaf at silking were determined and are reported in Table 1.

The 1974 growing season was characterized by a wet spring (total of 12 in. in April, May and June) followed by a very dry summer (total of 2.9 in. in July, August and September) and early frosts (September 3 and September 22) which seriously reduced the potential yield of the crop. Ear corn was harvested on Oct. 14 and the grain analyzed for N content. The 1974 grain yields, percentage dry matter at harvest, N in dry grain, and total N removed in the grain was calculated and these are shown in Table 1.

The yields in 1974 were considerably lower than those obtained in 1973 and were the lowest since 1966. Under the extreme weather conditions nitrogen applications of 94 and 174 lb/A resulted in surplus nitrogen when evaluated with crop removal and compared to the 14 or 54 lb/A treatments. The 174 lb/A rate did not increase yields and increased the percent N in the grain only slightly over what was observed in the 94 lbs N/A. The 174 lbs N/A should, therefore, be considered an excessive rate of N application (both economically and environmentally) for this location with the weather conditions experienced in 1974.

Fifteen Year Average

The average grain yields for the 15 years of this experiment are shown in Table 2. When only 40 lbs. of N/A was fall applied, surface application was slightly more effective than plow down with no differences between N sources. Plowing down 80 lbs. of N/A in the fall was much

more effective than the lower N rates and approached the yields that were obtained with the highest treatment of fall applied N. The results from spring surface applied N were equivalent to (fall surface) or better than (fall plow down) the same rate of N applied in the fall. Side dressing N produced grain yields similar to those of the same rates of spring applied N. The heaviest side dressing treatments were equally effective as the rates plowed down the previous fall.

General Conclusions

1. Urea is as effective as ammonium nitrate for the production of corn on these medium textured non-calcareous soils.

2. Late fall surface applied N is at least equal to that plowed down, but where N fertilization rates are relatively low, spring or side-dressing N treatments appear more effective.

3. Where corn is grown annually on these soils good yields can be maintained with annual applications of 100 lbs N/A providing adequate amounts of P and K are also supplied. At this rate of application most of the N will be removed in the grain leaving relatively small amounts to be lost to the environment.

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

N applied annually in lbs/A[1]	% N 6th leaf	Bu/A @ 15.5% Moisture I	II	III	IV	Ave.	% DM	% N in grain	lbs N/A re-moved	Annual fert. N (lbs/A)	Soil N status (lbs/A)
Check	1.83a	58.0	46.8	54.6	54.2	53.4a	84.3	1.15a	29.1	14	-15.1
40-NH_4NO_3-fpd[2]	2.28cde	77.9	79.5	75.5	89.1	80.5b	83.7	1.31cd	49.9	54	+ 4.1
40-urea-fpd	2.39defg	83.0	127.1	81.3	96.1	96.9bcdef	83.8	1.24abc	56.9	54	- 2.9
40-NH_4NO_3-fpd[3]	2.18bcd	71.3	92.5	96.5	92.8	88.3bcde	84.0	1.18ab	49.3	54	+ 4.7
40-urea-fps	2.27bcde	79.4	81.7	80.4	98.3	85.0bcd	83.2	1.29bcd	51.9	54	+ 2.1
80-NH_4NO_3-fpd	2.44efg	94.6	97.0	108.4	114.2	103.6cdef	83.8	1.44efg	70.6	94	+23.4
80-urea-fpd	2.53fgh	103.1	127.1	88.1	110.3	107.2def	84.2	1.41def	71.5	94	+22.5
160-NH_4NO_3-fpd	2.59gh	114.2	101.8	121.9	114.5	113.1f	83.7	1.54gh	82.4	174	+91.6
160-urea-fpd	2.68h	133.5	91.5	104.9	90.5	105.1cdef	84.0	1.64h	81.6	174	+92.4
40-NH_4NO_3-std[4]	2.27bcde	62.6	100.8	83.4	84.4	82.8bc	84.3	1.31cd	51.3	54	+ 2.7
40-urea-std	2.36def	92.3	106.2	93.8	85.8	94.5bcdef	84.7	1.30bcd	58.1	54	- 4.1
80-NH_4NO_3-std	2.57fgh	93.9	93.8	101.4	82.6	92.9bcdef	85.5	1.37def	60.2	94	+33.7
80-urea-std	2.46efgh	94.3	119.9	104.3	115.3	108.5ef	83.6	1.47fg	75.5	94	+18.5
40-NH_4NO_3-sd[5]	2.09bc	86.8	62.9	97.9	83.3	82.7bc	84.4	1.31cd	51.3	54	+ 2.7
40-urea-sd	2.07b	107.1	35.2	86.4	92.8	80.4b	84.3	1.30bcd	49.5	54	+ 4.5
80-NH_4NO_3-sd	2.17bcd	90.3	55.9	101.2	102.8	87.6bcde	84.2	1.41def	58.4	94	+35.6
80-urea-sd	2.37defg	105.8	99.7	86.5	90.2	95.6bcdef	84.4	1.32cde	59.7	94	+34.3
160-NH_4NO_3-sd	2.59gh	96.1	111.4	108.0	106.3	105.5def	84.0	1.46efg	72.9	174	+101.1
Significance	**					**		**			
C.V. (%)	7.0					16.1		6.6			
BLSD (0.05)	.22					22.4		.12			

[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 top dress

[5] sd -- side dress * Any letter(s) different from another letter in a column indicates a significant difference between the means at the 5% level.

Table 2. Yields of ear corn during 15 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
					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
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
40 Urea - fpd	55.1	78.2	29.1	148.8	100.3	38.8	19.8	86.9	132.5	124.5
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
40 Urea - fps	62.3	101.3	37.0	140.7	84.1	57.4	30.9	87.2	134.0	136.1
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
80 Urea - fpd	61.7	76.9	36.7	154.5	104.9	73.0	37.8	117.2	142.6	144.3
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
160 Urea - fpd	79.4	112.5	43.5	152.8	112.4	73.5	37.7	121.3	149.9	161.0
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
40 Urea - std	45.4	91.1	31.4	147.6	100.6	59.8	33.8	95.0	140.5	143.4
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
80 Urea - std	57.7	99.1	40.5	149.3	115.7	84.4	41.8	128.6	138.7	155.9
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
40 Urea - sd	57.7	95.6	24.9	142.3	94.1	48.4	50.4	86.1	132.2	143.3
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
80 Urea - sd	76.9	86.4	48.2	143.8	121.4	64.7	47.3	117.0	146.9	166.2
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
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

[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

Table 2 (continued). Yields of ear corn during 15 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]	1970	1971	1972	1973	1974	15 Year Average
			Ear corn yield in bushels per acre			
Check	85.7	40.8	75.6	69.2	53.4	65.8 a
40 NH_4NO_3-fpd[2]	96.3	88.7	113.6	92.0	80.5	83.1 b
40 Urea - fpd	120.4	100.7	113.9	101.5	96.9	89.8 cd
40 NH_4NO_3-fps[3]	122.5	81.5	109.9	93.0	88.3	87.8 bc
40 Urea - fps	121.2	82.4	106.7	97.8	85.0	90.9 cde
80 NH_4NO_3-fpd	134.7	108.0	143.1	121.7	103.6	104.9 gh
80 Urea - fpd	141.4	107.8	140.1	117.9	107.2	104.2 gh
160 NH_4NO_3-fpd	141.7	120.2	147.6	121.0	113.1	109.5 hi
160 Urea - fpd	140.4	110.6	151.7	114.9	105.1	111.1 i
40 NH_4NO_3-std[4]	125.6	84.0	117.0	104.0	82.8	95.1 def
40 Urea - std	118.9	94.6	116.5	97.1	94.5	94.0 def
80 NH_4NO_3-std	140.4	122.7	142.7	118.0	92.9	107.7 hi
80 Urea - std	146.2	116.0	142.1	117.6	108.5	109.5 hi
40 NH_4NO_3- sd[5]	127.1	104.5	136.0	99.1	82.7	96.7 ef
40 Urea - sd	117.7	100.5	133.9	103.9	80.4	94.1 def
80 NH_4NO_3- sd	127.7	97.6	124.7	109.4	87.6	99.2 fg
80 Urea - sd	140.5	124.4	149.8	124.0	95.6	110.2 hi
160 NH_4NO_3- sd	136.9	104.2	150.0	117.1	105.5	108.6 hi
Ave. annual corn yield in bu/A	127.0	99.4	128.6	106.6	92.4	97.9
Significance						**
C.V. (%)						9.2
BLSD (.05)						5.9

[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

* Any letter(s) different from another letter in a column indicates a significant difference between the means at the 5% level.

PLANT AND GRAIN YIELD AND NITROGEN CONTENT OF FERTILIZED CORN

(TILE DRAINAGE EXPERIMENT, SOUTHWEST EXPERIMENT STATION, LAMBERTON, MINN.)

A.C. Caldwell, W.W. Nelson, and L.L. Goodroad

Plot areas to examine water removed from controlled tile-drained soils were established on a Nicollet soil at the Southwest Experiment Station in 1972 and 1973.

The crop grown on the tiled plots was corn in 1973 and 1974. Hybrids of 110-day maturity were seeded in both years at 23-24,000 seeds per acre. Recommended weed and insect control practices were followed except for treatment 1, which received no chemicals at all (not even starter fertilizer). Treatments 2 through 6 got 100 lbs/A of 18-46-0 along the row. Additional inorganic fertilizer treatments consisted of nitrogen (N) as urea applied broadcast in the spring at rates of 100, 200, and 400 lbs. N/A. One organic source of N was used, i.e. soybean meal, which was applied in the spring at a rate sufficient to supply 200 lbs. N/A. Each treatment was replicated three times.

The total plant yield was obtained by sampling the corn when it had attained maximum growth and no loss of leaves. Grain yield was determined on matured corn. Grain and plant tissue were analyzed for N (except on 1973 grain).

Table 1 shows the yield of grain and total yield of plant and nitrogen in 1973. Use of additional inorganic N as urea increased grain yields progressively with rate, but not sufficiently to warrant the additional cost. It is of interest to note that the highest yield was obtained from soybean meal treatment. This was about 12 bu/A more than the 200-pound N rate in the form of urea. In assessing the reason or reasons for this increase in yield, it should be pointed out that this rate of application of soybean meal will add about 20 lbs. P/A and 60 lbs. K/A, plus other small amounts of essential nutrients.

Total plant yield was quite a bit greater from the higher rates of urea and from soybean meal, (Table 1), but this increase was not reflected in grain yields, which may indicate some factor other than N is affecting grain production. Total N in tissue on plots with row fertilizer only shows that this soil has considerable potential for supplying native soil N to crops.

In Table 2 are given total plant and grain yield and nitrogen content of corn in 1974. Yields were greatly affected by a shortage of water for the 1974 crop. The effects on yields are shown most dramatically by comparision of 1973 and 1974 figures for the 0 treatment plots. Weed competition, for moisture mostly, has reduced yields about 4 times. It is of interest also to note the relatively greater response to N in 1974 when a lack of water affected the supply of soil N for the plant.

Table 1. Yield of grain and yield of total plant plus nitrogen (1973).

Fertilizer treatments						
No.		in addition to starter N[3]-lbs/A	Grain yield bu/A	Total plant yield T/A	Nitrogen in tissue %	Nitrogen in tissue lbs/A
1	0[1]	-	66.7	4.50	0.81	72.9
2	Starter[2]	-	87.4	5.48	0.82	89.9
3	"	100	92.8	5.35	1.05	112.4
4	"	200	94.5	6.42	1.22	156.7
5	"	400	103.5	6.06	1.33	161.2
6	"	200	106.3	6.39	1.12	143.1

[1]These plots received no chemical additives.

[2]Starter - applied along the row at planting time. For formula see text.

[3]N - nitrogen applied as urea, except for treatment 6, which was soybean meal. For details see text.

Table 2. Total plant and grain yield and nitrogen content of corn (1974).

No.	Fertilizer treatments	in addition to starter [3]N-lbs/A	Total plant yield T/A	Nitrogen in tissue %	Nitrogen in tissue lbs/A	Grain yield bu/A	Nitrogen in grain %	Nitrogen in grain lbs/A
1	[1]0	-	1.69	0.73	22.9	15.2	1.45	10.5
2	[2]Starter	-	2.74	0.86	45.0	51.2	1.23	29.9
3	"	100	3.50	1.17	88.2	57.0	1.66	44.6
4	"	200	3.84	1.42	101.8	64.8	1.76	53.7
5	"	400	4.28	1.40	117.0	71.3	1.79	60.6
6	"	200	5.01	1.44	136.2	77.1	1.72	63.0

[1]These plots received no chemical additives.

[2]Starter - applied along the row at planting time. For formula see text.

[3]N - nitrogen applied as urea. except for treatment 6, which was soybean meal. For details see text.

NUTRIENT MOVEMENT PLOTS

SOUTHWEST EXPERIMENT STATION; LAMBERTON, MINNESOTA

R.G. Gast, W.W. Nelson and A.C. Caldwell

Tile drains from the 12 nutrient movement plots installed on the Southwest Experiment Station in 1973 and 1974 flowed during the period May 20 --- July 8, 1974. Total flow from the plots ranged from 2.1 to 4.7 acre inches with an average of 3.6 acre inches for all plots. Rainfall during this period was 7.2 inches, so equivalent to about 50 percent of the precipitation during this period ran through the tile lines. In comparison, 1.45 out of 5.94 inches of rainfall ran through the tile during the flow period April 12 - June 25, 1973.

The average (NO_3-N) concentration and total (NO_3-N) loss, in lbs/acre, are summarized in Table 1. The first fertilizer treatments were applied May 9, 1973, so little of this material was available for leaching during the 1973 tile flow period as evidenced by the relatively low nitrate concentrations and total NO_3-N losses. Both total flow and nitrate concentrations increased in 1974 resulting in some increase in NO_3-N losses with increasing nitrogen applications. However, the losses were not great at the recommended fertilization rates (100 lbs N/acre) and losses at the higher rates were much less than the additional fertilizer-N applied.

Corn yields in 1974 (Table 2) are not as high as might be expected which can be attributed largely to lack of rainfall after June 10, 1974.

Table 1. Average NO_3-N concentrations and loss from nutrient movement plots at the Southwest Experiment Station at Lamberton during 1973 and 1974.

Treatment	Ave. NO_3-N conc. (ppm) 1973	Ave. NO_3-N conc. (ppm) 1974	Ave. NO_3-N loss (lbs/A) 1973	Ave. NO_3-N loss (lbs/A) 1974
0 lbs. N/A	13	19	4.0	15.2
100 lbs. N/A	15	25	5.0	19.5
200 lbs. N/A	13	37	3.3	26.5
400 lbs. N/A	12	65	5.3	48.6

Table 2. Average corn yields on nutrient movement plots at the Southwest Experiment Station at Lamberton during 1973 and 1974.

Treatment*	Corn yield (bu/A) 1973	Corn yield (bu/A) 1974
0 lbs. N/A	87.4	49.2
100 lbs. N/A	92.9	57.0
200 lbs. N/A	94.5	64.8
400 lbs. N/A	103.5	71.3
200 lbs. organic N/A**	106.3	77.1
True check***	66.7	15.2

*100 lbs/A 18-46-0 as starter plus 100 lbs. P/A broadcast on all plots except true check.

**200 lbs. of N was applied as soybean meal (2233 lbs/acre).

***True check received no starter fertilizer, insecticide or herbicide.

WEST CENTRAL EXPERIMENT STATION - MORRIS

WEATHER SUMMARY - 1974

		Precipitation			Air Temperature			Soil (10 cm) Temperature	
Month	Period	1974	88-yr. av.	Dev. from av.	1974	88-yr. av.	Dev. from av.	1974	7-yr. av.
January	1-31	.02	.65	- .63	4.1	8.4	-4.3	19.5	23.5
February	1-28	.68	.66	+ .02	12.0	12.7	-0.7	23.9	25.3
March	1-31	.49	1.05	- .56	23.8	26.8	-3.0	26.9	29.8
April	1-10	.41	.58	- .17	35.1	38.2	-3.1	31.3	
	11-20	.48	.65	- .17	43.9	44.3	-0.4	38.2	
	21-30	.48	1.11	- .63	51.1	48.2	+2.9	44.9	
Total or av.		1.37	2.34	- .97	43.4	43.6	-0.2	38.1	40.9
May	1-10	.57	.79	- .22	47.2	52.1	-4.9	44.6	
	11-20	1.37	.98	+ .39	49.1	55.6	-6.5	46.6	
	21-31	.65	1.24	- .59	57.7	59.9	-2.2	56.4	
Total or av.		2.59	3.01	- .42	51.5	56.0	-4.5	49.4	55.1
June	1-10	2.27	1.30	+ .97	63.9	63.1	+0.8	63.8	
	11-20	.08	1.21	-1.13	60.9	66.6	-5.7	65.0	
	21-30	.05	1.38	-1.33	69.4	68.2	+1.2	76.0	
Total or av.		2.40	3.89	-1.49	64.7	66.0	-1.3	68.2	69.9
July	1-10	.92	1.52	- .60	75.2	69.9	+5.3	78.5	
	11-20	1.04	1.07	- .03	75.2	71.3	+3.9	80.9	
	21-31	1.92	1.02	+ .90	69.9	71.6	-1.7	77.7	
Total or av.		3.88	3.61	+ .27	73.3	70.9	+2.4	79.0	75.6
August	1-10	2.20	1.07	+1.13	65.0	70.5	-5.5	70.2	
	11-20	1.96	.88	+1.08	67.2	69.3	-2.1	70.6	
	21-31	.63	.98	- .35	61.4	66.9	-5.5	69.2	
Total or av.		4.79	2.93	+1.86	64.4	68.8	-4.4	69.7	74.0
September	1-30	.72	2.24	-1.52	53.9	59.2	-5.3	58.9	61.5
October	1-31	.68	1.62	- .94	47.1	47.5	-0.4	48.0	48.3
November	1-30	1.17	.93	+ .24	31.5	29.9	+1.6	34.6	34.3
December	1-31	.20	.69	- .49	21.3	15.6	+5.7	24.6	26.3
April-August Growing Season		15.03	15.78	- .75	59.5	61.1	-1.6	58.8	62.7
January-December Annual		18.99	23.62	-4.63	41.1	42.1	-1.0	45.2	44.4

CONTINUOUS CORN SILAGE

Samuel D. Evans
West Central Experiment Station, Morris

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 1974 the variety used was Pioneer 3932. Furadan was applied at 1 lb./acre (active ingredient) at planting on May 18. Lasso at 2 lbs./acre and Bladex at 2 lbs./acre were applied broadcast on May 18. Silage yields were taken on September 19 and grain yields on October 4.

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

A. On plots harvested as grain 1965-74:

	1974 Yield	1966-74 Yield
Low fertility (74 + 48 + 48)	5.43	5.40
High fertility (148 + 96 + 96)	6.05	5.85

B. On plots harvested as silage 1965-74:

Low fertility (74 + 48 + 48)	5.55	5.50
High fertility (148 + 96 + 96)	5.96	5.91

IV. Grain yields - Bushels/acre @ 15.5% moisture.

A. On plots harvested as grain 1965-74:

	1974	1966-74
Low fertility (74 + 48 + 48)	94.43	89.44
High fertility (148 + 96 + 96)	85.22	94.88

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

	1974	1966-74 Average
Grain (0 + 0 + 0)	38.62 Bu/A	54.80 Bu/A
Silage (0 + 0 + 0)	3.32 tons/A	3.95 tons/A

VI. DISCUSSION

A. In 1974 silage yields were increased by fertilization on areas that had been harvested for grain and for silage for 9 years. There was no significant reduction in yield due to growing continuous corn silage. Grain yields were not increased with additional fertilizer. Yields on the check plots were substantially lower than on fertilized plots.

B. The 9-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, G. Holcomb, and C. Overdahl

I. Experimental 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 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 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 1974 individual treatments are described in Table 1. Ten pounds per acre of zinc as zinc sulfate was broadcast over the entire area in the fall of 1971.

II. 1974 Operations

The broadcast fertilizer treatments were applied on May 28. The experiment was planted on May 29. The hybrid used was Pioneer 3956A. The corn was planted at 28,000 seeds per acre and hand thinned to 21,000 plants per acre. Lasso at 2 lbs./acre and Bladex at 2 lbs./acre were applied to the appropriate plots on May 29. There was a frost of 28° on September 3. The plots were harvested on October 4.

III. Plant Measurements

A. Broadcast P Effects

The broadcast P significantly affected all plant measurements. Pollen shedding and silking dates were advanced about 2.4 and 1.4 days, respectively. Total ears per acre at harvest were slightly lower where P was broadcast. Ear moisture at harvest was 4.4% lower on the broadcast treatments. Yield was 7.2 bu./acre higher where broadcast P was used.

B. Individual row treatments

1. Pollen shed and silking - Dates of these events occurred earliest on treatments 2, 3, 6, 8, 9, and 10. These were the treatments where at least some N was applied and weeds and insects were controlled.

2. Total ears per acre at harvest - There were wide differences in ears per acre with a low of 9,919 and a high of 20,520 ears per acre.

3. Ear moisture at harvest - There were significant differences with only treatments 7 and 8 drier than the conventional treatment.

4. Yield - The highest yielding treatments were Nachurs, conventional, conventional liquid, and high rate of conventional fertilizer. The lowest yielding were Wonderlife and Shurgro without pesticides.

C. Interaction between broadcast and row treatments

There were highly significant interactions with the following measurements:

Pollen shed date
Silking date
Total ears per acre at harvest
Yield

Individual treatment values for some of the plant measurements are given in Table 4.

Table 1. 1974 Treatment Descriptions.[1]

Treatment	Description
1	Check (0 + 0 + 0 total applied).
2	Nachurs Liquid: With seed: Nachurs liquid 9-18-9 @ 4 gal./acre + 1/2 pt. Mn/acre + 1/2 pt. Zn/acre. Broadcast: 95 lbs./acre N as 34-0-0 65 lbs./acre K_2O as 0-0-60 (99 + 8 + 64 total applied)
3	Same as 2 but no seed treatment (95 + 0 + 60 total applied)
4	Wonderlife (soil conditioner): 150 lbs./acre with the planter (0 + 0 + 0 total applied)
5	Shurgro (organic fertilizer, 6-2-1): 200 lbs./acre with the planter (12 + 4 + 2 total applied)
6	Conventional fertilizer: Broadcast: 80 lbs./acre N as 34-0-0 With planter: 121 lbs./acre 8-33-17 (90 + 40 + 21 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 insecticides and herbicides (12 + 4 + 2 total applied)
9	Conventional liquid 7-21-7: With seed: Liquid 7-21-7 @ 4 gal./acre Broadcast: 95 lbs./acre N as 34-0-0 65 lbs./acre K_2O as 0-0-60 (98 + 9 + 63 total applied)
10	High rate of conventional fertilizer: Same as treatment 6 except an additional 100 lbs./acre N and 100 lbs./acre K_2O broadcast before planting (190 + 40 + 121 total applied)

[1] All treatments were treated with Furadan @ 1 lb./acre and Lasso @ 2 lbs./acre + Bladex @ 2 lbs./acre except 4 and 5.

Table 2. Effect of Broadcast Phosphorus on Plant Measurements.

	No Broadcast	P Broadcast	Significance[1]
Date 50% plants shedding pollen	8-1.4	7-30.0	**
Date 50% plants silked	8-5.4	8-4.0	**
Total ears/acre at harvest	18,001	17,277	+
Ear moisture at harvest, %	35.4	31.0	+
Yield in bu./acre @ 15.5% moisture	38.6	45.8	**

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

Table 3. Effect of Fertilizer Materials on Plant Measurements.

Treatment	Date 50% plants shedding pollen	Date 50% plants silked	Total ears/acre at harvest	Ear moisture at harvest %	Yield in bu./acre @ 15.5% moisture
1	8-1.5	8-5.8	17,791	31.9	25.5
2	7-29.4	8-2.9	20,258	33.3	62.0
3	7-30.6	8-4.0	20,520	36.6	53.2
4	8-3.4	8-8.5	9,919	38.5	9.2
5	8-2.5	8-7.5	12,281	34.7	14.0
6	7-28.6	8-2.4	20,206	31.0	66.2
7	8-1.5	8-5.9	16,322	30.5	25.8
8	7-30.4	8-4.1	18,789	27.1	39.2
9	7-29.8	8-3.1	20,206	32.7	61.2
10	7-29.9	8-3.1	20,101	35.4	65.8
Significance:	**	**	**	**	**
BLSD[1] .10	1.3	1.7	2,537	6.4	7.1
.05	1.5	2.1	2,961	7.6	8.6
.01	2.0	2.7	3,926	10.5	11.4
Significance of Interaction	**	**	**	NS	**

[1] Bayes LSD

Table 4. Plant Measurements with and without Broadcast Phosphorus.

Treatment	Total Ears/acre @ Harvest		Ear Moisture @ Harvest, %		Yield in Bu./acre @ 15.5% Moisture	
	-P	+P	-P	+P	-P	+P
1	18,369	17,214	35.6	28.2	24.0	27.0
2	20,468	20,048	35.6	31.1	52.5	71.4
3	19,628	21,413	40.0	33.4	38.8	67.7
4	11,861	7,977	43.2	33.8	10.8	7.4
5	13,120	11,441	38.7	30.6	13.4	14.6
6	19,733	20,678	31.2	30.9	62.5	69.9
7	17,424	15,220	32.9	28.0	27.1	24.4
8	18,998	18,579	29.5	24.6	36.8	41.6
9	19,838	20,573	33.5	31.8	54.4	68.0
10	20,573	19,628	33.7	37.1	65.8	65.9

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, P. R. Goodrich, R. C. Munter, and R. E. Smith

The experiment initiated in 1970 was continued. Treatments and results in previous years are given Soil Series 88, 89, and 91. Manure was applied in 1970 and 1971 only. Fertilizer has been applied to the fertilized checks each year.

I. PLANTING INFORMATION

The plots were planted to Pioneer 3956A on May 8, 1974. Furadan at 10 lbs./acre (1 lb./acre active ingredient) was applied to the east 16 rows of each plot and the west 8 rows were left untreated. Starter fertilizer was used only on the fertilized treatment. Lasso was applied broadcast @ 2½ lbs./acre on May 8.

II. SOIL SAMPLING AND ANALYSIS

A. 1973 Measurements

The soils in each plot were sampled to a depth of 12 feet in the fall of 1973. The results are given in Tables 1 and 2.

1. NH_4-N - All levels are quite low except the top foot of the liquid beef plots.

2. NO_2-N - All levels less than .50 ppm.

3. NO_3-N - All treatments higher than the check. The fertilized plots were higher only in the top 3 feet. In all manure treatments NO_3-N has moved down to at least the 8-foot depth and there were slight increases to the 12-foot depth.

4. Chloride - All treatments are higher than the check. The fertilized treatment was higher in Chloride in the top 3 feet. All manure treatments were higher in Chloride to the 12-foot depth.

5. Conductivity - The fertilized treatment was higher than the check in the top 3 feet. The manure treatments were higher than the check down to the 8-foot level.

B. 1974 Measurements

The soils were sampled to a depth of 4 feet in the fall of 1974 but the results are not yet available.

III. GROUND WATER SAMPLING

Samples have been taken from two wells located near the plot areas. These wells are approximately 20 feet deep. The wells are emptied on one day and a sample is taken of the water on the next day. The west well is located on a corner of a plot that received fertilizer. The east well is located 30 feet outside a plot that received liquid beef manure. The results are given in Tables 3 and 4. The results indicate that there is no movement of large amounts of nitrogen or chloride into the shallow water table.

IV. CORN GRAIN YIELD

The yields on the plots in 1974 are given in Table 5. The effect of the main plot treatments and split plot treatments were significant at the 1% level. The interaction effect was not significant. After 4 years the manure treated plots are slightly higher yielding than the fertilized plots both with and without insecticide.

V. SUMMARY

Based on the results obtained so far, it appears that the application of very high rates of solid beef, liquid beef, and liquid hog manure for two consecutive years did not adversely affect yield. There were some detrimental effects of salts in the manures on plant growth in the years manure was applied. Movement of nitrates below the rooting zone of corn has been the biggest problem with the manure application. In the fall of 1973, one year after the second manure application, significant increases in soil NO_3-N levels were found to a depth of 12 feet.

Table 1. Effect of High Rates of Manure and Commercial Fertilizer Three Years (Fall 1973) after Application on the NH_4-N, NO_2-N and NO_3-N Content of a Tara-Doland Soil Profile.

		TREATMENT				
Depth	Initial[1]	CK	FE	SB	LB	LH
			NH_4-N (ppm)			
0-1'	4.6	4.1	4.9	4.0	7.3	3.7
1-2'	3.2	2.3	2.1	4.4	3.8	4.3
2-3'	- -	1.5	3.5	1.6	2.9	3.0
3-4'	2.4	1.8	1.4	1.1	0.9	1.9
4-5'	- -	2.0	2.3	2.6	1.9	2.2
5-6'	- -	2.2	1.9	2.5	1.5	2.1
6-7'	- -	2.5	2.5	2.4	1.6	1.7
7-8'	- -	2.4	2.7	2.4	1.9	2.3
8-9'	- -	2.9	3.8	2.0	1.9	1.9
9-10'	3.7	2.8	4.6	1.8	2.0	1.9
10-11'	- -	2.7	3.3	3.1	2.1	1.8
11-12'	- -	3.0	3.3	2.9	2.4	2.6
			NO_2-N (ppm)			
0-1'	1.3	.42	.32	.35	.27	.22
1-2'	0.5	.27	.35	.25	.28	.27
2-3'	0.4	.17	.29	.19	.19	.20
3-4'	0.4	.29	.11	.08	.10	.10
4-5'	0.3	.11	.12	.12	.09	.10
5-6'	0.3	.09	.12	.12	.06	.05
6-7'	0.3	.13	.13	.12	.07	.08
7-8'	0.3	.14	.15	.12	.12	.12
8-9'	0.3	.15	.23	.10	.13	.17
9-10'	0.3	.17	.28	.12	.13	.13
10-11'	- -	.15	.20	.18	.17	.12
11-12'	- -	.16	.22	.20	.15	.17
			NO_3-N (ppm)			
0-1'	15.2	5.7	12.2	67.2	91.8	25.3
1-2'	13.9	2.1	22.9	122.6	164.0	82.5
2-3'	12.5	4.4	26.5	88.4	110.3	74.1
3-4'	6.2	7.5	7.9	38.6	90.4	44.4
4-5'	4.2	8.6	6.2	39.2	83.6	34.9
5-6'	3.5	7.7	4.6	26.7	68.6	25.0
6-7'	3.6	7.1	4.2	19.9	46.6	25.4
7-8'	3.6	4.6	3.7	13.4	36.4	13.7
8-9'	3.4	3.7	3.7	7.7	20.8	9.0
9-10'	3.0	3.3	3.0	7.0	17.4	6.9
10-11'	- -	2.9	4.1	5.5	11.8	6.2
11-12'	- -	2.8	2.2	4.7	8.3	4.7

[1] Samples taken in the fall of 1970 before manure application; 0-6" and 6-12" samples were analyzed separately and averaged for initial analyses values.

Table 2. Effect of High Rates of Manure and Commercial Fertilizer Three Years (Fall 1973) after Application on the Chloride Content and Conductivity of a Tara-Doland Soil Profile.

		TREATMENT				
Depth	Initial[1]	CK	FE	SB	LB	LH
			Cl (ppm)			
0-1'	10.3	3.5	11.7	32.5	50.4	13.9
1-2'	8.9	4.9	25.7	158.4	166.9	50.2
2-3'	14.4	7.2	19.1	201.0	131.0	53.7
3-4'	12.8	8.9	10.4	117.8	80.2	32.0
4-5'	10.9	8.0	9.9	127.6	81.4	27.4
5-6'	8.1	7.0	6.5	91.8	77.5	23.5
6-7'	6.1	7.3	4.1	62.8	60.4	25.5
7-8'	5.6	5.1	3.0	42.3	44.6	12.2
8-9'	4.5	4.3	2.4	20.9	26.9	9.6
9-10'	4.1	3.7	3.5	19.4	22.2	7.1
10-11'	- -	3.1	6.6	14.9	15.2	9.0
11-12'	- -	3.2	3.4	12.3	12.6	6.1
			Conductivity (mmhos/cm)[2]			
0-1'	.175	.188	.217	.511	.598	.277
1-2'	.177	.194	.323	.785	.960	.513
2-3'	.191	.202	.312	.671	.677	.478
3-4'	.178	.208	.200	.403	.501	.323
4-5'	.156	.210	.308	.433	.507	.290
5-6'	.154	.204	.192	.353	.439	.254
6-7'	.150	.203	.187	.300	.354	.254
7-8'	.153	.194	.191	.259	.308	.203
8-9'	.155	.195	.203	.204	.239	.190
9-10'	.151	.222	.204	.208	.221	.177
10-11'	- -	.204	.211	.198	.213	.176
11-12'	- -	.220	.211	.223	.214	.183

[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 3. Analyses of Deep Well Water, 1972-73-74.

Date	NH_4-N ppm	NO_3-N ppm	NO_2-N ppm	PO_4-P ppm	Elec. Cond. umhos/cm
		- WEST WELL -			
8-31-72	0.5	18.0	0.0	0	645
1-26-73	0.32	3.9	0.068	< .001	530
2-27-73	0.34	5.4	0.075	0.005	592
3-30-73	0.69	16.7	0.405	0.001	540
6-7-73	0.76	13.5	0.070	0.015	292
7-5-73	1.25	9.4	0.344	0.004	618
8-1-73	0.84	6.7	0.214	0.004	635
8-31-73	0.54	7.5	0.288	0.008	710
9-28-73	0.46	6.2	0.258	0.001	754
10-31-73	0.22	7.7	0.210	0.001	698
11-30-73	0.24	5.7	0.187	0.002	680
12-28-73	0.22	6.5	0.176	0.002	745
1-31-74	0.10	5.3	0.098	0.001	620
2-28-74	0.14	4.3	0.044	0.005	680
		- EAST WELL -			
8-31-72	0.4	5.2	0.1	0	500
1-26-73	0.16	5.7	0.090	0.001	460
2-27-73	0.48	6.3	0.285	0.001	470
3-30-73	0.48	11.3	0.120	0.002	438
6-7-73	0.89	12.3	0.128	0.004	482
7-5-73	1.00	9.2	0.315	0.002	560
8-1-73	0.79	6.6	0.130	0.010	415
8-31-73	0.71	12.6	0.160	0.003	650
9-28-73	0.82	12.2	0.173	0.002	686
10-31-73	0.36	13.8	0.118	0.002	742
11-30-73	0.51	9.9	0.217	0.006	599
12-28-73	0.31	9.9	0.086	0.001	580
1-31-74	0.04	10.2	0.016	0.001	626
2-28-74	0.01	9.9	0.006	<0.001	667

Table 4. Analyses of Deep Well Water, 1974.

Date	NH_4-N ppm	$(NO_3 + NO_2)$-N ppm	Chloride ppm	PO_4-P ppm	Elec. Cond. umhos/cm
		- WEST WELL -			
3-29-74		4.14	10.1		
4-30-74		3.45	11.0		
5-31-74		9.76	11.0		
6-28-74	.028	4.92	5.8	<.001	574
7-31-74	.125	7.06	12.2	.001	
8-30-74	.295	5.34	11.6	.004	
9-30-74	.238	4.66	11.8	.002	680
		- EAST WELL -			
3-29-74		8.96	9.6		
4-30-74		6.38	7.1		
5-31-74		8.88	10.0		
6-28-74	.011	7.32	8.4	<.001	644
7-31-74	.034	9.82	10.8	.004	
8-30-74	.108	9.05	10.2	.006	
9-30-74	.016	8.19	9.0	.002	620

Table 5. Corn Grain Yield, 1974.

Main Plot Treatment	With Insecticide	Without Insecticide
	- Bu./Acre -	
CK	49.9	49.3
FE	93.3	76.8
SB	97.2	87.2
LB	99.6	90.3
LH	96.2	93.0

Treatments		Significance
Main plot	-	**
Insecticide	-	**
Interaction	-	NS

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

West Central Experiment Station - Morris

S. D. Evans

The experiment which was initiated in 1971 was continued. Treatment descriptions and results in previous years are given in Soil Series 89 and 91.

I. PLANTING INFORMATION

The plots were planted to Pioneer 3956A on May 8, 1974. Furadan was applied at 10 lbs./acre (1 lb./acre active ingredient) to one half of each main plot and the other half was left untreated. Starter fertilizer was used only on the fertilized treatment. Lasso was applied at 2½ lbs./acre on May 8.

II. TISSUE ANALYSIS

A. Early plants - Analysis of plant samples taken in mid-June showed significant treatment effects on the content of P, K, Fe, Zn, Cu, and Mn (Table 1). The effect was significant at the 5% level only with K, Fe and Mn. With K, the plant content increased with increasing amounts of manure. With Fe and Mn, the effect is not clear because the highest content is with 66 2/3 T/acre and the lowest is with 100 T/acre.

B. Leaf samples at silking - Analysis of these samples (Table 2) showed a slight decrease in percent Mg with increasing amounts of manure. The Mn content was significantly affected by treatments, but the effect was not clear.

C. 1973 grain samples - At final harvest grain samples were saved from all plots. The results are given in Table 3.

1. Phosphorus - All manure rates increased the phosphorus level in the grain.

2. Potassium - All manure rates increased the potassium level in the grain.

3. Magnesium - All manure rates increased the magnesium level in the grain.

4. Zinc - The fertilized and 100 T/acre manure rate grains were higher in zinc than the two lowest manure rates.

5. There was no effect of the insecticide on any element. The interaction between main plot and sub-plot treatment was not significant in any case.

III. CORN GRAIN YIELDS

Yields were significantly affected by main plot treatments as shown in Table 4. Grain yields on the 33 1/3 T rate plots are significantly lower than on the fertilized plots. The yields on the fertilized plots are lower than on plots which received 66 2/3 or 100 tons of manure per acre. There was no significant effect of insecticide.

IV. SUMMARY

Solid beef manure was applied at 33 1/3, 66 2/3, and 100 T/acre in the fall of 1972 (part of the 100 T/acre rate was applied in the spring of 1973). Manure has not been applied in subsequent years. Measurements on the manure treated plots are compared to those on fertilized plots.

Yields in 1973 were not significantly affected by treatment. In 1974 33 1/3 T/acre rate does not seem adequate to maintain top yields.

Table 1. Summary of Analysis of Early Plant Samples - 1974.[1]

Treatment	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%				ppm				
Fertilized	.42	3.68	.63	.47	330	49.7	6.8	91	8.1
Solid Beef @ 33 1/3 T/A	.41	3.97	.56	.45	333	24.6	9.4	95	8.4
Solid Beef @ 66 2/3 T/A	.46	4.56	.57	.42	353	24.7	7.2	101	8.0
Solid Beef @ 100 T/A	.43	4.62	.52	.37	302	23.2	6.2	81	7.8
Level of significance[2]	+	*	NS	NS	*	+	+	*	NS

[1] Two reps only.

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

Table 2. Summary of Analysis of Corn Leaves at Silking - 1974.[1]

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
Fertilized	3.38	.34	1.90	.86	.74	221	30.8	14.6	119	7.4
Solid Beef @ 33 1/3 T/A	3.27	.36	2.39	.74	.62	225	21.8	14.0	106	7.8
Solid Beef @ 66 2/3 T/A	2.75	.39	2.60	.90	.59	236	21.6	16.1	161	8.1
Solid Beef @ 100 T/A	3.34	.36	2.35	.79	.48	216	23.4	13.8	129	6.8
Level of significance[2]	NS	NS	NS	NS	+	NS	NS	NS	*	NS

[1] Two reps only.

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

Table 3. Chemical Analysis of Grain Samples Collected at Final Harvest on September 20, 1973.

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
Fertilized	1.54	.299	.33		.136	27	23.4			2.4
Solid Beef @ 33 1/3 T/A	1.54	.394	.39	Less than	.152	26	20.9	Incomplete data; most values below 0.5 ppm Cu and 5.0 ppm Mn		2.4
Solid Beef @ 66 2/3 T/A	1.63	.371	.37	.01%	.143	25	20.2			2.0
Solid Beef @ 100 T/A	1.65	.406	.40		.160	26	23.1			2.3
Level of Signif.[1]	NS	*	**	--	*	NS	**	--	--	NS
BLSD[2] .10	--	.064	.021	--	.011	--	1.3	--	--	--
.05	--	.079	.025	--	.014	--	1.6	--	--	--
.01	--	--	.038	--	--	--	2.5	--	--	--
+ Insecticide	1.59	.369	.37	--	.149	26	22.0	--	--	2.2
- Insecticide	1.60	.366	.37	--	.147	26	21.8	--	--	2.3
Level of Signif.	NS	NS	NS	--	NS	NS	NS	--	--	NS
Interaction - Level of Significance	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. Corn Grain Yields for 1974.[1]

Main Plot Treatment[2]	With Insecticide	Without Insecticide	Average
		- Bu/Acre -	
Fertilized	85.4	91.3	88.4
Solid Beef @ 33 1/3 T/A	81.8	81.8	81.8
Solid Beef @ 66 2/3 T/A	97.2	89.4	93.3
Solid Beef @ 100 T/A	98.1	97.1	97.6
Average	90.6	89.9	

Treatment	Significance[3]
Main plots	*
Insecticide	NS
Interaction	NS

[1] Two reps only.

[2] The manure treatments were applied only once.

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

MANURE RATE STUDY

West Central Experiment Station - Morris

S. D. Evans, P. R. Goodrich, R. C. Munter, and R. E. Smith

Solid and liquid beef manures were applied and the effects were compared against check plots. The experimental outline is given in Soil Series 91.

I. MANURE APPLICATION AND ANALYSIS

Manure was applied for the second time in the fall of 1973. Samples were taken at the time of application and were analyzed by the Animal Waste Laboratory in the Department of Agricultural Engineering. The amounts applied are given in Table 1. The chemical analysis of the manure is given in Table 2. Using these figures, the amount of each nutrient applied to each manure treatment was calculated and is given in Table 3.

II. PLANTING INFORMATION

The plots were planted to Pioneer 3956A on May 8, 1974. Furadan was applied at 10 lbs./acre (1 lb./acre active ingredient) to one-half of each main plot and the other half was left untreated. Starter fertilizer (consisting of 154 lbs./acre of 8-33-17) was used only on the fertilized treatment. Nitrogen had been applied to the fertilized treatment in the fall prior to plowing at a rate to give 110 lbs. N/acre. Lasso was applied broadcast at 2½ lbs./acre on May 8.

III. SOIL SAMPLING AND ANALYSIS

A. 1973 Measurements

The results of the analysis of the soil samples collected to an 8-foot depth are given in Tables 4 and 5.

1. NH_4-Nitrogen - There was no treatment effect on the soil level of ammonium nitrogen.

2. NO_2-Nitrogen - There was no treatment effect on the soil level of nitrite nitrogen.

3. NO3-Nitrogen - The fertilizer treatment was no higher than the check. Solid beef and liquid beef at levels 2 and 3 were higher in nitrate-nitrogen down to the 2-foot depth.

4. Chloride - The fertilizer treatment was no higher than the check. Solid beef was higher than the check at all levels down to 3 feet. Liquid beef was higher than the check at level 3 down to the 2-foot depth.

5. Conductivity - The conductivity was not greatly changed by any treatment. Solid beef at all levels and liquid beef at levels 2 and 3 brought about slight increases in conductivity.

B. 1974 Measurements

The results of the analysis of the soil samples collected to a 10-foot depth are given in Tables 6 and 7.

1. $(NO_3 + NO_2)$-N - The fertilizer treatment was higher than the the check in the upper 3 feet only. SB1 and LB1 levels were similar to those for the fertilized treatment. The higher levels of manure brought about increased levels of nitrate + nitrite nitrogen in the top 3 feet. In SB3 there appears to be some movement down to the 6-foot level.

2. Chloride - The manure treatments increased the chloride in the top 2 feet of soil, except with level SB3 where there was an increase down to the 6-foot depth.

3. Conductivity - The increases in soil conductivity were confined to the top 3 feet.

4. pH - There is an indication of a reduction in pH with SB2, SB3, and LB3.

5. Bray #1 P - All increases were confined to the top one foot of the profile. The solid beef manure brought about larger changes than the liquid beef manure. There may be some effect of pH on the measurement of phosphorus by this method.

6. Exchangeable Na - Both manures increased the Na level and the levels increased with the higher manure applications.

7. Exhangeable K - The K level was increased by all manure levels except LB1. The increases were confined to the top foot of the soil profile.

IV. PLANT SAMPLING AND ANALYSIS

A. 1973 Fodder, Grain and Root Samples

Fodder and root samples were collected from the insecticide treated portion of each main plot at the silage stage and analyzed. Grain was analyzed from all plots at final harvest.

1. Fodder and Root Analyses (Table 8).

   a. Nitrogen - All manure rates increased the nitrogen in the root samples only.

   b. Phosphorus - All manure rates increased the phosphorus in the fodder only.

c. Potassium - All manure rates increased the potassium in both the fodder and roots.

d. Calcium - Some significant effects in the roots only.

e. Magnesium - In the fodder manure decreased the magnesium, while LB caused some increase in the roots.

f. Zinc - All manure rates were lower than FE.

2. Grain Analyses (Table 9).

a. Nitrogen - Level increased as both manure rates increased.

b. Phosphorus - In general the amount of phosphorus in the grain increased with increasing manure rates.

c. Zinc - Most manure rates were significantly lower than FE and CK was lower than FE.

d. There were significant decreases in both zinc and boron due to insecticide.

B. 1974 Early Plants (Table 10)- The early plant samples from the liquid beef manure treated plots were lower in K and higher in Ca and Mg than the fertilized plots.

C. 1974 Leaf Samples at Silking (Table 11) - The highest levels of both solid and liquid manures caused a slightly higher leaf content of nitrogen as compared to the fertilized treatment. Both manures in general increased P and K levels and decreased Ca, Mg, and Zn levels. The level of iron was quite variable.

V. YIELD AND PLANT MEASUREMENTS

In 1974 many measurements were made during the growing season. At the silage stage 10 plants were selected at random in the insecticide treated portion of each plot. Silage yields were based on these plants and the average plant population in June for the entire experiment. Lodging and other plant measurements were made just prior to ear corn harvest. The results of these measurements are given in Tables 12 and 13.

A. Main Plot Effects

1. Early plant height - All manure levels increased the plant height.

2. Early plant dry weight - The liquid beef manure treated plots were slightly lower in weight than the fertilized plots.

3. Root lodging - All manure treatments decreased lodging except LB2.

4. Stalks broken above the ear - Solid beef manure resulted in slightly higher upper stalk breakage.