V. SOIL WATER SAMPLING AND ANALYSIS

Only a limited number of samples were obtained in 1973 due to the dry soil conditions during the growing season. On June 7 samples were obtained from only 9 of 36 wells. On August 2 samples were obtained from only 7 of 36 wells.

VI. PLANT SAMPLING AND ANALYSIS

Leaf samples were taken at silking and fodder, grain and root samples were taken at silage stage. All samples were thoroughly dried before submitting for chemical analysis.

A. 1973 Corn Leaf Analysis - Leaves were collected from only the insecticide treated portion of each plot in 1973, because in past years there had been very little effect of the insecticide on leaf analysis values. In Table 7 the results are summarized. The values listed after CK are averages of the two sets of check plots even though the data were analyzed with 6 treatments. The manure treatments significantly increased P, K, Mn, and B in the leaves as compared to levels in the leaves from the fertilized plots. Levels of Mg and Zn were reduced by the manure treatments.

B. 1972 Fodder, Grain, and Root Samples - The analysis of these samples for 1972 is given in Table 8.

1. Nitrogen - Manure treatments higher than FE and CK.
2. Phosphorus - Manure treatments higher than FE and CK.
3. Potassium - Manure treatments higher than FE and CK in the fodder and roots only.
4. Calcium - No effect of the manure.
5. Magnesium - Manure treatments lower than FE and CK in fodder and higher than CK in roots.
6. Iron - Manure treatments and FE higher than CK in grain only.
7. Zinc - Liquid beef manure higher than all other treatments in the fodder only.
8. Copper - No effect.
9. Manganese - Liquid beef manure higher than all other treatments in grain and roots.
10. Boron - No effect.

C. 1973 Fodder, Grain, and Root Samples - Statistical analysis not completed.

Table 7. Summary of Analysis of Corn Leaves at Silking - 1973.

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
CK	2.12	.228	1.853	.639	.540	130	14.7	8.1	66	3.0
FE	2.92	.258	1.810	.666	.494	109	25.3	9.0	83	5.5
SB	2.75	.332	2.440	.622	.321	119	13.8	7.5	123	7.1
LB	2.95	.381	2.640	.678	.306	119	14.6	7.3	174	10.3
LH	2.87	.307	2.547	.696	.307	112	21.8	7.1	105	8.1
Level of signif.[1]	**	**	**	NS	*	+	*	NS	**	**
BLSD[2] .10	.27	.059	.301	--	.119	18	6.7	--	25	1.5
.05	.32	.071	.360	--	.141	--	8.1	--	29	1.8
.01	.45	.101	.507	--	--	--	--	--	41	2.5

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

[2] Bayes LSD.

Table 8. Chemical Analysis of Plant Samples Collected on September 28, 1972.

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
				FODDER						
CK	.50	.093	1.194	.341	.291	230	9.5	5.3	50.0	7.4
FE	.71	.093	1.553	.376	.259	198	11.4	4.9	37.0	6.2
SB	1.14	.449	3.393	.355	.190	253	8.5	4.4	51.0	6.4
LB	1.39	.507	3.155	.479	.196	335	21.7	5.4	210.0	7.2
LH	1.12	.417	2.911	.412	.174	208	14.5	6.0	55.0	5.7
Level of Signif.[1]	**	**	**	NS	**	NS	*	NS	**	NS
BLSD[2] .10	.19	.079	.411	--	.046	--	6.4	--	48.0	--
.05	.23	.094	.487	--	.055	--	7.7	--	57.0	--
.01	.31	.130	.676	--	.078	--	--	--	81.0	--
				GRAIN						
CK	.97	.261	.408		.103	18	16.9	Incomplete data;		2.1
FE	1.12	.280	.405	Less	.109	23	22.5	some samples less		2.0
SB	1.27	.349	.423	than	.121	26	16.1	than 1.0 ppm for		2.1
LB	1.39	.334	.422	.02%	.116	23	21.4	both Cu and Mn		1.9
LH	1.27	.346	.409		.113	29	20.8			1.7
Level of Signif.	**	+	NS	--	NS	+	NS	--	--	NS
BLSD .10	.09	.064	--	--	--	10	--	--	--	--
.05	.11	--	--	--	--	--	--	--	--	--
.01	.15	--	--	--	--	--	--	--	--	--
				ROOTS						
CK	.35	.078	1.070	.242	.184	840	6.6	5.0	34.1	2.2
FE	.63	.111	1.464	.230	.217	1268	8.3	3.4	56.0	3.3
SB	1.18	.170	2.946	.244	.212	912	7.0	4.2	41.1	3.3
LB	1.40	.318	2.915	.393	.258	910	10.5	3.2	90.7	4.1
LH	1.21	.265	2.443	.321	.227	1446	10.5	3.0	65.3	4.1
Level of Signif.	**	**	**	NS	*	NS	NS	NS	*	NS
BLSD .10	.18	.048	.438	--	.043	--	--	--	35.1	--
.05	.21	.056	.520	--	.052	--	--	--	42.5	--
.01	.30	.078	.723	--	--	--	--	--	--	--

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

[2] Bayes LSD.

Table 9. Chemical Analysis of Grain Samples Collected at Final Harvest on October 16, 1972.

Treatment	N	P	K	Ca	Mg	Fe[1]	Zn	Cu	Mn	B
	%					ppm				
					GRAIN					
CK	1.21	.287	.329		.118	17	18.3	Incomplete data;		2.2
FE	1.39	.288	.319	Less	.115	18	19.4	some samples less		2.1
SB	1.57	.384	.395	than	.132	23	18.9	than 1.0 ppm for		2.3
LB	1.64	.366	.377	.02%	.128	26	25.3	both Cu and Mn		1.8
LH	1.55	.371	.373		.130	22	24.1			2.0
Level of Signif.[2]	**	**	**	--	NS	+	**	--	--	NS
BLSD[3] .10	.10	.039	.031	--	--	8	2.1	--	--	--
.05	.12	.046	.037	--	--	--	2.5	--	--	--
.01	.17	.065	.053	--	--	--	3.5	--	--	--
+ Insecticide	1.42	.320	.344	--	.120	21	20.4	--	--	2.0
- Insecticide	1.44	.340	.364	--	.127	20	21.1	--	--	2.2
Level of Signif.	NS	*	*	--	**	NS	NS	--	--	NS
Interaction Level of Significance	NS	NS	NS	--	+	NS	NS	--	--	NS

[1] Two values estimated at 10 ppm, the lower detection limit.

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

[3] Bayes LSD.

D. 1972 Grain Samples at Final Harvest - Samples were collected on all plots at the time ear corn yields were taken. The results are given in Table 9.

1. Nitrogen - FE higher than CK and all manures higher than FE.

2. Phosphorus - All manures higher than CK and FE.

3. Potassium - All manures higher than CK and FE.

4. Magnesium - All manures higher than CK and FE.

5. Zinc - LB and LH higher than CK, FE, and SB.

6. The levels of phosphorus, potassium, and magnesium were significantly lower where insecticide was used.

VII. YIELD AND PLANT MEASUREMENTS

In 1973 many measurements were taken prior to harvest. At the silage stage 10 plants were selected at random in the insecticide treated portion of each plot. Silage yields were based on the weight of these plants and the average population for the entire experiment. Lodging and other plant measurements were taken just prior to ear corn harvest. The results of these measurements are given in Tables 10 and 11.

A. Plant Height on June 22 - Plant height on CK was lower than on all other treatments.

B. Root Rating - On July 31 five plants were pulled from each plot at random, washed, and rated for root damage. The results show that the damage where manure was used was lower than on CK and FE plots. The use of insecticide also reduced the corn rootworm damage. Even where these high rates of manure have been used, it was beneficial to use insecticide.

C. Plants Dead on September 11 - In early September it was noted that many plants were dying prematurely; apparently from stalk rot. All manure treatments had a higher percentage dead plants than the CK and FE treatments. The FE treatment was also significantly higher than the CK treatment.

D. Root Lodging was the highest on the CK plots without insecticide. All other treatments had very few lodged plants.

E. Grain Yield - The CK treatment was significantly lower in yield than all other treatments. SB and LB were also significantly lower in yield than FE and LH. In all cases except on CK, yield was higher where insecticide was used.

F. Silage Yield - Yields on the CK treatments were lower than all other treatments.

Table 10. Plant Measurements, 1973.

Main Plot Treatment	Insecticide	Root rating[1] (0-5)	Plants dead 9/11,%	HARVEST MEASUREMENTS: Root lodged 30° or more,%	Stalks broken above ear,%	Stalks broken below ear,%	Barren stalks %	GRAIN: Nubbins %	Ear moisture at harvest %	Grain yield at 15.5% M. Bu/Ac
CK	W	1.8	7.3	0	1.2	2.0	0.9	9.3	34.8	102.6
	W/O	3.4	3.7	12.9	1.5	3.5	3.4	9.7	33.2	112.0
FE	W	1.3	33.3	0	5.0	3.6	1.1	4.2	32.5	132.0
	W/O	3.5	35.3	4.6	4.2	7.2	0.7	5.1	30.5	129.9
SB	W	1.0	56.7	0.2	10.3	9.4	0	3.7	31.2	123.8
	W/O	2.7	63.7	0.2	8.9	13.5	0.7	6.6	31.5	115.3
LB	W	0.6	51.7	0	9.2	5.9	0	6.1	32.2	125.6
	W/O	2.1	56.7	0	7.3	9.0	1.4	2.6	32.4	113.9
LH	W	0.7	43.3	0	3.5	8.5	0.2	3.4	31.6	131.0
	W/O	2.5	49.3	.5	11.1	8.7	4.4	3.6	30.0	122.9

[1] Root rating: 0 = no damage; 5 = severe root damage from corn rootworms.

Table 11. Summary of 1973 Plant Measurements.

Treatment	Plant height 6-22 inches	Root rating (0-5)	Harvest Measurements: Plants dead 9-11 %	Root lodged 30° or more,%	Stalks broken above ear,%	Stalks broken below ear,%	Barren stalks %	Grain: Nubbins %	Ear moisture at harvest %	Grain yield at 15.5% M. Bu/Ac	Silage: Dry matter at harvest %	Silage yield (DM) lb/Ac	Ear wt. / Silage wt. %
CK	26.9	2.6	9.2	6.4	1.4	2.7	2.1	9.5	34.0	107.3	48.0	11,300	54.6
FE	32.8	2.4	34.3	2.3	4.6	5.4	0.9	4.6	31.5	130.9	50.2	17,600	53.3
SB	35.3	1.8	60.2	0.2	9.6	11.4	0.3	5.2	31.4	119.5	50.8	15,600	53.8
LB	34.5	1.3	54.2	0	8.2	7.5	0.7	4.4	32.3	119.8	50.1	14,600	54.1
LH	36.5	1.6	46.3	0.2	7.3	8.6	2.3	3.6	30.8	127.0	49.6	15,900	58.0
Level of signif.[2]	**	**	**	*	**	+	NS	**	*	**	NS	**	NS
BLSD[3] .10	8.2	0.4	8.7	7.0	2.7	5.6	--	4.7	2.1	8.4	--	1,800	--
.05	9.7	0.5	10.3	8.3	3.3	--	--	5.7	2.6	9.9	--	2,200	--
.01	13.5	0.7	14.4	--	4.6	--	--	8.1	--	13.9	--	3,100	--
+ Insecticide	N.M.[1]	1.2	33.3	0	5.1	5.2	0.5	6.0	32.8	119.6	N.M.	N.M.	N.M.
- Insecticide	N.M.	3.0	37.9	5.2	5.8	7.6	2.3	6.2	31.8	117.7	N.M.	N.M.	N.M.
Level of signif.		**	+	*	NS	*	*	NS	*	NS			
Interaction Level of signif.	N.M.	NS	NS	*	NS	NS	NS	NS	NS	NS	N.M.	N.M.	N.M.

[1] N.M. = not measured on the portion of each plot where insecticide was not used.

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

[3] Bayes LSD.

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

West Central Experiment Station - Morris

S. D. Evans

I. EXPERIMENTAL DESIGN

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

II. TREATMENTS

A. Main Plots

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

2. Solid beef manure at 33 1/3 tons/acre (wet weight) in the fall of 1971 only.

3. Solid beef manure at 66 2/3 tons/acre (wet weight) in the fall of 1971 only.

4. Solid beef manure at 100 tons/acre (wet weight); 33 1/3 tons applied in the fall of 1971 and 66 2/3 tons in the spring of 1972.

B. Sub-plots

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

2. No rootworm control.

C. The plots were planted to Pioneer 3956A on May 10, 1973. Furadan at 10 lbs./acre (1 lb./acre active ingredient) was applied to 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 broadcast @ 2 1/2 lbs./acre on May 13; 2,4-D amine @ 1/2 lb./acre was applied as a postemergence spray on June 5; 2,4-D ester @ 1/3 lb./acre was applied on June 22.

III. MANURE ANALYSIS AND APPLICATION

Manure was applied in the fall of 1971 and the spring of 1972. Analysis of the 1971 manure is listed in the first column of Table 1. The analysis of the manure from the spring of 1972 is estimated from samples taken later in the year. The nutrients actually applied are estimated in Table 2 for each manure rate. No manure has been applied since these original applications.

IV. PLANT SAMPLING AND ANALYSIS

Leaf samples were taken at silking each year. Grain samples were also taken at final harvest.

A. 1973 Corn Leaf Analysis - Leaves were collected from only the insecticide treated portion of each plot in 1973, because in past years there has been very little effect of the insecticide on leaf analysis values.

1. Nitrogen - The two higher manure rates increased the leaf nitrogen levels.

2. Phosphorus - All manure rates increased leaf phosphorus levels.

3. Potassium - All manure rates increased leaf potassium levels.

4. Magnesium - All manure rates decreased leaf magnesium levels.

5. Zinc - All manure rates decreased leaf zinc levels.

6. Copper - The lowest rate of beef manure was highest in leaf copper level. The other two rates were not significantly different from the fertilized treatment.

B. 1972 Grain Samples - At final harvest each year grain samples were saved from all plots. The 1972 results are given in Table 4.

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.

C. 1973 Grain Samples - Statistical analysis not completed.

V. YIELD AND PLANT MEASUREMENTS

The 1973 plant measurements are summarized in Table 5. There were no effects of main plot treatments on any of the variables. The use of insecticide brought about a slightly higher ear moisture content and higher yield.

Table 1. Chemical Properties of Solid Beef Manure Applied at Morris in the Fall of 1971 and the Spring of 1972.

Properties	Units (Dry Matter Basis)	Fall 1971	Spring[1] 1972
Total solids	%	52.51	24.54
Total Volatile Solids	%	82.69	75.30
COD	mg/l (wet basis)	- -	370,050
Conductivity	umho's/cm	1550	2300
Total N	%	2.48	4.15
Org - N	%	1.44	3.54
NH_4 - N	%	1.13	0.62
NO_2 - N	%	.0155	N.M.A.
NO_3 - N	%	.1835	N.M.A.
Phosphates (PO_4-P)	%	0.59	0.93
Chlorides	%	2.56	2.74
Emission Spectrograph			
P	%	0.69	0.89
K	%	1.48	1.86
Ca	%	0.89	1.83
Mg	%	0.44	0.65
Na	%	0.76	0.73
Fe	ppm	523	1778
Al	ppm	351	1193
Mn	ppm	78	157
Zn	ppm	96	92
Cu	ppm	18	16
B	ppm	18	16

[1] All values except total solids estimated from samples of solid beef manure taken on July 19, 1972.

N.M.A. = No measureable amount.

Table 2. Nutrient Amounts Applied for the 1972 Crop Year.

Element	Solid Beef Manure		
	33 1/3 tons/acre	66 2/3 tons/acre	100 tons/acre
		- lbs./acre -	
Total solids	35,006	70,012	67,726
Total N	868	1736	2226
Org - N	504	1008	1662
NH_4 - N	396	791	599
NO_2 - N	5	11	5
NO_3 - N	64	128	64
PO_4 - P	207	413	511
Cl	896	1792	1809
P	242	483	533
K	518	1036	1127
Ca	312	623	911
Mg	154	308	367
Na	266	532	505
Fe	18	37	76
Al	12	25	51
Mn	2.7	5.5	7.8
Zn	3.4	6.7	6.4
Cu	0.6	1.3	1.1
B	0.6	1.3	1.1

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

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
Fertilized	2.69	.249	1.710	.667	.524	123	21.5	9.2	86	6.3
Solid Beef @ 33 1/3 T/A	2.77	.299	2.243	.619	.396	123	13.2	10.9	99	6.0
Solid Beef @ 66 2/3 T/A	2.86	.319	2.637	.651	.368	128	13.1	8.6	115	5.9
Solid Beef @ 100 T/A	2.90	.314	2.523	.635	.364	125	15.6	9.9	117	7.9
Level of signif.[1]	+	**	**	NS	*	NS	**	**	NS	NS
BLSD[2] .10	.14	.017	.275	--	.077	--	3.6	0.8	--	--
.05	--	.021	.334	--	.094	--	4.4	1.0	--	--
.01	--	.031	.497	--	--	--	6.6	1.5	--	--

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

[2] Bayes LSD.

Table 4. Chemical Analysis of Grain Samples Collected at Final Harvest on October 17, 1972.

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
Fertilized	1.50	.286	.326		.118	19	25.7			2.0
Solid Beef @ 33 1/3 T/A	1.48	.376	.386	Less than .02%	.139	18	20.2	Incomplete data; some samples less than 1.0 ppm for both Cu and Mn		2.2
Solid Beef @ 66 2/3 T/A	1.55	.395	.398		.148	21	20.1			1.9
Solid Beef @ 100 T/A	1.55	.380	.367		.143	19	23.1			1.7
Level of Signif.[1]	NS	**	**		**	NS	NS			NS
BLSD[2] .10	--	.024	.028		.006	--	--			--
.05	--	.029	.033		.008	--	--			--
.01	--	.043	.051		.011	--	--			--
+ Insecticide	1.51	.359	.365		.137	19	21.2			1.9
- Insecticide	1.54	.360	.373		.137	19	23.4			2.0
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 5. Summary of 1973 Plant Measurements.

Treatment	height 6-22 inches	Barren stalks %	Grain: Nubbins %	Grain: Ear moisture at harvest %	Grain: Grain yield at 15.5% M. Bu/ac
Fertilized	32.3	1.2	3.0	32.6	111.2
Solid Beef @ 33 1/3 T/A	32.0	0.7	4.8	32.2	126.5
Solid Beef @ 66 2/3 T/A	30.5	2.3	5.3	31.1	118.8
Solid Beef @ 100 T/A	32.0	0.2	4.8	31.8	121.5
Level of signif.[1]	NS	NS	NS	NS	NS
+ Insecticide	31.7	1.2	5.4	32.4	121.7
- Insecticide	31.7	1.0	3.4	31.4	117.2
Level of signif.	NS	NS	NS	**	+
Interaction Level of signif.	NS	NS	NS	*	NS

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

MANURE RATE STUDY

West Central Experiment Station - Morris

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

I. EXPERIMENTAL DESIGN

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

II. TREATMENTS

A. Main Plots

1. CK - No manure or fertilizer.
2. FE - Recommended amounts of inorganic fertilizer each year (120 N + 40 P_2O_5 + 40 K_2O).
3. SB1 - Solid beef manure @ 10 tons/acre (dry basis) each fall.
4. SB2 - Solid beef manure @ 20 tons/acre (dry basis) each fall.
5. SB3 - Solid beef manure @ 30 tons/acre (dry basis) each fall.
6. LB1 - Liquid beef manure @ 19 tons/acre (wet basis) each fall.
7. LB2 - Liquid beef manure @ 38 tons/acre (wet basis) each fall.
8. LB3 - Liquid beef manure @ 57 tons/acre (wet basis) each fall.

B. Sub-plots

1. Corn treated at planting with insecticide (Furadan) for corn rootworm control.
2. No corn rootworm control.

C. Plot Size - Main plots were 45' x 45'; sub-plots were 22 1/2' x 45'.

D. The plots were planted to Pioneer 3956A on May 10, 1973. Furadan @ 10 lbs./acre (1 lb./acre active ingredient) was applied to the insecticide treated sub-plot at planting. Starter fertilizer was used only on the fertilized treatment. Lasso was applied broadcast @ 2 1/2 lbs./acre on May 13; 2,4-D amine @ 1/2 lb./acre was applied as a postemergence spray on June 5; 2,4-D ester @ 1/3 lb./acre was applied on June 22.

III. MANURE ANALYSIS AND APPLICATION

Manure was applied for the first time in the fall of 1972 for the 1973 crop (Table 1). Samples were taken at time of application and were analyzed by the Animal Waste Laboratory in the Department of Agricultural Engineering. The chemical properties of the manure are given in Table 2. The total solids were 41.28% for the solid beef manure (SB) and 5.20% for the liquid beef manure (LB). Total N was 3.14% for SB and 8.95% for LB. The total nutrients applied are listed in Table 3. Total N varied from 174 lbs./acre on LB1 to 1998 lbs./acre on SB3. Phosphorus and potassium application rates were quite adequate for good corn production.

IV. SOIL SAMPLING AND ANALYSIS

A. The soils in each plot were sampled to a depth of 10' in the fall of 1972 prior to manure application. In the fall of 1973 the soils were sampled to a depth of 8' but the results are not yet available.

B. Soil samples were taken to a 4' depth in one rep on June 11. Electrical conductivity was determined on all samples. The results are given in Table 4. Increased amounts of manure in general resulted in an increased electrical condictivity. In no case was the E.C. high enough to be a detriment to plant growth.

V. SOIL WATER SAMPLING AND ANALYSIS

Suction lysimeters were installed at depths of 2', 4', and 6' in two reps of the experiment in May of 1973. A vacuum of about 0.7 atm. was applied to the well to obtain samples of the soil water. Samples were taken on June 7. Water was obtained from only 16 of the 48 wells and the results were not meaningful. Due to dry soil conditions no further samples were obtained in 1973.

VI. PLANT SAMPLING AND ANALYSIS

Leaf samples were taken at silking and fodder, grain, and root samples at the silage stage. All samples were thoroughly dried before submitting for chemical analysis.

A. 1973 Corn Leaf Analysis (Table 5) - In general the manures increased the leaf content of nitrogen, phosphorus, and potassium as compared to levels of these elements in the leaves from the fertilized plots. Magnesium and zinc levels were in general lower where manure was used. Levels of manganese and boron were quite variable.

B. 1973 Fodder, Grain, and Root Samples - Statistical analysis not completed.

Table 1. Actual Amounts of Manure Applied in the Fall of 1972.

Treatment	Dry Weight	Wet Weight
	- tons/acre -	
SB1	10.604	25.688
SB2	21.208	51.376
SB3	31.812	77.064
LB1	0.972	18.700
LB2	1.945	37.400
LB3	2.917	56.100

Table 2. Chemical Properties of Solid Beef and Liquid Beef Manures Applied at Morris in the Fall of 1972.[1]

Properties	Units (Dry Matter Basis)	Solid Beef Manure	Liquid Beef Manure
Total Solids	%	41.28	5.20
Total Volatile Solids	%	72.80	78.44
COD	mg/l (wet basis)	414,763	77,472
Conductivity	umho's/cm	1300	3600
Total N	%	3.14	8.95
Org - N	%	2.08	3.28
NH_4 - N	%	1.06	5.67
NO_2 - N	%	N.M.A.[2]	N.M.A.
NO_3 - N	%	N.M.A.	N.M.A.
Phosphates (PO_4-P)	%	0.78	1.66
Chlorides	%	1.22	4.33
Emission Spectrograph			
P	%	0.85	2.02
K	%	1.56	3.13
Ca	%	0.68	2.97
Mg	%	0.52	1.00
Na	%	0.26	1.94
Fe	ppm	1375	1284
Al	ppm	954	878
Mn	ppm	139	200
Zn	ppm	87	320
Cu	ppm	14	45
B	ppm	15	38

[1] Based on two analyses of one sample of each manure.

[2] N.M.A. = No measureable amount.

Table 3. Nutrients Applied in 1972 for the 1973 Crop Year.

Element	SB1	SB2	SB3	LB1	LB2	LB3
			- lbs./acre -			
Total N	666	1332	1998	174	348	522
Org - N	441	882	1323	64	128	191
NH_4 - N	225	450	674	110	221	331
NO_2 - N	N.M.A.	N.M.A.	N.M.A.	N.M.A.	N.M.A.	N.M.A.
NO_3 - N	N.M.A.	N.M.A.	N.M.A.	N.M.A.	N.M.A.	N.M.A.
PO_4 - P	165	331	496	32	65	97
Cl	259	517	776	84	168	253
P	180	361	541	39	79	118
K	331	662	993	61	122	183
Ca	144	288	433	58	116	173
Mg	110	221	331	19	39	58
Na	55	110	165	38	75	113
Fe	29	58	87	2.5	5.0	7.5
Al	20	40	61	1.7	3.4	5.1
Mn	2.9	5.9	8.8	0.4	0.8	1.2
Zn	1.8	3.7	5.5	0.6	1.2	1.9
Cu	0.3	0.6	0.9	0.09	0.18	0.26
B	0.3	0.6	1.0	0.07	0.15	0.22

Table 4. Electrical Conductivity of Soil Samples Taken on June 11, 1973.

Treatment	Depth	Saturation Extract	1:2.5[1] Extract
		- mmhos/cm -	
CK	0-1'	.560	.120
	1-2'	.420	.160
	2-3'	.600	.160
	3-4'	.470	.155
FE	0-1'	.500	.187
	1-2'	.510	.154
	2-3'	.720	.176
	3-4'	.540	.185
SB1	0-1'	.820	.260
	1-2'	.560	.150
	2-3'	.580	.142
	3-4'	.740	.150
SB2	0-1'	.950	.270
	1-2'	.650	.230
	2-3'	.540	.180
	3-4'	.770	.175
SB3	0-1'	.630	.300
	1-2'	.320	.195
	2-3'	.480	.170
	3-4'	.680	.175
LB1	0-1'	.870	.240
	1-2'	.800	.185
	2-3'	.760	.195
	3-4'	1.070	.240
LB2	0-1'	.670	.200
	1-2'	.590	.175
	2-3'	.810	.185
	3-4'	.710	.185
LB3	0-1'	1.080	.260
	1-2'	.740	.235
	2-3'	.710	.185
	3-4'	.710	.165

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

Table 5. Summary of Analysis of Corn Leaves at Silking - 1973.

Treatment	N	P	K	Ca	Mg	Fe	Zn	Cu	Mn	B
	%					ppm				
CK	2.40	.260	2.080	.659	.491	135	16.1	9.3	74	4.4
FE	2.72	.272	2.087	.715	.578	134	21.4	12.2	102	5.2
SB1	2.51	.302	2.527	.650	.454	133	15.3	10.1	92	4.5
SB2	2.77	.340	2.713	.628	.404	136	15.6	10.1	102	8.0
SB3	2.86	.363	2.810	.598	.339	135	13.5	10.0	105	7.5
LB1	2.75	.309	2.147	.698	.570	145	18.0	11.5	100	3.9
LB2	2.75	.314	2.027	.675	.544	122	17.0	10.7	96	5.8
LB3	2.87	.319	2.160	.686	.535	130	16.9	10.7	76	6.5
Level of signif.[1]	**	**	**	NS	**	NS	*	NS	+	+
BLSD[2] .10	.17	.040	.315	--	.077	--	3.4	--	28	3.7
.05	.20	.047	.374	--	.091	--	4.0	--	--	--
.01	.30	.067	.521	--	.127	--	--	--	--	--

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

[2] Bayes LSD.

VII. YIELD AND PLANT MEASUREMENTS

In 1973 many measurements were taken prior to harvest. 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 population for the entire experiment. Lodging and other plant measurements were taken just prior to ear corn harvest. The results of these measurements are given in Tables 6 and 7.

A. Plant Height in June - All manure treatments were taller than CK and FE.

B. Root Rating - On August 1 five plants were pulled from each plot at random, washed, and rated for root damage. There was no significant effect of main plot treatments, but there was some reduction in damage where insecticide was used.

C. Plants Dead on September 11 - In early September it was noted that many plants were dying prematurely; apparently from stalk rot. Increasing amounts of manure resulted in more dead plants. There were also more dead plants in FE than in CK. Insecticide also significantly reduced the percentage of dead plants.

D. Stalks broken above the ear were reduced by the insecticide.

E. Stalks broken below the ear were in general increased where manure was used; but the results were quite variable.

F. Ear moisture at harvest was quite variable.

G. Grain Yield - There were significant differences in yield. The CK was lower than all other treatments. FE was also lower in yield than SB1 at the 5% level.

Table 6. Plant Measurements, 1973.

Main Plot Treatment	Insecticide	Root Rating[1] (0-5)	Plants Dead 9-11 %	Harvest Measurements: Stalks broken above ear %	Harvest Measurements: Stalks broken below ear %	Harvest Measurements: Barren stalks %	Grain: Nubbins %	Grain: Ear moisture at harvest %	Grain: Grain yield at 15.5% M. Bu/Ac
CK	W	1.8	3.0	4.1	0.9	1.9	9.0	35.2	112.1
	W/0	2.3	7.0	5.1	2.0	0	3.8	34.3	122.0
FE	W	1.3	12.0	8.1	1.4	2.8	1.0	33.4	128.9
	W/0	2.7	14.0	10.4	6.2	1.9	2.9	33.6	123.3
SB1	W	1.6	16.7	7.4	6.0	0.5	1.8	33.5	141.0
	W/0	2.1	17.3	10.3	5.0	0.5	1.4	34.0	134.6
SB2	W	1.3	41.3	6.0	3.2	2.8	1.9	31.9	131.2
	W/0	2.0	51.7	9.4	2.8	0	3.3	30.2	126.9
SB3	W	1.2	31.0	6.7	8.4	0	3.7	32.3	137.9
	W/0	2.1	38.7	6.0	10.3	0	3.2	32.4	136.7
LB1	W	1.9	14.3	7.1	2.4	2.3	2.9	34.4	129.7
	W/0	2.2	22.7	10.4	2.9	2.9	1.0	33.4	125.2
LB2	W	1.7	32.3	7.0	7.2	1.5	2.9	32.4	133.7
	W/0	2.4	31.0	10.1	7.0	0.5	4.1	32.8	127.4
LB3	W	1.2	28.3	6.5	5.1	1.4	1.9	33.1	136.5
	W/0	2.2	35.0	9.4	2.9	2.4	1.4	33.0	128.4

[1] Root rating: 0 = no damage; 5 = severe damage from corn rootworms.

Table 7. Summary of 1973 Plant Measurements.

Treatment	Plant Height 6-22 inches	Root Rating (0-5)	Plants Dead 9-11 %	Harvest Measurements: Stalks broken above ear %	Harvest Measurements: Stalks broken below ear %	Harvest Measurements: Barren stalks %	Grain: Nubbins %	Grain: Ear moisture at Harvest %	Grain: Grain yield at 15.5% M. Bu/Ac	Silage: Dry matter at Harvest %	Silage: Silage Yield (DM) lb./Ac	Silage: Ear wt. / Silage wt. %
CK	28.5	2.1	5.0	4.6	1.4	0.9	6.4	34.8	117.0	39.7	12,100	47.6
FE	29.5	2.0	13.0	9.2	3.8	2.4	1.7	33.5	126.1	42.9	13,100	51.6
SB1	30.7	1.8	17.0	8.9	5.5	0.5	1.6	33.7	137.8	41.4	14,700	47.1
SB2	32.8	1.6	46.5	7.7	3.0	1.4	2.6	31.1	129.1	41.9	13,300	50.4
SB3	32.3	1.6	34.8	6.4	9.4	0	3.5	32.4	137.3	41.4	16,300	47.3
LB1	27.8	2.1	18.5	8.8	2.6	2.6	2.0	33.9	127.4	42.7	14,000	49.8
LB2	32.5	2.0	31.7	8.6	7.1	1.0	3.5	32.6	130.6	40.8	12,900	49.1
LB3	33.3	1.7	31.7	7.9	4.0	1.9	1.7	33.1	132.5	39.7	15,200	47.8
Level of signif.[1]	*	NS	**	NS	+	+	+	**	*	NS	NS	NS
BLSD[2] .10	4.1	--	8.9	--	4.6	1.8	2.9	1.5	11.5	--	--	--
.05	7.0	--	10.5	--	--	--	--	1.7	13.9	--	--	--
.01	--	--	14.4	--	--	--	--	2.5	--	--	--	--
+ Insecticide	N.M.	1.5	22.4	6.6	4.3	1.6	3.1	33.3	131.4	N.M.	N.M.	N.M.
- Insecticide	N.M.	2.2	27.2	8.9	4.9	1.0	2.6	33.0	128.1	N.M.	N.M.	N.M.
Level of signif.		**	+	*	NS	NS	NS	NS	NS			
Interaction Level of signif.		NS	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.

FERTILIZER USE EFFICIENCY AND THE BALANCE OF ESSENTIAL PLANT NUTRIENTS AND OTHER CHEMICAL ELEMENTS IN SOILS

West Central Experiment Station-Morris
A.C. Caldwell, S.D. Evans, A. Castro, L.L. Goodroad

The objectives of these studies are 1) to investigate the balance of input of plant nutrients into soils against plant needs, 2) the efficiency of fertilizer use by plants, and 3) to account for those chemical elements (essential and non-essential to plants) which are added to soils in fertilizer practice.

The crop used is corn and the treatments are replicated 4 times.

Treatments.

Treatment No.	Treatment description	Time of application
1.-N-0	check	starter fertilizer in spring*1
2.-N-1	40 lb N/A*2	30 lb N/A in spring + starter
3.-N-2	80 lb N/A	70 lb N/A in spring + starter
4.-N-3	120 lb N/A	110 lb N/A in spring + starter
5.-N-4	160 lb N/A	70 lb N/A in spring + starter + 80 lb N/A sidedressed
6.-N-2	80 lb N/A	70 lb N/A in fall + starter in spring
7.-N-3	120 lb N/A	110 lb N/A in fall + starter in spring
8.-N-2	80 lb organic-*3N/A	70 lb N/A (as soybean meal) in spring + starter
9.-N-3	120 lb organic-N/A	110 lb N/A (as soybean meal) in spring + starter
10.-N-2, P-1	80 lb N/A + 30 lb P/A	30 lbs P/A in fall + 70 lb N/A in spring + starter
11.-N-3	120 lb N/A	70 lb N/A in spring-starter-40 lb N/A sidedressed
12.-N-0	check	starter in spring*1

*1. Starter: all plots receive 143 lb/A of 6-24-24 as starter fertilizer. This provides 8.6 lb N, 15 lb P, and 28.5 lb K per acre. The nitrogen in the starter must be substracted from the total amount given under the treatment description. The same is valid for P under treatment No. 10.

*2. N as urea 45% N.

*3. Organic - N as soybean meal 8.1% N (44% protein).

Table 1 gives the leaf analysis and yield data. Treatments had no significant effect on yield during this first year of experiment.

Higher N% in leaves was obtained with spring N applications of 80 lb/A and more, both in the chemical and organic forms. Fall N applications are slightly lower and the leaves of the check plots show the lowest N%.

Additional 30 lb P/A (Trt. No. 10) had no significant effect over the same treatment without the additional P (Treat. No. 3) but was higher than the 80 lb organic N/A (Treat. No. 8), the 40 lb N/A and the checks at the 5% level.

All the nutrient levels in plant tissue are above critical amounts for normal plant growth.

Soils were sampled in the fall of '72 (some to a depth of 10'), and selected plot areas were sampled again in the spring to a depth of 3'. Samples were subsequently analyzed for NO_3-N. Some of these data are shown in Table 2 and Fig. 1. There is a definite increase in NO_3-N content in the top 3 ft. from fall to spring (ave. of 48 plots vs. ave. of treatments #3 and 4) of some 68 lb. The increase in NO_3-N content of Treats. #6 and 7 can, probably, account for most of the 70 and 110 lb of N applied in fall as well as for the natural increase in NO_3-N in the soil.

Table 1. Leaf Analysis and Yield, Nutrient Balance Study, Morris, 1973.

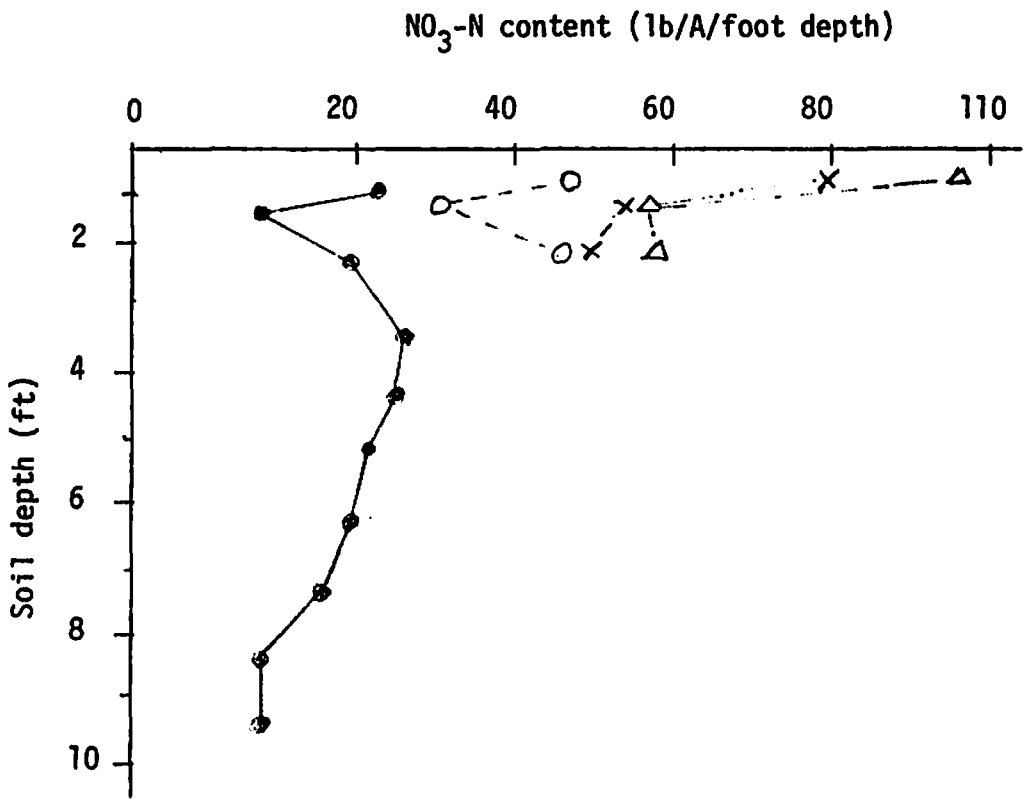
Treatment No.	Analysis of Leaf Samples at Silking											Yield Bu/Ac
	N %	P %	K %	Ca %	Mg %	Fe ppm	Zn ppm	Cu ppm	Mn ppm	B ppm	Al ppm	
1	2.20	.234	2.18	.62	.40	117	22.6	7.5	59	6.3	44	112.5
2	2.40	.248	2.24	.68	.43	106	22.8	8.2	64	6.4	38	122.1
3	2.53	.262	2.11	.65	.48	115	24.2	9.7	64	6.0	42	129.8
4	2.74	.274	2.15	.71	.48	116	24.0	9.6	66	6.3	44	128.2
5	2.62	.263	2.05	.66	.45	114	26.8	9.9	70	6.4	39	128.9
6	2.50	.272	2.28	.66	.42	127	22.2	8.4	68	6.3	47	118.2
7	2.48	.263	2.18	.68	.47	114	24.1	9.8	68	6.4	39	128.9
8	2.52	.252	2.18	.68	.43	110	25.0	8.8	66	6.2	42	122.2
9	2.61	.277	2.17	.68	.43	116	23.8	9.4	65	6.6	42	127.7
10	2.49	.272	2.20	.70	.47	114	23.1	8.8	59	6.6	42	123.6
11	2.55	.271	2.20	.70	.47	118	23.8	9.8	71	6.6	44	126.5
12	2.18	.227	2.15	.67	.45	106	20.6	7.3	60	5.8	41	116.3
Signif.[1]	**	**	NS	NS	NS	NS	**	**	NS	NS	NS	NS
BLSD[2] .10	.19	.017	--	--	--	--	2.3	1.2	--	--	--	--
.05	.22	.020	--	--	--	--	2.7	1.4	--	--	--	--
.01	.29	.027	--	--	--	--	3.7	1.9	--	--	--	--

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

Table 2. NO_3-N content of soil (lb/A per foot depth) as affected by time and season and the effect of two levels of fall applied nitrogen.

Soil depth	Fall 1972 (Ave. of 48 plots)	Spring 1973 (Ave. Trt. 3, and 4) (8 plots)	Spring 1973 (Trt. 6:80# N/A fall applied)	Spring 1973 (Trt. 7:120# N/A fall applied)
	lbs NO_3-N/A per foot depth			
0-1	24	48	80	104
1-2	12	30	52	52
2-3	20	46	48	56
sub-total lbs/A to 3 ft.	56	124	180	212
3-4	28			
4-5	28			
5-6	24			
6-7	24			
7-8	20			
8-9	12			
9-10	12			
Total lbs/A to 10 ft.	206			

Figure 1. Effect of time, season, and fall applied nitrogen on the initial content of NO_3-N (lb/A/foot depth) in soils. (Morris, 1973).



●——● Fall 1972 (initial content, av. of 48 plots)

o------o Spring 1973 (effect of time and season, ave. trts. #3 and 4)

x—··—x Spring 1973 (effect of time, season and Trt. #6, or 70 lb fall applied N)

Δ——Δ Spring 1973 (effect of time, season, and Trt. #7, or 110 lb fall applied N)

COMPARATIVE VALUE OF SEVERAL SMALL GRAIN CROPS FOR FORAGE AND GRAIN IN WEST CENTRAL MINNESOTA

Morris, Minnesota - 1973

C. Simkins, S. Evans and R. Schoper

Oats harvested as a forage crop and stored either as silage or haylage has been used extensively in Minnesota in the past. Most recently, barley has been harvested at a high moisture content (28-30%), stored as silage, and successfully fed to livestock. Although it is not common to produce wheat as a feed grain or a forage crop in Minnesota, researchers and farmers in other states, i.e. Kansas, Nebraska and others, have used wheat successfully as a feed grain for both ruminant and non-ruminant livestock. The introduction of high yielding semi-dwarf wheat varieties has created an interest in comparing the abilities of small grain species to produce forage and grain. This study was initiated to evaluate and compare wheat, oats and barley varieties under varying levels of fertility.

METHODS

Trials at Morris, Minnesota included a comparison of Era wheat, Lodi oats, and Larker barley. Fertilizer treatments investigated on the wheat crop included nitrogen applied at the rates of 0 and 80 pounds of nitrogen per acre. The oats and barley crops received treatments of 0, 30 and 60 pounds of nitrogen per acre. All small grain varieties received an application of 40 pounds of P_2O_5 per acre. The nitrogen fertilizer was applied broadcast prior to seeding of the grain. The phosphorus application was made at time of seeding. The trial included an irrigation treatment on Era wheat which had been fertilized with 80 pounds of nitrogen per acre. Three irrigations were applied using a total of 9 acre inches of water. This water was applied during the "boot stage", "flag stage" and "soft dough stage" of the wheat. No irrigation water was applied to the oats and barley crops. The precipitation received during the growing season - April to July 15 - was 6.8 inches. This was approximately 4 inches below normal.

The soil chemical characteristics of the experimental site were:

NO_3-N lb/acre 2 ft.	P lb/acre	K lb/acre	pH
100 high	39 high	480 high	7.4

Manure had been applied to the site prior to seedbed preparation at approximately 20 tons per acre. A portion of each plot was harvested when the grain of the oats, barley or wheat were at the soft dough stage. Data was collected for forage and protein content. Grain and straw yields, as well as protein content, were determined on the matured crop.

RESULTS

Forage and Protein Yields of Small Grains

The yields and protein content of the wheat, oats and barley harvested at the soft dough stage are shown in Table 1. The yields for protein are on an oven dry basis.

Table 1. Forage yields and protein content of wheat, oats, and barley as influenced by various fertilizer and irrigation treatments. Morris, Minnesota 1973.

Treatment	Era Wheat		Lodi Oats		Larker Barley	
	Forage tons/A	Protein %	Forage tons/A	Protein %	Forage tons/A	Protein %
$N-P_2O_5-K_2O$						
0-40-0	3.1	8.6	2.9	9.4	3.3	9.0
80-40-0	2.8	9.8	-	-	-	-
80-40-0 (irrigated)	3.4	9.7	-	-	-	-
30-40-0	-	-	2.8	10.5	3.2	8.9
60-40-0	-	-	3.0	10.2	3.1	9.2

The forage, as well as the protein content, of the small grain varieties were not significantly increased by the fertilizer or irrigation treatments. The highest yield of forage was produced by Era wheat which had been irrigated 3 times (3.4 tons dry matter per acre). The forage yields of oats, wheat and barley were not significantly different on this high fertility soil. The protein content of the harvested forage was similar for all small grain species, as well as for all fertilizer treatments.

Grain Yields, Straw Yields and Protein Content of Small Grains

The application of 9 inches of irrigation water to Era wheat produced the only significant increase in yields of the small grains. The yields of wheat, oats and barley are given in Table 2 in pounds per acre.

Table 2. Grain yields of wheat, oats and barley as influenced by various fertilizer and irrigation treatments. Morris, Minnesota 1973.

	Grain Yields - Lbs/acre				
	0-0-0	80-40-0	80-40-0 irrigated	30-40-0	60-40-0
Era wheat	2100	2220	4020*	--	--
Lodi oats	2772	--	--	2464	2432
Larker barley	2304	--	--	2256	2304

* significant 1% level

Under conditions of these trials, i.e. high fertility and relatively low precipitation, little or no response to fertilizer could be expected. It is interesting to note, however, that yields of more than 2,000 pounds per acre of wheat, oats and barley were obtained with only 6.8 inches of precipitation. The yields of Era wheat were nearly doubled by the application of 9 inches of irrigation water.

The tons of straw produced by the various small grain crops (wheat, oats and barley) were similar under similar conditions. Highest yields of straw were produced by Era wheat. Lowest yields of straw were obtained with Larker barley. The tons of straw produced per acre by the wheat, oats and barley crops are shown in Table 3.

Table 3. Straw yields of wheat, oats and barley as influenced by various fertilizer and irrigation treatments (tons/acre). Morris, Minnesota 1973.

	Straw Yields - Tons/acre				
	0-0-0	80-40-0	80-40-0 irrigated	30-40-0	60-40-0
Era wheat	1.91	1.76	2.13*	--	--
Lodi oats	1.62	--	--	1.51	1.35
Larker barley	1.25	--	--	1.34	1.16

* significant 5% level

The fertilizer treatments had little or no effect on the protein content of oats and barley grain. The protein content of wheat was significantly increased by the use of 80 pounds of nitrogen per acre. The application of irrigation water resulted in a significant decrease in protein content of the wheat grain. Table 4 shows the protein content of the small grain crops as influenced by the various fertilizer and irrigation treatments.

Table 4. Protein content of wheat, oats and barley as influenced by various fertilizer and irrigation treatments. Morris, Minnesota 1973.

	Protein Content %				
	0-0-0	80-40-0	80-40-0 irrigated	30-40-0	60-40-0
Era wheat	12.6	15.2	12.9	--	--
Lodi oats	12.8	--	--	13.2	13.4
Larker barley	14.4	--	--	15.1	15.5

SUMMARY

Wheat, oats and barley crops produced similar yields of grain (pounds per acre) under similar moisture and fertility conditions. Wheat yields were increased 1,800 pounds per acre (30 bushels) by application of 9 inches of irrigation water.

Era, a semi-dwarf wheat variety, produced as much straw as the taller oats and barley varieties.

The forage yields of wheat, oats and barley, as determined by cutting the small grain crops at the soft dough stage, were not significantly different.

PHOSPHORUS PLACEMENT STUDY ON SOYBEANS

G.E. Ham

P^{33} was applied to study the efficiency of fertilizer phosphorus (ordinary superphosphate) utilization by field-grown soybeans under different methods of application at Rosemount.

^{15}N was used to determine the influence of a small dose of starter nitrogen fertilizer (urea) on nitrogen fixation and utilization of fertilizer phosphorus.

Clay variety soybeans and non-nodulating soybeans of Clay background were grown in rows spaced 45 cm apart. The sub-plots for N^{15} and P^{33} were two meters long and the yield plots were eight meters long. Plots were irrigated as needed.

The seed yield was increased significantly with all phosphorus fertilizer placements and no significant differences were noted among placements either in yield or phosphorus derived from fertilizer.

Treatment	Seed yield kg/ha	Total nutrient uptake (kg/ha) N	P	Nutrient derived from fertilizer N %	P %
1) 30 kg N + 80 kg P_2O_5 (mixed in top 8 cm soil)	3867	314	45	3.6	27.3
2) 30 kg N + 80 kg P_2O_5 (surface broadcast)	4035	327	53	3.0	23.4
3) 30 kg N + 80 kg P_2O_5 (4 cm away from row on surface)	3941	305	47	4.2	27.7
4) 30 kg N + 80 kg P_2O_5 (4 cm away from row, 8 cm deep)	3811	307	47	3.7	27.4
5) 30 kg N + 80 kg P_2O_5 (22.5 cm away from row, 8 cm deep)	3929	320	51	3.0	27.0
6) 30 kg N + 258 kg/ha gypsum (mixed in top 8 cm soil)	3214	269	35	3.7	-
7) 0N + 80 kg P_2O_5 (mixed in top 8 cm soil)	3975	315	51	-	28.5
8) 258 kg/ha gypsum (mixed in top 8 cm soil)	3200	257	35	-	-
9) Nonnodulating crop 100 kg N + 80 kg P_2O_5 (mixed in top 8 cm soil)	3186	255	47	16.5	45.2

* All nitrogen was broadcast and mixed in top 8 cm soil; placements in parentheses refer to P or gypsum placement.

PESTICIDE INTERACTION PLOTS AT ROSEMOUNT

Russell S. Adams, Jr.

In 1973 an experiment began at Rosemount, Minnesota which is examining the effects of combinations of the insecticide Furadan, the herbicide Atrazine and soil pH. Treatments included Furadan at 0, 0.5 and 2 pounds per acre, Atrazine at 0, 2, 4 and 8 pounds per acre and soil pH ranging from pH 5.5 to pH 7.2. Each treatment was replicated four times.

Both weed and corn root worm infestation were extremely variable in 1973. One replication might have little or no infestation and thus show no damage from weeds or insects. Whereas, another replication might be severely infested and sustain considerable damage. As a result of the large variability, differences frequently were not statistically different and may have been due to chance alone. No interaction effects of Furadan with Atrazine, Atrazine with soil pH, or Furadan with Atrazine with soil pH occurred. Slightly better yields of corn were obtained with the Furadan treatments at an intermediate pH. Corn yields were directly related to stand ranging from 54 to 165 bushels per acre at populations of 8,700 to 29,100 stalks per acre. Lodging from corn root worm damage was least where weed populations were high.

Data comparing Furadan treatments to lodging and corn yields and Atrazine to weed control and corn yields are given in Tables 1 and 2, respectively.

Table 1. Corn lodging and grain yields at three rates of Furadan at Rosemount in 1973.

Rate of Furadan lbs/A	Lodging %	Grain Yields bu/A
0	39 a*	104 a
0.5	30 b	109 ab
2.0	17 c	112 b

* Numbers followed by the same letter are not significantly different at the 5% level.

Table 2. Weed and corn grain yields at three rates of Atrazine at Rosemount in 1973.

Rate of Atrazine lbs/A	Weed Yields Broadleaf	Weed Yields Grass	Grain Yields bu/A
	----- tons/A -----		
0	0.11 a	0.97 a*	103 a
2	0.04 b	0.30 b	111 ab
4	0.01 b	0.19 bc	110 ab
8	0 b	0.03 c	107 a

* Numbers followed by the same letter are not significantly different at the 5% level.