Corn leaves on the different treatments failed to exhibit any marked symptoms of boron deficiency at any observed time during the growing season, and there was no observable effect on the ear shape, kernel production, or in the percentage of barren stalks or nubbin development. Since the growing season of 1961 was relatively favorable for corn production, relatively high corn yields were obtained except on the lower lying and untiled McLeod county field.

The experiment will be continued in 1962 for the purpose of obtaining additional results on the possible boron need for maximum corn production in Minnesota.

Table 3. Effects of Different Fertilizer Treatments to Anoka loamy fine sand on the 1961 Yield of Ear Corn Medium and Heavy Plant Populations. (Isanti County-Laurence Collin farm--Isanti.)

A. 15,000-15,500 stalks per acre.

Fertilizer Treatments: Special Fertilizer (lbs/A)	Starter (lbs/A)	S.D. (lbs/A)	Replication I	II	III	IV	V	VI	Average of 6 reps	Increases over check
			(Bushel of ear corn per acre at 15.5% moisture)							
----------	110#4-12-36	----------	85	103	98	42	101	96	67	----
----------	"	155#N,120#K_2O	98	103	110	108	102	117	106	Check
1 Boron (broadcast)	"	"	100	113	112	100	116	102	107	1
2 " "	"	"	99	108	103	102	98	102	102	-4
1 " (row)	"	"	100	108	110	96	109	98	104	-2
2 " "	"	"	106	116	102	96	99	104	104	-2
6 Solubor (foliar)	"	"	105	114	99	91	98	90	100	-6
15 FTE (broadcast)	"	"	91	106	101	103	113	118	105	-1

B. 21,500-22,000 stalks per acre.

----------	110#4-12-36	----------	104	93	112	93	97	113	102	----
----------	"	155#N, 120#K_2O	127	106	117	84	120	92	108	Check
1 Boron (broadcast)	"	"	121	111	119	113	105	114	114	6
2 " "	"	"	128	108	114	109	114	110	114	6
1 " (row)	"	"	106	112	121	110	109	115	112	4
2 " "	"	"	121	102	121	99	108	120	112	4
6 Solubor (foliar)	"	"	114	93	114	105	112	104	107	-1
15 FTE (broadcast)	"	"	112	116	120	107	116	81	109	1

1961 Field Experiments Using Iron and Magnesium Ammonium Phosphates on Corn and on Chlorotic Soybeans Growing on Calcareous Webster Clay Loam Near Springfield -- Brown County and to Falx on Hegne Clay Loam Near Fisher -- Polk County

J. M. MacGregor & R. G. Hanson

Two newly developed experimental fertilizer materials were applied at four different rates of application to chlorotic soybeans and to slowly growing corn on a "high lime" Webster clay loam on the Matt Holles farm four miles west and one-half mile south of Springfield in western Brown county. These materials were:

1. Ferrous ammonium phosphate (7-35-0) containing 7% nitrogen, 35% available P_2O_5, and 26% ferrous iron.

2. Magnesium ammonium phosphate (8-40-0) containing 8% nitrogen, 40% available P_2O_5, and 24% magnesium oxide.

The two materials were available in either granular or in powder form. Only the granular form was used at Springfield on the soybeans and on the corn (Tables 1 and 2) -- both forms were used on the chlorotic flax experiment near Fisher in Polk County (Table 3).

An area of chlorotic Lindarin soybeans and slowly growing field corn was reported on a limited "high lime" area of Webster silty clay loam on the Matt Holles farm west of Springfield in late June. On July 7th, a randomized block experiment was set up for both crops, using four rates of both of the two metal ammonium phosphates previously mentioned to supply 5, 10, 20 and 50 pounds of iron per acre, and the 8-40-0 at rates which would supply the same amounts of nitrogen and phosphorus as with the 7-35-0. One additional basic treatment consisted of APCA-Fe (Chel 138-Fe) to supply chelated iron at the rate of five pounds per acre since this was a known effective treatment. An untreated row was also included to make a total of ten treatment rows in each of the four replications. All materials were applied two inches to one side of each soybean row and two inches below the soil surface by hoeing out a trench and placing the granulated metal ammonium phosphates and the powdered iron chelate in the trench and then filling it in. The corn treatments were made directly alongside each hill, approximately one to two inches beneath the surface of the soil.

During the following three week period, scattered rains totaled only 1.10" and on July 20th, it was visually evident that the Chel 138-Fe was effective in alleviating the soybean chlorosis, but the 7-35-0 and 8-40-0 treatments were not. None of the three material treatments produced any visual improvement in corn growth.

Precipitation increased during August and was relatively ample both in August and in September, with the chelated Fe treatment apparently producing the only beneficial effect on soybean color and plant development.

The soybeans and the corn were harvested on October 7th, and the granular 7-35-0 and 8-40-0 applied in early July still remained in the soil in granules apparently similar to those applied, and this limited solubility was probably a major reason for the relative ineffectiveness of these two materials in these calcareous soils in 1961. Increased solubility of these two materials might have produced a beneficial growth effect. The yields obtained are shown in Tables 1 and 2.

Table 1. 1961 yields of soybeans growing on calcareous Webster clay loam and fertilized with Ferrous Ammonium Phosphate (7-35-0), Magnesium Ammonium Phosphate (8-40-0), and Iron Chelate 138 (6% Fe). Matt Holles Farm, Springfield.

(Average of 4 replications)

Yield Rank	Treatments: Fertilizer Applied	lbs./A Applied	lbs./A Mg	lbs./A Fe	Yield of Soybeans in bu./A
1	Chelate 138	83	0	5	24.5**
2	7-35-0	200	0	50	17.7
3	Check	0	0	0	17.3
4	8-40-0	35	8.4	0	17.0
5	8-40-0	70	16.8	0	15.1
6	8-40-0	18	4.2	0	14.5
7	7-35-0	80	0	20	14.0
8	7-35-0	40	0	10	13.1
9	7-35-0	20	0	5	12.7
10	8-40-0	175	42.0	0	10.1**

Student-Newman-Kuels Range = 0.05

** Significantly different from check at the 1% level

8-40-0 = 24% Mg, 8% N, 40% P_2O_5

7-35-0 = 25% Fe, 7% N, 35% P_2O_5

Table 2. 1961 yields of corn growing on calcareous Webster clay loam and fertilized with Ferrous Ammonium Phosphate (7-35-0), Magnesium Ammonium Phosphate (8-40-0), and Iron Chelate 138 (6% Fe). Matt Holles Farm, Springfield.
(Average of 4 replications -- at 15% moisture)

Yield Rank	Treatments				Yield of corn at bu./A
	Fertilizer Applied	lbs./A Applied	lbs./A Mg	lbs./A Fe	
1	7-35-0	80	0	20	42.3*
2	8-40-0	17.5	42	0	40.7*
3	7-35-0	200	0	530	39.4
4	Chelate 138	83	0	5	39.0
5	8-40-0	17.5	4.2	0	38.4
6	8-40-0	70	16.8	0	37.8
7	7-35-0	20	0	5	37.4
8	Check	0	0	0	36.9
9	8-40-0	35	8.4	0	36.7
10	7-35-0	40	0	10	35.9

Student-Newman-Kuels Range = 0.05
* Significantly different from check above the 5% level

8-40-0 = 24% Mg
8% N
40% P_2O_5

7-35-0 = 25% Fe
7% N
35% P_2O_5

It is evident that the chelated iron was effective for improving soybean yields, but had no appreciable effect on improving corn growth. The metal ammonium phosphates were ineffective at the four rates of application used.

A smaller, two replicate experiment was placed on the Hegne clay loam of the Sam Berland farm near Fisher, in Polk County to try and remedy a chlorotic condition in flax. Both the 7-35-0 and the 8-40-0 were applied in powder and in a granular forms to the soil surface as a broadcast application. No chelated iron was applied to this field.

There was no visible effect of improvement of the chlorotic condition from the different treatments used. The resulting flax yields are shown in Table 3. All treatments were made at the rate of 50 pounds of material per acre.

Table 3. The effect of 7-35-0 and of 8-40-0 when applied to chlorotic flax in late June on Hegne clay loam near Fisher (Sam Berland farm).

	Flax Yield in bu./A.		
Treatment & Form	Replicate[1]	Replicate[2]	Average
None	9.3	10.1	9.7
7-35-0 - Granular (25% Fe)	8.4	7.3	7.9
8-40-0 - Granular (24% MgO)	7.1	8.1	7.6
7-35-0 - Powdered	8.1	7.4	7.8
8-40-0 - Powdered	9.0	9.3	9.2

It is evident that applications of either of the two materials to the surface of the soil at the rate of 50 pounds per acre failed to increase flax growth or to increase flax yields.

Fertilizer Rotation Studies at the Waseca Morris and Crookston Branch Experiment Stations (1961 Results)

A. C. Caldwell, J. R. Kline, Roy Thompson, John Thompson, and Henry Kramer

Introduction

The permanent fertilizer rotation plots which are established at the Waseca, Morris, and Crookston Branch Experiment Stations have now been in existence for 6 years. These plots were designed to evaluate the effects of the nutrients, nitrogen, phosphorus, and potash, on soil properties and crop response when crops are grown in typical rotations for an area. While all crops receive the three nutrients alone and in all combinations with one another the rates of application are selected appropriately for the specific crops. All fertilizers are applied as a broadcast application in the spring with the exception of a small portion for corn which is applied as a starter at planting.

The crops at Morris and Waseca are in a five year rotation. Continuous corn is also grown at both stations. The rotations at the Waseca and Morris stations are as follows:

Waseca	Morris
corn	corn
corn	corn
soybeans	soybeans
oats	flax
alfalfa	alfalfa
continuous corn*	continuous corn*

The Crookston experiment consists of two rotations, a three and a four year rotation. The three year rotatinn consists of a sequence of sugar beets, wheat and sweet clover fallow. The four year rotation is a sequence of corn, soybeans, wheat and alfalfa.

Besides the regular fertilizer treatments an extra plot has been added to each experiment which receives a very heavy treatment of N, P, and K. These plots, which are known as NPK+ treatments are not analyzed statistically with the rest of the experiment but are used to make qualitative comparisons.

Waseca Yields

Corn

Corn yields were higher in 1961 than they have been since the first year of the experiment. They ranged from 130 to about 160 bushels per acre with unfertilized plots for the three corn strips averaging about 140 bushels per acre. No yield response to any fertilizer treatment was observed on either the continuous corn or the first year corn. Yield increases amounting to about 11 bushels per acre were obtained with the application of potassium on second year corn.

The reported yields have been corrected to a stand of 20,000 plants per acre although this stand was not actually obtained on a few plots due to pheasant infestion. As has been the usual practice, soil insects were controlled by the use of alderin and weeds were controlled by the use of a band spray application of Randox T.

Oats

Fertilizer treatments resulted in reduced grain yields with respect to the untreated plots although the results were not statistically significant. The yields ranged from 60 to about 78 bushels per acre in spite of the fact that the plots were uniformly lodged. The degree of lodging was severe on all plots.

Significant increases in yield of oats forage were found due to the application of N, P, and K. N and K applications resulted in about 1 ton increases while P applications resulted in a 2 ton per acre increase.

Soybeans

Soybean yields ranged from 31 to 37 bushels per acre but no treatment effect was found. Observations made in late summer showed that all plots treated with potassium had moderate lodging of bean plants. This had no effect on ultimate yield.

Five years of data from these plots were tabulated and analyzed statistically (table 9). The results show that the fertility program as practiced in this experiment has produced no significant increase in the long term yield of soybeans.

Alfalfa

Two crops of alfalfa were obtained. Yields of the first crop ranged from 2.4 to 3.5 tons per acre with phosphorus giving a significant increase.

Lower yields were obtained on the second crop and no fertilizer response was found.

Waseca 1961

Table 1. Yield of Continuous Corn

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	139.6	---	
N	160 + 0 + 0	144.4	4.8	
P	0 + 160 + 0	147.4	7.8	
K	0 + 0 + 160	145.7	6.1	
NP	160 + 160 + 0	136.1	-3.5	
NK	160 + 0 + 160	141.2	1.6	
PK	0 + 160 + 160	144.4	4.8	
NPK	160 + 160 + 160	147.6	8.0	
NPK+	320 + 320 + 320	154.4	14.8	

Table 2. Yield of First Year Corn

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	139.0		
N	40 + 0 + 0	142.0	3	
P	0 + 80 + 0	133.0	-6	
K	0 + 0 + 80	133.3	-5.7	
NP	40 + 80 + 0	136.4	-2.6	
NK	40 + 0 + 80	154.9	15.9	
PK	0 + 80 + 80	152.7	13.7	
NPK	40 + 80 + 80	148.6	9.6	
NPK+	80 + 160 + 160	152.1	13.1	

Waseca 1961

Table 3. Yield of Second Year Corn

Treatment	Lbs./A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	141.7		
N	80 + 0 + 0	156.8	15.1	
P	0 + 80 + 0	142.7	1.0	
K	0 + 0 + 80	150.3	8.6	10.9*
NP	80 + 80 + 0	132.3	-9.4	
NK	80 + 0 + 80	151.7	10.0	
PK	0 + 80 + 80	152.4	10.7	9.1**
NPK	80 + 80 + 80	162.7	21.0	
NPK+	160 + 160 + 160	161.9	20.2	

* Indicates significance at 95% level

** Indicates significance at 99% level

Table 4. Yield of Oats Grain

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	77.6		
N	80 + 0 + 0	64.8	-12.8	
P	0 + 80 + 0	76.2	- 1.4	
K	0 + 0 + 80	63.3	-14.3	
NP	80 + 80 + 0	72.4	- 5.2	
NK	80 + 0 + 80	60.4	-17.2	
PK	0 + 80 + 80	66.5	-11.1	
NPK	80 + 80 + 80	61.0	-16.6	
NPK+	120 + 160 + 160	74.4	- 3.2	

Waseca 1961

Table 5. Yield of Oats Forage[1]

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield tons/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	6.66	-	
N	80 + 0 + 0	8.27	1.61	0.96*
P	0 + 80 + 0	8.59	1.93	2.04**
K	0 + 0 + 80	8.57	1.91	1.14*
NP	80 + 80 + 0	10.54	3.88	
NK	80 + 0 + 80	8.76	2.10	
PK	0 + 80 + 80	10.60	3.94	
NPK	80 + 80 + 80	10.70	4.04	
NPK+	120 + 160 + 160	10.46	3.80	

[1] Yields are in tons of Fresh Forage (69.2% moisture).

Table 6. Yields of Soybeans

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	32.6	---	
N	20 + 0 + 0	35.5	2.9	
P	0 + 40 + 0	37.4	4.8	
K	0 + 0 + 40	35.6	3.0	
NP	20 + 40 + 0	31.0	-1.6	
NK	20 + 0 + 40	36.8	4.2	
PK	0 + 40 + 40	34.6	2.0	
NPK	20 + 40 + 40	33.8	1.2	
NPK+	40 + 80 + 80	36.7	4.1	

Waseca 1961

Table 7. Yield of First Crop Alfalfa[1]

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield T/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	2.75	-	
N	20 + 0 + 0	2.66	-.26	
P	0 + 80 + 0	3.13	1.15	0.75**
K	0 + 0 + 80	2.42	-1.0	
NP	20 + 80 + 0	3.36	1.82	
NK	20 + 0 + 80	2.54	- .62	
PK	0 + 80 + 80	3.53	2.33	0.22*
NPK	20 + 80 + 80	3.38	1.90	
NPK+	20 + 160 + 160	2.54	-0.21	

[1] Yields are corrected to 15% moisture

Table 8. Yield of Second Crop Alfalfa[1]

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield T/A	Difference from untreated	Treatment Effect
None	0 - 0 - 0	1.27	-	
N	20 + 0 + 0	1.18	-0.09	
P	0 + 80 + 0	1.31	0.04	
K	0 + 0 + 80	1.30	0.03	
NP	20 + 80 + 0	1.42	0.15	
NK	20 + 0 + 80	1.36	0.09	
PK	0 + 80 + 80	1.35	0.08	
NPK	20 + 80 + 80	1.45	0.18	
NPK+	20 + 160 + 160	1.55	-0.28	

[1] Yields corrected to 15% moisture.

Waseca 1956-1960

Table 9. Five Year Average Yield of Soybeans

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 - 0 - 0	31.1	[illegible]	
N	20 - 0 - 0	32.5	1.4	
P	0 - 40 - 0	32.7	1.6	
K	0 - 0 - 40	31.0	-0.1	
NP	20 - 40 - 0	32.7	1.6	
NK	20 - 0 - 40	31.9	0.8	
PK	0 - 40 - 40	32.4	1.3	
NPK	20 - 40 - 40	33.2	2.1	
NPK+	40 + 80 + 80	33.3	2.2	

Morris Yields

Corn

Continuous corn yields ranged from 53 to about 84 bushels per acre on a stand of 15,600 stalks per acre of drilled corn. Nitrogen has continued to be an important factor in the production of continuous corn as yields were increased by about 23 bushels per acre by this nutrient.

Yields were decreased significantly by the use of nitrogen on both first and second year corn. The decrease amounted to about 8 bushels per acre on both years of corn. This observation has not been explained.

Soybeans

Soybean yields ranged from 16 to 21 bushels per acre in the experiment proper and to 29.6 bushels per acre on the NPK+ plots. No statistical treatment effect was found.

The five year average yields of soybeans were computed and analyzed statistically (table 16). Average annual yields of beans ranged from 23 to 27 bushels per acre. Forty pounds of P per acre annually was found to give an average annual yield increase of 2.4 bushels per acre. This increase was significant at the 95% level.

Flax

Flax yields were poor in 1961 in ranging from only 8 to 11 bushels per acre. No treatment effect was found.

The average annual yield of flax was calculated for five years and found to range from 17 to 20 bushels per acre (table 17). Nitrogen at the rate of 60 lbs. per acre annually was found to give a small but significant average yield increase. On the other hand 40 lbs. P_2O_5 per acre resulted in a small but significant average yield decrease.

Alfalfa

Only one crop of alfalfa was obtained in 1961 due to the fact that the stand had suffered severe winter killing. The yields ranged from 0.2 to 0.9 tons per acre. Phosphate treatments resulted in a yield increase of over 0.4 tons per acre. Nitrogen treatments on the other hand showed yield decreases amounting to 0.2 tons per acre.

Table 10. Yield of Continuous Corn

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	61.0	-	
N	160 + 0 + 0	74.1	13.1	22.9**
P	0 + 160 + 0	59.5	- 1.5	
K	0 + 0 + 40	57.1	- 3.9	
NP	160 + 160 + 0	81.7	20.7	
NK	160 + 0 + 40	84.3	23.3	
PK	0 + 160 + 40	53.2	- 7.8	
NPK	160 + 160 + 40	82.4	21.4	
NPK+	320 + 320 + 80	70.2	9.2	

Table 11. Yield of First Year Corn

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	56.0	-	
N	60 + 0 + 0	48.7	- 7.3	-8.2*
P	0 + 40 + 0	66.7	10.7	
K	0 + 0 + 40	59.8	3.8	
NP	60 + 40 + 0	57.4	1.4	
NK	60 + 0 + 40	51.8	- 4.2	
PK	0 + 60 + 40	53.2	- 2.8	-8.2*
NPK	60 + 40 + 40	44.9	-11.1	
NPK+	100 + 120 + 80	58.0	2.0	

Morris 1961

Table 12. Yield of Second Year Corn

Treatment	Lbs/A $N+P_2O_5+K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	81.9	-	-7.6 (90%)
N	80 + 0 + 0	78.6	- 3.3	
P	0 + 80 + 0	75.4	- 6.5	
K	0 + 0 + 40	78.9	- 3.0	
NP	80 + 80 + 0	73.9	- 8.0	
NK	80 + 0 + 40	67.8	-14.1	
PK	0 + 80 + 40	85.5	3.6	
NPK	80 + 80 + 40	70.6	-11.3	
NPK+	120 + 120 + 80	74.0	- 7.9	

Table 13. Yield of Soybeans

Treatment	Lbs/A $N+P_2O_5+K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	17.8	-	
N	20 + 0 + 0	19.2	1.4	
P	0 + 40 + 0	17.8	0	
K	0 + 0 + 40	17.7	-0.1	
NP	20 + 40 + 0	21.5	3.7	
NK	20 + 0 + 40	18.3	0.5	
PK	0 + 40 + 40	16.2	-1.6	
NPK	20 + 40 + 40	19.7	1.9	
NPK+	40 + 80 + 80	29.6	11.8	

Table 14. Yield of Flax

Treatment	Lbs/A $N+P_2O_5+K_2O$	Average Yields bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	10.4	-	
N	60 + 0 + 0	10.8	0.4	
P	0 + 40 + 0	9.9	-0.5	
K	0 + 0 + 20	11.1	0.7	
NP	60 + 40 + 0	10.3	-0.1	
NK	60 + 0 + 20	11.4	1.0	
PK	0 + 40 + 20	10.6	0.2	
NPK	60 + 40 + 20	8.7	-1.7	
NPK+	120 + 80 + 40	7.7	-2.7	

Table 15. Yield of Alfalfa

None	0 + 0 + 0	0.25	-	
N	20 + 0 + 0	0.18	-0.07	-0.21**
P	0 + 80 + 0	0.78	0.53	0.42**
K	0 + 0 + 40	0.18	-0.07	
NP	20 + 80 + 0	0.42	0.17	-0.18**
NK	20 + 0 + 40	0.19	-0.06	
PK	0 + 80 + 40	0.88	0.63	
NPK	20 + 80 + 40	0.44	0.19	
NPK+	20 + 160 + 80	0.38	0.13	

Table 16. Five Year Average Yield of Soybeans

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	23.6		
N	20 + 0 + 0	23.8	0.2	
P	0 + 40 + 0	26.6	3.0	2.4*
K	0 + 0 + 40	22.8	-0.8	
NP	20 + 40 + 0	25.8	2.2	
NK	20 + 0 + 40	24.2	0.6	1.3 (90%)
PK	0 + 40 + 40	24.4	0.8	
NPK	20 + 40 + 40	27.4	3.8	
NPK+	40 + 80 + 80	26.2	2.6	

Table 17. Five Year Average Yields of Flax

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	18.4	-	
N	60 + 0 + 0	18.4	0.0	1.1 (90%)
P	0 + 40 + 0	16.6	-2.2	-1.3*
K	0 + 0 + 20	17.3	-1.1	
NP	60 + 40 + 0	17.7	-0.7	
NK	60 + 0 + 20	20.1	1.7	
PK	0 + 40 + 20	17.0	-1.4	
NPK	60 + 40 + 20	17.7	-0.7	
NPK+	120 + 80 + 40	19.5.	1.1	

Crookston Yields

Alfalfa - Soybeans

Yields not obtained in 1961.

Sugar beets

Yields of sugar beets were exceptionably large ranging from 23 to 32 tons per acre. Phosphorus at the rate of 120 pounds per acre resulted in an average yield increase of 4.8 tons.

Wheat (3 and 4 year rotation)

Yields were significantly increased by phosphorus treatments in both rotations.

Corn

Corn yields ranged from 55 to 91 bushels per acre with significant increases to 40 lbs. P_2O_5 per acre.

Crookston 1961

Table 18. Yields of Sugar Beets

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield T/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	23.2		
N	40 + 0 + 0	25.3	2.1	
P	0 + 120 + 0	32.3	9.1	4.8**
K	0 + 0 + 40	22.9	-0.3	
NP	40 + 120 + 0	25.3	2.1	-2.3*
NK	40 + 0 + 40	23.0	-0.2	
PK	0 + 120 + 40	28.3	5.1	
NPK	40 + 120 + 40	28.2	5.0	
NPK+	80 + 240 + 80	29.3	6.1	

Table 19. Yield of Wheat; Three Year Rotation

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	17.8		
N	20 + 0 + 0	22.5	4.7	
P	0 + 40 + 0	33.0	15.2	14.9**
K	0 + 0 + 20	20.3	2.5	
NP	20 + 40 + 0	32.4	14.6	
NK	20 + 0 + 20	13.4	-4.4	
PK	0 + 40 + 20	29.0	11.2	
NPK	20 + 40 + 20	39.3	11.5	
NPK+	40 + 80 + 40	31.8	14.0	

Crookston 1961

Table 20. Yield of Wheat; Four Year Rotation

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	28.2		
N	40 + 0 + 0	27.1	-1.1	
P	0 + 40 + 0	33.0	4.8	5.6*
K	0 + 0 + 20	26.0	-2.2	
NP	40 + 20 + 0	35.3	7.1	
NK	40 + 0 + 20	28.8	0.6	
PK	0 + 40 + 20	29.4	1.2	
NPK	40 + 40 + 20	34.8	6.6	
NPK+	40 + 120 + 40	40.1	11.9	

Table 21. Yield of Corn

Treatment	Lbs/A $N-P_2O_5-K_2O$	Average Yield bu/A	Difference from untreated	Treatment Effect
None	0 + 0 + 0	57.0		
N	40 + 0 + 0	59.9	2.9	
P	0 + 40 + 0	82.3	25.3	23.5**
K	0 + 0 + 20	62.3	5.3	
NP	40 + 40 + 0	84.8	27.8	
NK	40 + 0 + 20	55.1	-1.9	
PK	0 + 40 + 20	76.6	19.6	
NPK	40 + 40 + 20	84.8	27.8	
NPK+	80 + 120 + 40	90.7	33.7	

THE NICOLLET COUNTY PLOTS
Soil Fertility and Crop Production Studies on the Webster Soils of Southern Minnesota

W. P. Martin, Fred Wetherill and H. W. Kramer

Yield Results - 1960

Re: 1959 results, "A Report on Soils and Soil Fertility", p. 74. Dept. Soils, Mimeo, April 1960; ibid 1960 results, p. 44, Feb. 1961.

Soils: Webster and closely related Nicollet silty clay loams; level topography, minimum erosion, adequate tile drainage.

Cropping systems: (established 1948) (1) corn-oats, (2) corn-oats with clover green manure, (3) 4-yr. rotation of oats-hay-corn-corn extended to five years in 1958 with soybeans between two corn years, and (4) continuous corn included beginning in 1954.

Fertilizer treatments: Multiple rates and materials including barnyard manure at regular and "extra" heavy levels; see tables for treatments and 1959 report for details on materials, rates and methods of applications. There were four replications.

CONTINUOUS CORN: RATE AND TIME OF APPLICATION

Nitrogen:		Yield results:	
Rate	Time*	Starter only**	+PK broadcast***
None	0-0-0	42 bu.	48 bu.
40 lbs	1-0-0	76	98
80 "	1-1-0	105	115
120 "	1-1-1	101	121
80 "	1-0-1	91	109
80 "	0-1-1	94	114
40 "	0-0-1	74	93
40 "	0-1-0	79	101
80 "	2-0-0	102	125
120 "	3-0-0	107	121

* 0-0-0 refers to time of application, i.e. planting time-first cultivation-second cultivation.
** 175 lbs. 6-24-12 starter in row at planting time.
*** Starter plus 300 lbs. 0-20-20 broadcast.

CORN-OATS, WITH AND WITHOUT LEGUME GREEN MANURE: (three replications)

	Corn:	(with legume)	Oats:	(with legume)
1. Check	52 bu.	61 bu.	41 bu.	46 bu.
2. N on oats	60	68	70	63
3. NP on oats	52	74	92	104
4. NPK on oats	55	71	92	108
5. P plowdown	57	73	49	75
6. NPK in hill	58	86	46	66
7. N plowdown	73*	60*	67*	48*
8. N sidedress	88*	67*	73*	38*
LSD (5%)	13	15	20	8.9

*One replication only

CORN-SOYBEANS-CORN-OATS-HAY (WITH REGULAR AND EXTRA-HEAVY FERTILIZATION LEVELS):(four replications)

Treatments (regular)	Corn (1)		Soybeans		Corn (2)		Oats		Hay	
	Reg.	Extra*	Reg.	Extra*	Reg.	Extra*	Reg.	Extra*	Reg.	Extra*
6. Check	70 bu.	108 bu.	35 bu.	46 bu.	68 bu.	113 nu.	59 bu.	101 bu.	4.6 t.	5.1 t.
1. P for oats	86	94	40	46	78	69	64	56	4.8	5.3
2. PK for oats	81	104	39	46	80	72	58	47	5.0	5.8
7. NP for oats	88	107	38	42	82	79	99	85	5.5	5.3
3. NPK for oats	84	123	38	46	75	77	95	74	4.8	5.4
10. P for oats & corn	95	108	41	43	81	115	59	56	5.4	5.0
9. P for corn	84	98	39	43	79	84	50	81	5.5	5.3
4. Manure for corn	115	119	47	48	95	130	57	51	4.7	5.3
8. Manure & P for corn	110	115	49	48	87	120	61	65	4.8	5.4
5. " & NPK for corn	120	127	44	47	94	108	65	56	4.7	5.6
LSD (5%)	13.5	16	6.5	5.5	-	15.7	10.3	13	0.22	0.32

*Refers to extra-heavy fertilization treatments in addition to regular treatments outlined.

Profit Possibility Plots

(NPK rates on corn 1961)

C. J. Overdahl, John Grava, L. D. Hanson, M. V. Halverson and James App

The 1961 demonstration plots on corn were designed to show the economics of fertilizer use. Approximately 65 out of 90 established plots were harvested. Hail and uneven stands reduced the number available for summary to 55.

Fertilizer was packaged and furnished to county agents along with complete instructions on plot establishment.

Emphasis was placed on starter fertilizer with half of the total plot area receiving broadcast potash on plots in the eastern portion of the state, while phosphate was broadcast on half the plot area in western Minnesota. Different rates of N, P and K were used to observe most profitable responses and soil test relationships.

Results in southeast Minnesota (13 fields)

Nitrogen (all starter rows had 15 lbs of nitrogern per acre)

supplemental nitrogen	Increase in bushels/acre
25#	6
65#	8

phosphate (N treatment 80#, K_2O = 30#)

soil test level	low	med	high	very high
number fields	2	1	5	5
	yield increases			
30# P_2O_5 row	0	10	9	-8
60# P_2O_5 row	9	8	9	1

potash (N treatment 80#, P_2O_5 = 30#)

soil test level	low	med	high
number fields	4	4	5
	yield increases		
30# K_2O (row)	23	5	0
60# K_2O (row)	26	16	1
60# K_2O (brcst)	14	4	3
90# K_2O (30#r + 60#br)	20	17	1
120# K_2O (60#r + 60#br)	23	10	1

All broadcast potash was applied on plowed land and incorporated into the soil. Broadcast potash plowed under might have shown better results. Nitrogen was applied on the surface down the middle of paired rows. Rainfall appeared adequate to move nitrogen into the soil but perhaps if applied closer to the row or placed deeper results would have been better. Corn followed a non-legume crop and a larger response to nitrogen would have been expected. Subsoil phosphorus on most of these soils is high which appears to make responses to row applied phosphorus on low tests about equal to that of the high tests. There was no broadcast phosphate on these 13 fields.

Results on coarse textured soils (10 fields in Washington, Chisago, Anoka Mille Lacs and Isanti counties.)

	rate	increase
supplemental nitrogen *	25# S D	14 bu
	65# S D	21 bu
phosphate **	30# row	6 bu
potash	low test	medium test
30# K_2O (row)	9 bu increase	7 bu increase
60# K_2O (bcst)	9 bu increase	-2 bu increase
90# K_2O (30#r + 60#bct)	13 bu increase	8 bu increase

* all starter rows had 15 lbs of N plus adequate P and K corn on most plots appeared to need more than 80 pounds of nitrogen

** all plots had high phosphorus tests and increas s were determined where N and K were adequate.

Results southwest Minnesota (32 fields)

Nitrogen (all starter rows had 10 lbs of N per acre)

supplemental nitrogen	Increase in bu/acre
30#	3
70#	8

Phosphate (N treatment 80#, K_2O = 40#)

soil test level	low	medium	high	very high
number fields	6	14	9	3
	yield increases in bu/acre			
40# P_2O_5 (row)	2	3	1	-4
40# P_2O_5 (brcst)	10	3	4	-1
80# P_2O_5 (40r + 40#bct)	11	4	4	-4

Potash (nitrogen treatment 80#, P_2O_5 = 40# or 80#)

soil test level	low-med	high-med	high
number fields	8	6	18
	yield increases in bu/acre		
40# K_2O (row)	6	5.5	2

Responses to nitrogen and phosphate in 1961 in the western half of the state were lower than in past years, particularly for phosphate. The following are individual treatment effects showing the variation from field to field. Corn followed a non-legume crop on all but four fields. Four followed soybeans.

Yield increases due to 80# N

(Barnes-Aasted and Moody soils)

-11, -1, 1, 8, 4, 28, 6, 3, 5, -1, 2, 19, -3, -6, 1, 15, 1. AVERAGE = 4 bu

(Clarion-Webster soils)
after non-legume

10, 17, 10, 11, 27, 8, 7, 37, 10, 12, 26. AVERAGE = 16 bushels

after soybeans

-2, 1, 8, 2. AVERAGE = 2 bushels

phosphate yield increases

(Barnes-Aasted and Moody soils)

40 lbs P_2O_5 in row

low test	10, 5, 10, 1, -2, -13
high test	-1, -8, -8, -9

80 lbs P_2O_5 (40 row + 40 bcst)

low test	16, 12, 9, 7, 2, 21
high test	0, -7, -7, -19

The yield reductions from phosphate particularly on high testing soils in western Minnesota appears to occur consistently.

A multilithed booklet will be made regarding the profits from these plots. In general on coarse and medium textured soils in the eastern portion of the state profits were very high from starter applications of P and K. In western Minnesota profits appeared to be as good or better from broadcast phosphate. Profits from potash in the row on low and medium tests were extremely high.

Fertilizer materials were supplied by the Minnesota Fertilizer Industry Association and funds for packaging and delivering fertilizer to the counties were supplied by the National Plant Food Institute.

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FIELD FERTILITY STUDIES WITH CORN ON FAYETTE SOILS - 1961

John Grava and Lowell D. Hanson[1]

The Fayette soils of southeastern Minnesota often have puzzled soil fertility men. On one hand, their light color would lead one to suspect that he is dealing with low-producing soils. On the other hand, we often see evidence of unexpectedly high productivity. Harold Jones and others[2], for example, in their demonstration "Corn Yesterday and Today" produced 123 bushels/acre yield under proper management in Goodhue County. Top corn yields are produced almost every year by farmers in southeastern Minnesota who participate in Minnesota's X-tra Yield Corn Contest. Consequently, properly managed Fayette soils are given the highest yield potential ratings of any soil in the state.

Fayette soils originally were included in the Fayette-Tama Soil Association. This association occupies about 2.3 million acres in southeastern Minnesota. All of Houston, Wabasha, and parts of Fillmore, Winona, Olmsted, Goodhue and Dodge Counties are included in it. A large portion of the region has a rugged topography which is more pronounced near the Mississippi River, and its larger tributaries. Recently the Fayette-Tama soil area was split up into two separate associations, namely the Fayette-Dubuque, and the Tama-Downs. The Fayette-Dubuque are light-colored, silty soils developed under forest vegetation and underlain by limestone. Fayette soils are deep and have silty subsoils. Dubuque soils are shallow with clayey subsoils over limestone. Topography ranges from rolling to steep. Erosion is serious. The Fayette-Dubuque soils occupy about 1.5 million acres in Minnesota, and are also extensively distributed in southwestern Wisconsin and northeastern Iowa.

Soil test summaries[3] of 10,522 samples received from southeastern Minnesota (Fayette-Dubuque and Tama-Downs areas combined) indicate the following fertility trends: 92% of all samples had silt loam textures; 64% of all samples tested less than 3.1% in organic matter content; 33% of these samples showed pH values of less than 6.3; 65% of samples showed high and very high phosphorus levels; 80% of samples had low to medium potassium contents.

An NPK-Rate Study was initiated last spring in southeastern Minnesota to solve several problems encountered in our soil testing program. The Fayette soil and the corn crop were chosen for the experiments because of their agricultural importance in the area. The main objectives of this study were:

1. To evaluate the reliability of the present soil testing methods by using leaf analyses and yield measurements.

2. To evaluate corn response to different rates of commercial nitrogen, phosphate and potash.

3. To compare the effectiveness of broadcast and row-placed phosphate.

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1 Assistant Professor of Soils and Soils Extension Specialist, respectively.

2 H.E.Jones, Edwin Jensen and Arnold Wiebusch, Plant Food Review, Vol. 1, No. 3, N.P.F.I. Publication, Washington, 1955.

3 J. Grava and R. J. Poff, Unpublished data.

For this purpose five fields of Fayette soil were selected in Goodhue, Wabasha, Winona and Fillmore counties. None of these fields had received manure, heavy fertilization, or alfalfa plowdown in the previous year. Surface and subsoil samples were collected in April for routine chemical analysis and moisture determination. Each field experiment consisted of 12 treatments, replicated three times, for a total of 36 plots. Individual plots were 50 feet long and 13.3 feet wide. The amounts of nutrients applied and the method of application used are given in treatment description (Table 1).

Pioneer 376 (108-112 day) corn variety was planted at all locations. Atrazine was applied in bands at planting time. Fields were cultivated once to control weeds effectively. Corn was thinned to a uniform population of 18,500 plants per acre. The farmer cooperators were provided with rain gauges and asked to keep rainfall records. Corn leaf samples were collected at tasseling time at three locations, and their N, P, and K contents determined. Finally, corn yields were measured. Because of the extremely uneven corn stand at one location, the results from only four of the experiments are reported.

Soil tests indicate (Table 2) that the soils used are comparatively low in organic matter, medium to high in extractable phosphorus and low to medium in exchangeable potassium.

Relatively high amounts of phosphorus were extracted with Bray's No. 1 extracting solution from Fayette subsoil samples (Tables 3, 4, 5, & 6). Subsoil moisture was sufficient at planting time (Table 7). All locations received about 15 inches of rainfall during June, July, August and September (Table 8).

Good subsoil moisture, adequate and well distributed rainfall, sufficient corn populations and effective weed control obviously contributed to comparatively high corn yields at all locations (Table 9). Check plots yielded on the average 102 bushels/acre.

Although three out of four fields showed yield increases to rates of nitrogen as high as 110 pounds per acre, yields of 100 bushels were measured on plots receiving only 10 pounds of row-placed nitrogen. Obviously the Fayette silt loam soils, under proper management and favorable weather conditions, can release substantial amounts of nitrogen to corn.

The effects of phosphate on corn yields were in the main, negative. On all but the Maus field, yields were reduced from one to 30 bushels. This relationship is not presently understood and requires further study.

Broadcast application of phosphate (40 lbs. P_2O_5/acre) resulted in lower yields (average of 4 fields 14 bu./A) than the same amount of phosphate applied in a row.

Corn leaves collected from no phosphate plots had an average phosphorus content of 0.28% (Table 11) only slightly less than the safe level of 0.295% P. Corn response and leaf analysis would indicate that Bray's No. 1 method is quite reliable in measuring phosphorus availability in Fayette soils.

Soil tests show that Fayette soils are deficient in potassium. This was also substantiated by leaf analysis and corn yield response. Potassium contents of 0.64, 0.79, and 0.90% (Table 12) in leaves collected from no potassium plots were well below the 1.3% K level which is considered to be safe.

In two of the four locations, the 120 pounds per acre K_2O rate was most economical; in the other two locations, 60 pounds of K_2O per acre was as effective as any higher rate.

Acknowledgments

The authors are indepted to the National Plant Food Institute for financial assistance, and to members of the Minnesota Fertilizer Industry Association for contributions of fertilizer materials. They are also grateful to extension agents: Messrs. Arnold Wiebusch, Mat Metz, Oliver Strand and Milton Hoberg for their assistance, and to Messrs. Dale Flueger, Jerome Mahoney, Ervin Maus and Clair Gossman for their generous cooperation.

Table 1. Treatment Description

Treatment Number	Broadcast[1] Lbs./A.	Row Lbs./A.	Total Nutrients Lbs./A.
1	None	None	None
2	100+0+100	10+0+20[2]	110+0+120
3	100+0+100	10+20+20[3]	110+20+120
4	100+0+100	10+40+20[4]	110+40+120
5	100+40+100	10+0+20	110+40+120
6	100+40+0	10+40+0[5]	110+80+0
7	100+40+0	10+40+20	110+80+20
8	100+40+40	10+40+20	110+80+60
9	100+40+160	10+40+20	110+80+180
10	0+40+100	10+40+20	10+80+120
11	50+40+100	10+40+20	60+80+120
12	100+40+100	10+40+20	110+80+120

Fertilizers used:
1 33-0-0; 0-45-0; 0-0-60
2 33-0-0; 0-0-60 (applied on applicator belt separately)
3 10-20-20
4 6-24-12
5 9-36-0

Table 2. Soil Test Results

Location	pH	Organic Matter %	Extractable Phosphorus Lbs./Acre	Exchangeable Potassium Lbs./Acre	Texture
Flueger, Goodhue County	6.9	2.0	16	93	Silt loam
Mahoney, Goodhue County	7.5	3.9	23	145	Silt Loam
Freeze, Wabasha County	6.9	2.3	21	97	Silt Loam
Maus, Winona County	7.2	2.9	17	105	Silt Loam

Table 3. Subsoil Fertility
Dale Flueger, Goodhue County

Depth in Inches	pH	O.M. %	P p.p. 2m*	K p.p. 2m*
0-6	6.8	1.8	15	100
11-14	5.9	0.6	23	135
18-24	5.3	0.6	50	120
30-35	5.6	0.4	44	70
42-48	5.8	0.4	40	70
50-56	6.3	0.4	53	55
56-60	8.0	0.4	39	70

* p.p. 2m = parts per 2 million

Table 4. Subsoil Fertility
Jerome Mahoney, Goodhue County

Depth in Inches	pH	O.M. %	P p.p. 2m	K p.p. 2m
6-9	6.4	1.9	18	120
10-13	5.6	1.5	12	110
15-19	5.3	1.1	17	110
20-24	5.2	0.8	37	110
26-30	5.3	0.7	61	110
32-36	5.4	0.4	68	110
38-40	5.4	0.4	71	110
44-48	5.5	0.3	65	90
53-56	5.5	0.4	66	100
56-60	5.5	0.3	66	100

Table 5. Subsoil Fertility
Edwin Freeze, Wabasha County

Depth in Inches	pH	O.M. %	P p.p. 2m	K p.p. 2m
0-7	6.8	2.1	26	120
7-14	6.3	2.1	19	100
14-19	6.3	1.0	28	95
19-24	6.0	0.8	46	110
24-30	5.7	0.6	52	120
30-36	5.5	0.5	54	135
36-42	5.5	0.4	50	140
42-48	5.5	0.5	48	120
48-54	5.4	0.5	45	110
54-60	5.4	0.4	50	125

Table 6. Subsoil Fertility
Ervin Maus, Winona County

Depth in Inches	pH	O.M. %	P p.p. 2m	K p.p. 2m
6-12	7.3	2.3	17	90
16-20	6.2	0.9	33	100
22-26	5.5	0.5	60	130
32-36	5.5	0.6	54	130
38-44	5.4	0.6	50	120
46-50	5.6	0.6	40	110
54-56	5.6	0.5	42	130
56-60	5.6	0.5	41	150

Table 7. Subsoil Moisture

Depth in Feet	Location				Average of 4 locations
	Flueger	Mahoney	Freeze	Maus	
	Moisture in percent				
1	24.8	30.6	25.2	26.3	26.7
2	22.8	26.4	23.4	21.1	23.4
3	21.9	21.0	18.4	20.5	20.5
4	14.9	18.9	19.1	22.5	18.9
5	16.6	19.6	18.0	25.0	19.8

Table 8. Rainfall Data

Month	Location				
	Flueger Goodhue Co.	Freeze Wabasha Co.	Maus Winona Co.	Rochester-Airport Total	Rochester-Airport Long term ave.
	Rainfall Inches				
June	1.2	3.6	1.8	3.9	4.3
July	5.5	4.1	5.9	5.0	3.5
August	2.2	2.5	7.0	2.5	3.5
September	4.9	4.4	4.9	4.0	4.1
Total (4 months)	13.8	14.6	19.6	15.4	15.4

Table 9. Corn Response to Fertilization.

Treatment Number	Rate of Nutrient Applied Lbs./Acre	Flueger Goodhue County	Mahoney Goodhue County	Freeze Wabasha County	Maus Winona County	Average of 4 Locations
		Location				
		YIELD OF SHELLED CORN (15.5% MOISTURE) BUSHELS/ACRE				
1	Check	117	111	79	101	102
	Nitrogen (N)					
10	10	124	118	97	100	110
11	60	139	120	108	123	122
12	110	145	122	125	133	131
	Phosphate (P_2O_5)					
2	0	144	133	126	117	130
3	20	136	129	115	118	124
4	40 Row	137	132	116	123	127
5	40 Bcst.	119	116	96	120	113
12	80	145	122	125	133	131
	Potash (K_2O)					
6	0	133	108	111	102	113
7	20	132	122	114	120	122
8	60	151	127	100	113	123
12	120	145	122	125	133	131
9	180	156	124	121	123	131

Table 10. Effect of Fertilization on Nitrogen Content in 6th Corn Leaf at Tasseling Time.

N Applied Lbs/Acre	Location Flueger	Freeze	Maus	Average of 3 Locations
	N % in Corn Leaf*			
10	2.65	2.52	2.48	2.55
60	3.16	3.13	2.69	2.99
110	3.19	3.42	2.89	3.17

* Safe level (according to Tyner) 2.9% N

Table 11. Effect of Fertility on Phosphorus Content in 6th Corn Leaf at Tasseling Time.

P_2O_5 Applied Lbs./Acre	Location Flueger	Freeze	Maus	Average of 3 Locations
	P % in Corn Leaf			
0	.285	.300	.270	.285
20 Row	.293	.305	.281	.293
40 Row	.299	.293	.293	.295
40 Bcst.	.314	.306	.297	.306
80 (40 Row + 40 Bcst.)	.321	.333	.298	.317

Table 12. Effect of Fertilization on Potassium Content in 6th Corn Leaf at Tasseling Time.

K_2O Applied Lbs./Acre	Location Flueger	Freeze	Maus	Average of 3 Locations
	K % in Corn Leaf			
0	0.90	0.64	0.79	0.78
20	1.09	0.95	1.29	1.11
60	1.55	1.11	1.24	1.30
120	1.58	1.24	1.31	1.38
180	1.91	1.50	1.45	1.62

Comparison of Fertilizer Materials on a Field Basis at Rosemount

By R. Dennistoun, J. B. Weber, and A. C. Caldwell

An experiment was established at the Rosemount Experiment Station in 1961, to determine the corn yield response from application of several fertilizer sources. Sources used were 30-10-0, 20-52-0, 0-52-0, and 5-20-20. Rates of application were: 100, 200, and 300 pounds per acre of 30-10-0, 100 pounds per acre of 20-52-0 plus 0 and 60 pounds per acre of N, 100 pounds per acre of 0-52-0 plus 0, 60, and 90 pounds per acre of N, and 150 pounds per acre of 5-20-20 plus 0 and 90 pounds per acre of N. All fertilizers were applied as starter except N (urea) which was sidedressed. KCl was applied broadcast to the entire experiment at the rate of 100 pounds per acre K_2O. Pioneer 377A corn was planted at the rate of 3 hills per 24 inches in 40 inch rows. Randox was used to control weeds. The experiment was laid out in two replications with plots 8 rows wide and 990 feet long.

Soil tests indicated the area to be relatively low to medium in both available P and exchangeable K.

Yield Results

Corn yield data was obtained by sampling and also by harvesting the entire plots.

Table 1 shows the average yields for the respective treatments by the two methods of harvesting. Results from the two harvesting methods are comparable and yield similar information. Due to the small number of replications and the lack of randomization the small sample method contains a much larger standard error and thus larger values for the lsd and hsd values. Because of this the entire plot harvest presents a more representative picture of the yields on this particular field and will therefore be used in discussing the significant yield differences.

All fertilizer application, except treatment 7 yielded significant increases in yield above the control (treatment 1), lsd at 5%. N application of 60 and 90 pounds per acre were in every case significantly higher than comparable treatment without N, hsd at 5%. There were no treatments which did not receive P, so it is impossible to tell whether the N treatment or the interaction of N and P had the greatest effect on increasing corn yields. There were no significant yield differences attributable to P applications alone, however.

Higher rates of application 30-10-0, treatments 3 and 4, were not significantly different from the 100 pound per acre application, hsd at 5%. Fertilizers were not applied at similar nutrient rates so comparisons cannot be made between fertilizer materials.

The results indicate the most effective fertilizer applications were treatments 2, 6, 8, 9, and 11. The most economical fertilizer application was treatment 2.

Phosphorus Analyses

Chemical analysis of the leaves showed no significant differences in P content which were attributable to the fertilizer applications, table 1. P content of plants receiving P applications was generally higher than the control plants, however.

Table 1. Effect of various fertilizer sources on the yields of corn and phosphorus content of leaves (Rosemount, 1961).

Treatment Number	Kind of Fertilizer	Rate of appl. lbs./acre	N Treatment lbs. N/A	Corn yields by two harvesting methods: Small Sample bu/A.	Small Sample diff.	Entire Plot bu/A.	Entire Plot Diff.	Phos. Content of Leaves % P
1	0	0	0	68	--	65	--	.266
2	30-10-0	100	0	85	17	94	29	.274
3	30-10-0	200	0	94	26	97	32	.288
4	30-10-0	300	0	96	28	105	40	.292
5	20-52-0	100	0	82	14	86	21	.274
6	20-52-0	100	60	98	30	108	43	.299
7	0-52-0	100	0	73	5	72	7	.262
8	0-52-0	100	60	94	26	105	40	.299
9	0-52-0	100	90	105	37	110	45	.308
10	5-20-20	150	0	70	2	76	11	.252
11	5-20-20	150	90	96	28	101	36	.282
Standard error =					5.7		3.1	.013
lsd ($F_{.95}$) =					14		8	NS
hsd ($F_{.95}$) =					32		17	NS

Comparison of Fertilizer Materials On A Field Basis at Morris

R. L. Thompson & A. C. Caldwell

In 1961 a series of fertilizer materials, including superphosphate, diammonium phosphate and 30-10-0 were applied on corn at Rosemount, Waseca, and Morris. Yields were obtained by hand and by corn picker. The data for Morris are given below.

Previous Cropping History	Fertilizer
1960 - Corn	100 lbs./A 10-20-0
1959 - Alfalfa & South end in Corn	42 lbs. P_2O_5/A on alfalfa. Nothing on corn.
1958 - Oats seeded down to alfalfa	35 lbs. P_2O_5 per Acre.

1958 Soils test - Three tests were taken; one from the higher areas and two others from the low areas in the field.

1961 Soil Samples taken July 20, 1961. Samples taken from areas divided approximately as in 1958.

	pH	Organic Matter	Available Phosphorus lbs.	Exchangeable Potassium lbs.	Soil texture
1958 - High areas	7.5	5.2% Med	47 High	460 V High	Silty Clay loam
" Low areas	7.7	6.2% Med	7 Low	300 V High	Silty Clay loam
" Low areas	7.7	6.3% Med	10 Low	350 V High	Silty Clay loam
1961 - High areas	7.9	6.4% Med	40 V High	440 V High	Silty Clay loam
" Low areas	7.7	7.1% High	37 V High	490 V High	Silty Clay loam

Minnhybrid 612 corn was planted May 23-24, 1960. The field was fall plowed. Spring soil preparation consisted only of digging with spring tooth cultivators immediately prior to wheel track planting. Randox was band sprayed over the row at a rate of 5 lbs. per acre. The corn was later sprayed with 2,4-D to control Canada thistles. Two cultivations were used to complete the weed control program. Anhydrous ammonia was applied approximately June 16.

Yield Determination

Samples were harvested from 25 feet of row two places in the field. These samples were weighed and some kernels shelled off to make a moisture determination by oven drying the sample. Because of excess heat in the oven, several samples were lost so a moisture content of 31% was used in the yield determination. This was the average moisture content of seven treatments in which at least two samples were available out of the three replicates. The range in moisture in these seven treatments was from a low of 29.09 to a high of 32.67 per cent. All yields were then converted to a 15 per cent moisture basis.

The combine harvested plots were harvested with a John Deere two-row combine with corn head attachment. The center four rows from each plot were harvested by making a single round. The corn was then put into a truck and the moisture sample taken and the corn weighed. The length of the plots varied slightly; yields were based on the actual size of plot which ranged from .526 acre to .699 acre in size. The moistures were determined with a Stienlite moisture meter which had been checked against the Brown Duval oil tester. All yields were then converted to bushels per acre at 15 per cent moisture.

CORN YIELDS IN BUSHELS PER ACRE AT 15 PER CENT MOISTURE

Treatment	Rep I Combine	Rep I Hand Harvest	Rep II Combine	Rep II Hand Harvest	Rep III Combine	Rep III Hand Harvest	Average Combine	Average Hand Harvest
1. 100 lbs. 0-52-0 + 54 lbs. N	56.74	70.62	66.96	76.98	64.95	69.41	62.88	72.34
2. 100 lbs. 0-52-0 + 92 lbs. N	62.96	75.16	67.17	63.95	66.69	67.59	65.61	68.90
3. 100 lbs. 20-52-0 + 54 lbs. N	63.35	60.00	66.87	62.74	66.42	59.71	65.55	60.82
4. 100 lbs. 20-52-0	63.25	59.71	67.74	71.53	65.81	63.34	65.61	64.86
5. Check	60.43	62.42	69.64	62.43	67.23	81.53	65.77	68.79
6. 200 lbs. 30-10-0	63.93	57.28	68.85	74.56	69.05	61.22	67.28	64.35
7. 300 lbs. 30-10-0	61.05	56.37	63.25	53.95	68.84	71.53	64.38	60.62
8. 100 lbs. 30-10-0	64.80	54.85	69.00	63.95	71.74	67.59	68.51	62.13
Border Between Reps (2nd check)	63.69	61.53	71.40	70.62	69.98	- -	68.36	66.02 (Ave. of 2)
							525.90	522.81
						Ave.	65.7	65.4

Continuous Corn - High Fertility Experiment
Rosemount Experiment Station
Soils

W. P. Martin and H. W. Kramer

Yield Results - 1961

Re: 1959 results, page 97, Department of Soils Mimeo, April, 1960; 1960 results, page 82, ibid, February, 1961.

Soil Type: Port Byron silty clay loam

Object: To determine profitable rates of fertilization for continuous corn.

Site: Fairly level with minimum erosion hazard; protected from hill pastures with terrace; tile drained.

Past results: Yields have varied from 45 bu./ac. to 133 bu. as an average of all treatments, 1953-1960. Highest yields were obtained in 1954 and lowest in 1957 (because of excess ppc. and weediness). Yields have consistently reflected fertilizer responses.

	16,000 plants	20,000 plants
1. Check	70 bu.	102
2. H*	80	107
3. HS_1	89	114
4. HS_2	87	116
5. B_1H	77	107
6. B_1HS_1	89	119
7. B_1HS_2	86	118
8. B_2H	80	114
9. B_2HS_1	88	117
10. B_2HS_2	88	115
LSD (5%)	6.3	7.7

*H = 200 lbs. 10-20-20 hill drop
S_1 = 100 lbs. 33-0-0 sidedress
S_2 = 200 lbs. 33-0-0 sidedress
B_1 = 400 lbs. 6-24-12 broadcast
B_2 = 800 lbs. 6-24-12 broadcast

Table 5. Yield response and sedimentation values as effected by method of placement and rate of nitrogen application at Ness farm (silty clay loam soil)

Method of placement	Nitrogen rate (#/acre)					
	Check	30	40	50	60	80
	..... yields - bu/acre.....					
1	39.9	48.5	(-)	66.0	64.2	60.1
2		50.2	60.0	58.8	64.9	59.5
3		50.3	55.3	60.6	58.9	53.7
Average of 3 methods		49.7	57.7	61.8	62.7	57.8
Average of 1 & 2 "		49.4	-	62.4	64.6	59.8
	----------sedimentation values----------					
1	36 (ck)	38	-	44	46	44
2		38	39	43	44	47
3		37	38	39	43	49
Average of 3 methods		38	39	42	44	47
Average of 1 & 2 methods		38	-	44	45	45

Table 6. Yield response to 5 rates of nitrogen as affected by method of nitrogen placement at Hermandson farm (silty clay loam soil)

Method of placement	Nitrogen rate (#/acre)					
	check	30	40	50	60	80
	.....yields - bu/acre.....					
1	21.5	22.7	22.3	22.9	24.9	22.9
2		20.4	23.9	24.3	26.8	22.5
3		23.5	22.7	24.7	26.3	22.7
Average of 3 methods		22.2	23.0	24.0	26.0	22.7
Average of 1 & 2 methods		21.6	23.1	23.6	25.8	22.7

Table 7. Yield response to 5 rates of nitrogen application as affected by method of nitrogen placement at Sewill farm (fine sandy loam)

Method of placement	Nitrogen rate (#/acre)					
	Check	30	40	50	60	80
	.....yields - bu/acre.....					
1	14.8	19.0	19.0	14.4	20.9	16.1
2		15.4	19.1	17.5	22.9	20.8
3		22.9	18.0	22.5	18.2	19.2
Average of 3 methods		19.1	18.7	18.1	20.7	18.7
Average of 1 & 2 methods		17.2	19.1	16.0	21.9	18.5

Table 8. Proposed premium prices for specific wheat sedimentation scores - USDA

Sedimentation value	Premium (cents/bu)
40-44	3
45-49	6
50-54	10
55-59	14
60-64	19
>65	24

Table 9. Relationship of sedimentation values to % protein with several wheat varieties - USDA

% Protein	Selkirk	Thatcher	Conley	Lee
	.....sedimentation values.....			
12	40	42	43	38
13	47	48	51	42
14	55	57	58	49
15	64	65	65	58
16	70	69	70	65

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