Phosphorus and potassium fertilizers were broadcast before plowing to supply 100 pounds of phosphate per acre and 50 pounds of potash. Urea nitrogen at 100 pounds of nitrogen per acre was broadcast in early June.

The two mineral soil fields were seeded in mid-May; planting on the colder peat soil was delayed until June 5. Herbicides were used to control weed growth. Plant populations approximated 18,000 plants per acre.

The no-zinc corn plants on the Litch field and on the Behr peat were more seriously affected by zinc deficiency whereas the Larson field showed little vegetative deficiency during the growing season. The Litch corn showed some stunting but no distinct leaf symptons, until July 10, 11, and 12, when severe leaf striping developed rapidly. Since the peat soil of the Behr field was planted late, leaf striping commenced relatively late in July.

An early frost the morning of September 5 killed corn leaves on the low lying peat field, but ears filled to some degree after this damage and all three fields were harvested and sampled in mid-October.

Results

Broadcasing fertilizer at the rate of 100-100-50 over the three entire experimental areas should have insured an ample supply of the three major nutrients. Plant populations of 18,000 per acre, with ample rainfall, should have allowed for maximum zinc effect.

Wet corn on the early frosted peat field lowered yield averages substantially, the no-zinc treatments of the three fields averaging only 47 bushels ear corn per acre. Where zinc as zinc sulfate (about 30 percent zinc) was plowed under at rates of 5, 10, 20, or 40 pounds per acre, average yield increases varied from 13 to 15 bushels per acre, with the 10-pound zinc treatment increasing yields very well.

Banding ammonium nitrate at the rate of 20 pounds of nitrogen per acre (no zinc) about 1 inch to the side and below the seed showed an average yield increase of some 10 bushels per acre. This effect has usually been observed by other investigators and the increase has been attributed to nitrogen stimulation of the plants and to a greater extraction of native zinc from the soil.

Banding both nitrogen and the zinc as the sulfate at the rate of 10 pounds of zinc per acre increased average corn yields only about 8 bushels per acre.

Banding both 20 pounds of nitrogen (as NH_4NO_3) and zinc sulfate at rates of 5, 10, or 20 pounds of zinc per acre increased yields an average of 8 to 13 bushels per acre.

Zinc chelate treated seed was only slightly effective for increasing corn yield, possibly because of the limited amount of zinc chelate adhering to the seed. Since only 1 year's results are available, no definite conclusions can be mad e as to optimum rate and placement of the zinc. However, it appears that heavier rates were not beneficial and may have been somewhat detrimental.

Conclusions

Although much more reaearch is essential before definite recommendations can be made, it appears that plowing down zinc sulfate at a cost of $2 or $3 per acre may be practically effective. Further research may show that (1) granulation of either zinc sulfate of of an effective low cost zinc chelate in the fertilizer manufadturing process, and (2) either plowing such materials under or banding near the seed may be done at relatively low cost, and may supply sufficient zinc for maximum corn production.

Application of zinc to soil is not recommended unless there is a known need for including this element with the fertilizer treatment.

Zinc analysis of the corn leaves has shown that much more zinc is present where the zinc sulfate was plowed down, and the increase is greater with the higher rates of application. Banding zinc sulfate adjacent to the seed was not as effective for increasing zinc uptake by corn as the plowed down application. Zinc chelate treated seed had little effect on increasing the zinc content of the leaves. Banding of nitrogen near the seed increased corn yield, but did not increase zinc concentrations in the leaves.

1962 Studies of Boron and FTE Fertilization for Corn

J.R. Peterson and J.M. MacGregor

Leaf Sampling and analysis: Leaf samples of corn were taken on all treatments to determine time of boron uptake and critical level of boron in the plants. The July and September leaf samples were taken from the upper part of the plant. The August sampling included leaves from the upper, middle, and lower part of the plants. The samples were dried, ground in a Wiley Mill, and stored in polyethylene bags. Leaf sampling dates are given in Tables 1, 2 and 3.

The curcumin-oxalic acid method was used for the analysis of total boron in the leaves. The results are given in Tables 1, 2 and 3.

Table 1. Boron Content of Corn Leaves on Milaca Very Fine Sandy Loam - 1962.

Time of Sampling	Leaves Sampled	Treatments (Lbs./A.)*				
		Check	1B	2B In Row	15 FTE504	2B Broadcast
		(ug. B/gm. Tissue, oven dry basis)**				
July 20	Upper	21.2	40.9	55.3	19.4	32.6
August 20	Upper	34.3	71.2	93.8	37.2	43.6
August 20	Middle	18.0	47.2	54.7	12.6	22.0
August 20	Lower	13.4	42.4	72.2	14.1	22.5
September 18	Upper	39.9	46.5	63.3	34.2	39.2

* All treatments received 122# N, 73# P_2O_5, and 169# K_2O per acre.
** Average of 6 replications.

Table 2. Boron Contents of Corn Leaves on Onamia Very Fine Sandy Loam - 1962.

Time of Sampling	Leaves Sampled	Treatments (Lbs./A.)*				
		Check	1B	2B In Row	15 FTE504	2B Broadcast
		(ug.B/gm. Tissue, oven dry basis)**				
July 13	Upper	9.7	28.0	64.9	17.6	22.2
August 14	Upper	14.8	19.4	26.1	16.3	25.9
August 14	Middle	9.7	12.4	18.6	11.0	12.6
August 14	Lower	10.1	16.9	15.2	11.0	14.1
September 18	Upper	26.9	30.4	38.4	31.3	36.4

* All treatments received 124# N, 64# P_2O_5, and 160# K_2O per acre.
** Average of 6 replications.

Table 3. Boron Content of Corn Leaves on Fayette Silt Loam - 1962.

Time of Sampling	Leaves Sampled	Treatment (Lbs./A.)*				
		Check	1B	2B In Row	15 FTE504	2B Broadcast
		(ug. B/gm. Tissue, oven dry basis)**				
July 15	Upper	13.0	23.1	23.1	14.5	19.2
August 16	Upper	24.6	34.6	36.1	24.2	28.1
August 16	Middle	14.9	20.3	26.0	14.6	19.2
August 16	Lower	15.5	21.2	27.1	15.2	20.2
September 15	Upper	15.6	19.6	17.2	13.0	15.2

* All treatments received 123# N, 77# P_2O_5, and 173# K_2O per acre.
** Average of 6 replications.

Soil pH and water soluble boron level: The pH was determined on a saturated soil paste using a Beckman zeromatic pH meter. The native water soluble boron was determined by adding 40 ml. of distilled water to 20 gm. airdried soil and boiling this solution five minutes. A reflex condensor was used to contain the volatile boron during the boiling process. After cooling, the solution was filtered and an aliquot was analyzed by the curcumin-oxalic acid method. The results are given in Table 4.

Table 4. Soil pH and Water Soluble Boron Content of Three Soil Series Used in the 1962 Boron-Corn Experiments.

Soil Series	pH	Water Soluble Boron (ug./gm. air dry soil)
Milaca very fine sandy loam	5.8	0.92
Onamia fine sandy loam	5.7	0.72
Fayette silt loam	6.5	0.64

Harvest: The Milaca fine sandy loam field was severely damaged by hail on July 21. This storm resulted in a near loss of the plants and as a result very few ears developed. We did not harvest this field.

The other two plots were harvested in October. Forty-five feet of the two center rows of the four row plots were hand picked and weighed. A moisture sample was taken and dried to determine the yield on a 15.5% moisture level. Yields are given in Table 5. None of the treatments gave a significant yield increase at the five percent level.

Table 5. The Effect of Boron and Fritted Trace Element Fertilization on the Yield of 1962 Corn: Fayette Silt Loam, Tony Wallrich - Wabasha.

Fertilizer Treatments*	I	II	III	IV	V	VI	Mean	Increase over check
Check	117.8	85.9	130.5	113.8	117.0	98.7	111	--
1# B/A. in row	104.6	108.3	124.6	110.5	112.4	109.1	112	1
2# B/A. in row	103.6	120.4	105.2	127.6	102.9	119.8	113	2
2# B/A. broadcast	130.6	113.9	131.3	103.2	116.3	118.8	119	8
10# FTE504/A. in row	127.6	126.9	122.2	126.1	106.4	116.1	121	10

* All treatments received 123# N, 77# P_2O_5, and 173# K_2O per acre.

Fertilizer Treatments*	Onamia very fine sandy loam, Carl Erickson - Mora.							
Check	88.7	79.0	72.3	81.7	65.0	67.3	76.	--
1# B/A. in row	76.6	69.6	75.1	70.6	65.8	73.6	72	-4
2# B/A. in row	88.2	66.8	77.9	74.5	70.5	73.3	75	-1
2# B/A. broadcast	78.4	73.2	66.1	81.5	69.9	68.6	73	-3
10# FTE504/A. in row	75.2	78.7	70.0	84.5	75.7	79.9	77	1

* All treatments received 124# N, 64# P_2O_5, and 160# K_2O per acre.

It is evident that the boron fertilization increased the boron content of the corn leaves, but did not increase corn yield.

Boron and FTE Fertilization Studies on Alfalfa-Grass Stands in Wabasha County on Fayette Silt Loam

J.R. Peterson, J.M. MacGregor and Henning Swanson

Three established hay fields were top dressed as growth commenced in the spring of 1962 and two cuttings were made of the hay crop.

Plant Tissue sampling and analysis: Tissue samples of two of the four replicates were taken at harvest times. These samples were dried, ground, and analyzed for total boron using the same method as was used with the corn leaves. These samples included alfalfa and brome, or orchard grass. A summary of the boron content of the two hay cuttings on the three farms is given in Table 1.

Table 1. Boron Content of Alfalfa-Grass Mixture on Fayette Silt Loam in Wabasha County - 1962.

Fertilizer Treatment* (#/A.)	ug.B/gm. oven dry hay ** 1 st crop	2 nd crop
Bremer Farm:		
Check	28.5	30.6
1 B	40.6	29.4
2 B	40.4	41.2
15 FTE502	36.2	31.4
Walter Danchwart:		
Check	19.6	17.6
1 B	24.8	19.6
2 B	25.4	23.7
15 FTE502	20.0	17.2
Edwin Freiheit:		
Check	32.2	24.4
1 B	33.2	28.3
2 B	47.0	34.2
15 FTE502	30.9	18.8

* All treatments received 500# of 0-20-20 per acre.

** Average of two replications.

Soil pH and water soluble boron level: The same analytical procedure was used as stated earlier in this report. The results are given in Table 2.

Table 2. Soil pH and Water Soluble Boron Content of Fayette Silt Loam at the Three Locations in Wabasha County Used in the 1962 Boron-Alfalfa Experiment.

Farm	pH	Water Soluble Boron (ug/gm. air dry soil)
Bremer	6.7	0.79
W. Danchwart	6.9	0.96
E. Freiheit	6.3	0.65

Harvest: From each 16' x 16' plot, $7.27.10^{-4}$ acre were cut with a power mower. This hay was weighed. A moisture sample was taken and dried todetermine the yield in tons per acre at 15 percent moisture. The yields of the first crop, second crop, and total for the season are given in Table 3. None of the yields are significantly different at the five percent level.

Table 3. The Effect of Boron and Fritted Trace Elements on the Yield of 1962 Alfalfa-Grass Mixture on Fayette Silt Loam in Wabasha County.

Fertilizer Treatment* (Lb./A.)	Tons/Acre at 15% Moisture** 1st Crop	2nd Crop	Total	Increased over check
Bremer Farm:				
Check	2.14	1.53	3.67	-
1 B	2.15	1.52	3.67	0
2 B	2.22	1.54	3.76	0.08
15 FTE502	2.08	1.63	3.71	0.04
Walter Danckwart:				
Check	2.18	1.82	4.00	-
1 B	2.17	1.94	4.11	0.11
2 B	2.12	1.70	3.82	-0.18
15 FTE502	2.08	1.87	3.95	-0.05
Erwin Freiheit				
Check	1.92	1.56	3.48	-
1 B	1.93	1.47	3.40	-0.08
2 B	1.92	1.43	3.35	-0.13
15 FTE502	1.90	1.48	3.38	-0.10

* All treatments received 500# of 0-20-20 per acre.

** Average of 4 replications.

Conclusions: Boron top dressing increased the levels of boron in the hay to some extent but did not excrease hay yields.

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 - 1962

Re: 1959 results, "A Report on Soils and Soil Fertility", p. 74, Dept. Soils, Mimeo, April 1960; ibid 1960 results, p. 44, Feb. 1961, ibid 1961 results, p. 61, Feb. 1962.

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 are four replications.

CONTINUOUS CORN: RATE AND TIME OF APPLICATION

Nitrogen:		Yield Results:	
Rate	Time*	Starter only**	+PK broadcast***
None	0-0-0	42 bu.	44 bu.
40 lbs	1-0-0	52	68
80 "	1-1-0	58	63
120 "	1-1-1	55	64
80 "	1-0-1	54	65
80 "	0-1-1	59	61
40 "	0-0-1	59	61
40 "	0-1-0	56	64
80 "	2-0-0	59	67
120 "	3-0-0	62	61

* 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	36	40	40	42
2. N on oats	35	41	75	72
3. NP on oats	40	48 4	79	84
4. NPK on oats	45	53	72	92
5. P plowdown	40	4949	44	53
6. NPK in hill	52	62	43	47
7. N plowdown	47*	41*	64*	49*
8. N sidedress	39*	40*	43*	54*

*One replication only

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

Treatments (regular)	Corn (1) Reg.	Corn (1) Extra*	Soybeans Reg.	Soybeans Extra*	Corn (2) Reg.	Corn (2) Extra*	Oats Reg.	Oats Extra*	Hay Reg.	Hay Extra*
6. Check	52 bu.	68 bu.	22 bu.	31 bu.	45 bu.	75 bu.	48 bu.	82 bu.	3.2 t.	5.1 t.
1. P for oats	66	68	24	26	47	59	48	51	4.4	5.0
2. Pkfor oats	68	70	23	27	48	60	51	57	4.7	4.9
7. NP for oats	78	69	24	28	46	56	83	82	4.2	4.4
3. NPK for oats	74	71	26	28	50	63	87	70	4.5	5.4
10. P for oats & corn	64	66	27	27	51	57	54	63	4.2	5.1
4. Manure for corn	70	71	29	30	62	82	62	86	4.0	5.4
8. Manure & P for corn	75	76	30	30	62	82	56	75	4.7	5.1
5. " & NPK for corn	70	72	28	30	65	81	60	86	4.8	5.4

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

Profit Possibility Plots
(Results of NPK rates on corn demonstrations in 1962)

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

Rainfall was considerably above normal in most areas and fertilizer responses appeared more profitable than in 1961.

In the western half of Minnesota a total of 25 fields averaged 26 bushels increase over the check plot from the most profitable treatment used. This was 200# of 5-20-20 in the row and 70# of supplemental nitrogen. Profits beyond fertilizer costs were increased $9.60 per acre for this treatment. There were 4 fields with high phosphorus tests and 10 with high tests in potassium. Forty pounds of P_2O_5 in the row averaged a 9 bushel increase while 40 pounds P_2O_5 broadcast averaged an increase of 6 bushels.

Results are shown in Table 1 from the 15 fields in the area testing low in phosphorus and medium in potassium. Profits are slightly higher on these lower testing fields.

In the eastern half of Minnesota the 19 fields harvested averaged a 19 bushel yield increase from the best treatment. This was again as in the western part of the state 200# of 5-20-20 in the row plus 70 pounds of supplemental nitrogen. Soil tests were considerably higher on the plot sites in the eastern area. Sixteen fields had medium or above phosphorus tests and 11 medium or higher potassium tests. Profits from fertilizer were only $2.90 above fertilizer costs. Forty pounds of K_2O in the row showed an average yield increase of 4.3 bushels while 80 pounds broadcast averaged 4.6 bushels increase. There appeared to be higher efficiency by placing potassium near the seed than by broadcasting on the majority of the fields.

Table 2 shows results from the eastern half of the state from only the plots having tests with low potassium or medium phosphorus. The sandy textured soils are excluded from these averages. Profits from fertilizer are about $10 per acre higher than the overall averages of all fields in this area. Note that the highest trestment of potash (120# K_2O) was the most profitable. Also note that 40# K_2O in the row averaged about the same as 80# K_2O broadcast.

There are 5 plots located on sandy loam soils. The best treatment of those used was 80+0+80. These plots showed an average increase of 14 bushels from 70 pounds of supplemental nitrogen, no apparent phosphorus response and 80 pounds of K_2O broadcast increased yields an average of 9 bushels. The average profits from the best treatment was $8.60 beyond fertilizer costs.

A complete summary will be in Soil Series 67 entitled "Profit Possibilities with Fertilizer on Corn". This booklet includes individual summaries of all 53 plots harvested. The demonstrations were established and tended by county agents and vo-ag teachers. There were 12 treatments and 2 replications as follows:

East and West	Western Minn.	Eastern Minn.
1. 0+0+0	1B. 80+40*+0	1B. 0+0+80**
2. 10+40+40	2B. 10+80*+40	2B. 10+40+120**
3. 80+40+40	3B. 80+80*+40	3B. 80+40+120**
4. 80+40+0	4B. 80+80*+0	4B. 80+40+80**
5. 80+0+0	5B. 80+40*+0	5B. 80+0+80**
6. 80+0+40	6B. 80+40*+40	6B. 80+0+120**

* has 40# P_2O_5 broadcast

** has 80# K_2O broadcast

Table 1. Western half of Minnesota, averages for fields with low P and medium K (15 fields)

MOST PROFITABLE PLOT COMPARED TO CHECK

Plant nutrients/A.	Yield	Labor & Mgt. Returns/A.*	Fertilizer net profit	Cost/bu.	Acres to net $1000	Bu. to net $1000
1. 0 + 0 + 0	66	$ 21.00	--	$0.68	48	3140
3. 80 + 40 + 0	94	32.60	$ 11.60	0.65	31	2880

INDIVIDUAL BENEFITS FROM NITROGEN, PHOSPHORUS AND POTASSIUM

Nitrogen Effect				Phosphorus Effect**				Potassium Effect**			
	Treatment	Yield	inc.		Treatment	Yield	inc.		Treatment	Yield	inc.
2	10 +40 + 40	83		6	80 + 0 + 40	84		4	80 + 40 + 0	87	
3	80 + 40 + 40	94	+11	3	80 + 40 + 40	94	+10	3	80 + 40 + 40	94	+7
				3B	80 + 80 + 40	96	+12				

Average soil test

pH	P	K
7.05	6.8	149

* production cost other than fertilizer estimated at $ 45 per acre. CORN VALUED AT $1/BU.

** all treatments of 40# are in row, 80# P_2O_5 has 40# broadcast plus 40# in row

Remarks - Average starter profits $ 9.70
Average 40# P_2O_5 row 10 bu.
Average 40# P_2O_5 best 8 bu.

Table 2. Eastern half of Minnesota, averages for fields with low K and medium P (excluding sady textured soils).

MOST PROFITABLE PLOT COMPARED TO CHECK

	Plant nutrients/A.	Yield	Labor & Mgt. Returns/A.*	Fertilizer net profit	Cost/bu.	Acres to net $1000	Bu. to net $1000
1.	0 + 0 + 0	73	$ 23.00	--	$0.69	43	3170
3B	80 + 40 + 120	106	35.60	$ 12.60	0.66	28	2980

INDIVIDUAL BENEFITS FROM NITROGEN, PHOSPHORUS AND POTASSIUM

Nitrogen Effect				Phosphorus Effect**				Potassium Effect**			
	Treatment	Yield	inc.		Treatment	Yield	inc.		Treatment	Yield	inc.
2B	10+40+120	95		6B	80 + 0 + 120	99		4	80 + 40 + 0	91	
3B	80+40+120	106	+11	3B	80 + 40 + 120	106	+7	3	80 + 40 + 40	101	+10
								4B	80 + 40 + 80	100	+9
								3B	80 + 40 + 120	106	+15

Average soil test	pH	P	K
	6.5	15.1	76.0

* Production and fixed cost other than fertilizer estimated at $ 50 per acre. CORN VALUED AT $1/BU.

** all treatments of 40# are in row, 80# K_2O is best, 120# has 80# broadcast plus 40# in row

Remarks - Average starter profits $9.70
Average increase from 40# K_2O row 10 bu.
Average increase from 80# K_2O best 9 bu.

The Effect of Very High Fertilizer Rates and Ratio on Stand of Corn

Rosemount Agricultural Experiment Station - U. of M.
1961
Paul M. Burson
Department of Soils

This trial was not designed to study the economics of high rates of fertilizer on the yield of corn. The primary purpose was to determine whether or not starter fertilizer at very high rates placed in a band 2 inches to the side and 2 inches below the corn kernels would injure germination and thereby reduce stand or adversely affect the growth of the crop during the growing season. The effect on yield was purely accidental.

In this trial the fertilizer band placement was used so that the fertilizer could be precisely controlled. The planter was equipped with the new extra high speed type of auger and a special high speed sproket in the fertilizer attachment so that much higher than normal rates per acre could be applied.

The fertilizer used was made up by blending three fertilizer material s. The three included ammonium nitrate (33 -/- 0 ≠ 0), 46 percent superphosphate (0 + 46 + 0) and 60 percent muriate of potash (0 + 0 + 60). There was one additional fertilizer which was a manufactured grade of 6 + 12 + 24.

In all cases the planter was set to deliver the maximum amount permitted by the gauging mechanism. In other words, the fertilizer distributor was wide open.

Corn stand vs. high fertilizer rates and ratios

N	P_2O_5	K_2O	Ratio	Total lbs. of fert./acre[1]	Plant population	Percent lodging	Yield bu./acre
0	0	0	----	-------	14,000	0	38.5
230	115	115	2:1:1	1290	16,000	40 +	100.3
365	122	122	3:1:1	1370	16,000	40+	102.4
365	73	73	5:1:1	1400	16,000	40 +	105.7
95	188	376	1:2:4	1570	16,000	Trace	98.6

Soil type: Port Byron silt loam

It is to be noted in the table that as the three fertilizer ingredients were varied in the ratio the rate of flow also varied and that the same amounts were not applied with the same machine adjustment. This suggests that as blends and fertilizer grades vary in composition the fertilizer distributor should be calabrated each time for each blend or grade if a specific rate per acre is desired.

A planting rate of 18,000 kernels per acre was used on all plots. It is ordinarily assumed that the mortality rate between planting and harvest time may range from 10 to 15 percent. If 15 percent is used the plant population or final stand at harvest time when 18,000 kernels are planted would be about 15,300. In this trial where the final stand was 16,000 the mortality was 12.2 percent. On the check plots with final stands at 14,000 the mortality rate was 22.2 percent.

This trial further indicates that when starter fertilizer is placed in a band there is little or no danger for "so called burning" or injury to germination. This means that when the fertilizer band attachment is used the farmer could make whatever rate of application he may desire without fear of injury to germination.

It is to be noted that while very high rates of nitrogen did not affect germination it did promote lodging. With the use of 95 pounds of nitrogen in the starter there was no lodging. As much as 120 pounds of nitrogen in starter was used in other trials with little or no lodging. When nitrogen rates in the starter reached beyond 200 pounds per acre there was a higher rate of lodging.

Field and laboratory studies with corn

A. C. Caldwell and R. W. Blanchar

The effects of nitrogen, phosphorus and potassium on corn yield and nutrient composition were studied. No broadcast applications were made. All materials were applied as starter materials at planting time. These experiments were carried out at Red Wing, Waseca, Lamberton, and Morris.

Lamberton location (Nicollet soil)

The effects of nitrogen, phosphorus, and potassium alone and in combination are shown in Table 1. Results indicate that the most striking effect was the interaction between nitrogen and phosphorus.

Table 1. Effects of nitrogen, phosphorus and potassium on nutrient content and yield of corn at Lamberton.

Treatment*	Stage of Growth: Young plants (12 to 18 inch height)				Tasseling	Yield Shelled corn
	Weight gm/pl.	N %	P %	P-Yield mgP/pl.	P %	bu/A
0+0+0	.7	2.4	.28	2	.18	34
90+0+60	.7	3.8	.23	2	.21	55
90+60+60	4.4	4.0	.45	20	.21	93
00+60+60	1.2	2.3	.38	5	.24	43
90+60+0	4.5		.47	22	.21	107
L.S.D. (.05)	1.6	.5	.06	8	.04	11

*Fertilizer sources were: nitrogen (33-0-0), phosphorus (0-46-0), and potassium (0-0-60).

Yield was increased only slightly by phosphorus or nitrogen alone, however when applied together striking increase in yield occurred. (Table 1) There was also a significant increase in percent phosphorus and phosphorus-yield due to the application of nitrogen and phosphorus together over phosphorus alone. Percent nitrogen was not affected by the addition of phosphorus, however nitrogen uptake was increased due to phosphorus application.

Thinning samples (young plants 12-18" high) appeared to reflect more accurately the phosphorus effects on yield than did 6th leaf samples at tasseling time.

Waseca location (Nicollet soil)

An experiment identical to the one reported at Lamberton was carried out at the South Central ExperimentaStation at Waseca.

The most striking effect at Waseca was the influence of starter nitrogen and phosphorus together on early corn growth. This effect, however, was not apparent later in the season and was not reflected in either analysis of samples at tasseling

time or corn yield (Table 2). The only significant effect on corn yield at Waseca was due to nitrogen. The analysis of young plants does indicate early effects of the starter materials and is of interest from that stand point.

The effect of nitrogen, phosphorus, potassium and the nitrogen-phosphorus interaction is shown in Table 2.

Table 2. Effects of starter nitrogen, phosphorus and potassium on the nutrient content and yield of corn at Waseca.

Treatment*	Stage of Growth							
	Young plants (12 to 18 inch height)					Tasseling		Yield
	Weight gm/pl	P %	K %	P-Yield mg/pl	K-Yield gm/pl	P %	K %	Shelled corn bu/A
0+0+0	5.6	.31		18		.28		114
90+0+60	5.7	.29		16		.29		135
90+60+60	11.7	.38	4.3	45	.53	.29	2.0	133
0+60+60	8.3	.25		21		.26		123
90+60+0	11.6	.37	2.6	43	.33	.30	1.5	132
L.S.D. (.05)	2.8	.04	.5	12	.13	.02	.3	9

*Fertilizer materials used were: nitrogen (33-0-0), phosphorus (0-46-0) and potassium (0-0-60).

About a 20 bushel yield increase resulted from nitrogen application. Phosphorus and potassium also significantly increased yield over no treatment. However, yield was not increased by either phosphorus or potassium on plots which had received nitrogen.

Analysis of young plants revealed that application of either phosphorus or nitrogen alone did not increase percent phosphorus in the tissue or phosphorus uptake by the corn plants. When nitrogen and phosphorus were applied together both percent phosphorus and phosphorus yield were significantly increased (Table 2).

Red Wing location (Fayette soil)

This experiment was carried out on a Fayette soil of relatively high fertility.

The effects of nitrogen, phosphorus, and potassium are shown in the following table. In this experiment application of starter fertilizers did not increase corn yield (Table 3). The application of phosphorus significantly increased phosphorus content of the plant tissue. No significant increasee in potassium content of corn was found due to the application of potash (Table 3).

There were no significant increases in phosphorus content due to the nitrogen phosphorus interaction as was shown at Lamberton and Waseca. Percent phosphorus in young plants was decreased by the addition of nitrogen without phosphorus (Table 3).

Table 3. The effect of nitrogen, phosphorus and potassium on nutrient content and corn yield at Red Wing.

Treatments*	Stage of Growth: Young plants (12 to 18 inch height) Weight gm/pl	P %	K %	Tasseling P %	K %	Yield: Shelled corn bu/A
0+0+0	2.4	.51		.35		114
0+60+60	3.1	.53		.38		115
90+0+60	2.4	.37		.35		119
90+60+60	3.0	.51	5.8	.41	2.5	123
90+60+0	2.9	.53	5.5	.43	2.3	125
L.S.D. (.05)	.7	.06	1.0	.05	.3	13

*Fertilizers were: nitrogen (33-0-0), phosphorus (0-46-0), and potassium (0-0-60).

Morris location (Barnes soil)

Results of this field trial with corn using 27-14-0 supplemented with ammonium nitrate when necessary are shown in Table 4.

Data presented in Table 4 indicate that neither nitrogen, phosphorus or zinc applied as starter materials affected the yield of corn significantly.

Table 4. 27-14-0 as a starter fertilizer for corn at Morris.

Treatment	Young plants (12 to 18 inch height) Weight gm/pl	P %	P-Yield mg P/pl	Yield: Shelled corn bu/A
0+0+0	1.4	.40	5.8	76
90+0+0	1.2	.33	4.0	79
90+15+0	1.7	.41	7.3	81
90+30+0	2.3	.48	11.1	80
90+45+0	1.7	.43	7.6	85
90+45+0 plus zinc 12#/A	2.0	.48	9.7	77
L.S.D. (.05)	.8	.08	4.1	11

Phosphorus content of young corn plants was significantly increased by the first 15#/A of phosphorus added, but further increments did not significantly increase phosphorus content.

Summary

Nitrogen applied with phosphorus as starter fertilizers on Nicollet soils at Lamberton and Waseca had a very significant effect on the phosphorus nutrition of corn. At both these locations, phosphorus content of young corn treated with both nitrogen and phosphorus was much greater than that from phosphorus without nitrogen. This effect resulted in about a 50 bushel per acre increase in corn yield at Lamberton, but no yield differences were found at Waseca. No nitrogen-phosphorus interactions were found on a Fayette soil at Red Wing, however this soil is an extremely fertile one as indicated by soil test and analysis of plant tissue.

Tissue analysis was carried out on both young corn plants and corn leaves at tasseling time. In general it appears that phosphorus effects manifest themselves more greatly early in the development of the plant, and also that differences in phosphorus levels are at a maximum at this time. When small differences between fertilizer materials are to be detected they can most easily be determined from the tissue analysis of young plants.

The addition of K to the soil increased the K content of plant tissues, particularly the young plant. Nitrogen content of plants was increased substantially by the application of ammonium nitrate.

Results of Six Years of Continuous Corn Fertilization at Morris Barnes Loam - Stevens County

J. M. Mac Gregor, R. G. Hanson, G. R. Blake and R. Thompson

In 1957, a continuous corn experiment was initiated to study the effect of fertilizing annually with differing rates of nitrogen with constant rates of phosphate and of potash, and the effect of different tillage methods on corn yield and soil structure.

The following table shows the corn yields for the 1957-62 period.

The Effect of Annual Fertilization of Corn on Barnes Loam, Applied in Spring or Fall With Minerals on the Yield of Ear Corn.

Annual Nutrients applied (lbs/A)	Time of Fertilization	1957	1958	1959	1960	1961	1962	Six Year Average
		bushels of ear corn per acre @ 15.5% moisture						
0+40+40	spring	65.2	73.2	36.1	53.3	32.3	26.7	47.8
40+40+40	fall	71.0	81.5	40.9	48.2	48.3	41.2	55.2
40+40+40	spring	69.4	81.0	41.5	55.0	47.6	44.1	56.4
80+40+40	"	72.1	82.4	39.7	53.7	45.0	45.7	56.4
240+40+40	"	71.3	80.3	36.8	52.5	46.1	47.8	55.8

Plant populations have been maintained at about 18,000 plants per acre each year.

Yields during the first two years of the experiment were considerable higher than durigg the succeeding four yeabs of the study. It was very dry in 1961 and very cool and wet during the summer of 1962.

It is evident that the annual application of nitrogen at the rate of 40 pounds per acre increased corn yields to the same extent as twice to six times (80 to 240 lbs N/A) the 40 pound per acre rate, even though the heavier rates produced much healthier appearing corn plants. It appears that some factor other than soil nitrogen supply is limiting the corn yields on this experimental field.

Continuous Corn - High Fertility Experiment
Rosemount Experiment Station
Soils

W. F. Martin and H. W. Kramer

Yield Results - 1962

Re: 1959 results, page 97, Department of Soils Mimeo, April, 1960: 1960 results, page 82, ibid, February, 1961, 1961 results, p. 79, ibid, February, 1962.

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, 1953-1961. 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	74 bu.	93
2.	H*	86	110
3.	HS_1	91	110
4.	HS_2	90	114
5.	B_1H	97	114
6.	B_1HS_1	95	117
7.	B_1HS_2	94	117
8.	B_2H	94	118
9.	B_2HS_1	95	119
10.	B_2HS_2	96	118

*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. 6-12-24 broadcast
B_2 = 800 lbs. 6-12-24 broadcast

Continuous Corn - High Fertility Experiment
Rosemount Experiment Station
Soils

John Grava

I. Soil test results* 1958 and 1960

Treatment No.	Manual application of N P_2O_5 K_2O	Soil pH	Extractable Phosphorus (P)	Exchangeable Potassium (K)
	lbs./acre		lbs./acre	lbs./acre
	1. Sampling Date: July 18, 1958			
1	0 + 0 + 0	5.8	17 M	105 M
4	82 + 32 + 32	5.8	27 H	135 M
6	69 + 112 + 112	5.7	91 VH	218 M
9	89 + 192 + 192	5.4	143 VH	278 VH
	2. Sampling date: August 1, 1962			
1	0 + 0 + 0	5.9	17 M	130 M
4	86 + 40 + 40	6.0	26 H	155 M
6	77 + 88 + 136	5.7	78 VH	208 M
9	101 + 136 + 236	5.3	150 VH	340 VH

* average of four replications

II. Effect of fertilization on N, P and K contents** in 6th corn leaf at tasseling time - 1962

Treatment No.	Nitrogen	Phosphorus	Potassium
	%	%	%
1	3.02	0.233	1.36
4	3.20	0.290	2.30
6	2.87	0.302	2.55
9	3.16	0.340	2.80

Critical levels (according to Tyner): 2.9% N, 0.295 % P, and 1.3%K.

**Average of four replications.

NPK - Rate and Placement Studies with Corn on Fayette Soils-1962

John Grava and Lowell Hanson

Most farmers who get their soils tested are beyond the stage where the question whether or not to use fertilizer is being asked. A fertilizer recommendation now has to provide information on what grade, how much of it, and how to apply it. To provide such information rather complicated field experiments are needed. With these questions in mind an NPK-rate and placement study with corn was initiated on Fayette and related soils in southeastern Minnesota in 1961. Results of that study were reported in a report on field research in soils, February 1962.

The study was continued on three corn fields in Goodhue and Wabasha counties in 1962. Following is a brief description of the location, soil type, cropping pattern, fertilization and soil management.

FIELD 1 Nygren Brothers, Red Wing, Minnesota, Goodhue County
Soil Type: Fayette-Seaton silt loam

Year	Crop	Fertilizer	Manure
1961	Corn	100 lbs./A. 5-20-20	---
1960	Alfalfa	---	10 To/A. in fall
1959	Oats & Alfalfa	---	---

Limed: 1957 2 To./A.
Plowed: Spring, 1962
Weed Control: Cultivated 1x; weeds not eliminated

FIELD 2 Dale Flueger, Red Wing, Minnesota, Goodhue County
Soil Type: Fayette silt loam

Year	Crop	Fertilizer	Manuer
1961	Corn	125 lbs./A. 5-20-20 Row	8 To/A.
1960	Corn	125 lbs./A. 5-20-20 Row	8 To/A.
1959	Pasture (Brome Grass & Alfalfa)	---	---

Plowed: Spring, 1962
Weed Control: Atrazine (post-emergence); weeds not eliminated

FIELD 3 Edwin Freeze, Kellogg, Minnesota, Wabasha County
Soil Type: Fayette silt loam

Year	Crop	Fertilizer	Manure
1961	Sweet corn	275 lbs./A. 4-12-36 + 80 lbs./A. of N	---
1960	Sweet corn	200 lbs./A. 6-24-24	---
1959	Sweet corn	200 lbs./A. 6-24-24	---

Limed: 1957 or 1958, 3 To./A.
Plowed: Fall, 1961
Weed Control: Atrazine (post-emergence); cultivated 1x; weeds eliminated

In 1961 the experiments were conducted on soils testing medium to high in phosphorus and low to medium in potassium. The three fields used for experiments in 1962 showed much higher P and K fertility levels, as shown in Table 1.

Table 1. SOIL TEST RESULTS

Location	pH	Organic Matter %	Extractable Phosphorus lbs./A	Exchangeable Potassium lbs./A	Soil Texture
Nygren Brothers, Goodhue County	6.7	2.8L	58 VH	220M	Silt Loam
Flueger, Goodhue County	7.4	2.8L	18 M	225H	Silt Loam
Freeze, Wabasha County	7.1	2.6L	64VH	185M	Silt Loam

These fertility levels are reflected also in the check yields:

Nygren Brothers	129 Bu./Acre
Flueger	99 Bu./Acre
Freeze	121 Bu./Acre

Surface and subsoil samples were collected during the first week of May for moisture determinations and routine chemical analysis. Each field experiment consisted of 15 treatments, replicated five times, for a total of 75 plots. Individual plots were 25 feet long and 13,3 feet wide. A part of the fertilizer was broadcasted, plowed down on fields No. 1 and2, and disced-in on field No. 3.

Pioneer 376 (108-112 day) corn variety was planted (May 16, 17 and 18) at all locations. Corn was thinned to a uniform stand of 20,000 plants per acre (2 plants per hill, 15 inches apart in 40-inch rows). The farmer cooperators were provided with rain gauges and asked to keep rainfall records. Corn leaf samples were collected at the tasselling time for N, P and K determinations.

Finally, corn yields were determined by harvesting and weighing ears from 20-two stalk hills from each plot. Moisture content was determined on five representative ears from each treatment.

Subsoil moisture was sufficient at the planting time. All locations received about 18.5 inches of rainfall from May 15 to September 30. Corn developm ent was delayed, particularly in the early stages of growth.

Corn yield response to nitrogen fertilization is shown in Table 2.

Table 2. CORN YIELD RESPONSE TO NITROGEN FERTILIZATION

Rate of Nitrogen N lbs./Acre	Location		
	Nygren Brothers	Flueger	Freeze
	Yield of shelled corn (15.5 % moisture)		Bu./Acre
10	140	134	133
60	164 +24	146 +12	140 +7
120	164 +24	155 +21	136 +3

Note: All treatments received 0+0+80 broadcast and 10+40+40 row treatment.

The 60 pound rate of nitrogen was sufficient in producing profitable yield increases on two fields. At one location the highest yield was realized with the application of 120 pounds of nitrogen. However, one of the most significant conclusions that can be derived from this study is the ability of the Fayette soils to release nitrogen to corn. An average corn yield of 132 bushels per acre was produced with only 10 pounds per acre of row-placed nitrogen (Ave. 110 Bu./A at 4 locations in 1961).

A comparison of three phosphorus rates and two types of placement is given in Table 3.

Table 3. CORN YIELD RESPONSE TO PHOSPHORUS FERTILIZATION

Rate of Phosphorus P_2O_5 lbs./A.	Location		
	Nygren Brothers	Flueger	Freeze
	Soil Test = 58	Soil Test =18	Soil Test=64
	Yield of shelled corn (15.5% moisture)		Bu./Acre
0	151	139	135
40 Bcst.	156 +5	140 +1	143+8
40 Row	157 +6	156 +17	136 +1
80 (40 Bcst. + 40 Row)	170 +19	155 +16	144 +9

Note: All treatments received 110+0+80 broadcast and 10+0+40 row treatment.

It should be pointed out that in 1961 on similar soils phosphorus applications resulted in decreased yields at three out of four locations. Furthermore, broadcast application of 40 lbs. P_2O_5/A. resulted in lower yields (average of 14 Bu./A.) than the same amount of phosphorus applied in a row.

Corn responses to phosphorus applications were observed on all fields in 1962. On Flueger's field with a medium P test, row placement was more effective than broadcast. Both types of placement were equally effective on a soil with very high P test (Nygren Brothers).

Corn yield responses to five potassium rates and two types of placement are given in Table 4.

The potassium test values on these fields are approaching the high level, generally higher than most Fayette soils. On two fields the 80 lbs. of K_2O per acre rate was most efficient, resulting in 6 to 12 more bushels of corn than the 0 K treatment. At one location the 120 pound rate of K_2O increased the yield by 25 bushels per acre. While corn leaves collected from row placed potassium treatments showed higher K content than those from broadcast treatments, no such clear cut differences due to placement were observed in corn yields.

The recommenced rates and placement of N, P and K, based on the reported experimental data, are indicated in Table 5.

Table 4. CORN YIELD RESPONSE TO POTASSIUM FERTILIZATION

Total K_2O lbs./A.	Broadcast K_2O lbs./A.	Row K_2O lbs./A.	Location: Nygren Brothers Soil Test: 220	Flueger Soil test: 225	Freeze Soil Test: 185
			Yield of shelled corn (15.5% Moisture)		Bu./ Acre
0	--	--	146	145	141
40	40	--	166 +20	150 +5	131 -10
40	--	40	161 +15	148 +3	132 -9
80	80	--	156 +10	157 +12	137 -4
80	--	80	169 +14	154 +9	133 -8
80	40	40	154 +8	152 +7	147 +6
120	80	40	171 +25	153 +8	136 -5
120	40	80	157 +13	159 +14	145 +4
160	80	80	162 +16	156 +11	147 +6

Note: All treatments received 110+0+0 broadcast and 10+40+0 row treatment.

Table 5. MOST EFFICIENT FERTILIZER TREATMENTS - 1962

Location	N		P_2O_5		K_2O
			lbs./Acre		
Nygren Brothers	60	+	80[1]	+	120[2]
Flueger	120	+	40[3]	+	80[4]
Freeze	60	+	40[5]	+	80[6]

1) P_2O_5 40 lbs./A. Broadcast + 40 lbs./A. Row

2) K_2O 80 lbs./A. Broadcast + 40 lbs./A. Row

3) Row

4) Broadcast

5) Broadcast

6) K_2O 40 lbs./A. Broadcast + 40 lbs./A. Row

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PROPER FERTILIZER PLACEMENT CAN IMPROVE STAND AND YIELD OF CORN

Rosemount Agricultural Experiment Station - U. of M.
1961
Paul M. Burson
Department of Soils

Two types of fertilizer attachments on the corn planted were tested on four fields. The planters were the splitboot type and the band placement type. All the fertilizer was applied as starter and consisted of several different grades.

The fertilizer placement with the splitboot is intended to be at seed level and at the side of the seed. However, the actual placement varies with the make of the machine, the condition of the seedbed, soil conditions and the physical condition of the fertilizer to mention a few. It may be placed as intended but the fertilizer may be above or with the seed. With the band type the placement is definitely determined by the mechanical adjustments. In these trials the placement was 2 inches to the side and 2 inches below the seed placing the fertilizer in an exact position to the seed. Both planters had been previously calibrated for both seed and fertilizer rates.

The trials consisted of 4 rows of corn in paired plots which were replicated two or four times. The data shown in the table below are averages of the results from four fields. Two of the fields were on Clyde silty clay loam and two on Port Byron silt loam.

Split boot vs. band placement

	Splitboot	Band	Increase
Yield all fertilizers	79.8 bu.	99.9 bu.	20.1 bu.
Final stand - plants/ac	10,000	15,900	5,100

4 fields

Planting rate - 18,000 kernels per acre

With the splitboot attachment some of the fertilizer comes in direct contact with the seed and appears to have seriously injured germination. In these trials the average final stand at harvest time was 5100 plants per acre less with the split boot than when the band type attachment was used. The lower plant population is reflected in a lower yield, of 20.1 bushels per acre.

Both nitrogen and potash will injure germination when any considerable amounts come into direct contact with the seed. Phosphorus is less harmful. However, the splitboot attachments limit the amount of starter fertilizer that should be applied. If the rate of a mixed fertilizer should exceed 150 pounds per acre there is the probability that germination may be injured. Moisture supply and weather conditions can make considerable difference.

The Effect of Potash Placement in Starter Fertilizer on the Yield of Corn

Rosemount Agricultural Experiment Station
U. of Minn., 1961
Paul M. Burson
Department of Soils

Two types of fertilizer placement attachments on the corn planter were used. They were the splitboot and the side band. The splitboot attachment is designed to place the fertilizer at seed level but to the side of the seed. However, this is not the case. It may place the fertilizer above the seed or with the seed depending on the condition of the soil, the condition of the fertilizer, particle size, weight of ingredients, the design of the attachment and the way the planter is operated.

The band fertilizer attachment places the fertilizer positively in relation to the seed by using a separate opener which may be set for a predetermined rate and placement. In these trials the fertilizer band was 2 inches to the side and 2 inches below the seed. With this placement there was no chance for seed and fertilizer contact.

Splitboot vs. band placement

Method	40 lbs. K_2O	No potash	Increase or decrease
Splitboot	72.2 bu.	76.0 bu.	- 3.8
Band	111.9	97.4	+ 14.5

The fertilizers compared, as shown in the table above, were 40-40-40 with 40-40-40 and 80-40-40 with 80-40-0. The planting rate was 18,000 kernels per acre.

Using the splitboot type the inclusion of potash in the starter reduced the yield by 3.8 bushels per acre. This indicates that in all probability some fertilizer came in direct contact with the seed with a consequent reduction in stand due to injury at germination.

The inclusion of potash in the starter and placed in a band to the side and below the seed increased the corn yield 14.5 bushels per acre. This increase is nearly the same as obtained in 1960 for including potash in the starter which was 12.0 bushels per acre. In 1962 the increase was 14.0 bushels per acre. The results from the trials in 1960, 1961 and 1962 are similar to those conducted in other parts of Minnesota in 1961 and indicate that some potash should be included in starter for corn. All trials have shown that placement of the fertilizer is becoming most important to successful and profitable corn production.

Comparative Effects of Deep Tillage Versus Plowing on Soil & Water Losses and Corn Yield over Four Years (1959-62) on Port Byron Silt Loam at Rosemount

J. M. Mac Gregor

In 1953, a seed-bed preparation experiment was initiated on a 9% slope of the Port Byron silt loam at Rosemount to determine the relative effect of deep tillage seed-bed preparation versus conventional plowing, on losses of soil and water and of corn, oat, and hay yields where a four year rotation of corn, oats, followed by two years of alfalfa was practiced.

Six years of experimental results (1953-1958) indicated that the four year rotation in use was adequately maintaining soil tilth, and with no treatment replication there was no significant difference in soil or water loss with the two methods of soil preparation of in the yields of corn, oats, or of alfalfa hay.

Therefore, in 1959, the four-year rotation was changed to a continuous corn sequence on each of the eight plots. After harvest each fall, a stalk cutter was used on all plots, after which four were plowed and the remianing four adjacent plots were deeply cultivated (to approximately an eighth inch deep) and then reworked to a slightly shallower depth in the spring. Corn was planted to obtain approximately 16,000 plants per acre, using 5-20-20 as starter fertilizer each year at the rate of 200 pounds per acre. A nitrogen sidedressing of 80 pounds of ammonium nitrate nitrogen per acre was broadcast annually in late June or in early July.

Results

The growing season of 1959 was abnormally wet, followed by two comparatively dry summers of 1960 and 1961 and about normal rainfall in 1962. This variation in growing season moisture has produced considerable difference in all of the results obtained, as shown in the following table:

Table 1. The effect of seed-bed preparation by plowing or by deep cultivation on soil and water losses and resulting corn yield on a 9% slope of Port Byron silt loam at Rosemount (1959-62 (Averages of four replicates).

	Year			
	1959	1960	1961	1962
Total precipitation (April-Oct. inc.)	32.5"	21.8"	19.3"	20.4"
Water runoff on plowed plots	6.3"	0.7"	None	None
Runoff as % of 7 month pptn.	19	3	None	None
Runoff on cultivated plots	5.6"	0.3"	None	None
Runoff as % of 7 month pptn.	17	1	None	None
Tons of soil eroded/A on plowed plots	2.4	None	None	None
Tons of soil eroded/A on cultivated plots	1.3	None	None	None
Yield of ear corn per acre on plowed plots	119	88	99	71
Yield of ear corn per acre on cultivated plots	122	74	81	60