Preplant vs. Weekly Applications of N-P-K Fertilizers

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Many studies have compared time of fertilizer application to corn, but few have looked at weekly applications of complete N-P-K fertilizers. Often only one nutrient is looked at individually making sure that the other nutrients of concern are adequately supplied. In some instances the ratio between the nutrient in question and other nutrients may be greatly out of proportion, thus resulting in an imbalance and less than maximum response. Is it possible to add N-P-K nutrients in a certain ratio on a periodic basis such that the supply will be more readily available to the plant throughout the growing season? The primary objective of this investigation was to determine any benefits that might be derived from weekly applications of a complete N-P-K fertilizer as compared to applying all of the fertilizer preplant.

Procedure

A study was initiated in 1985 to compare preplant fertilizer with weekly applications of a 20-10-10 fertilizer. The study was conducted on two soil types (Metea loamy sand and Capac loam) with two corn hybrids (Pioneer 3707 and Pioneer 3475). In 1986 the experiment was repeated with only one change. Hybrid Pioneer 3475 was replaced by Pioneer 3540. Soybeans was the previous crop in both years. All experiments were irrigated based on soil tensiometer readings. All plots received a starter fertilizer consisting of 250 lbs of a 20-10-10 fertilizer banded two inches to the side and two inches to the side of the seed. The preplant fertilizer plots received 250 lbs N, 100 lbs P205 and K20 per acre. The sidedress treatments received 50 lbs N preplant and 10 weekly applications of 100 lbs 20-10-10 fertilizer. The total application of plant food for each treatments was 300 lbs N, 125 lbs P205 and K20. Additional information on these studies can be found in the 1985 and 1986 Soil Fertility Progress Reports (1).

Results

Yield data for 1985 is shown in Table 1. No significant differences in corn yield were observed due to fertilizer placement, even though a higher plant population was found when the fertilizer was sidedressed. It was postulated that the large application of fertilizer at planting may have reduced emergency; however, no data were obtained at emergence to confirm our supposition. This was particularly true for the Pioneer 3475 hybrid. There were significant yield differences between soil type and hybrids when yields were averaged over fertilizer placement and hybrid or soil type. The highest yields were obtained with Pioneer 3475 on the Capac loam soil.

Yield data for 1986 are shown in Table 2. Weekly sidedress treatments were found to yield 4 bushels better than the preplant treatment. The only interaction that was not favored by the weekly sidedress treatment was with Pioneer 3707 on the Capac loam soil. Hybrids averaged over soil type and fertilizer placement were similar. Yields on the Capac loam soil were slightly better than on the Metea loamy sand soil in both years.

Elemental composition of corn ear leaves taken at early silking in 1985 are shown in Table 3. Preplant fertilizer resulted in significantly higher concentrations of P, K, Zn, and Mn. There were also many differences in elemental composition related to soil type and hybrid.

In 1986, whole corn plants were collected from the Pioneer 3707 hybrid plots at three bi-weekly intervals prior to tasseling. A combined analysis of the data is shown in Table 4. Nitrogen, K, Zn, and Mn were significantly higher when all of the fertilizer was preplant applied. As expected, the biggest differences were observed at the early sampling date which is directly related to the total amount of fertilizer applied at the time of sampling. By the time of ear leaf sampling, no differences in elemental composition were observed in the leaves due to fertilizer placement (1). Differences in K however, were still evident in stalks sampled after silking and stover sampled at maturity.

Surface soil samples (0-10 inches) taken in July, August, and September (Tables 5 and 6) show higher levels of nitrate when fertilizer was sidedressed compared to preplant. The difference between preplant and sidedress fertilizer treatments is represented by 68 to 84 lbs N/acre-3 feet for Metea and Capac soils, respectively.

Summary

Very little yield advantage was gained in these experiments from weekly applications of the 20-10-10 fertilizer. Because of the large amount of fertilizer applied in these studies, some damage to seedling emergence may have been observed from applying all of the fertilizer preplant. This would be particularly a problem if corn seedlings became drought stressed. Plant analysis indicated that phosphorus and potassium should be applied early. Delaying or spreading out the time of P and K applications would appear to have no advantage in these studies. Because P and K are relatively immobile in the soil environment, they are not subject to sudden loss.

Nitrogen in comparison, is subject to leaching and denitrification losses and is much less stable. In this study nitrogen was never in short supply from either preplant or weekly applications. Under limited N conditions, we would anticipate greater efficiency from the sidedress applications. Under conditions of excess nitrogen such as occurred in these experiments, more nitrogen will be left at the end of the season from weekly sidedress treatments. This represents a potential for increased contamination of ground water on sandy soils where the aquifer is unprotected. We should not under estimate the importance of

selecting a realistic yield goal and applying the appropriate rate of N fertilizer to obtain an favorable economic yield while minimizing the potential for groundwater contamination.

References

1. Vitosh, M. L. 1985-86. Soil Fertility Progress Report. Department of Crop and Soil Sciences, Michigan State University, East Lansing, Mi. 48824. 155p.

Table 1. Corn yield, grain moisture at harvest, plant population, and percent barren stalks for two corn hybrids and two methods of fertilizer placement on two soil types - 1985.

Soil Type	Hybrid	Fertilizer Placement 1/	Grain Yield 2/	Grain Moisture	Plant Population	Barren Stalks 3/
			bu/A	%	plants/A	%
Metea Loamy Sand	Pioneer 3707	Preplant	190bc	27.4ab	33454ab	0.3
	Pioneer 3707	Sidedress	188c	26.4b	34953a	2.0
	Pioneer 3475	Preplant	197b	28.5a	31224c	0.7
	Pioneer 3475	Sidedress	201ab	28.4a	32897b	1.5
Capac Loam	Pioneer 3707	Preplant	199ab	25.0bc	34917a	-0.2
	Pioneer 3707	Sidedress	200ab	24.4c	35196a	1.8
	Pioneer 3475	Preplant	193bc	26.7b	29411d	-1.5
	Pioneer 3475	Sidedress	205a	26.3b	30945cd	-3.1
			---------- Overall Means 4/ ----------			
Soil Type						
Metea Loamy Sand			194b	27.7a	33132	1.1a
Capac Loam			199a	25.6b	32618	0.0b
Hybrid						
Pioneer 3707			194b	24.7b	34630a	1.0a
Pioneer 3475			199a	26.5a	31119b	0.0b
Fertilizer Placement						
Preplant			195	25.9	32251a	0.0
Sidedress			199	25.3	33498b	0.5

1/ 1000 lbs of 20-10-10 fertilizer applied either preplant or sidedressed in 10 weekly applications starting June 13th.
2/ Adjusted to 15.5 % moisture.
3/ A negative value indicates percent double eared stalks.
4/ Any two means followed by different letters are significantly different as measured by the LSD method (p=.05).

Table 2. Corn yield, grain moisture at harvest, plant population and percent barren stalks for two corn hybrids and two methods of fertilizer placement on two soil types - 1986.

Soil Type	Hybrid	Fertilizer Placement 1/	Grain Yield 2/	Grain Moisture	Plant Population	Barren Stalks 3/
			bu/A	%	plants/A	%
Metea Loamy Sand	Pioneer 3707	Preplant	183	26.5	32548	2.8
	Pioneer 3707	Sidedress	194	27.1	33837	0.6
	Pioneer 3540	Preplant	187	26.0	27809	0.7
	Pioneer 3540	Sidedress	191	26.1	27042	-0.4
Capac Loam	Pioneer 3707	Preplant	193	23.6	32791	2.5
	Pioneer 3707	Sidedress	193	23.4	32966	4.1
	Pioneer 3540	Preplant	191	23.5	28436	-1.1
	Pioneer 3540	Sidedress	193	23.3	29725	-2.8
			---------- Overall Means 4/ ----------			
Soil Type						
Metea Loamy Sand			189b	26.4a	30309	0.1
Capac Loam			192a	23.4b	30980	0.6
Hybrid						
Pioneer 3707			191	25.2a	33036a	2.5a
Pioneer 3540			190	24.7b	28253b	-1.8b
Fertilizer Placement						
Preplant			189b	24.9	30396	1.2a
Sidedress			193a	24.9	30893	-0.5b

1/ 1000 lbs of 20-10-10 fertilizer applied either preplant or sidedressed in 10 weekly applications starting June 13th.
2/ Adjusted to 15.5 % moisture.
3/ A negative value indicates percent double eared stalks.
4/ Any two means followed by different letters are significantly different as measured by the LSD method (p=.05).

Table 3. Elemental composition of corn ear leaves sampled at early silking (July 17, 1985).

Soil Type	Hybrid	Fertilizer Placement	Elements									
			N	P	K	Ca	Mg	Zn	Mn	Cu	B	Fe
			%					ppm				
Metea Loamy Sand	P 3707	Preplant	3.14	0.33	1.71	0.36	0.27	40	84	10	8	227
		Sidedress	3.03	0.32	1.63	0.34	0.27	32	44	10	9	228
	P 3475	Preplant	2.86	0.33	1.86	0.51	0.29	45	72	10	9	228
		Sidedress	2.89	0.31	1.74	0.49	0.30	37	43	9	9	213
Capac Loam	P 3707	Preplant	2.88	0.28	1.36	0.50	0.35	36	33	10	12	412
		Sidedress	2.83	0.27	1.30	0.53	0.37	34	25	9	11	414
	P 3475	Preplant	2.77	0.29	1.53	0.73	0.37	37	30	8	11	429
		Sidedress	2.67	0.27	1.44	0.69	0.40	32	21	9	11	395
			Overall Means 1/									
Soil Type												
Metea Loamy Sand			2.98a	0.32a	1.73a	0.43b	0.28b	39	61a	10	9b	224b
Capac Loam			2.79b	0.28b	1.41b	0.61a	0.37a	35	27b	9	11a	413a
Hybrid												
P 3707			2.97a	0.30	1.50b	0.43b	0.31b	36	47	10	10	320
P 3475			2.80b	0.30	1.64a	0.61a	0.34a	38	42	9	10	316
Fertilizer Placement												
Preplant			2.91	0.31a	1.61a	0.53	0.32	40a	55a	10	10	324
Sidedress			2.86	0.29b	1.53b	0.51	0.33	34b	33b	9	10	313

1/ Any two means followed by different letters are significantly different as measured by the LSD method (p=.05).

Table 4. Elemental composition of whole corn plants sampled June 11, June 25 and July 9, 1986 (Pioneer 3707 only).

Soil Type	Sample Date	Fertilizer Placement	Elements N	P	K	Ca	Mg	Zn	Mn	Cu	B	Fe
			%					ppm				
Metea Loamy Sand	6/11	Preplant	3.29	0.38	2.30	1.10	0.50	71	259	38	7	459
	"	Sidedress	2.91	0.35	2.33	1.05	0.63	53	118	35	6	370
	6/25	Preplant	2.40	0.30	2.02	0.75	0.40	46	129	10	6	165
	"	Sidedress	2.03	0.26	1.78	0.68	0.37	34	61	11	6	180
	7/9	Preplant	1.65	0.22	1.68	0.74	0.39	33	109	12	8	112
	"	Sidedress	1.54	0.21	1.57	0.71	0.38	27	53	9	8	111
Capac Loam	6/11	Preplant	2.88	0.36	2.43	1.61	0.67	52	78	32	8	474
	"	Sidedress	2.72	0.42	2.30	1.51	0.67	47	54	33	8	497
	6/25	Preplant	2.32	0.30	1.67	0.99	0.60	39	50	13	7	324
	"	Sidedress	2.02	0.28	1.56	1.04	0.64	33	33	11	8	272
	7/9	Preplant	1.60	0.21	1.16	0.85	0.67	25	37	13	7	147
	"	Sidedress	1.57	0.20	1.00	0.83	0.64	24	27	11	8	126
			Overall Means 1/									
Soil Type												
Metea Loamy Sand			2.30a	0.29	1.95a	0.84b	0.44b	44a	122a	19	7b	233b
Capac Loam			2.18b	0.30	1.69b	1.14a	0.65a	37b	47b	19	8a	307a
Sample Dates												
6/11			2.95	0.38	2.34a	1.32	0.62	56	128	34	7	450
6/25			2.19	0.28	1.76b	0.87	0.50	38	68	11	7	235
7/9			1.59	0.21	1.35c	0.78	0.52	27	56	11	8	124
Fertilizer placement												
Preplant			2.36	0.29	1.88a	1.01	0.54	44a	110a	20	7	280
Sidedress			2.13	0.29	1.76b	0.97	0.56	36b	58b	18	7	259

1/ Any two means followed by different letters are significantly different as measured by the LSD method (p=.05).

Table 5. Soil nitrate and ammonium nitrogen concentrations on July 23 and August 6, 1986 (0-10 inch depth).

Soil Type	Sample Date	Soil NO3-N	Soil NO3-N	Soil NH4-N	Soil NH4-N
		Preplant	Sidedress	Preplant	Sidedress
		ppm			
Metea Loamy Sand	7-23	21	24	1.4	3.1
	8-06	14	20	1.6	10.8
Capac Loam	7-23	18	28	1.1	2.0
	8-06	13	30	0.7	7.8
		Overall Means 1/			
Soil Type					
Metea Loamy Sand		20		4.2	
Capac Loam		22		2.9	
Sample Date					
7-23		23a		1.9b	
8-06		19b		5.2a	
Fertilizer Placement					
Preplant		17b		1.2b	
Sidedress		25a		5.9a	

1/ Any two means followed by different letters are significantly different as measured by the Duncan's Multiple Range Test (p=.05).

Table 6. Residual soil nitrate and ammonium nitrogen concentrations (September 1986).

Soil Type	Sample Depth	Soil NO3-N	Soil NO3-N	Soil NH4-N	Soil NH4-N
		Preplant	Sidedress	Preplant	Sidedress
	Inches	ppm			
Metea	0-12	3	7	1.2	1.1
Loamy	12-24	5	12	0.5	0.5
Sand	24-36	6	12	0.4	0.3
		--	---	---	---
	Average lb/A 1/	56	124	8.4	7.6
Capac	0-12	6	15	0.7	0.7
Loam	12-24	6	14	0.3	0.3
	24-36	5	9	0.1	0.1
		--	---	---	---
	Average lb/A 1/	68	152	4.4	4.4
			Overall Means 2/		
Soil Type					
Metea Loamy Sand		8b		0.7a	
Capac Loam		9a		0.3b	
Sample Depth					
0-12		8b		0.9a	
12-24		9a		0.4b	
24-36		8b		0.2c	
Fertilizer Placement					
Preplant		5b		0.5	
Sidedress		11a		0.5	

1/ Based on 4,000,000 lbs of soil per foot of depth.
2/ Any two means followed by different letters are significantly different as measured by the Duncan's Multiple Range Test (p=.05).

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PROCEEDINGS

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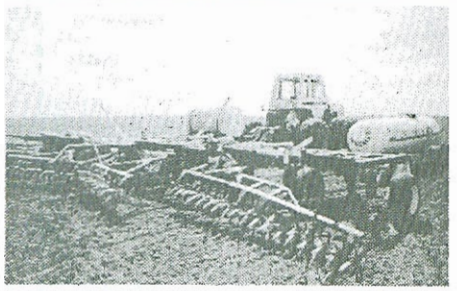

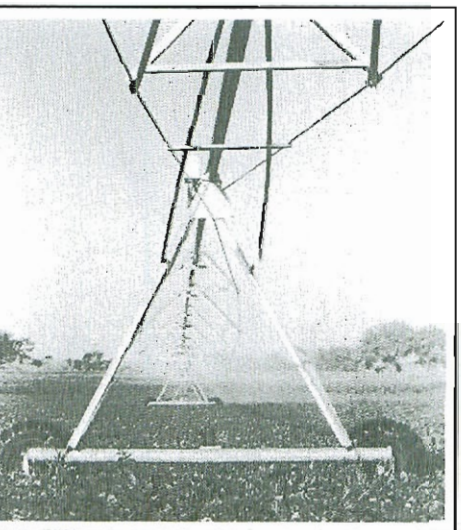
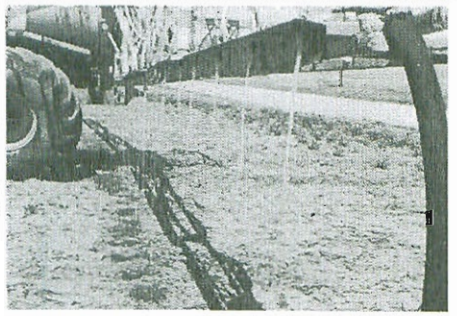
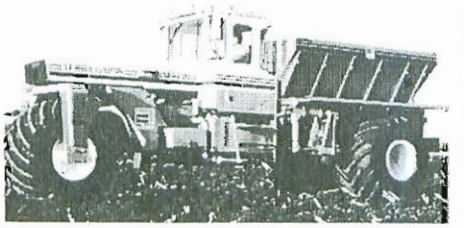
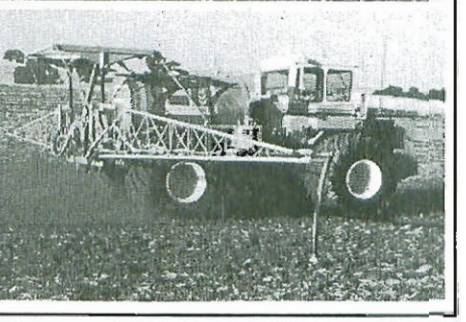

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