THE EFFECT OF TILLAGE AND SOIL TEST AND APPLIED K ON CORN AND SOYBEAN PRODUCTION[1]

R.G. HOEFT, L.V. BOONE, T.R. PECK
G.A. RAINES, M.J.MAINZ, AND L.E. PAUL[2]

The buildup-maintenance fertility concept for P and K has a strong theoretical basis, but much of the research from which it was derived was not designed to accurately determine the true maintenance requirement. Most of that research was confounded by an annual application at set rates irrespective of yield obtained. Experience in recent years has shown that on some soils the K soil test has not consistently accounted for past additions of fertilizer. In addition, applications equivalent to crop removal have not maintained the K test. Because of these observations, and the concern about the possible effect of tillage on K soil test results and interpretation, an experiment was initiated in 1985 with the following objectives:

1. To determine the specific relationship of applied K fertilizer to soil test K.
2. To determine the K test necessary for optimum yield.
3. To determine the amount of K fertilizer necessary to maintain K test under high yield conditions.
4. To evaluate the influence of tillage on K soil test.

MATERIALS AND METHODS:

Experiments were established at three locations in 1985 using a split plot design with tillage as the main plot, 4 desired soil test levels as sub-plots, and 3 annual application levels as sub-sub plots. The experiments were established at the Northern Illinois Research Center at DeKalb on a Drummer sicl, at the Northwest Research Center at Monmouth on an Ipava sil, and at the Orr Research Center at Perry on a Herrick sil.

Prior to establishment, soil samples were collected from each individual plot to a depth of 7 inches and analyzed for pH, P, K, Ca, and Mg. Based upon the results, lime was applied to selected plots at DeKalb and Perry to adjust soil pH to a level of 6.5.
Phosphorus was applied at DeKalb, Monmouth, and Perry to adjust the level to 100 lbs. P/acre.

Four sub-plot K levels were established at each location in the spring of 1985. The levels were inherent, and inherent plus sufficient K to increase soil test K values 100, 200, or 300

[1]Presented at the nineteenth North Central Extension-Industry Soil Fertility Conference, November 8-9, 1989, St. Louis, MO.

[2] Professor, Agronomist, Professor, and Agronomists, Department of Agronomy, University of Illinois, Urbana, IL 61801.

lb/acre. The highest individual plot test level of the 18 plots which were assigned to remain as inherent was selected as the base level and all other plots were adjusted accordingly. The amount of K to be applied for each individual plot was calculated by subtracting the inherent level for each plot from the desired level and then multiplying that value by 4. The inherent soil test levels used at each location were: DeKalb-245 lbs K/acre, Monmouth-352 lbs K/acre, and Perry-320 lbs K/acre. After application of the materials, all plots were moldboard plowed to thoroughly mix the fertilizer and lime throughout the plow layer.

A soybean-corn rotation was used on these plots, commencing with soybeans in 1985. Samples of the most recently matured trifoliate leaves were collected at late bloom to early pod when soybeans were grown and ear leaf samples were collected at tasseling when corn was grown for plant analysis. Plot yields were collected at all locations. Soil samples have been collected at each location to monitor change in K test levels over time.

RESULTS AND DISCUSSION:

At Perry, conventional tillage resulted in a significant yield increase in all 3 years in which tillage was a factor, i.e. 86 through 88 (Table 1). This differential occurred irrespective of base K test level although in 1986, the difference seemed to be accentuated more at the low base K level. Conventional tillage resulted in superior yields in 1988 and 89 at DeKalb, both seasons characterized by early season drought stress. Similar to Perry, base K levels had little if any influence on this tillage differential. In contrast, the only tillage difference at Monmouth occurred in 1988 when no-till resulted in significantly higher yield than conventional tillage. In that instance, the differential was higher with increased base K levels.

Base K test levels had only minor influence on yield in most years of the study. The exception was in the drought year of 1988 when increased test levels resulted in a significant increase at both DeKalb and Perry. In 1985, the high rate of application necessary to establish the base levels resulted in significant yield decreases at both Monmouth and Perry.

The amount of K fertilizer required to increase the soil test 1 lb. varied by location, being the highest at DeKalb (9 lbs.) and lowest at Monmouth (4 lbs) with Perry intermediate between the two (6 lbs). As a result, the highest test levels were attained at Monmouth and the lowest at DeKalb. At both Monmouth and Perry, the test levels peaked in the first year and then decreased, while at DeKalb, the peak did not occur until the second year. The rate of decrease at DeKalb was consistent

across all base levels, but at Perry and Monmouth the decrease was greatest at the highest base levels.

SUMMARY:

Results of this study indicate little if any interaction between tillage and optimum K soil test level across a range of soil types. Since there has been no yield increase associated with increasing soil test levels, the optimum level cannot be determined from the data. However, it is obvious that currently suggested levels are adequate for optimum yield irrespective of tillage system. The continual decrease in test level even when twice the maintenance level has been applied needs further evaluation.

Table 1. Effect of tillage, base K soil test level and maintenance K application on corn and soybean yield. DeKalb

Factor	Year				
	1985 Soybean	1986 Corn	1987 Soybean	1988 Corn	1989 Soybean
	Yield (bu/acre)				
Tillage					
Conventional	36.2	150	40.4	166	41.7
0-till	36.2	146	42.1	142	34.3
Base K level					
Inherent	35.5	150	39.4	147	38.9
Inherent +100	36.4	148	41.7	155	39.6
Inherent +200	36.7	147	42.4	159	37.7
Inherent +300	36.1	146	41.7	154	35.9
Maintenance K					
None	35.9	146	42.3	150	38.8
Removal	36.7	150	40.8	155	35.5
Twice removal	35.9	148	40.8	156	39.8

Table 2. Effect of tillage, base K soil test level and maintenance K application on corn and soybean yield. Monmouth

Factor	Year			
	1985 Soybean	1986 Corn	1987 Soybean	1988 Corn
	Yield (bu/acre)			
Tillage				
Conventional	36.0	191	52.8	86
0-till	37.1	187	53.3	100
Base K level				
Inherent	37.9	192	53.2	88
Inherent +100	37.2	191	53.2	95
Inherent +200	36.6	191	53.4	96
Inherent +300	34.5	183	52.6	92
Maintenance K				
None	36.7	193	53.6	94
Removal	36.5	190	52.6	92
Twice removal	36.3	185	53.1	93

Table 3. Effect of tillage, base K soil test level and maintenance K application on corn and soybean yield. Perry

Factor	Year			
	1985 Soybean	1986 Corn	1987 Soybean	1988 Corn
	Yield (bu/acre)			
Tillage				
Conventional	35.7	172	48.1	88
0-till	36.3	161	38.3	77
Base K level				
Inherent	36.9	169	42.4	82
Inherent +100	36.2	171	45.6	90
Inherent +200	36.3	164	43.2	82
Inherent +300	34.7	162	41.7	76
Maintenance K				
None	36.0	167	43.2	79
Removal	36.1	167	43.9	86
Twice removal	36.0	165	42.6	82

Table 4. Effect of tillage, base K soil test level and maintenance K application on soil test K. DeKalb

Factor	Year			
	1985	1986	1987	1988
	Soil Test K (lb/acre)			
Tillage				
Conventional	204	327	359	234
0-till	218	332	374	254
Base K level				
Inherent	209	222	290	173
Inherent +100	206	282	330	224
Inherent +200	212	367	395	268
Inherent +300	217	447	450	311
Maintenance K				
None	218	358	353	232
Removal	216	329	360	248
Twice removal	199	302	386	252

Table 5. Effect of tillage, base K soil test level and maintenance K application on soil test K. Monmouth

Factor	Year			
	1985	1986	1987	1988
	Soil Test K (lb/acre)			
Tillage				
Conventional	266	609	512	443
0-till	306	626	518	523
Base K level				
Inherent	269	414	356	348
Inherent +100	289	567	467	454
Inherent +200	295	660	571	516
Inherent +300	294	829	666	614
Maintenance K				
None	270	602	497	449
Removal	291	600	519	492
Twice removal	298	650	529	509

Table 6. Effect of tillage, base K soil test level and maintenance K application on soil test K. Perry

Factor	Year		
	1985	1986	1987
	Soil Test K (lb/acre)		
Tillage			
Conventional	335	436	336
0-till	309	381	362
Base K level			
Inherent	284	318	270
Inherent +100	317	361	330
Inherent +200	345	449	354
Inherent +300	342	506	442
Maintenance K			
None	320	384	328
Removal	332	424	348
Twice removal	313	419	371

PROCEEDINGS OF THE NINETEENTH

NORTH CENTRAL EXTENSION - INDUSTRY SOIL FERTILITY CONFERENCE

November 8-9, 1989, Holiday Inn St. Louis Airport

Bridgeton, Missouri

Volume 5

Program Chairman:

Robert G. Hoeft

Department of Agronomy
University of Illinois
Turner Hall
1102 S. Goodwin Avenue
Urbana, IL 61801