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BACKGROUND

An on-farm, small plot study conducted in 1996, on a Crider soil in Larue County, Kentucky, resulted in unanticipated wide variability of soil test potassium (STK) values between spring and fall sampling. Because of this, the small plots were sampled monthly over a period of time with the objective of determining if such variability in STK values was real.

METHODS

A uniform site of Crider silt loam soil on 2-6% slopes was selected in early March of 1996, for a small plot experiment to test the grain yield response of no-till corn to potassium (K) at different rates of soil test based K-fertilizer recommendations. The field had been cropped to no-till corn for silage the previous year, following which, it was lightly disked and sown to wheat. After the general area for the experiment was located, it was divided into 5 subsections for taking soil samples to determine suitability of the site for the experiment. Random, composite 0-4 inch soil samples from these 5 subsections showed a range of soil test values within the area, as follows: pH 7.2-7.4; P 100-140 lbs/A; K 177-262 lbs/A; Ca 3300-3600 lbs/A; Mg 147-203 lbs/A. This experiment was designed to test rates of K-fertilizer at 0, 0.5, 1.0, 1.5, and 2.0 times the amount recommended by the University of Kentucky Agronomy Department at any specific STK value. Because of this, the absolute amount of K_2O used for each treatment varied as the STK level of each individual plot varied. These 5 STK-based K_2O treatments were tested in a randomized block design with 4 replications. Individual plot size was 12 ft x 40 ft (0.011 A), thus the total area used for the experiment was 48 ft x 200 ft (0.22 A). The plot boundaries were determined and each of the 20 individual plots was soil sampled by pulling a composite of six, 0-4 inch depth random cores from the center 6 ft x 30 ft area of the plot. Based on STK results from the individual plots, appropriate amounts of fertilizer K (applied as KCl) were applied. This resulted in 10 plots receiving no K-fertilizer, and 10 plots receiving amounts of K ranging from 15-120 lbs K_2O/A, depending on the specific treatment and the specific STK level of the specific plot. Corn was no-till planted into the standing wheat cover, and nitrogen (N) was topdressed over each plot as ammonium nitrate at 150 lbs N/A. At maturity, corn was hand harvested from 25 ft of each of the two center rows of each four-row plot, after which all corn in the experimental area was shelled for grain. Each plot was then soil sampled again (11-04-96) by pulling a composite of six, 0-4 inch depth random cores from the center 6 ft x 30 ft area of the plot. Corn was no-till planted into the previous year's corn residues on the same plots in 1997, but no K fertilizer was applied. Due to effects of severe drought during July-September, yield was not measured. Soil samples were taken from each plot on 10 additional dates from 12-11-96 to11-17-97, as previously described. Samples were analyzed by the University of Kentucky's Division of Regulatory Services Soil Testing Lab after drying them at 95° F, and grinding and sieving them through a 2-mm screen. Measurement of nutrients was made on a Mehlich-3 extract of the samples.

RESULTS AND DISCUSSION

Corn yields in 1997 were good, ranging mostly from 135-175 bu/A, but there was no apparent relationship between yield and either March or November STK values (Figure 1). Since the soil at this site was known to contain vermiculite in its clay content, and since the presence of vermiculite can cause fixation of soil K when it is dried in preparation for soil test analysis, it is likely that this caused lower STK levels than actually existed. This (higher content of plant available K than indicated by routine STK values), could account for the fact that there was no yield response to K fertilization.

There was a sizeable decrease in STK values between the March 1996 and November 1996 samplings which may have been due to K-uptake by the crop. Although not measured, it was assumed that about 40 lbs K/A was removed from the soil by corn grain, and that about 100 lbs K/A was recycled back to the soil surface by the corn stover left on the field. However, there was great variability in STK values among the 20 plots for the March and November soil samples from each plot (see tables 1-2). Because of this, it was decided to sample each plot monthly for an extended period of time, and samples were pulled on an approximate monthly basis until November of 1997. Results for STK obtained from individual plot sampling at each sampling date are tabulated in Table 1 (for those plots which did not receive K) and Table 2 (for those plots which received K; the absolute amount of K_2O applied to each of these 10 plots on 5-14-96 is shown in Table 3).

These data provided a basis for examining STK variability within a small area (0.22 A), over a time period of 18 months. Initial soil samples taken (3-27-96) before application of K-fertilizer showed that STK values of the 20 plots within the 0.22 A experimental area varied from 187-371 (tables 1 and 2), averaging 265 for the entire 0.22 A. Fertilizer K was applied to appropriate plots (5-14-96) so that there were 4 replications each of 0, 0.5, 1.0, 1.5, and 2.0 times the recommended rate based on the STK of each specific plot. This provided a test of the accuracy of UK soil test based K fertilization for corn. As shown in Figure 1, there was no relationship between STK values and corn yields.

Ranges in STK values for each of the 20 plots was interpreted in terms of UK recommended rates for K_2O, and recommendations are shown in Table 3 for temporal variability. As is shown, there was a vast difference in recommended rate of K_2O on each individual 0.011 A plot, depending on when the sample was taken. Application of K_2O to the 10 plots fertilized on 5-14-96 had minimal effect on ranges of STK over time.

Within plot, or spatial variability of STK values, is summarized in Table 4, showing wide differences within the 20 small plots at any date sampled. This variability resulted in a wide range of recommended K_2O rates within the 20 small plots of the 0.22 A area at any sampling date.

The cause of such wide spatial and temporal variability in STK values for such a small area is not fully understood. These data raise concern about how to most accurately soil sample so as to get STK results which represent a field on a scale which can be practically managed in applying fertilizer.

Averaging STK values at each sampling date for the 10 plots receiving fertilizer and for the 10 plots which did not receive fertilizer K, smoothes out much of the spatial variability and provides a better explanation of temporal variability. This is shown in figure 2, and, except for an unexplained drop in STK values measured on the samples taken on 3-13-97, shows the expected decline in STK from spring to fall due to crop uptake, the overwinter buildup as crop residues release K, and the subsequent decline during the next growing season as the crop takes up K, again.

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Table 1. Soil Test Potassium (lbs K/A) in Ten Small (12' x 40') Plots Which Received No K_2O

	Sampling Date												
Plot	3-27-96	11-04-96	12-11-96	2-03-97	3-13-97	4-18-97	5-22-97	6-25-97	7-29-97	8-28-97	9-18-97	11-17-97	AV
2	246	175	232	200	144	202	177	179	143	183	138	188	184
5	334	237	292	297	216	266	265	237	222	250	230	183	252
6	200	183	211	286	200	215	194	185	191	225	159	197	204
9	303	187	239	237	170	213	240	197	174	204	166	193	210
10	305	213	275	254	237	250	293	267	240	248	202	185	247
14	213	179	197	232	162	159	190	178	184	185	158	111	179
15	372	192	205	233	186	216	237	230	193	175	179	128	212
17	218	149	183	206	171	181	207	154	176	138	143	109	170
18	317	199	208	212	239	282	226	222	179	178	178	158	217
20	371	202	228	277	198	281	246	213	227	167	162	130	225
AV	288	192	227	243	192	227	228	206	193	195	172	158	

Table 2. Soil Test Potassium (lbs K/A) in Ten Small (12' x 40') Plots Receiving K_2O May 14, 1996

	Sampling Date												
Plot	3-27-96	11-04-96	12-11-96	2-03-97	3-13-97	4-18-97	5-22-97	6-25-97	7-29-97	8-28-97	9-18-97	11-17-97	AV
1	250	174	234	270	188	257	199	226	204	257	179	187	219
3	290	220	264	301	239	248	247	268	209	216	193	198	241
4	286	190	240	283	194	211	217	223	186	239	188	172	219
7	243	221	325	279	193	298	246	218	214	209	188	202	236
8	276	294	321	254	234	228	252	241	223	256	199	210	249
11	187	163	241	244	168	220	227	212	201	156	175	247	203
12	204	187	249	261	174	257	233	178	222	179	194	206	212
13	250	205	201	217	171	199	243	213	241	171	186	157	205
16	213	187	226	217	200	190	203	177	201	192	156	137	192
19	221	241	237	246	213	230	206	185	200	180	156	186	208
AV	242	208	254	257	187	233	227	214	210	206	181	190	

Table 3. Effect of Temporal Variability of Soil Test Potassium Among Small Plots on Fertilizer Recommendations

Plots Not Fertilized With K_2O			Plots Fertilized with K_2O (5-14-96)			
Plot	Range in STK[1/]	Range in Fert. Recomm.[3/]	Plot	lbs K_2O/A Applied	Range in STK[1/]	Range in Fert. Recomm.[3/]
2	144-246	30-90	1	45	174-270	30-70
5	183-334	0-70	3	60	193-301	0-60
6	159-286	30-80	4	15	172-286[2/]	30-80
9	166-303	0-80	7	15	188-325	0-70
10	185-305	0-70	8	45	199-294	30-60
14	111-232	40-110	11	105	156-247	30-80
15	128-372	0-100	12	120	178-261	30-70
17	109-218	50-100	13	15	157-250[2/]	30-80
18	158-317	0-80	16	75	137-226	40-90
20	130-371	0-100	19	25	156-246	30-80

1/ lbs K/A

2/ the high value in this range was measured on 3-27-96 before application of K_2O

3/ lbs K_2O/A

Table 4. Effect of Spatial Variability of Soil Test Potassium Among Small Plots on Fertilizer Recommendations

	Plots Not Fertilized With K_2O		Plots Fertilized With K_2O (5-14-96)	
Date Sampled	Range in STK, lbs/A	Range in Fert. Recomm.[1/]	Range in STK, lbs/A	Range in Fert. Recomm.[1/]
3-27-96	200-372	0-60	187-290 [2/]	30-70
11-04-96	149-237	40-90	174-294	30-70
12-11-96	183-192	30-70	201-325	0-60
2-03-97	200-297	30-60	217-301	0-50
3-13-97	144-239	40-90	168-234	40-80
4-18-97	159-282	30-80	190-298	30-70
5-22-97	177-293	30-70	199-252	30-60
6-25-97	154-267	30-90	178-268	30-70
7-29-97	143-240	40-90	186-241	40-70
8-28-97	138-250	30-90	156-257	30-80
9-18-97	138-230	40-90	156-199	60-80
11-17-97	109-197	60-110	137-247	30-90

1/ lbs K_2O/A

2/ STK values before application of K_2O

Figure 1. RELATIONSHIP BETWEEN SOIL TEST K AND NO-TILL CORN YIELD – CRIDER SOIL – LARUE CO., KY., 1996

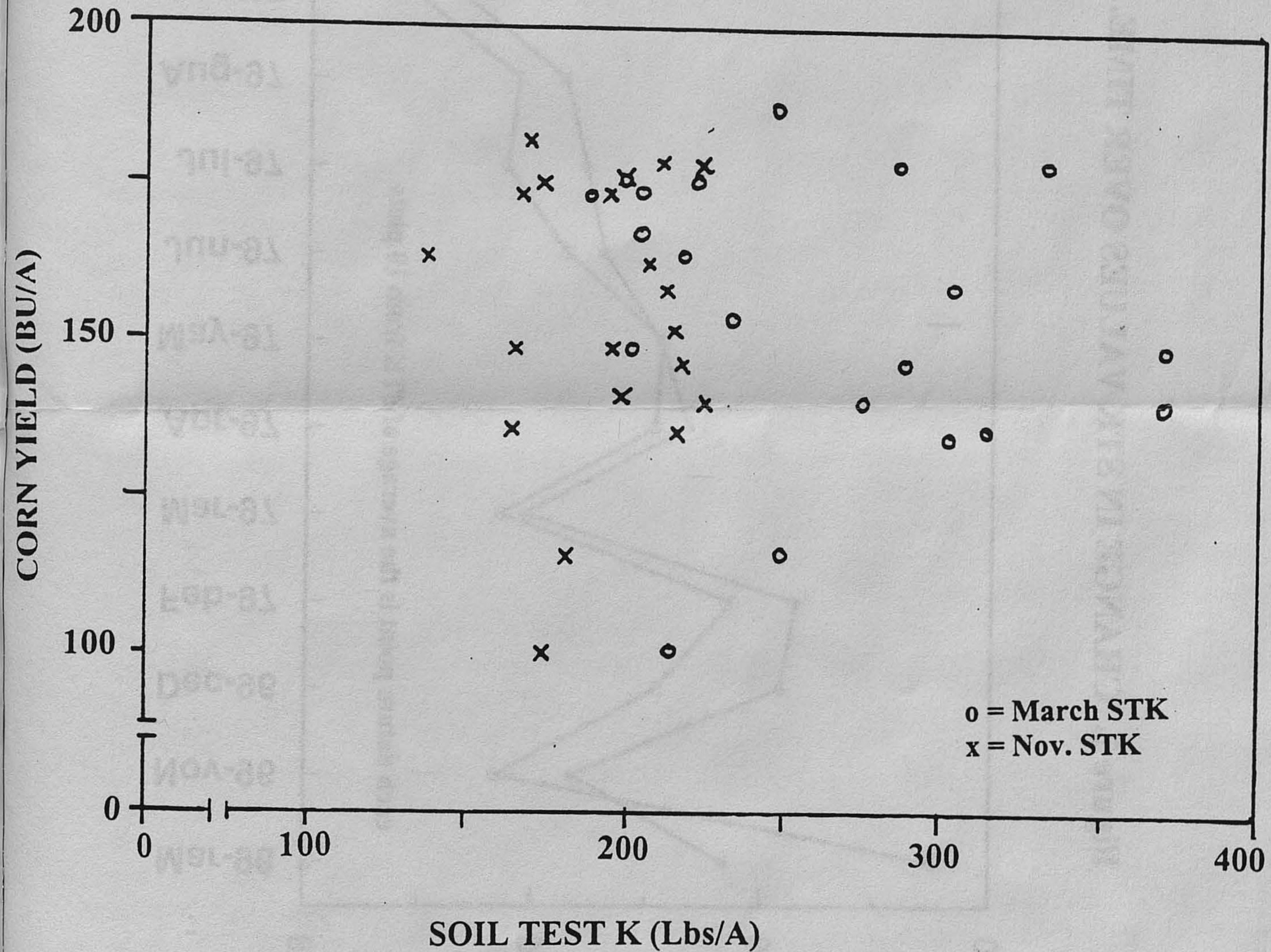
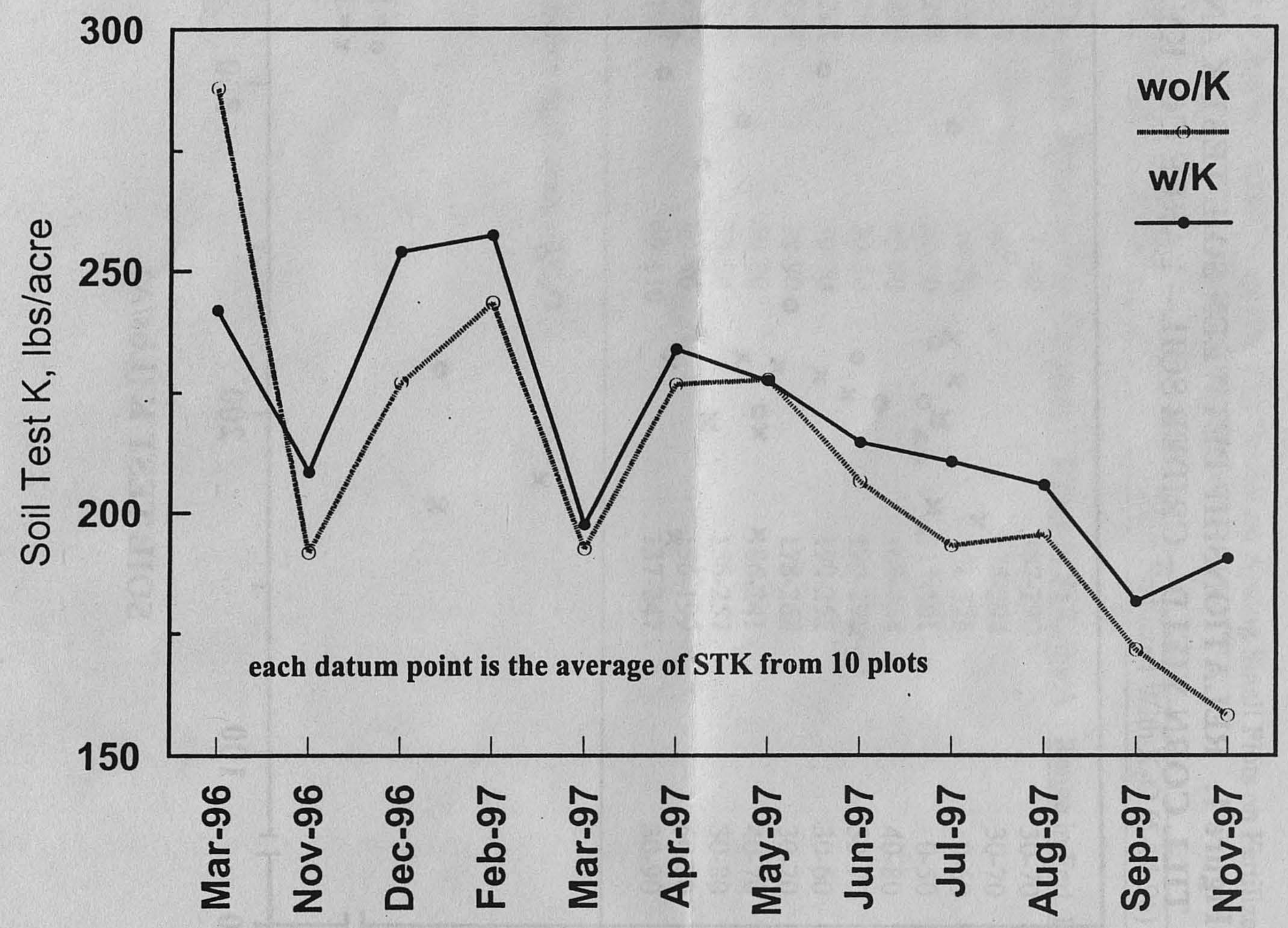


Figure 2. CHANGE IN STK VALUES OVER TIME.



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