LONG-TERM ALFALFA STUDY WITH K RATES[1]

William Thom
Extension Soils Specialist
University of Kentucky

ABSTRACT

A long-term potassium rate study was conducted on a Maury silt loam as part of the soil test calibration program to develop data for more soils in Kentucky. Beginning soil test K levels were established with initial applications of either 0, 150 or 300 lb of K2O per acre. Annual applications of 0, 120, 240 and 360 lb of K2O per acre were applied about 1 month before fall freezedown. Results indicated (1) there were significant yield responses to annual applications after the first year; (2) the soil test K value for near maximum yield was at 280 lb extractable K per acre; and (3) soil test K was increased with annual applications of 240 and 360 lb K2O per acre.

INTRODUCTION

Alfalfa acreage in Kentucky has gone from a low of about 170,000 to the current acreage of near 350,000. Demand by both the horse and dairy farms along with progress in good insect management has largely been responsible for this increase. Alfalfa is a heavy nutrient feeder especially of potassium. Soils have varying abilities to supply adequate potassium for alfalfa. In an effort to develop data for more soils in Kentucky, this long-term study was undertaken to determine the soil-crop relationships important in soil test calibration.

MATERIALS AND METHODS

Initial K containing fertilizer application rates of either 0, 150, or 300 lb K2O per acre were made to a conventionally prepared seedbed in April 1984 to serve as main plots of this 6 year (1985 to 1990) study on a Maury silt loam with four replications. Two seeding year cuttings of hay were taken during 1984. After the second cutting in the fall of 1984, the main plots were randomly divided into four equal sub-plots for application of four annual rates of 0, 120, 240 and 360 lb K2O per acre. These annual rates were applied each successive fall about one month before freezedown.

Four cuttings of alfalfa were taken during each year of the study, subsamples were placed in airtight bags, weighed, transferred to drying bags, dried and reweighed to determine dry matter. A fraction of the dried subsample was ground and used for elemental analysis. Soil samples were taken each fall before the fall K application, air dried and extracted by the Mehlich III solution. Hay yields are reported as containing 12% moisture.

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RESULTS AND DISCUSSION

Table 1. Alfalfa hay yields following initial and annual potash applications.

Initial K2O	Annual K2O	Year 1985	1986	1987	1988	1989	1990
lb/A		tons/A					
0	0	5.8	4.2	5.1	3.0	4.0	2.0
	120	5.9	4.8	6.1	3.9	5.2	2.6
	240	6.1	4.7	6.1	3.7	4.9	2.6
	360	6.2	4.8	6.0	3.9	5.3	2.7
150	0	6.2	4.7	5.8	4.0	4.9	2.6
	120	6.3	4.9	6.2	4.4	5.8	2.6
	240	6.2	4.9	6.5	4.5	5.6	2.8
	360	5.9	5.1	6.4	4.5	5.8	3.3
300	0	6.0	4.7	5.7	3.8	4.9	2.6
	120	6.3	4.9	6.2	4.4	5.7	2.7
	240	6.2	4.8	6.3	4.5	5.8	3.1
	360	6.5	4.9	6.7	4.5	6.1	3.2
Means	0	6.0	4.5	5.6	3.7	4.5	2.4
	120	6.2	4.9	6.2	4.3	5.6	2.7
	240	6.2	4.7	6.3	4.2	5.5	2.9
	360	6.3	4.9	6.4	4.3	5.8	3.0
LSD (.05)		NS	.2	.3	.2	.3	.2

Alfalfa hay yields were significantly increased after the first season by annual applications of potash fertilizer (Table 1). The response to rate of application was significant only during the last year. Year-to-year variability in total yields was influenced by rainfall during the growing season except for 1990, in which the yields were lower due to appreciable stand loss. The hay yields are typical of those obtained by other Kentucky researchers with the Maury silt loam near Lexington.

The soil test K levels reported in Table 2 indicate that when K containing fertilizer was applied at either 240 or 360 lbs K2O per acre, the soil test was consistently increased. However, the application of 120 lbs K2O per acre did not maintain soil test K levels during this study.

Table 2. Soil test K following initial and annual potash applications, and cutting for hay.

Initial K2O	Annual K2O	Year 1984	1985	1986	1987	1988	1989	1990
- - lb K2O/A - -		- - - - - - - - lb K/A - - - - - - - - - -						
0	0	223	176	174	143	162	135	139
	120	217	213	218	176	211	182	207
	240	205	229	263	286	341	372	373
	360	211	275	369	440	522	590	708
150	0	307	236	203	185	182	156	167
	120	279	276	233	194	244	198	212
	240	290	302	308	328	382	362	384
	360	291	326	372	512	551	614	682
300	0	333	246	212	173	185	153	158
	120	301	265	257	221	255	203	214
	240	346	309	352	380	424	431	440
	360	340	345	469	497	612	677	751

Table 3. Soil test K levels at various depths initially and following potash application and alfalfa harvests.

Depth	Initial	Annual Potash Rates 0	360
in.	- - - lb K2O/A - - -		
0 - 6	263	147	835
6 - 12	208	129	219
12 - 18	180	157	177
18 - 24	177	179	180
24 - 30	189	192	188
30 - 36	196	197	197

Plotting relative yield (%) vs. soil test K for this study resulted in a relationship best explained by the equation, relative yield = 0.714286x - 0.0012755x2 when soil test K was less than or equal to 280 lbs K/A, R2 = 0.63. The value of 280 lbs K/A for maximum yield is somewhat below 375 lbs K/A which is the soil test level currently used in Kentucky as the level needing no further K fertilization for alfalfa production. This lower value may in part be due to the yield level, although this level is considered typical for the Maury soil.

Initially and at the completion of the study, soil samples were obtained from the profile to a depth of 36 inches by 6 inch increments (Table 3). These data indicated that K was removed down to 18 inches with no potash application, and increased greatly in the upper 6 inches with the highest potash application rate. There was no indication that K moved downward into soil depths below the upper 6 inches.

Upon closer inspection of the the data (Table 2) reflecting soil test K changes with potash application rates, there is an indication that when soil test K is below the maximum yield level of 280 lbs K/A, alfalfa yield responded very significantly to potash applications. In order to maintain an adequate level of soil test K, the current Kentucky recommendations encourage annual soil sampling for alfalfa production when yield levels are in the range of 5 tons/A or above.

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Program Chairman and Editor:

Ray Lamond
Department of Agronomy
Throckmorton Hall
Kansas State University
Manhattan, KS 66506