Response of Berseem Clover to Fertilizer on High pH Soils

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Summary

A study to determine the fertilizer needs of clover on alkaline soils was begun in the fall of 1986. Combinations of phosphorus and potassium plus additional treatments of nitrogen, sulfur, boron, and a micronutrient mix were applied annually to 'Bigbee' berseem clover on a soil with a pH of 7.9. During the second year, clover yields for 0, 40, 80, and 120 lbs P/A treatments were 1,055, 3,179, 4,408 and 4,776 lbs/A, respectively. There was no response to potassium, nitrogen, sulfur, boron, or micronutrients. Applying phosphorus significantly increased the nitrogen, phosphorus, and potassium levels in the clover forage.

Introduction

Past fertilizer studies on clover in the eastern third of Texas have been conducted on acid soils (Haby and Smith 1988; Cheaney et al. 1956; Riewe and Smith 1955). Although most of the soils in southeast Texas are acidic, there are 1.5 million acres of calcareous clay soils that are alkaline (pH 7.0). Information concerning fertilizer requirements of forage legumes on these soils is lacking. A 3-year study evaluating various levels of phosphorus (P) and potassium (K) and other nutrients at set P and K rates was carried out on an alkaline soil in Washington County (Evers 1988). Results of the second year (1987-1988) of the study are reported here.

Procedure

The test site was on a Bleiblerville clay with an A_1 horizon to 33 inches and A_2 horizon from 33 to 63 inches. Soil pH was 7.9. Soil samples were collected from the phosphorus only treatments in September 1987 and fertilizer treatments were repeated on the same plots for a second year. Bigbee berseem clover was seeded into a sparce native grass sod at a planting rate of 16 lbs of seed per acre on 21 October 1987. All combinations of 0, 40, 80, and 120 lbs of P_2O_5 and 0, 40, and 80 lbs K_2O/A were applied on the soil surface at planting. Additional treatments of nitrogen (N), sulfur (S), boron (B), and a micronutrient mix were applied to plots receiving 80 lbs P_2O_5 and 40 lbs K_2O. A randomized, complete block experimental design with four replications was used. Plots were harvested on 5 April and 2 May 1988. Harvested forage was removed so any nutrient recycling was limited to that in the clover stubble and root system. A subsample of harvested forage from each plot was used to determine percent dry matter and for chemical analysis. Nitrogen, P, and K content was determined by near infrared reflectance spectroscopy.

KEYWORDS: Pasture/phosphorus/potassium/boron/sulfur/micronutrient.

Results and Discussion

One year after the first annual fertilizer application, the P level was increased on plots which received different levels of P fertilizer (Table 1) and soil N increased threefold to fourfold where phosphorus fertilizer was applied. This was due to greater N fixation from higher clover forage production. A higher level of N would be recycled under grazing or if the accumulated clover growth had been turned under as a green manure crop. Clover growth was removed from the plot area at each harvest. Only the N in the stubble and root system was allowed to return to the soil.

Phosphorus produced the greatest increase in clover yield (Table 2). Averaged across K fertilizer levels, 40 lbs P_2O_5/A improved clover production threefold (1,055 to 3,179 lbs/A). An additional 40 lbs of P_2O_5 increased production 1,200 lbs/A. There was no significant yield increase when P_2O_5 was raised to 120 lbs. Potassium did not affect yields. Averaged across P rates, 0, 40, and 80 lbs/A of K_2O produced 3,240, 3,371, and 3,454 lbs of dry matter per acre, respectively. At the 120-lb P_2O_5 rate, there was a small response to 40 lbs of K_2O. There was no response to N or micronutrients (Table 3).

The nitrogen, P, and K content of the forages at harvest time is reported in Table 4. There was a significant increase in N when P fertilizer was applied. This indicates P was limiting N_2-fixation as well as growth. There was little difference between the 40, 80, and 120 lbs/A P_2O_5 rates. Phosphorus content of the forage increased as P fertilizer rate increased. A level of 0.20 percent P is optimum for clover growth and livestock performance. Potassium content was not influenced by K fertilizer, but did increase when P fertilizer was added.

Berseem clover response to these fertilizer treatments was similar to those observed the first year of the study (Evers 1988). The most economical fertilizer rate for clover on these high pH (alkaline) soils was 80 lbs of P_2O_5/A.

It is always best to collect a soil sample from a proposed clover pasture to check the level of soil nutrients. Plant nutrient content will vary from pasture to pasture depending on soil type, previous use of the land, and past fertilization practices.

Literature Cited

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TABLE 1. SOIL pH AND N, P, AND K LEVELS OF SELECTED FERTILIZER TREATMENTS IN SEPTEMBER BEFORE INITIATION OF SECOND YEAR TREATMENTS

Previous treatment N-P_2O_5-K_2O	Soil pH	Nitrogen	Phosphorus	Potassium
lbs/A		ppm		
0-0-0	7.9	3	4	439
0-40-0	7.8	9	5	552
0-80-0	7.9	13	6	546
0-120-0	7.8	10	7	538

TABLE 2. RESPONSE OF BIGBEE BERSEEM CLOVER TO P AND K ON AN ALKALINE SOIL (pH 7.9) FOR 1987-1988 SEASON

Potassium (K_2O)	Phosphorus (lb P_2O_5/A) 0	40	80	120	Average
	pounds of dry matter per acre				
0	936	3,198	4,472	4,353	3,240
40	1,253	3,013	4,208	5,009	3,371
80	977	3,326	4,544	4,967	3,454
Average	1,055	3,179	4,408	4,776	3,355

TABLE 3. RESPONSE OF BIGBEE BERSEEM CLOVER TO N, S, AND MICRONUTRIENTS AT 80 AND 40 LBS/A OF P_2O_5 AND K_2O, RESPECTIVELY

Treatment	Yield
	pounds of dry matter per acre
0-80-40	4,208
0-80-40 + micro	4,545
0-80-40 + S	4,378
0-80-40 + B	4,001
0-80-40 + 60N	4,115
0-80-40 + 31N	3,912

TABLE 4. NITROGEN, PHOSPHORUS, AND POTASSIUM CONTENT OF BIGBEE BERSEEM AT VARIOUS FERTILITY RATES

Treatment $N-P_2O_5-K_2O$	April 5			May 2		
	N	P	K	N	P	K
lbs/A	percent					
0-0-0	2.23	0.10	1.61	2.22	0.10	1.87
0-40-0	3.23	0.17	3.00	2.62	0.14	2.32
0-80-0	3.25	0.19	2.81	2.69	0.17	2.06
0-120-0	3.23	0.23	3.05	2.72	0.20	1.92
0-0-40	2.46	0.12	1.91	2.23	0.11	1.87
0-40-40	3.18	0.17	3.09	2.72	0.14	2.36
0-80-40	3.22	0.19	3.15	2.70	0.17	2.33
0-120-40	3.21	0.23	3.06	2.67	0.18	2.02
0-0-80	2.32	0.11	1.72	2.34	0.11	1.87
0-40-80	3.13	0.15	2.89	2.73	0.15	2.36
0-80-80	3.20	0.19	3.15	2.66	0.16	2.32
0-120-80	3.21	0.23	3.30	2.72	0.19	2.14
0-80-40+micro[1]	3.23	0.20	3.21	2.80	0.17	2.12
0-80-40+2B	3.42	0.21	3.13	2.70	0.17	2.23
0-80-40+53S	3.27	0.20	3.28	2.63	0.16	2.22
31-80-40	3.41	0.21	3.28	2.63	0.15	2.28
60-80-40	3.26	0.22	3.28	2.61	0.16	2.23
LSD .05	0.24	0.02	0.30	0.19	0.02	0.16

[1]Micronutrient mixture, 200 lbs/A (Magnesium 30%, Zinc 6%, Manganese 6%, Copper 2%, Iron 2% and Boron 0.5%).