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Forage Quality Response by Coastal Bermudagrass to Residual Soil Phosphorus and pH

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Summary

Fiber components and in vitro digestibilities were measured for samples of Coastal bermudagrass harvested from plots where one of two levels of limestone and one of four levels of phosphorus had been applied more than 3 years earlier. Those measures of forage quality that showed significant differences among treatment means consistently indicated that higher quality was related to high lime and low phosphorus application. However, these results were confounded by the lower bermudagrass yields that followed higher ryegrass yields on the same treatment combinations.

Introduction

Some research reports have indicated increased forage digestibility from application of phosphorus or lime to the soil where the forage is grown. An experiment already in progress provided an opportunity to evaluate these factors on a site typical of the acidic soils of East Texas.

Procedure

The primary study was initiated in July 1983, on a Lilbert loamy fine sand with pH 4.5 in the 6-inch surface depth. Limestone was applied at the rates of 0, 0.3, and 1.7 tons/A as main plots in a split-plot design. Sub-plots (9×15 ft) were 0, 30, 61, 92, 123, 245, and 491 lbs/A of P_2O_5 incorporated into the soil along with the limestone. Duplicate rates of P_2O_5 were broadcast and incorporated into the same plots in the spring of 1984. Each of these treatment combinations was replicated eight times. Annual potash treatments on the whole site exceeded 250 lbs/A each year. A total of 240 lbs N/A was applied to the 1986-87 ryegrass crop. An additional 100 lbs N/A were applied after the first bermudagrass harvest. Soil samples were taken from each sub-plot in May 1987 to determine soil pH and residual phosphorus levels.

During the second harvest in 1987 (July 14), samples of forage were taken in four replications from plots having treatment combinations of 0 or 1.7 tons/A of limestone with 0, 92, 245, or 491 lbs/A of P_2O_5. These samples were frozen in liquid nitrogen within 5 minutes after harvest and stored at −30°F. until freeze-dried. The samples were ground and analyzed for content of neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin, and cellulose as well as in vitro digestibility after 6 days of fermentation.

Results and Discussion

Soil test results showed pH of plots receiving the high level of limestone had nearly returned to the pH of plots where no lime was applied (4.6 vs. 4.5). Residual soil

phosphorus was still evident (Table 1), particularly in subplots where higher levels of P_2O_5 were applied. Residual phosphorus levels appeared to be further enhanced by a high rate of limestone application, possibly due to Ca/P/Al interactions.

Means for the fiber analyses and in vitro dry matter disappearance (IVDMD) are shown in Table 2. Statistical analyses revealed no significant interactions between limestone and phosphorus treatments for any of the indicators of forage quality that were examined. Therefore, the means for limestone and phosphorus treatments were evaluated statistically. Small, but significant ($P<.05$) differences were found between limestome treatments for ADF, cellulose and IVDMD, and among phosphorus treatments for IVDMD. All of these differences are consistent among themselves in that they all reflect higher forage quality for the high limestone rate and lower quality for the higher phosphorus rates. These differences also appear related to differences in forage yield (Table 3) for the second cutting.

Numerous experiments have found that forage yield and forage quality are negatively related as was the case here. Yield differences for this cutting, on the other hand, must be interpreted in light of the increased competition from ryegrass in the high lime treatment. Increased shading from the ryegrass reduced bermudagrass yields even at the July 14 harvest. Serial harvest of bermudagrass without a preceeding winter crop will be needed to resolve the question of the influence of limestone and phosphorus on forage quality.

TABLE 1. MEAN RESIDUAL SOIL PHOSPHORUS, MAY 1987

	P_2O^5 Application Rates			
Limestone	0	92	245	491
tons/A	----------	ppm	----------	
0	4.4	5.6	10.2	19.1
1.7	3.0	6.9	12.5	36.3

TABLE 2. EFFECT OF LIMESTONE AND PHOSPHORUS FERTILIZATION ON CONTENT OF FIBER CONSTITUENTS AND IN VITRO DRY MATTER DISAPPEARANCE OF COASTAL BERMUDAGRASS FORAGE

Limestone/ P_2O_5 rate	NDF	ADF	Lignin	Cellulose	$IVDMD_{144}$
0/0	.7105	.3499	.0508	.2864	.7721
3400/0	.7163	.3460	.0491	.2864	.7789
0/92	.7123	.3543	.0527	.2895	.7637
3400/92	.7039	.3473	.0505	.2864	.7715
0/245	.7076	3552	.0525	.2897	.7562
3400/245	.6969	.3456	.0506	.2844	.7696
0/491	.7055	.3565	.0538	.2898	.7510
3400/491	.7035	.3482	.0521	.2870	.7726
Means					
0/...	.7090	.3540[a]	.0524	.2888[a]	.7607[a]
3400/...	.7052	.3468[b]	.0506	.2860[b]	.7732[b]
.../0	.7134	.3479	.0499	.2864	.7755[a]
.../92	.7081	.3504	.0516	.2879	.7676[ab]
.../245	.7022	.3508	.0516	.2870	.7629[b]
.../491	.7044	.3523	.0529	.2884	.7618[b]

Values in the same means category with different superscripts are significantly different ($P<.05$).

TABLE 3. MEANS FOR FORAGE DRY MATTER YIELD OF COASTAL BERMUDAGRASS, SECOND CUTTING, 1987

Limestone/P_2O_5 rate	Yield
---------- Pounds per Acre ----------	
0/...	4,340
3400/...	3,730
.../0	3,810
.../92	3,930
.../245	3,990
.../491	4,400