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COASTAL BERMUDAGRASS RESPONSE TO RESIDUAL SOIL PHOSPHORUS AND pH

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SUMMARY

Coastal bermudagrass yield response was evaluated relative to residual soil phosphorus (P) and to soil pH change due to limestone treatments applied in 1983. Limestone and initial P treatments were incorporated into the surface of the Lilbert soil in mid-1983. A duplicate P application was surface applied to the same plots and incorporated in early 1984. Coastal bermudagrass and ryegrass forages have been grown on this site to evaluate residual effects of these treatments. The luxurious growth of ryegrass in the high lime treated plots shaded the growth of Coastal bermudagrass during spring. In the zero lime and low lime treated plots, the poor growth of ryegrass allowed the more acid tolerant Coastal bermudagrass to start rapid growth earlier. At the mid-October harvest, the 1.7 ton/ac limestone treated plots produced a yield increase of 939 lbs/ac compared to the 0.3 ton/ac lime treatment. Coastal bermudagrass did not show a response to limestone treatment during 1986 when averaged over all harvests. Dry matter yields increased progressively with increasing residual soil phosphorus.

INTRODUCTION

East Texas soils are becoming increasingly acidic. The effect of this increased acidity often does not noticeably lower yields of monocultured Coastal bermudagrass, an acid-tolerant crop. Plant utilization of nutrients becomes less efficient as soil acidity increases. The main objective of this study was to evaluate the effect of limestone application and phosphorus (P) use efficiency on Coastal bermudagrass production in a strongly acid soil.

PROCEDURE

The study was initiated in July 1983, on a Lilbert loamy fine sand. The surface 6-inch depth pH was 4.5. Limestone treatments of 0, 0.3, and 1.7 ton/ac were applied as main plots in a split-plot design. The subplot treatments were P_2O_5 rates of 0, 30, 61, 92, 123, 145, and 491 lb/ac roto-till incorporated into the soil along with the limestone. The same P_2O_5 rates were reapplied to individual plots in 1984. Each of these treatment combinations was replicated eight times. Phosphorus was supplied as triple superphosphate. Limestone was applied as 100 percent minus 7-mesh and 27 percent minus-100 mesh agricultural grade limestone consisting predominantly of $CaCO_3$ with a minute amount of $MgCO_3$. Individual plots were 9 x 15 feet.

Soil samples were collected from the surface 6-inch depth in the summer of 1985. Potassium was applied to this site at the rate of 200 lb K_2O/ac on 12/18/85. A total of 240 lb N/ac was applied to the preceding ryegrass crop. Following the final 1986 ryegrass harvest in May, 100 lb N/ac was applied for first growth Coastal bermudagrass production. Additional 100 lb N/ac applications of $(NH_4)_2SO_4$ were made after each of the first two harvests. Potash was applied on 7/3/86 at the rate of 60 lb K_2O/ac. Approximately 64 ft^2 of each plot was cut, weighed, and sampled for moisture content. Yields were calculated from these data. First harvest yields were adjusted upwards to reflect the amounts of Coastal contained in the last two ryegrass harvests.

RESULTS

The overall effects of limestone and phosphorus treatment on Coastal bermudagrass yield are presented in the analysis of variance (Table 1). Coastal bermudagrass yield showed a negative yield

TABLE 1. ANALYSIS OF VARIANCE OF FACTORS BY HARVEST

	Significance of Effect[1]			
Source	Harvest 1	Harvest 2	Harvest 3	Total
Lime	**	NS	**	NS
Phosphorus	**	NS	**	**
Lime x Phosphorus	NS	**	NS	*

[1]*-significant at $p<0.05$ **-significant at <0.01
NS-nonsignificant

response to limestone application in the first harvest, the second harvest produced no response, and the third harvest exhibited a positive response to limestone treatment (Table 2). The negative

TABLE 2. COASTAL BERMUDAGRASS RESPONSE TO LIMESTONE RATES

Limestone Rate	Soil pH	Dry Matter Yield			
		Harvest 1	Harvest 2	Harvest 3	Total
Tons/Ac		Pounds/ac			
0	4.50	3902	2125	3901	9928
0.3	4.65	3072	2145	3812	9028
1.7	6.20	2597	2166	4751	9514

response to limestone observed in the first harvest was due to the vigorous ryegrass growth which occurred in plots receiving 1.7 ton lime/ac, and to a lesser extent in plots receiving 0.3 ton lime/ac. Shading and cooling in plots with luxuriant ryegrass growth accounted for the reduced Coastal bermudagrass yields in these plots. Yields were relatively low during the second harvest because of drought which diminished treatment effects. Positive response to limestone the third harvest was attributed to increased soil pH.

Coastal bermudagrass dry matter yields were increased by increasing levels of residual soil P (Table 3). Data were averaged over all limestone rates. Total yields were progressively larger with higher residual soil P. However, results were complicated by the presence of a significant lime x P interaction for total dry matter yield (Table 1).

TABLE 3. COASTAL BERMUDAGRASS RESPONSE TO RESIDUAL SOIL P

Residual Soil P	Dry Matter Yield			
	Harvest 1	Harvest 2	Harvest 3	Total
ppm	Pounds/ac			
3.4	2837	2021	3762	8620
4.7	2795	2152	4117	9064
7.6	3159	2198	4129	9486
11.5	3160	2190	4171	9521
13.9	3129	2222	4173	9524
23.6	3626	2105	4201	9932
44.4	3625	2129	4530	10284

The interactive effects of limestone treatment and residual soil P are presented in Table 4. Yield response to residual soil P occurred in a quadratic pattern that was influenced by the limestone rate.

When yield data were regressed against lime rate and residual soil P, the following best-fit regression equation, where Y is the estimated dry matter yield, was obtained:

$$Y = 9734.5 - 1.865 \times \text{lime} + 92.4 \times P + 0.000509 \times \text{Lime}^2 - 1.243 \times P^2.$$

The effects of interaction of limestone and P on dry matter yields are presented in Table 4. At very low soil P levels, data

TABLE 4. INTERACTION OF LIMESTONE AND RESIDUAL SOIL PHOSPHORUS ON COASTAL BERMUDAGRASS DRY MATTER YIELDS. TAES-OVERTON

		Dry Matter Yield		
		Limestone Rates, lb/ac		
Residual Soil P	P Index	0	600	3400
ppm		Pounds/ac		
3.4	v. low	9280	8657	7876
4.7	v. low	9798	8794	8551
7.6	low	9855	8910	9696
11.5	med	10451	8343	9770
13.9	med	9819	8850	9904
23.6	high	9336	10002	10428
44.4	v. high	10923	9652	10236

appear to indicate that lime application lowered Coastal bermudagrass yields. The shading effect of the previous ryegrass crop must be considered to interpret these data. The high lime rate produced more ryegrass to shade the Coastal bermudagrass and keep the soil cool longer. Thus, as the lime rate was increased, the first-harvest yield of Coastal bermudagrass decreased at the low residual soil P levels. High soil P levels prevented this from occurring. Decisions on optimum soil P levels for Coastal bermudagrass production based on yield data in this report should not be made without first consulting the accompanying report on ryegrass response to these same treatments.

Coastal bermudagrass yields continued to increase as soil P increased up to and including the high level of 44 ppm. The most efficient soil P level from prior years has been the medium level of approximately 12 to 14 ppm.

In previous years, Coastal bermudagrass has not responded to limestone treatment even though the check plot soil pH in 1985 was 4.5. The third harvest of 1986 indicates that this grass has begun responding to limestone.