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# Forage Response to Residual Soil Phosphorus and pH. II. Coastal Bermudagrass

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**Summary**

Coastal bermudagrass yield response relative to residual soil phosphorus (P) and to soil pH change due to limestone treatments applied in 1983 was evaluated. Limestone and initial P treatments were incorporated into the surface of the Lilbert soil in mid-1983. A duplicate P application was surface applied 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 early spring. In the 0 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/A treatments increased Coastal bermudagrass yields 939 lbs/A compared to the 0.3 ton/A lime treatments. Over all harvests, Coastal bermudagrass did not respond to limestone treatment during 1986. Dry matter yields did increase progressively with increasing residual soil phosphorus in 1986.

**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 many nutrients becomes less efficient as soil acidity increases. This study was designed to evaluate the effect of limestone application on Coastal bermudagrass production and phosphorus (P) use efficiency in a strongly acid, sandy soil.

**Procedure**

This study was initiated in July 1983, on a Lilbert loamy fine sand having a surface 6-inch depth pH of 4.5. Limestone treatments of 0, 0.3, and 1.7 ton/A were applied as main plots in a split plot design. The sub plot treatments were $P_2O_5$ rates of 0, 30, 61, 92, 123, 245, and 491 lbs/A as superphosphate and roto-till incorporated into the soil along with the limestone. The same $P_2O_5$ rates were re-applied to individual plots in 1984. Each of these treatment combinations was replicated eight times. 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 × 15 ft.

Soil samples were collected from the surface 6-inch depth in summer 1985. Potassium was applied to this site at the rate of 200 lbs $K_2O$/A on December 18, 1985.

KEYWORDS: Liming/phosphorus/Coastal bermudagrass/soil acidity.

A total of 240 lbs N/A was applied to the preceding ryegrass crop. Following the final 1986 ryegrass harvest in May, 100 lbs N/A was applied for Coastal bermudagrass production. Additional 100 lbs N/A applications of $(NH_4)_2SO_4$ were made after each of the first two harvests. Potash was applied on July 3, 1986 at the rate of 60 lbs $K_2O$/A. 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 bermudagrass contained in the last two ryegrass harvests.

**Results and Discussion**

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 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 response to limestone observed in the first harvest was due to the vigorous ryegrass growth which occurred in plots receiving 1.7 ton lime/A, and to a lesser extent in plots receiving 0.3 ton lime/A. Shading in plots with heavy ryegrass growth accounted for the reduced Coastal bermudagrass yield in these plots. Yields were relatively low during the second harvest because of drought and which may have served to diminish treatment effects. The positive response to limestone which occurred in 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). Harvest 2 was the exception as this harvest followed a droughty period. Yield data presented in Table 3 were averages of all limestone rates. The yield increases appeared progressively larger with higher residual soil P. However, results were somewhat complicated by the presence of a significant lime × P interaction for total dry matter yield (Table 1). The interactive effects of limestone treatment and residual soil P are presented in Table 4. When the yield data was regressed against lime rate and residual soil P, the following best-fit regression equation was obtained: $Y = 9138 - 1.93\,(\text{Lime}) + 86.4\,(\text{P}) + 0.045\,(\text{Lime*P}) + 0.00051\,\text{Lime}^2) - 1.24\,(\text{P}^2)$, where y equals Coastal bermudagrass yield. This equation indicates Coastal bermudagrass yield response to residual soil P followed a quadratic pattern that was influenced by limestone rate. Coastal bermudagrass yield as a function of residual soil P at the three limestone rates as derived by this regression equation is shown in Figure 1.

From yield data presented in Table 4 and Figure 1, Coastal bermudagrass yields reached a maximum at a lower level of residual soil P in plots receiving no limestone treatment than in those plots receiving limestone. At all limestone rates the response to residual soil P was curvilinear, with maximum dry matter yield occurring in the medium to high soil test level of residual soil P. Interpretation of this years results were somewhat complicated by the effects of variable ryegrass growth during the period when the Coastal bermudagrass was beginning its spring growth.

In conclusion, Coastal bermudagrass has shown a greater response to residual soil P than to limestone treatment. While the lime × P interaction somewhat obscured the picture, yields were highest in the medium to high soil test levels of available soil P. Because the plots have now been continuously cropped for several years, the residual effects of limestone treatment may finally be making a contribution to improved Coastal bermudagrass production as seen in the yield increase due to limestone treatment for the third harvest.

**TABLE 1. THE ANALYSIS OF VARIANCE RESULTS FOR COASTAL BERMUDAGRASS DRY MATTER YIELD AS AFFECTED BY LIMESTONE AND PHOSPHORUS TREATMENT**

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

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

**TABLE 2. COASTAL BERMUDAGRASS RESPONSE TO LIMESTONE RATES (TAES—OVERTON)**

| Limestone Rate | Soil pH | Dry Matter Yield Harvest 1 | Harvest 2 | Harvest 3 | Total |
|---|---|---|---|---|---|
| Tons/Acre | | Pounds/Acre | | | |
| 0 | 4.50 | 3,902 | 2,125 | 3,901 | 9,928 |
| 0.3 | 4.65 | 3,072 | 2,145 | 3,812 | 9,028 |
| 1.7 | 6.20 | 2,597 | 2,166 | 4,751 | 9,514 |

**TABLE 3. COASTAL BERMUDAGRASS RESPONSE TO RESIDUAL SOIL P**

| Residual Soil P | Harvest 1 | Dry Matter Yield Harvest 2 | Harvest 3 | Total |
|---|---|---|---|---|
| ppm | Pounds/Acre | | | |
| 3.4 | 2,837 | 2,021 | 3,762 | 8,620 |
| 4.7 | 2,795 | 2,152 | 4,117 | 9,064 |
| 7.6 | 3,159 | 2,198 | 4,129 | 9,486 |
| 11.5 | 3,160 | 2,190 | 4,171 | 9,521 |
| 13.9 | 3,129 | 2,222 | 4,173 | 9,524 |
| 23.6 | 3,626 | 2,105 | 4,201 | 9,932 |
| 44.4 | 3,625 | 2,129 | 4,530 | 10,284 |

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

| | | Dry Matter Yield | | |
|---|---|---|---|---|
| P Rate | Soil P Status | Limestone Rate, lbs/A 0 | 600 | 3,400 |
| lbs/A | | Pounds/Acre | | |
| 0 | v.low | 9,280 | 8,657 | 7,876 |
| 30 | v.low | 9,798 | 8,794 | 8,551 |
| 61 | low | 9,855 | 8,910 | 9,696 |
| 92 | med | 10,451 | 8,343 | 9,770 |
| 123 | med | 9,819 | 8,850 | 9,904 |
| 245 | high | 9,336 | 10,002 | 10,428 |
| 491 | v.high | 10,923 | 9,652 | 10,236 |

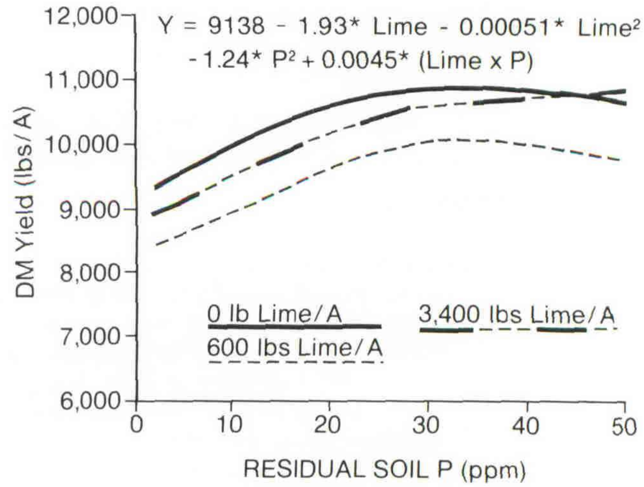


*Figure 1. Coastal bermudagrass yield in response to applied limestone and residual soil P.*