FORAGE AND LIVESTOCK RESEARCH - 1986

RESEARCH CENTER TECHNICAL REPORT 86-1

Texas A&M University Agricultural Research
and Extension Center at Overton

Texas Agricultural Experiment Station
Texas Agricultural Extension Service

Overton, Texas

April 24, 1986

RESPONSE OF RYEGRASS TO RATES OF LIMESTONE AND PHOSPHORUS

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SUMMARY

Ryegrass response to limestone and phosphorus was evaluated on a strongly acid (pH 4.5) Lilbert loamy fine sand testing low in phosphorus, calcium, and magnesium and very low in potassium. Limestone treatments of 0, 600, and 3400 lb/ac were applied in early July, 1983. Phosphorus treatments were applied at this same time at rates of 0, 30, 61, 92, 123, 245, and 491 lb P_2O_5/ac. The existing stand of Coastal bermudagrass was mowed to a two-inch length and Marshall ryegrass was seeded in rows 9 inches apart in November.

The first harvest of ryegrass was clipped April 16, 1984, and the second was taken May 22, 1984. Limestone increased first cutting ryegrass yield from 1135 to 2701 and 3346 lb/ac at the zero, 0.3 and 1.7 tons/ac rate, respectively, and from 1647 to 1818 and 2032 lb/ac on the second cutting. Phosphorus increased ryegrass yields from 3677 lb to 5023 lb/ac over the two harvests.

OBJECTIVES

1. Determine the yield and quality of forage produced at varying levels of soil acidity (limestone rates).
2. Determine the effect of phosphorus rates on yield and quality of warm and cool season forages.
3. Determine the interactive effects of limestone and phosphorus on warm and cool season forage production.
4. Evaluate the effect of limed soil pH change on phosphorus availability to forage plants.

PROCEDURE

A Lilbert loamy fine sand was selected for this study. It is an East Texas benchmark soil, which means that it occupies a large acreage. This soil was selected because it had a surface 6-inch depth pH of 4.5, phosphorus, calcium, and magnesium levels of 8, 200, and 30 ppm, respectively, and a very low 60 ppm potassium level. Three rates

of limestone, 0, 0.3, and 1.7 tons/ac were applied as major plots in a split-plot statistical design. Phosphorus rates of 0, 30, 61, 92, 123, 245, and 491 pounds of P_2O_5/ac were applied over the limestone treatments as split plots. Eight replications of each treatment were applied. Nitrogen and potash were applied as urea and muriate of potash at rates of 150 and 260 lbs/ac, respectively, in 1983. The existing grass was mowed and all treatments were roto-till incorporated. Two harvests of Coastal bermudagrass were made in 1983.

'Marshall' ryegrass (30 lbs/ac) and 'Mt. Barker' subterranean (sub) clover (20 lbs/ac) were each seeded into one half the research area (4 replications) on November 4, 1983. The ryegrass was fertilized on 12/6/83 and 2/3/84 with 60 lbs N/ac from urea. The sub clover was not fertilized. Ryegrass yields were evaluated statistically by analysis of variance using MSUSTAT.

RESULTS AND DISCUSSION

The severe cold temperatures in mid- to late December of 1983 killed both the young sub clover seedlings and the Coastal bermudagrass. The Coastal bermudagrass was resprigged over the plot area on 5/25/84, and the remaining growing season was devoted to managing the plot area to a full stand of bermudagrass. Therefore no yield data were available for this grass in 1984. A reasonable stand of Coastal bermudagrass was obtained and limestone and phorphorus treatments were evaluated by Coastal bermudagrass yields in 1985.

Ryegrass survived the winter cold and produced up to three tons of oven dry forage in the highest limestone and phosphorus treated plots. Yield data were taken on April 16, and May 22, 1984. Ryegrass responses to limestone treatments are presented in Table 1. Dry matter yield was increased nearly 1600 lbs/ac at the first harvest by application of 0.3 tons of limestone/ac, and by an additional 650 lbs when the limestone rate was increased to 1.7 tons/ac. Ryegrass responses to limestone rates were not significantly different at the second harvest, but total yields were. A total ryegrass response of 1735 lbs was produced by the 0.3 ton rate of limestone, compared to nearly 2600 lbs of grass produced by the 1.7 ton per acre rate. The 0.3 ton rate of limestone reduced the toxic effects of the pH 4.5

TABLE 1. RESPONSE OF RYEGRASS TO LIMESTONE RATES APPLIED TO A pH 4.5 LILBERT LOAMY FINE SAND

Limestone Rate	Yield, dry weight		
	Harvest 1	Harvest 2	Total
Tons/ac	----------lbs/ac----------		
0	1135 A[1]	1647 A	2783 A
0.3	2701 B	1818 A	4518 B
1.7	3346 B	2032 A	5378 C

1. Yield data within columns followed by the same letter are not significantly different, statistically, at the 95% probability level.

Lilbert soil during the first season, but was not enough limestone to completely overcome the soil acidity. In addition, the 0.3 ton rate of limestone will not have the lasting effect, especially where high rates of nitrogen are applied to Coastal bermudagrass.

Ryegrass yield response to phosphorus rates are shown in Table 2. Dry matter yield continued to increase as the phosphorus rate increased up to 491 lbs P_2O_5/ac, but the ryegrass yield response at this high rate was not significantly greater than the 4186 lbs/ac yield at the 92 lbs P_2O_5/ac rate.

TABLE 2. RESPONSE OF RYEGRASS TO PHOSPHORUS RATES APPLIED TO AN 8 PPM, LOW PHOSPHORUS, LILBERT LOAMY FINE SAND

Phosphorus rate	Yield, dry weight		
	Harvest 1	Harvest 2	Total
lbs P_2O_5/ac	----------lbs/ac----------		
0	2097 A[1]	1580 A	3677 A
30	2105 A	1685 AB	3790 A
61	2209 A	1766 ABC	3975 AB
92	2417 A	1769 ABC	4186 ABC
123	2637 A	2065 BC	4702 BC
245	2441 A	1791 ABC	4232 ABC
491	2852 A	2171 C	5023 C

1. Yield data within columns followed by the same letter are not significantly different, statistically, at the 95% probability level.

Yield results in Tables 1 and 2 are averages over all phosphorus rates and limestone rates, respectively, and do not reflect the differences which occurred due to individual treatments. These differences are illustrated in Figs. 1 and 2. Generally, the application of agricultural limestone is thought to increase the efficiency of fertilizers, and this can be seen in Figure 1. One example to note is the effect of the 0, 0.3, and 1.7 ton rates of limestone on the response of ryegrass to the 123 lb rate of P_2O_5. Grass yield at the zero limestone and 123 lb P_2O_5/ac rate was 2920 lbs of DM/ac. When the limestone rate was increased to 0.3 tons/ac, yield increased to 5107 lbs/ac, and at 1.7 tons of limestone/ac, yield increased to 6078 lbs/ac. When adequate phosphorus was applied (245 and 491 lbs P_2O_5/ac) the 0.3 ton/ac limestone rate appeared to be sufficient for the first year of production.

Figure 2 illustrates the same data by comparing the effect of fertilizer phosphorus on the efficiency of limestone. When an inadequate rate of limestone was applied, the efficiency of that limestone for grass production was improved as the rate of fertilizer phosphorus increased. This response is indicated by the bars representing the 0.3 ton/ac rate of limestone. As the rate of P_2O_5 increased from zero to 123 lbs/ac, grass yield increased from 3450 to 5107 lbs/ac. At the 491 lb P_2O_5/ac rate, 0.3 tons of limestone was responsible for producing 5624 lbs/ac.

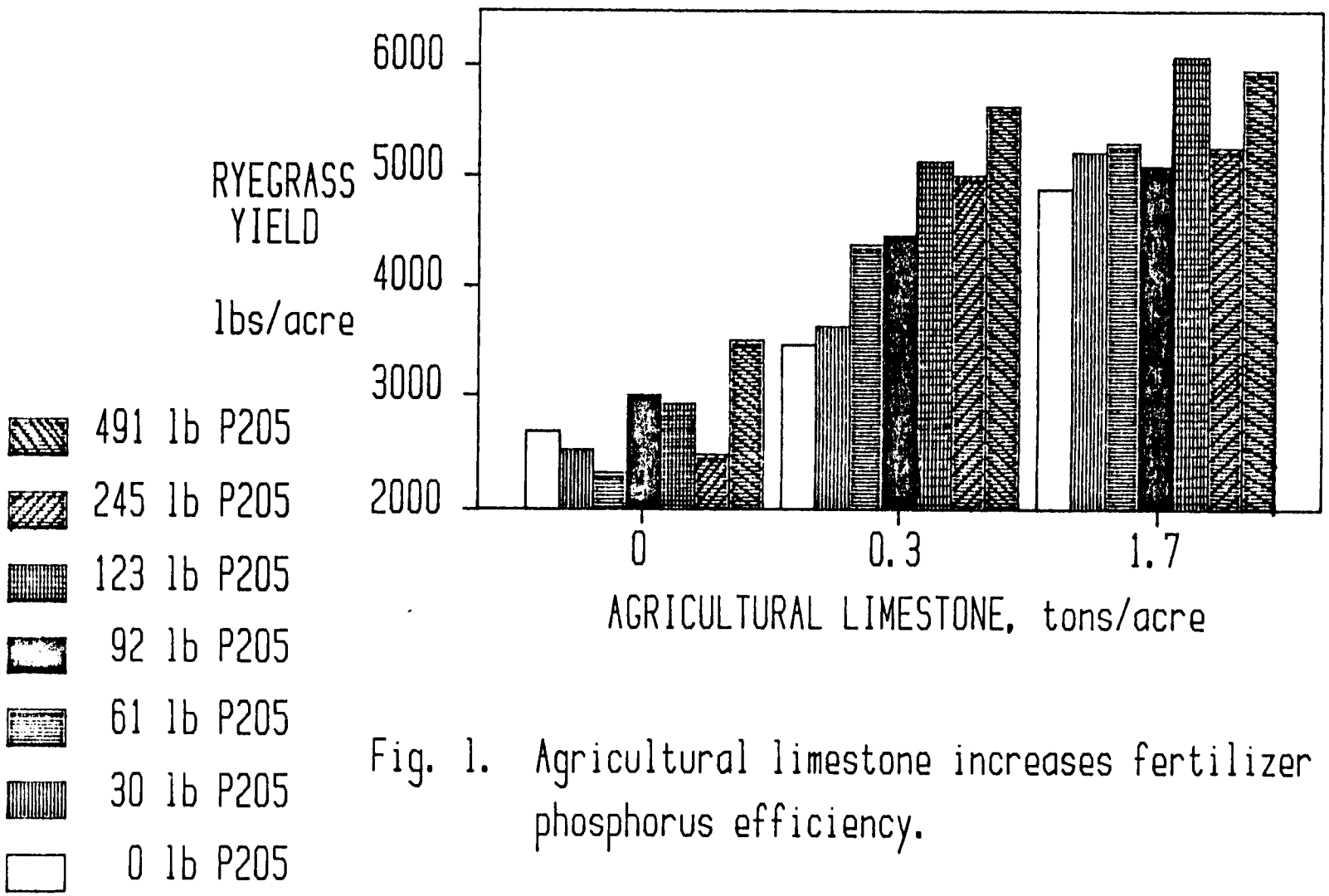

Fig. 1. Agricultural limestone increases fertilizer phosphorus efficiency.

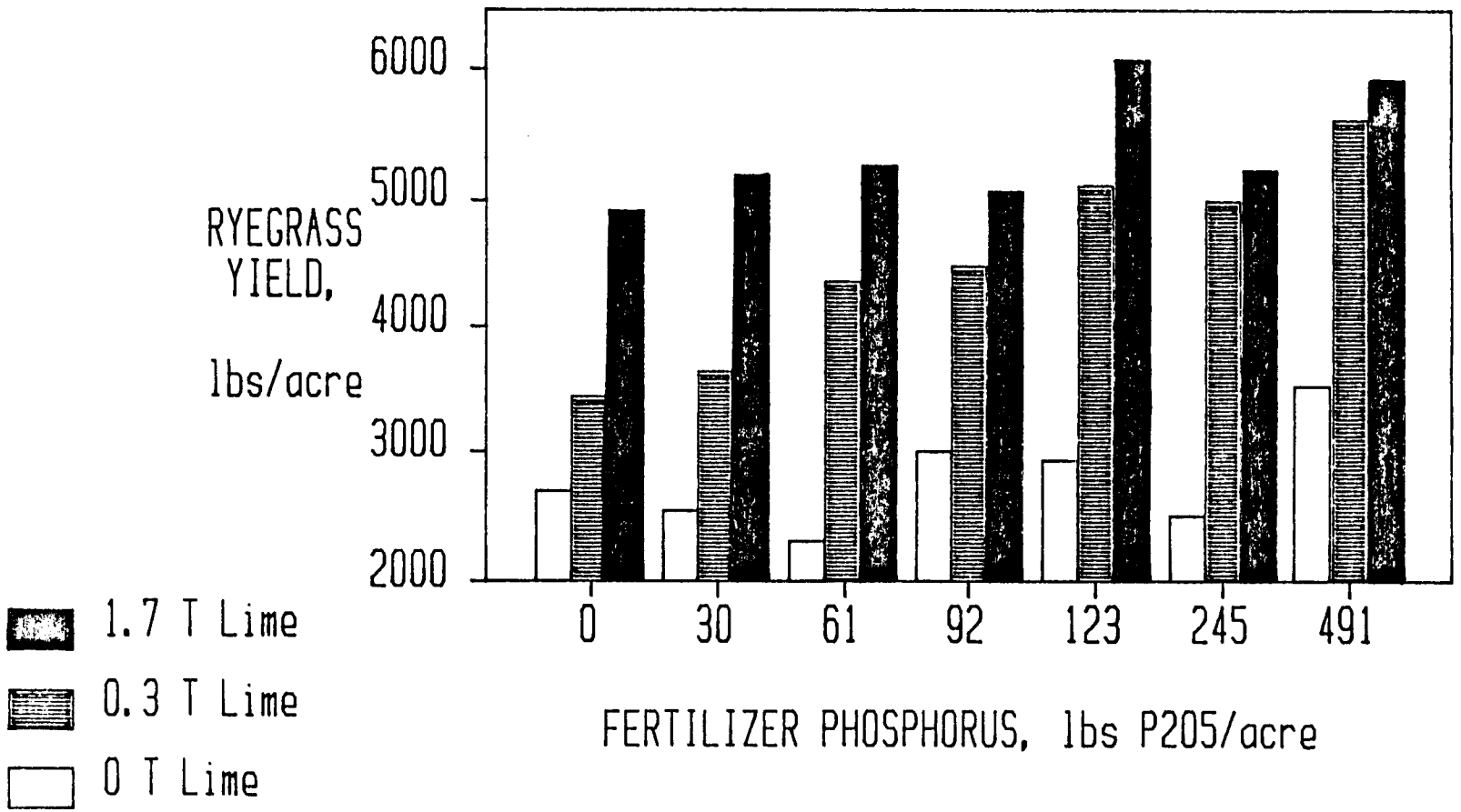

Fig. 2. Fertilizer phosphorus increases limestone efficiency