Legume Response to Limestone Rate, Fineness, and Boron

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Summary

Yield of crimson clover and alfalfa was enhanced by increasing the rate of limestone, its effective calcium carbonate equivalence (ECCE), and by increasing rates of boron. Legume regrowth after the first cutting of crimson clover and alfalfa in 1992 was related to boron, limestone rate, and ECCE. Regardless of the limestone rate or limestone ECCE, if boron was not applied to the soil, regrowth of alfalfa or crimson clover did not occur. In a producer's pasture that has been fertilized and grazed for several years without receiving boron, a deficiency of soil boron could be the limiting factor to clover production when the soil is limed.

Introduction

This research responds to questions concerning the reactivity of agricultural-grade limestone, especially when it is surface-applied to soils in permanent pasture. Our preliminary research also showed that clovers responded to boron on certain sandy acid soils in eastern Texas.

Materials and Methods

A study begun in 1988 evaluated 1- and 2-ton/A rates of ECCE 62% and 100% limestone materials applied in the spring to Darco sand. In addition, 1- and 2-lb/A rates of boron were applied in the fall to this soil in a randomized block study with four replications. Control plots that received no limestone or boron were included. The boron rates were reapplied each fall. Limestone treatments were reapplied in spring 1991 in an attempt to increase the range of pH levels. 'Alfagraze' alfalfa was overseeded into the 'Coastal' bermudagrass stand in 27-in. row spacings the following fall. At the same time, two rows of 'Tibbee' crimson clover were overseeded at 9-in. row spacings between the alfalfa rows. A predominantly crimson clover harvest that included some alfalfa was made in spring 1992. Soil samples to the 6-in. depth were collected in June 1992.

Keywords: soil pH / acidity / crimson clover / alfalfa / limestone ECCE.

Results and Discussion

Soil pH in the 0- to 6-in. depth was increased by increasing limestone rate (Table 1). The total 4-ton/A limestone rate applied as ECCE 100 material over a 4-year period maintained soil pH at 6.7 compared with a pH of 6.3 from the ECCE 62 limestone. Three to four cuttings of Coastal bermudagrass were taken each summer. Fertilizer nitrogen (N) was added for each growth period at a rate approximating 100 lb N/A. Over the 4 years, nitrification of the ammonium form of this N has produced acidity that has lowered soil pH compared with what it should have been had no N been applied.

Increasing limestone ECCE from 62% to 100%, when averaged over limestone rate, increased soil pH from 6.1 to 6.5 and significantly increased yield of the clover-alfalfa forage (Table 2). Legume yields were significantly increased by increasing limestone rates and were increased by limestone ECCE at each limestone rate (Table 3).

Table 1. Effect of limestone rate on soil pH 4 years after initial limestone treatment.

Limestone rate, ton/A		Darco soil, pH 0 to 6 in.		
1988	1991	Avg.†	ECCE 62‡	ECCE 100‡
		pH		
0	0	5.69 c*	5.69 b	5.69 c
1	1	6.10 b	5.90 b	6.31 b
2	2	6.48 a	6.26 a	6.70 a

*Within a column, values followed by the same letter are not different statistically at the p = 0.05 level.
†Averaged across lime ECCE and boron rate.
‡Averaged across boron rate.

Table 2. Effect of limestone ECCE on soil pH† and legume dry matter (DM) 4 years after initial limestone treatment.‡

Limestone ECCE	Darco soil	
	pH	DM
%		lb/A
62	6.08 b*	1172 b
100	6.50 a	1358 a

*Within a column, values followed by the same letter are not different statistically at the p = 0.05 level.
†Averaged across lime and boron rates.
‡Treatments reapplied at end of third year.

Fertilizer boron had a similar effect on increasing legume yield as did increasing limestone rate (Table 4). Legume yield at 2-lb boron/A was higher because of the ECCE 100 limestone compared with ECCE 62 material. Regrowth of Tibbee crimson clover and Alfagraze alfalfa was nonexistent regardless of limestone rate or ECCE when boron fertilizer had not been applied the previous fall.

Table 3. Effect of limestone rate on legume dry matter (DM) production 4 years after initial treatment.

Limestone rate, ton/A		DM yield		
1988	1991	Avg.†	ECCE 62‡	ECCE 100‡
		lb/A		
0	0	617 c*	617 b	617 b
1	1	1180 b	1106 a	1255 a
2	2	1350 a	1238 a	1462 a

* Within a column, values followed by the same letter are not different statistically at the p = 0.05 level.
† Averaged across limestone ECCE and boron rate.
‡ Averaged across boron rate.

Table 4. Effect of boron rate and limestone ECCE on legume dry matter (DM) production in spring 1992.

	DM Yield		
Boron rate	Avg.†	ECCE 62‡	ECCE 100‡
lb/A	lb/A		
0	670 b*	550 b	685 b
1	1331 a	1228 a	1240 a
2	1405 a	1183 a	1409 a

*Within a column, values followed by the same letter are not different statistically at the p = 0.05 level.
†Averaged across limestone ECCE and rate.
‡Averaged across limestone rate.