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ANNUAL RYEGRASS AND CLOVER RESPONSE TO LIMESTONE RATES AND PARTICLE SIZE

A. T. Leonard, J. V. Davis, and V. A. Haby

Background. East Texas soils are generally acidic due to leaching caused by high rainfall and fertilizer nitrogen applications on crop and pasture land. Clovers and ryegrass can be planted during the cool season to provide grazing for livestock. However, dry matter production in both species decreases as soil pH declines. Agricultural grade limestone is used to neutralize soil acidity and increase soil pH. The effective calcium carbonate equivalence (ECCE) is a measure of the neutralizing efficiency of a limestone. Finer limestone has a higher ECCE and greater ability to increase pH than low ECCE limestone. This research was conducted to evaluate the effectiveness of limestone materials with ECCE ratings of 62, 81, and 100.

Research Findings. Calcitic (calcium carbonate) limestone rates of 0, 1, 2, and 3 tons/ac in all combinations of 62, 81, and 100% ECCE were applied in October 1989. These treatments were applied randomly to 3 Coastal bermudagrass-based forage systems: (1) bermudagrass only; (2) bermudagrass-annual ryegrass; and (3) bermudagrass-annual clovers. 'Marshall' ryegrass, and a 50:50 mixture of 'Yuchi' arrowleaf and 'Dixie' crimson clovers were each planted at 30 lb/ac on 7" row spacings October 1991. The experiment was conducted on two soils, a Darco loamy sand and a Kirvin fine sandy loam. Sufficient fertilizer nutrients were applied for plant growth.

Table 1 presents the 1992 total cool-season forage yields for three cuttings from each site and species. Ryegrass yield at both sites increased due to the application of limestone. Ryegrass production was similar at all limestone ECCE levels. The 2 ton/ac lime rate at the Darco site increased yields 51% over the yield from the limestone check (0 ton/ac). Soil pH in fall 1991 soil samples measured 4.6 for the check and 5.4 for the 2 tons/ac lime rate. Ryegrass at the Kirvin site responded similarly with a 25% increase in dry matter yield with a 2 ton/ac lime application. Soil pH was 4.7 in the check plots and 6.0 at the 2 ton/ac lime rate.

The arrowleaf-crimson clover yields were increased due to limestone applications for both sites. Clover yields increased linearly with lime rates at the Darco site, with maximum yields at the 3 ton/ac lime rate. This yield increase coincides with a linear increase in the 0-6" depth soil pH from 4.5 to 5.8 with increasing lime rates. At the Kirvin site, the clover yield was increased significantly by the 1 ton/ac lime rate. No significant yield differences were measured for lime rate above 1 ton/ac, although a slight increase in yield was noted at the 2 ton/ac rate over the 1 and 3 ton/ac rates.

Clover yields were also affected by the ECCE of the limestone. At the Darco site, a 305 lb/ac dry matter increase was measured in plots receiving the 100% ECCE limestone over those plots receiving the 62% ECCE lime. Yields from plots receiving the 81% ECCE lime were intermediate. Soil pH, averaged over lime rates, measured 5.3, 5.5, and 5.8 from the 62, 81, and 100% ECCE plots, respectively. Response to lime sources at the Kirvin site was different than at the Darco. At the Kirvin site, the 81% ECCE lime plots yielded the highest dry matter production, with yields from the other two sources being both lower and similar. Soil pH was 5.8, 5.9, and 6.1 from the 62, 81, and 100% ECCE plots, respectively.

Application. Although response to limestone is shown to be variable between species and soil types, both ryegrass and clover showed yield increases from limestone applications to acid soils. Yield response of Marshall ryegrass should be seen when limestone is applied to soil with a pH less than 5.7. Clover yields from these two soils indicated a growth response could be obtained when liming soils that have a pH less than approximately 5.9. Although lime ECCE had no effect on ryegrass yield, the grades finer than 62% ECCE improved production. Soil pH levels measured through this 3-year study showed that finer limestones maintained soil pH higher than did the 62% ECCE material.

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Table 1. Dry matter yield response of annual ryegrass and arrowleaf-crimson clover mixture to limestone rates and sources at two sites (lb/ac).

Lime rate	Ryegrass		Clover	
(ton/ac)	Darco site	Kirvin site	Darco site	Kirvin site
0	2147 B[1]	6385 B[1]	865 D[1]	3457 B[1]
1	2969 A	7651 A	2379 C	4553 A
2	3242 A	7998 A	2684 B	4724 A
3	2957 A	7950 A	3059 A	4469 A
Lime source (ECCE)				
Ag grade (62)	2818 NS	7810 NS	2552 B[1]	4456 B[2]
Combination (81)	3086	7859	2714 AB	4817 A
Super-fine (100)	3265	7830	2857 A	4472 B

[1]Means within a column not followed by the same letter are significantly different according to the SNK multiple range test (P = 0.05).
[2]Mean values differ at P = 0.10 level.