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EFFECT OF LIMESTONE INCORPORATION, APPLICATION TIME, AND MOLYBDENUM ON YIELD OF ALFALFA

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Background. Limestone applied to soils producing perennial forages such as hybrid bermudagrasses is often not mixed into the soil. Surface applied lime is relatively inefficient for neutralizing soil acidity in the short term compared to incorporated limestone. When limestone is surface applied, only a fraction of the particle surface is exposed to the acids in the soil. By contrast, nearly the total surface of each particle that is mixed into the soil is exposed to soil acids. Mixing the limestone into the surface soil is of greater importance for growth of warm-season perennial forages than it is for cool-season annual forages. Rainfall occurs more frequently during the cool season so plant roots have greater access to the fraction of the soil that has been limed by surface application. By contrast, warm-season perennial forages in East Texas experience a drought in July and August that causes the surface depth to dry, many times even below the 6-inch depth that should have been limed by incorporation of applied limestone. Alfalfa is perennial forage that is susceptible to the summer drought and would be affected by lack of incorporated limestone. Data reported herein represent work to verify this hypothesis.

In late spring, limestone having an ECCE of 72% [1,440 lb of effective liming material (ELM)/ton, ELM= ECCE % x 20] was used in an experiment to evaluate the need to mix limestone into the soil for alfalfa production. The limestone rate was 5.6 tons/acre equivalent, or 8,064 lb ELM per acre. For treatment one, lime was applied to one set of plots and the whole experiment was roto-tilled to a depth of 6 inches. Treatment two was limestone roto-tilled to a depth of 2 inches. Treatment three was limestone left on the soil surface. Treatment four was a zero-lime check. Immediately before planting, ECCE 61% limestone was applied at 5.6 tons per acre (6,832 lb ELM/acre) to one set of plots and 5.6 tons of ECCE 100% limestone per acre (11,200 lb ELM/acre) was applied to another set of plots. These preplant limestone treatments were left unincorporated on the soil surface. All limestone treatments were duplicated and the duplicates were each treated with 2.82 oz of molybdenum/acre. Alfalfa was initially seeded in fall of 1997, but the stand died due to the drought in 1998. Alfalfa was replanted in fall 1998.

Research Findings. A good stand was maintained through the drought in 1999 and succeeding years except in the zero lime check plots and in the plots that were surface treated with ECCE 61% limestone immediately before seeding. Data in Table 1 indicate that alfalfa yields in plots that received 8,064 lb of ELM incorporated 2- or 6-inches deep were statistically similar each year. Alfalfa production in surface limed plots was similar to the lime-incorporation

treatments, but tended to be lower each year and yielded about one ton less per acre or 88% of maximum yield over three years. Limestone applied in fall and left on the soil surface produced significantly lower yields compared to spring-applied limestone. The ECCE 100% lime surface applied in fall doubled the alfalfa yield produced by similarly applied ECCE 61% material. Response of alfalfa to molybdenum was observed only in the second year. Total yield due to adding molybdenum to the lime-treated soils was only 4.4% greater than in limed plots that received no molybdenum.

Application. These data provide a glimpse of the necessity for proper application and incorporation of limestone for production of alfalfa. This is the second study on the Darco soil that indicates that molybdenum is not needed for alfalfa production on Darco soils that are properly limed.

Table 1. Alfalfa response to limestone (5.6 t/ac) incorporated at various depths and to molybdenum applied to Darco loamy fine sand in 1997. Yield 2, 3, and 4 yr. following treatment.

Lime treatment[1]	Dry matter yield by year and three-year total				Yield,
	1999	2000	2001	3-yr total	Percent of
	----------lb/acre----------				Maximum
ECCE 72%, incorporated 6 inches, spring	3,660 a	7,405 a	8,382 a	19,448 a	100.0
ECCE 72%, incorporated 2 inches, spring	3,280 a	7,641 a	8,516 a	19,437 a	99.9
ECCE 72%, surface applied in spring, not incorporated	3,000 a	6,720 a	7,422 a	17,142 a	88.1
Zero lime, no additional incorporation	640 c	424 c	245 d	1,309 d	6.7
ECCE 61%, applied just before planting in fall	1,158 c	1,581 bc	2,571 c	5,309 c	27.3
ECCE 100%, applied just before planting in fall	1,923 b	3,226 b	5,204 b	10,353 b	53.2
Molybdenum, grams/acre					
0	2,320 a	4,610 b	5,680 a	12,610 a	64.8
80	2,528 a	5,227 a	5,702 a	13,457 a	69.2

[1] Plots in which lime was to be incorporated to 6 inches were treated with limestone, then the whole experiment was roto-tilled to 6 inches. Appropriate lime treatments were applied to other plots and those to be tilled to 2 inches were roto-tilled to that depth.