EFFECT OF LIMESTONE INCORPORATION, APPLICATION TIME, AND MOLYBDENUM ON YIELD OF ALFALFA IN A DROUGHT YEAR

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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. The research reported here is the initial work to verify this hypothesis.

Research Findings. In late spring, limestone having an ECCE of 72% (1440 lb of effective liming material (ELM)/ton) 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. 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 no-limed check. Immediately before planting, limestone from the same lot was applied at 5.6 tons per acre to one set of plots and a limestone having 2000 lb of ELM/ton was applied to another set of plots. These preplant limestone treatments were left on the soil surface. All limestone treatments in the four replications were duplicated with 80 grams of molybdenum added. Alfalfa was initially seeded in fall of 1997, but the stand died due to the drought in 1998. Alfalfa was replanted in fall 1998. An excellent stand was maintained through the drought in 1999 except in the zero lime check plots and in the plots that were surface treated with limestone immediately before seeding. Data in Table 1 indicate that dry matter yield at each of three cuttings in 1999 was quite low due to drought conditions. However, these data begin to provide a glimpse of the effectiveness of limestone incorporation well in advance of seeding alfalfa. Two years after limestone was

applied yield trends indicate that, although there were no statistically significant differences among the early applied lime treatments, the limestone that was incorporated to the 6-inch depth produced the highest yield. This yield was assigned 100% of maximum. Yield was 90% of maximum when the limestone was incorporated 2 inches deep. Where limestone was left on the soil surface, yield was 82% of maximum. Only 17.5% of maximum yield was produced in the unlimed plots. Where the limestone was surface applied immediately before planting, the ECCE 72% produced only 32% of maximum yield while the ECCE 100% produced 52.5% of maximum. Molybdenum had no effect on alfalfa yield.

Application. The preliminary data reported for 1999, a relatively dry year, provide a glimpse of the necessity for proper application of limestone for production of alfalfa. Additional yield data will be collected and evaluated in succeeding years to provide more definitive verification of the proper timing and methods for limestone application. The is the second study on the Darco soil that indicates that molybdenum may not need to be applied for alfalfa.

Table 1. Alfalfa response to limestone applied at 5.6 tons/acre and incorporated at various depths and to molybdenum surface applied to Darco loamy fine sand in 1997. Yield data are from 1999.

	Alfalfa dry matter yield by harvest date and total				
Lime treatment[1]	5/7/99	6/9/99	7/29/99	Total	Max Y'ld
	----------lb/acre----------				%
ECCE 72%, incorporated 6 in, spring	1181 a	1395 a	1084 a	3660 a	100
ECCE 72%, incorporated 2 in, spring	901 ab	1500 a	879 a	3280 a	89.6
ECCE 72%, not incorporated in spring	898 ab	1309 a	793 a	3000 a	82.0
Zero lime, no additional incorporation	237 c	186 c	216 b	640 c	17.5
ECCE 72%, applied just before planting	576 bc	281 c	301 b	1158 c	31.6
ECCE 100%, applied just before planting	543 bc	979 b	400 b	1923 b	52.5
Molybdenum, g/acre					
0	668 ns	988 ns	664 ns	2380 ns	94.1
80	843 ns	1020 ns	665 ns	2528 ns	100

[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.