FIELD DAY REPORT - 1993

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

Texas Agricultural Experiment Station
Texas Agricultural Extension Service

Overton, Texas

May 28, 1993

Research Center Technical Report 93-1

EFFECTIVE CALCIUM CARBONATE EQUIVALENCE (ECCE) OF LIMESTONE AND NEUTRALIZATION OF SOIL ACIDITY

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

Background. The soil acidity neutralizing efficiency of limestones having effective calcium carbonate equivalence (ECCE) levels approximating 60% was questioned. Concerns were expressed that limestones with higher percentages of coarser rock were not sufficiently reactive when surface applied to soils supporting permanent grass sod and overseeded pastures. The effectiveness of finer limestones (higher ECCE) to maintain a high soil pH compared to coarser rock was also a concern. Research was conducted to answer these questions.

Research Findings. Limestone was applied to the surface of a Darco sand and a Kirvin sandy loam in 10 by 20 foot plots at rates of 0, 1, 2, and 3 tons/ac. Limestone ECCE percentages for each rate were 62, 81, and 100. Treatments were applied to three forage systems that included: (1) 'Coastal' bermudagrass; (2) Coastal bermudagrass overseeded to 'Marshall' ryegrass; and (3) Coastal bermudagrass overseeded with 'Dixie' crimson and 'Yuchi' arrowleaf clovers. Limestone from the same quarry was used in this study. The ECCE 81 limestone was a 50/50 mixture of the ECCE 62 and 100 materials. Sites were selected, sampled, and the limestone treatments applied in autumn of 1989. Collection of soil samples began one week after the first rain on the treated plots. Soils were sampled at doubling weekly intervals, i.e., 1, 2, 4, etc.

Initial soil pH increase in the 0- to 6-inch depth after application of the 62 and 100 ECCE limestones was rapid in the Darco and Kirvin soils (Figure 1 and 2, respectively). Limestone with the 81% ECCE produced a pH increase that was intermediate between the ECCE 62 and 100. Throughout the three-year study, the ECCE 100 limestone has maintained a higher soil pH than the ECCE 62. The increased effectiveness of the finer limestone occurred in both soils. The ECCE 100 limestone is maintaining soil pH at a higher level than is the ECCE 62 limestone three years after application.

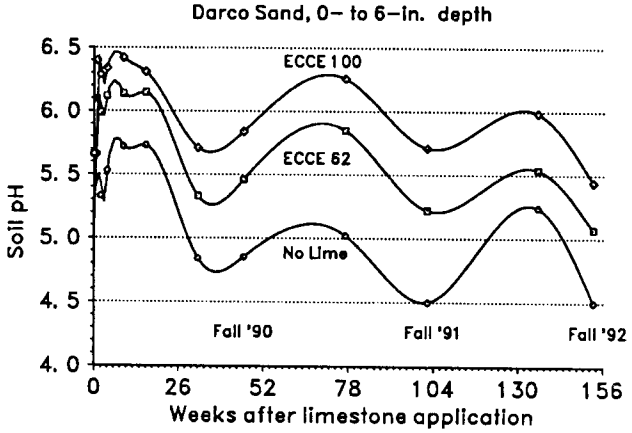

Fig. 1. Effect of limestone ECCE on soil pH over time.

The cyclic nature of the pH change is noteworthy. After the initially rapid rise in soil pH during the first fall and winter, soil acidity increased rapidly (pH decreased) during the following warm season grass production period. Similar trends occurred during the second and third years after treatment. Changes were more striking in the Darco soil but are evident in the Kirvin soil, especially in the unlimed plots.

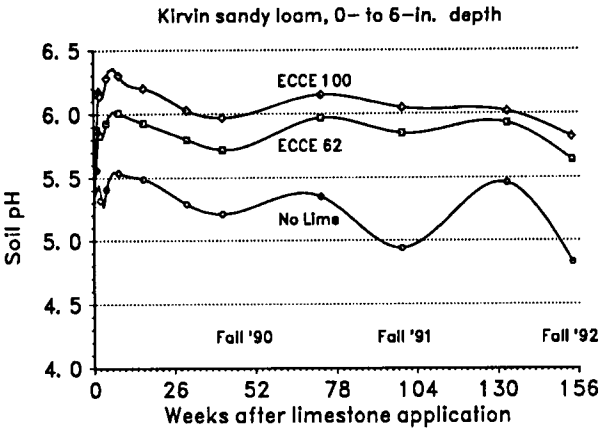

Fig. 2. Effect of limestone ECCE on soil pH over time.

The cause of this seasonal pH fluctuation is not known. At least two conditions are occurring that could affect pH in this manner. Fertilizers are applied at high rates for Coastal bermudagrass production and ammonium nitrogen fertilizers acidify low buffer capacity soils. Each pound of nitrogen applied as ammonium sulfate produces acidity that requires approximately 5.4 pounds of limestone to neutralize. Each pound of nitrogen applied as urea or ammonium nitrate requires about 1.8 pounds of limestone to counter the acidity produced. This acidity may be forming faster than the surface applied limestone can react to neutralize it, thus the pH decrease.

The second condition that may be causing the pH decline in the summer could be salt accumulation. Fertilizers are salts. Low salt levels can change the pH measurement by increasing soil solution hydrogen (H^+). This increased level of soil solution H^+ is measured by the pH meter electrodes and registered as increased soil acidity. Additional research is needed on this problem.

Application. The ECCE 100 limestone is more efficient for neutralizing soil acidity. Lower rates of ECCE 100 limestone can be applied to change soil pH. If it is available and priced right, ECCE 100 material is an excellent limestone. Because of the seasonal fluctuations in soil pH, soil samples for lime requirement testing should be collected in late summer and early fall. At that time, soil pH should be at its lowest point and the test should generate an adequate prediction of the lime requirement. Samples collected in spring for lime requirement testing may show a soil pH reading that is interpreted as adequate for clover production. By fall when the clover is seeded, the pH will be too low to support good growth of young clover seedlings.

Acknowledgement. Monetary support for this work was provided by Texas Crushed Stone Company, The Texas-Louisiana Aglime and Fertilizer Association, and The Texas Plant Food Institute.