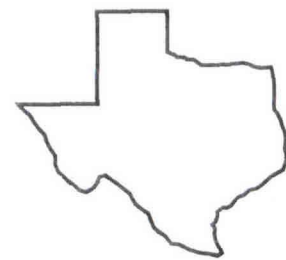
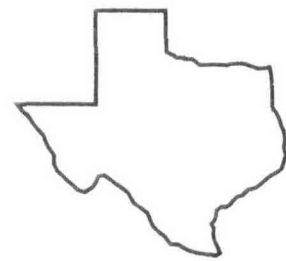
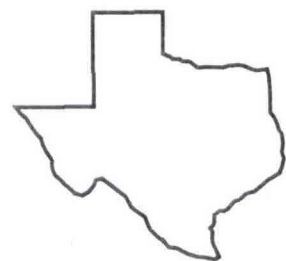
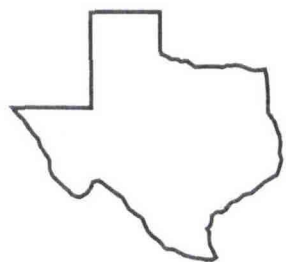
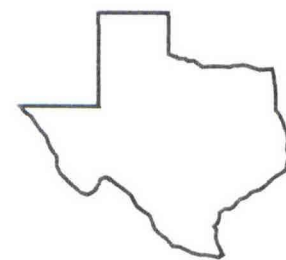




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SOIL BORON AVAILABILITY AFFECTED BY APPLIED BORON AND LIMESTONE

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Background. Limestones ranging from 49 to 100% effective calcium carbonate equivalence (ECCE) are applied to acid soils in Texas. Low ECCE limestones are less reactive than high ECCE limestones. Past research showed that as soil pH increased from strongly acid toward 7.0, boron (B) adsorption increased on clays and amorphous aluminum (Al) oxides. Maximum B adsorption occurs on hydroxy Al in a pH range of 6 to 9. Some soil B is fixed in organic compounds. We evaluated the effects of surface-applied, finer-ground limestone on chemical changes in soils producing perennial forages. Limestones with ECCE percentages of 62 and 100 were applied on 9 Nov. 1988 at rates of 0, 1, and 2 t/ac to a Darco loamy fine sand. Boron (B) was applied preplant each year at rates equivalent to 0, 1, and 2 lb/ac to study its effects on soil B levels and interaction with limestone and soil pH change. Soil samples to the 2-inch depth were collected 125 days after limestone and B treatment.

Research Findings. Increasing the limestone rate and ECCE increased soil pH (Fig. 1). Soil samples collected from the 0-6 in. depth 2.5 years following limestone treatment showed that the 2 t/ac rate of ECCE 100 limestone maintained soil pH above 6. This was compared to a pH of 5.7 when ECCE 62 limestone was applied at the same rate. Slightly wider differences in soil pH were found between limestone ECCE at the 1 t/ac rate of application. At the 2.5 year post-treatment sampling, 1 ton of ECCE 100 limestone maintained soil pH at a higher level than where 2 tons of ECCE 62 limestone had been applied.

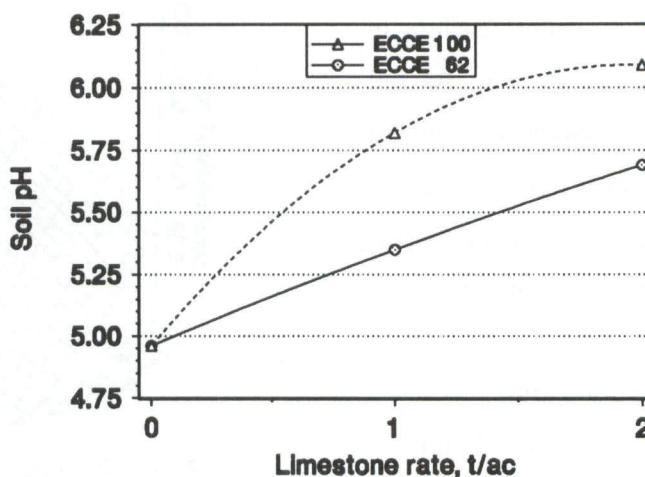


Figure 1. Effect of limestone rate and ECCE on pH of the 0-6 in. soil depth in 1991, 2.5 yr following treatment.

Soluble B at 0-2 in. was not affected by increasing rates of applied B in the unlimed soil 125 days after treatment (Fig. 2). Application of 1 ton of ECCE 62 limestone/ac increased soluble B in the soil at the zero B treatment, probably because of increased mineralization from organic matter. Within each limestone treatment, B levels in the soil were elevated progressively by

increasing the rate of B except at 2 tons of ECCE 62 material/ac when 2 lb B/ac were applied. Soluble B decreased in soil treated with 1 ton limestone/ac when ECCE was switched from 62 to 100. At the high limestone rate and no added B, ECCE 100 limestone also decreased soluble B in the soil, but this reduction in soil B was not evident when B was applied.

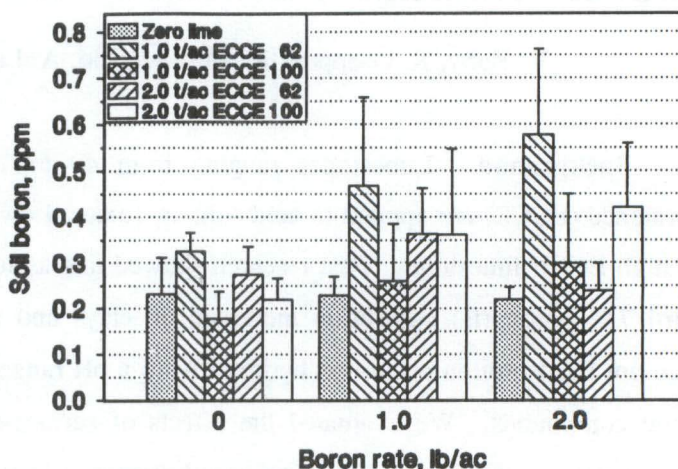


Figure 2. Effect of limestone rate, ECCE, and B on soil B in the 0-2 in. depth on 14 Mar. 1989, 125 days after treatment ($P = 0.10$).

Boron adsorption in the Darco soil was highest at high rates of B and high pH (Fig. 3). In a column study, only a small percentage of the adsorbed B was retained against leaching in soil with a pH of 5.8. As soil pH was increased, the amount of B retained against leaching increased. These data support field results in unlimed, B-treated soil.

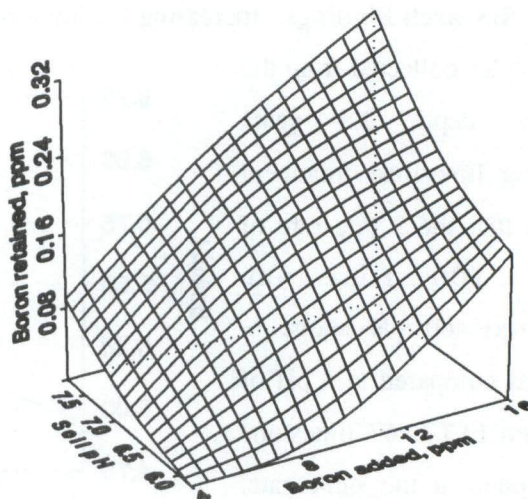


Figure 3. Effect of pH and added B on soil retention of B.

Application. When a low rate such as 1 ton of limestone is applied to neutralize soil acidity, the finer ground limestone (ECCE 100) can cause soil B to become less available. If the soil B is already near the critically low level, fixation caused by higher ECCE limestone can lower B into a deficiency level that can cause a yield decrease in legume forages. When high ECCE limestone is used to correct soil pH for production of legume forages, it is important to soil test for B and apply the recommended level. Application of B to an acid, unlimed soil had no effect on increasing the soil level of available B.