THE EFFECT OF APPLICATIONS OF GYPSUM AND A COAL COMBUSTION BY-PRODUCT ON ACID EAST TEXAS SOILS

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Background. Acid soils are common throughout most of east Texas. The primary reason for soil acidity in the region is that high precipitation has leached basic cations from the soil, leaving elements that contribute to acidity. In addition, the use of ammonium-containing nitrogen fertilizers can lower soil pH. At low soil pH, plants do not use nutrients as efficiently, thus a portion of the money spent for fertilizer is wasted. This reduction in efficiency can be significant, possibly as much as 50% when compared to nutrient use efficiency at pH closer to neutral. Another problem associated with acid soils is that aluminum (Al) rapidly increases in solubility as pH decreases below 5.5. Soluble Al is toxic to the roots of some plants. Roots of Al-sensitive plants will not grow into soil with high Al levels, thus limiting water and nutrient uptake, and ultimately plant productivity. Forage legumes such as clovers and alfalfa are sensitive to low soil pH and high levels of soluble Al. Acidity in surface soils is typically managed through periodic application of limestone. Although lime applications are effective for raising surface-soil pH, there is little immediate benefit to the subsoil. Gypsum (calcium sulfate) has been shown to be effective in reducing the toxic effects of high levels of subsoil Al. A by-product that consists of gypsum and calcium sulfite is often produced when electric generating facilities clean the flue gasses that are released when coal and lignite are burned. When surface applied, water will slowly dissolve these materials and the calcium (Ca) and sulfate (SO_4) will move into the subsoil. The movement of the Ca and SO_4 into the subsoil reduces the toxic effects of Al. Field experiments were established in 1999 at two locations to evaluate the effectiveness of surface-applied gypsum and flue gas scrubber sludge for reducing the toxic effects of Al in strongly acidic subsoils. One field site was on the Stephen F. Austin State University Walter Todd Beef Farm on a Sacul fine sandy loam soil. The other site was on the Texas Agricultural Experiment Station research farm at Overton on a Cuthbert fine sandy loam. Both sites had high concentrations of Al in the subsoil. In the spring of 1999, lime was applied to raise pH in the surface soil to about 7.0. The gypsum and calcium sulfite materials were applied at rates of 0, 2.2, 4.5, and 6.7 tons/acre with each treatment replicated four times. Alfalfa was planted in the fall of 1999. Soil fertility was maintained to support alfalfa production. Before treatment, soil was sampled in each plot at depths of 0 to 6, 6 to 12, 12 to 24, 24 to 36, and 36 to 48 inches. Sampling at these depths was repeated five times during the following four years. Soil was analyzed to determine movement of Ca and sulfur (S), and the effect on subsoil acidity and Al.

Research Findings. Calcium and S were detected in the subsoils at each location. Figure 1 shows Ca and S levels by depth before treatment, and on three dates after treatment in the plots that received 6.7 tons of gypsum/acre at the Nacogdoches County site. Results were similar at the Rusk County site, and for the scrubber sludge at both locations. Treatments did not raise subsoil pH, or significantly reduce levels of Al in the subsoil.

Application. Sites with subsoil pH below 5.0 and with very high levels of soluble Al are not suitable for production of Al sensitive crops like alfalfa. Although Ca and S moved into the subsoil, the excessive levels of Al could not effectively be reduced by gypsum or by-product gypsum on these Sacul and Cuthbert soils in three years.

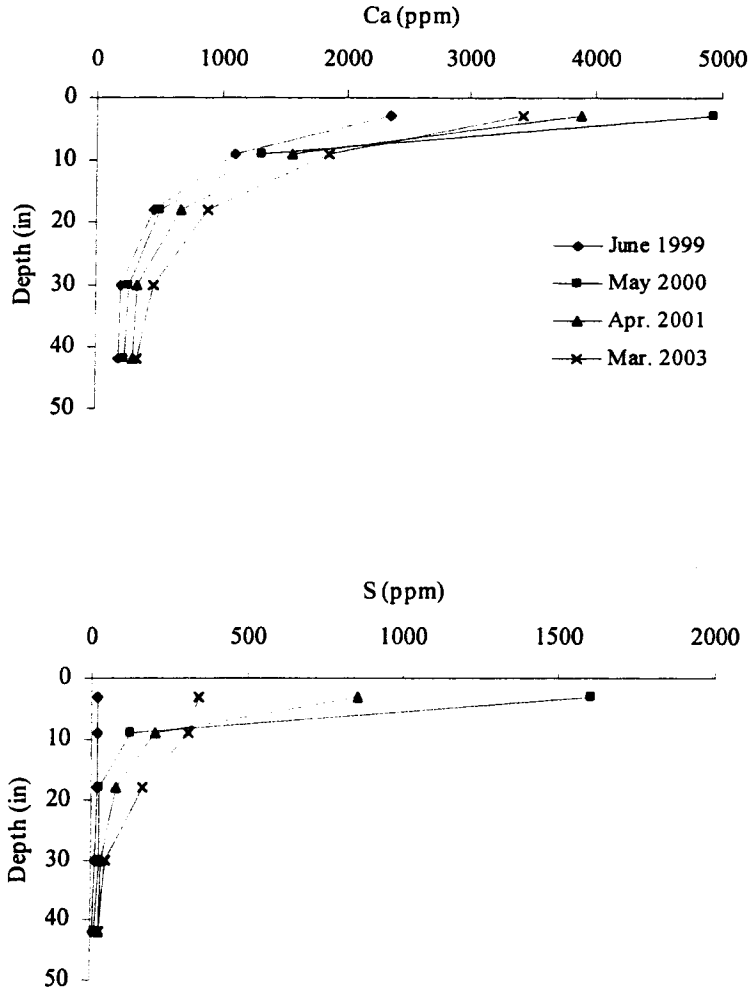

Figure 1. Effect of surface-applied gypsum at 6.7 tons/acre on soil calcium (Ca) and sulfur (S) with depth on four sampling dates on the Sacul soil, Nacogdoches Co. The June 1999 sampling was before treatment.