Southern Regional Fact Sheet

September, 2004 SERA-IEG-6*3

A New Method for Measuring Lime Buffer Capacity

Introduction:

Most buffers contain some toxic chemicals; therefore, many labs are looking for alternatives to determine the lime requirement of soils. Through research at the University of Georgia, a new automated method that uses non-toxic chemicals has been developed to measure a soil's pH buffering capacity. Because the measured value is expressed as a soil concentration of calcium carbonate needed per unit pH change, we call it the Lime Buffer Capacity (LBC). The measurement is carried out using a new robotic measurement system that automatically adds fast acting lime (calcium hydroxide) to soil samples that have an equivalent water pH less than 6.0 or pH 5.4 when measured in 0.01 Molar calcium chloride (see Southern Regional Fact Sheet, SERA-IEG-6*4 "University of Georgia's New Method for Measuring Soil pH"). A new method is introduced below to measure the buffering capacity directly.

Soil pH and lime recommendations:

Soil pH is an important chemical property because it influences the availability of soil nutrients for plant uptake and it affects a crop's root system development. Soil pH also indicates whether lime is needed for correcting toxicities caused by aluminum and manganese, or for increasing calcium levels in the soil. But pH alone does not indicate how much lime is needed because soils vary in their soil pH buffering capacities, i.e., a soils resistance to a change in pH (the amount of soil acidity that must be neutralized to raise pH to any given level**).** Most soil testing laboratories make lime recommendations from a calibration based on soil pH and a buffer pH measurement, but they do not directly measure the acidity that must be neutralized by lime application.

What is the LBC?

The LBC is a fundamental property of the soil. It is a measure of the amount of soil acidity that must be neutralized to raise soil pH by one unit, expressed as pure calcium carbonate. For example, it is the parts per million of pure and finely ground calcium carbonate (pounds of pure calcium carbonate per million pounds of soil) needed to raise soil pH from 5 to 6. Based on the weight of soil in an 8-inch plow depth and on the reactivity/purity of available liming materials, a multiplier of 4 converts LBC values into lbs of ag lime per acre to raise pH one unit. In the figure below, the soil with LBC of 250 would require 1000 lbs of ag lime to raise pH of that soil from 5 to 6.

Lime Recommendations:

The primary purpose of the LBC Method is to calculate a lime recommendation. A lime recommendation is calculated based on three factors: 1) the soil's initial pH in a dilute solution of calcium chloride, 2) the desired pH for the field or soil area being analyzed, and 3) the soil's LBC, which is calculated from the change in pH from adding the fast acting lime to the soil. Lime recommendations are typically for an 8-inch depth of soil. In this case, the lime recommendation is:

Lbs ag lime = LBC X (target pH - pH_{CaCl2}) X 4

How much does LBC vary between soils?

The LBC varies primarily because of differences in the soil organic matter and clay contents of soils. We have found the LBC to vary as much as tenfold within crop production fields in South Georgia, depending on field location. The differences in LBC of two soils are illustrated in Figure 1 below. Soil A has a LBC of five times that of soil B. The soil with the lower LBC is lower in organic matter and sandier. It has a lower cation exchange capacity (CEC).

Figure 1. Lime Buffer Capacity of two Georgia soils.

Why the LBC is a useful measurement?

As mentioned above, the primary purpose of the LBC method is to calculate a lime recommendation, but it can also be useful for other purposes. Since the LBC Method directly measures soil acidity, it can be used in a calculation, along with soil test calcium, magnesium, and potassium values to provide a reasonable estimate of soil cation exchange capacity. The measurement of LBC will not change appreciably over time because soil levels of clay and organic

matter remain about the same from year to year in typical agronomic farming operations. Therefore, the LBC does not need to be measured annually to calculate a cation exchange capacity for a field or field area. For soils amended with heavy applications of organic materials (gardens, potting soils, flower beds, etc.), annual measurements would be needed to calculate the cation exchange capacity.

D.E. Kissel and P.F. Vendrell, University of Georgia