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A LABORATORY METHOD TO ELIMINATE SEASONALLY VARIABLE SOIL pH

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Background. In Texas and several other states, laboratories routinely determine soil pH in a suspension of two parts water to 1 part soil. Other states use a one:one ratio of water to soil. Some soil chemists favor analysis of soil pH in a water-saturated soil paste. The more concentrated the soil in the water, the lower the pH reading. The saturated-soil-paste method most closely approximates the true pH of the soil in the field. However, routine analysis of thousands of soil samples for pH using the saturated paste method is impractical for many reasons, including time required for preparation of the saturated paste (Van Lierop, 1990). For practical reasons, most analytical laboratories determine soil pH in a 1:1 or a 2:1 water to soil suspension, disregarding the knowledge that the pH value reported is higher than in field-moist soil conditions. This paper reports results of seasonal variability in 2:1 water to soil pH determinations on soil samples collected from the same plots over a three-year period. An analytical method for determining soil pH that will eliminate the seasonal pH variability, while reporting a pH value that more closely approximates that of the soil in the field is proposed. Cropping systems in this experiment were (1) bermudagrass with no overseeded winter crop, (2) bermudagrass overseeded with ryegrass, and (3) bermudagrass overseeded with clovers.

Research findings. Soil pH changes in the 0-6 in. depth of a Darco loamy sand over three years are shown in Fig. 1. The two solid lines represent the 2:1 water to soil pH resulting from unlimed soil in check plots and from plots treated with effective calcium carbonate equivalent (ECCE) 100% limestone applied to the soil surface. The limed plot data were averaged over 1, 2, and 3 ton/ac limestone rates and forage systems. Soil pH varies by season. Low pH occurs in samples collected in fall. High pH occurs in samples collected in spring.

What causes these cyclic swings in soil pH with season? Rainfall amounts decline from spring to fall. During this time, the warm-season forage and the temperature are drying the soil. Fertilizers are also being applied. This combination of factors causes the salt concentration in the soil to increase. (Technically, soil ionic strength increases.) As the salt content of the soil increases, the soil pH declines. Conversely, high rainfall during the winter months removes soil salts by leaching. (Soil ionic strength decreases.) As the salts are leached from these soils, the soil pH measurement goes up.

What is the significance of these results? Historically in Texas, recommendations for limestone to correct soil acidity are based on the 2:1 water to soil pH determination. The

recommendation is to apply the limestone six months in advance of when an acid-intolerant crop is to be planted. In practice, the producer will sample his fields in spring to determine the limestone needs for the cool-season crops that are much less tolerant to soil acidity. Sampling for soil pH determination in late winter or spring means the soil pH will be in the high cycle. A limestone recommendation based on this high pH will be for application of a lower rate than had the soil been sampled in the low pH cycle in the fall. The lower limestone application rate may not eliminate all the soil acidity and the cool-season crop may produce lower yields.

The cyclic, seasonal variability in the measurement of soil pH can be eliminated by analysis of soil pH in a 0.01 M $CaCl_2$ solution at the 2:1 solution to soil ratio. Examples of the effectiveness of this dilute salt solution are indicated by the dashed lines in Fig. 1. Points on these dashed lines represent the salt solution pH determination of the same samples represented by the 2:1 water to soil pH represented by the solid lines. This dilute salt pH stabilizes soil pH readings over seasons and lowers the pH value closer to what it is under field conditions.

Application. Determination of soil pH in a dilute calcium chloride salt solution more nearly approximates the real soil pH as it exists under field-soil moisture conditions.

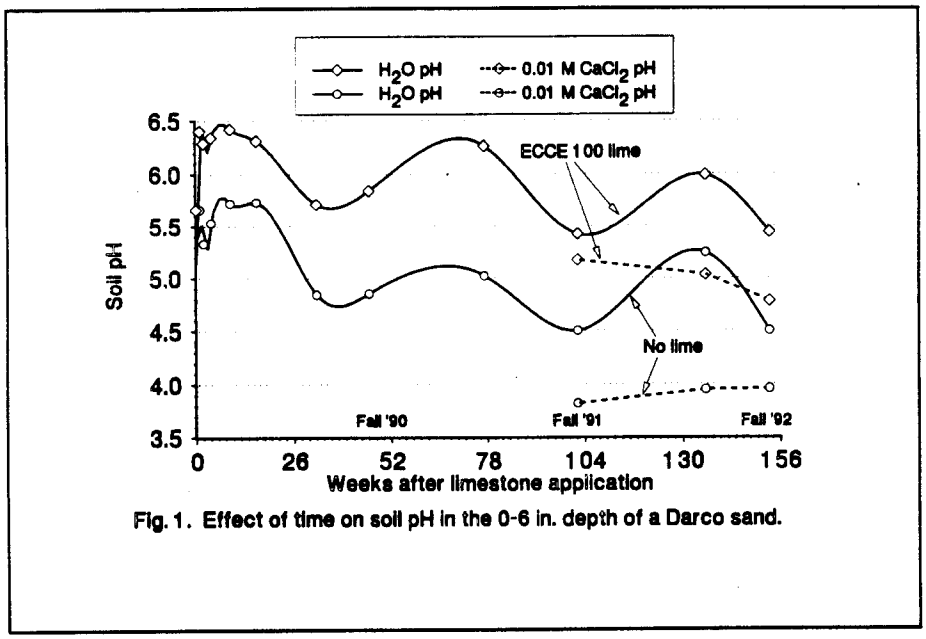

Fig. 1. Effect of time on soil pH in the 0-6 in. depth of a Darco sand.

Literature Cited

Van Lierop, W. 1990. Soil pH and lime requirement determinations. 73-120. *In* R. L. Westerman (ed.) Soil Testing and Plant Analysis. 3rd ed. SSSA Book Series No. 3, Soil Science Society of America, Inc., Madison, Wisconsin.