THE CHANGES IN SOIL TEST POTASSIUM IN KENTUCKY SOILS FOLLOWING INCUBATION AND THE ADDITION OF POTASSIUM FERTILIZER

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Introduction

Soil test potassium levels across the state of Kentucky have been declining for the past several years. The high price of potash fertilizer has definitely played a role in this decrease, but crop removal rates have also been increasing. This research is being conducted to improve fertilizer recommendations, to help producers raise or maintain K soil test level, and to obtain an optimum, profitable yield. Currently, University of Kentucky has a single set of K recommendations regardless of soil type or mineralogy, but we know that soils vary greatly in their ability to fix and release K. Bertsch and Thomas (1985) noted that the Pembroke soil series has never shown a response to applied K. Other studies like Thom and Dollarhide have found that the amount of P_2O_5 needed to change the soil test P levels by 1 mg/kg were primarily determined by the starting soil test P level and unrelated to soil series. The results supported a single state-wide interpretation of soil test phosphorus. Using similar procedures as Thom and Dollarhide, this project will answer similar questions about soil test potassium.

Another aspect to this project involves an investigation of the subsoil K status across Kentucky. Potassium recommendations are currently based only on a surface soil sample (0-4 and 0-6 inch for reduced and conventional tillage, respectively). Other states, for example, Iowa has updated their K recommendation to include different recommendations base on subsoil K (Mallarino, 2003 and Sawyer et al., 2008). Wisconsin, Illinois, and Minnesota also use subsoil K status as a basis for K recommendations. The second objective of this study is to determine subsoil K levels to see if, Kentucky should consider subsoil status for recommendations.

Materials and Methods

Project Protocol

This study began in July of 2008 by collecting soils from 38 sites across the major physiographic within Kentucky (Figure 1). Sites were selected based upon the following criteria:

1) Soils are agriculturally productive (crop and pasture)
2) Belonged to a dominate soil series
3) Whole field soils test K below 300 and were not recently fertilized

In November of 2008, an email for was sent to ANR county agents across the state requesting volunteer efforts from local producers to participate in this study. With the approval of local producers we intend to collect about 2-3 samples from different soil series from each county (who participates) in the state. It is important to note that many productive soils are located in the central and western parts of Kentucky; therefore much of this study will concentrate on soils from these regions.

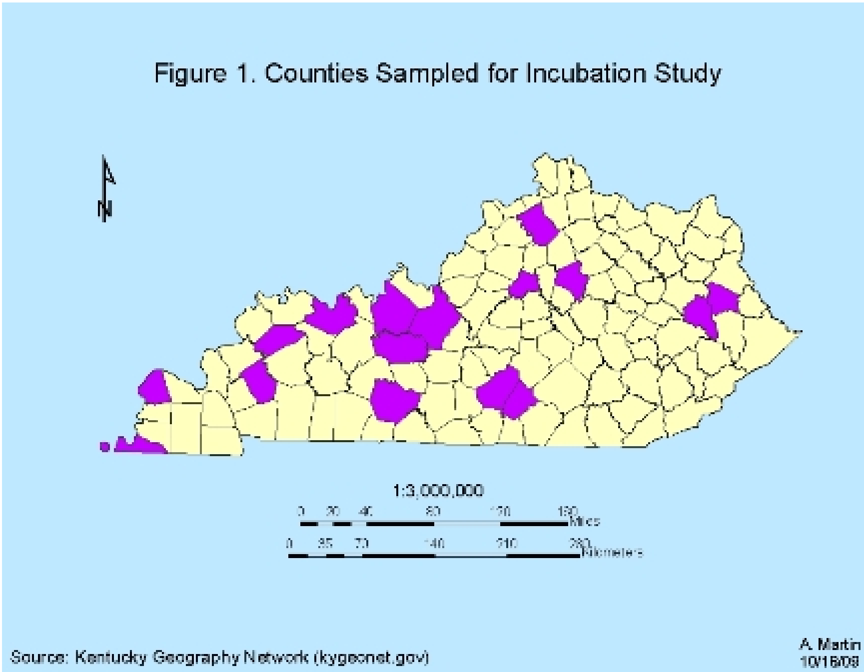

Figure 1. Counties Sampled for Incubation Study

Field Procedures

A portion of the A horizon was collected at a depth no more than four inches. Enough soil was excavated to fill a 5 gallon plastic bucket. The contents in the bucket were air dried. For the incubation study these soils were passed through a soil crusher and sieved to 2 mm.

Also, in the field, soil cores were taken within 2 feet of the bucket sample. Cores were collected at the following depths: 0-4 in, 4-8 in, 8-12 in, and 12 to 24 in. These samples were tested using the Mehlich III method of extraction and the University of Kentucky's Regulatory Services. GPS coordinates were used to establish the soil series at each location using Web Soil Survey.

Laboratory Procedures

This is an incubation study involving six different potassium fertilizer additions (0, 50, 100, 150, 200, and 250 mg K/kg). The rates were obtained by using laboratory grade potassium chloride (KCl) in a concentrated solution. Aliquots of the K solution were mixed with 50 grams of soil using a v-mixer for a period of 3 minutes. After mixing, the soil was placed in 120 mL specimen cups, and wet to 80% of the soil's field capacity (80% of the water content at 33 kPa). Field Capacity was determined using pressure plate analysis of soil moisture retention (Klute 1986). Specimen Cups were then covered by ventilated lids, and placed in a cabinet away from light for 4 weeks to avoid any plant growth, and potassium loss due to plant uptake.

After 4 weeks of incubation samples were rewetted to 80% of field capacity and incubated for another 4 weeks; so the total period of incubation will be 8 weeks. At the end of incubation samples were analyzed for Mehlich III soil test K by University of Kentucky Division of Regulatory Services. There were a total of three replications for each soil sample and treatment.

Results

Soil Test K with depth is (Fig. 2) varied greatly amongst the 38 sites. The range in the surface layer was from 27 to 300 ppm and was not related to the levels found in the surface. For most sites, the STK levels decreased with depth. However, some sites like the Fredrick soil series, exhibited a drastic increase with depth. A possible explanation for this variability may be due to the mineralogy of the parent material that exists below the plow layer. This presents a challenge to determining if Kentucky should consider a subsoil K status when making fertilizer recommendations. It is likely that more sites are needed across the state in order to have a more thorough evaluation of the subsoil K status.

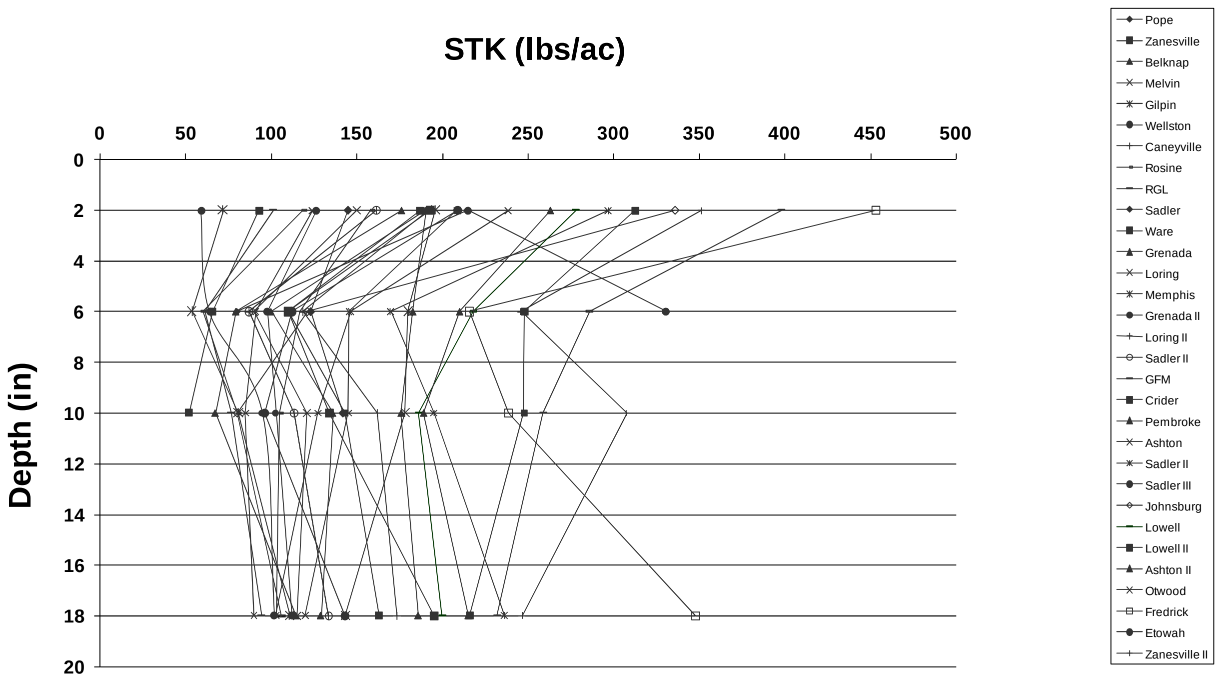

Figure 2. Soil test potassium with depth for 31 Kentucky soils.

The incubation portion of this study is still ongoing. Preliminary results show a significant interaction of STK with K rates and soil series. For example, in Figure 3, site 6 initially testing at 73 lb/ac had a relatively slow response to K addition compared to site 23 which had a greater response to K fertilization (seen with the steeper curve). This interaction, if it is found to be statistically significant over the entire study, will be a will be utilized to improve potassium fertilizer recommendations for producers of all commodities in Kentucky.

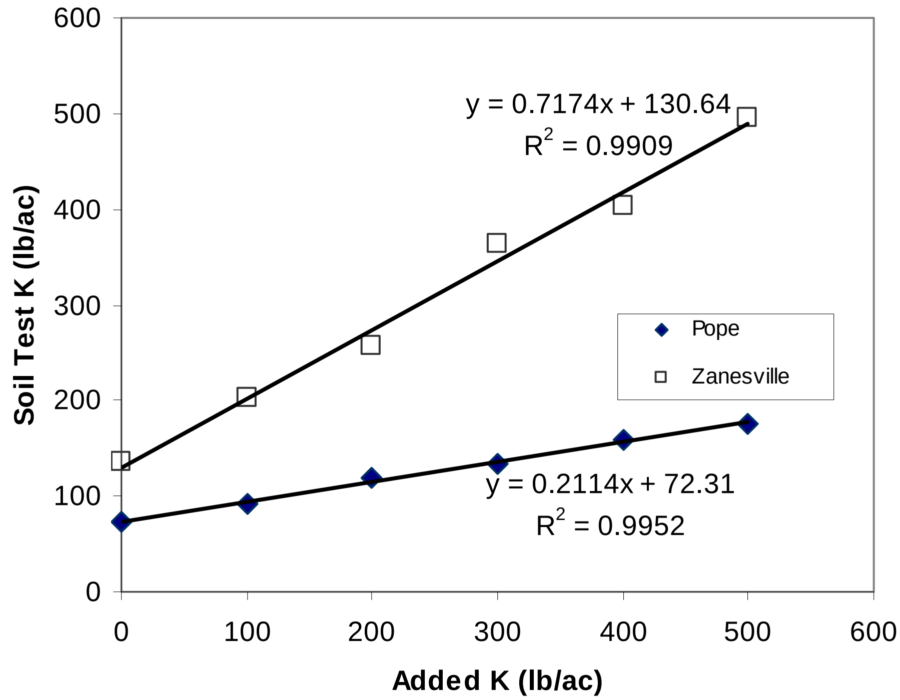

Figure 3. Average Change in STK for Site 6 and 23 After K Fertilizer Addition

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