PROFITABLE POTASSIUM SOIL MANAGEMENT USING THE BUILDUP CONCEPT FOR LOW TESTING COTTON FIELDS

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Abstract

Different programs for building up soil test K were evaluated for two soil types in Missouri in terms of response soil test K and cotton lint yields. For a fine sand soil K levels were not increased above critical levels. Also yield response was not consistent. On the silt loam soil buildup programs were on track to increase soil test K above the critical level in their respective time frame. Lint yields decreased as the build up period increased. Producers should consider soil type when electing to use a build up program for soil test K

Introduction

University of Missouri (MU) soil test laboratory recommendations for K fertilizer are based on three components: target level, crop removal, and build-up. Target level is the amount of extractable nutrient found in a soil at which point applying more fertilizer containing the nutrient will probably not increase crop yields. Crop removal is how much the nutrient is reduced in the soil annually from harvested fiber. Build-up is the additional fertilizer needed above crop removal to increase low- and medium-testing soil K to the target fertility levels for crop production.

Soil K build-up can be slow or fast depending on the economic situation of the farmer. Total fertilizer applied in slow and fast build-up programs is about the same amount, but the cost may be spread out over more years in slow build-up periods. The current soil test recommendation system used by MU allows growers to select the number of years over which to build-up soils. This decision has a large effect on the amount of fertilizer that a farmer will purchase and apply in a given year. If a grower does not select a build-up period, the soil test lab uses an 8-year default build-up time to calculate fertilizer recommendations.

Research has not been conducted to determine which build-up strategy is the most profitable to manage crop nutrients in row crop and forage production. Long build-up programs help farmers manage their financial resources by spreading fertilizer costs over several years. However, growers need information concerning the magnitude of yield loss that may occur early in an 8-year build-up as compared to a shorter build-up (1 to 4 years).

The objectives of this long-term study are to evaluate the effects K build-up periods on yields of cotton grown on two typical Missouri cotton soils and to validate the build-up equations used in the MU fertilizer recommendation program

Materials and Methods

Shown below are the equations used at MU to calculate the K build-up component of soil test recommendations.

$$\text{Build-up } K_2O = \frac{75.5(X_d^{1/2} - X_o^{1/2})}{\text{Years}}$$

X_d = target soil test level in lb P or K per acre

X_o = observed soil test level in lb P or K per acre

Years = desired time period for build-up

Cotton field experiments were begun in 2007 on a Malden fine sand soil (0.8% organic matter, 3.8 meq/100 g soil cation exchange capacity, CEC) at Clarkton, Missouri and a Dundee silt loam (2.3% organic matter, 14.7 meq/100g soil CEC) at Wardell, Missouri.

All plots received equal nitrogen rates. Phosphorus (P) fertilizer was applied to all plots at a rate of 30 lb P2O5 per acre. Standard treatments for K include an untreated check and 1 through 8-yr buildup fertilizer programs. Buildup treatments of 1 to 8 years were applied at rates of 167, 97, 74, 63, 56, 51, 48, and 45 lb K2O per acre. In the following years, each treatment, excluding the 1-yr buildup, will get K fertilizer based on the years of buildup treatment (2 to 8 years). After each buildup has been completed, treatments will receive maintenance K applications based on crop removal of K2O. Plots were mechanically harvested and grab samples were collected to identify crop removal of nitrogen, phosphorus and potassium.

Results and Discussion

Target K levels are calculated for cotton as 220 + (5 x soil CEC). Target K levels for the loam and sand were 294 and 239 lb K per acre, respectively. One year K buildup on the loam soil was above target levels (Figure 1). However, the 1-yr buildup failed to reach the target level on the fine sand soil. This suggests that either insufficient K was applied or K+ may have leached below 6-inch soil depth. Soil samples collected in April 2008 showed that part of the K had leached to the 18 inch soil layer (Figure 2).

On the silt loam soil, cotton yields decreased during longer buildup programs (Figure 3). One year buildup treatments averaged 220 lb lint per acre more than check plots with no K fertilizer. All treatments longer than one year were not significantly higher than check plots. On the sandy loam soil, we did not observe a consistent response to K fertilizer (Figure 4).

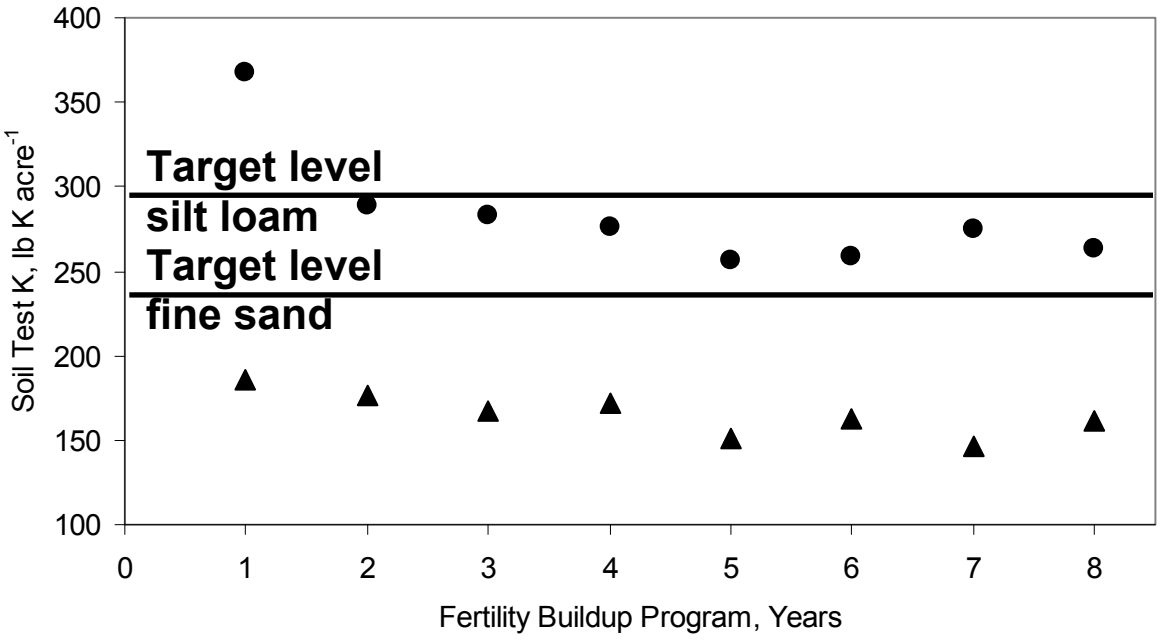

Figure 1. Average K soil test levels for two typical Missouri cotton soils in May 2008 following one year of buildup program.

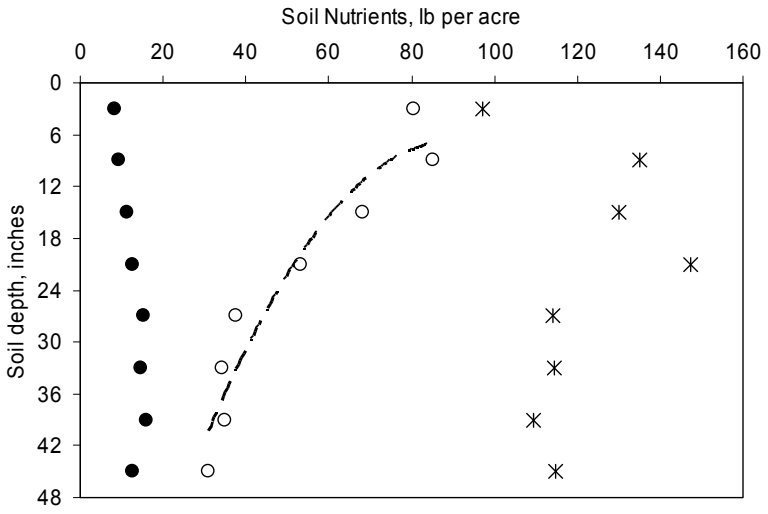

Figure 2. Cotton soil test levels of N, P, and K from 0 to 48 inches collected in 6-inch increments in 2008 at Clarkton, MO from 2-year K buildup treatment on sandy loam soil.

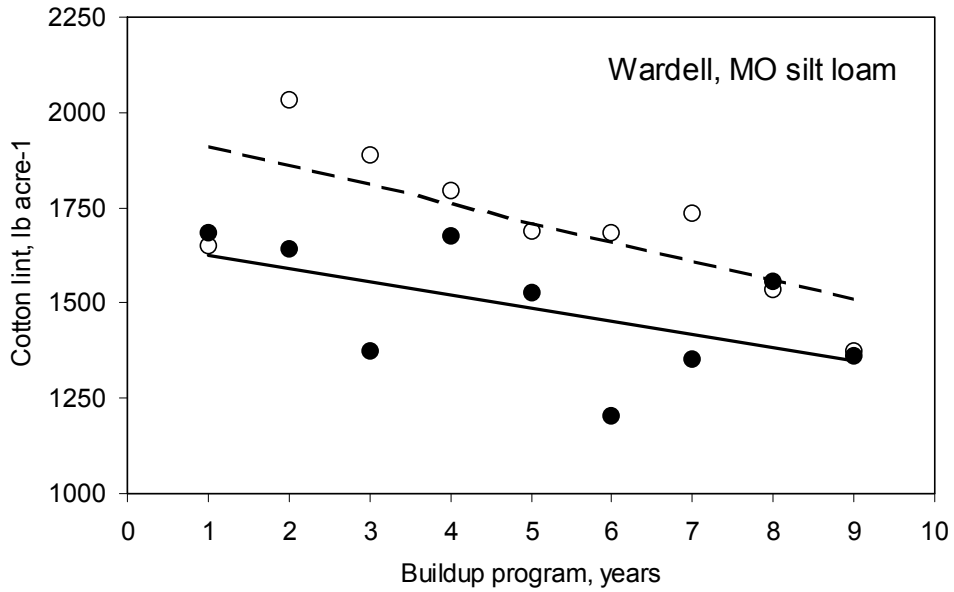

Figure 3. Cotton yields in 2007 (bottom line) and 2008 (top line) after one and two years in buildup programs at Wardell, MO on a Dubbs silt loam soil.

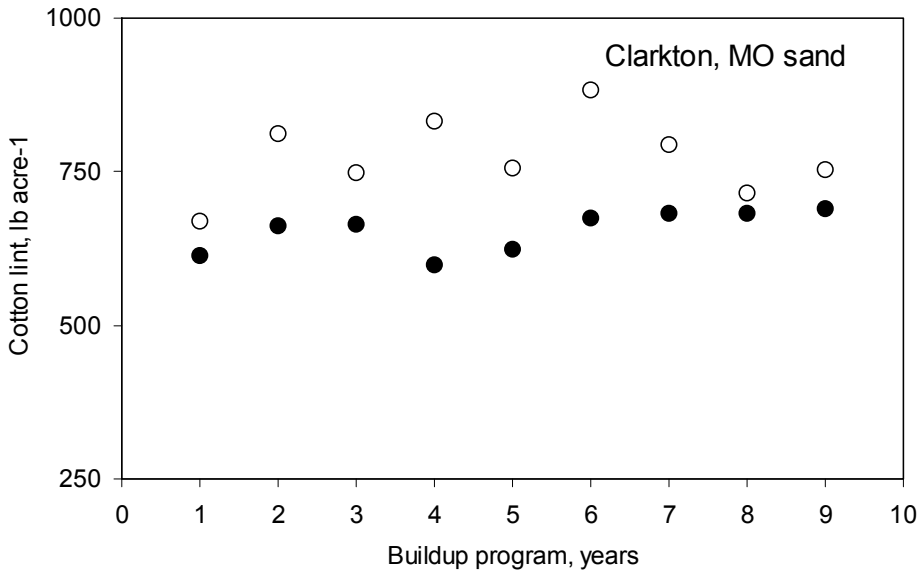

Figure 3. Cotton lint yields in 2007(bottom points) and 2008(top points) with 1 to 8 year build up programs at the MU Rhodes Farm on a sandy loam soil.

Summary

The two soils behaved differently in terms of soil test K levels and yield response to the K buildup programs. Based on this preliminary data soil test recommendations which seeking to build up K in low or medium soils should be modified to reflect soil type. As this report represents the first two years of an eight year study it is difficult to draw definitive conclusions. Therefore, more study is needed.

Acknowledgements

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