BUILDING SOIL POTASSIUM IN A LOW-TESTING COTTON FIELD

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Abstract

University of Missouri (MU) soil test laboratory recommendations for potassium (K) fertilizer are based on three components: target level, crop removal, and buildup. 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. Buildup is the additional fertilizer needed above crop removal to increase low and medium K testing soil into the optimum fertility levels for crop production. Cotton producers may choose the number of years over which the buildup will occur.

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 buildup 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-yr buildup as compared to a shorter buildup (1 to 4 years). The objective of this study is to evaluate the effects of soil K buildup and release on cotton using different buildup options in the current MU recommendation program.

Field experiments were conducted 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. The experimental design was a randomized block design with four replications. Permanent markers were placed to help locate research plots in following years. In the spring before fertilizer applications were made, composite soil samples were collected from each plot and analyzed at the MU Delta Center Soil Lab. Dry fertilizer materials were broadcast and incorporated before planting. All plots received equal nitrogen rates. Phosphorus (P) fertilizer was applied to all plots at a rate of 30 lb P_2O_5 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 K_2O 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 K_2O. At the end of eight years, all treatments will have received the same amount of K fertilizer and all input costs for K will be approximately equal. Plots were mechanically harvested and grab samples were collected to identify crop removal of nitrogen, phosphorus and potassium. In the following years, buildup treatments for K will include the standard buildup rate in addition to the amount lost by crop removal.

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. 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.

Fiber micronaire and length were not significantly affected by buildup rate. Potassium extracted from the cotton seed ranged from 1.2 to 1.9 % in both locations. Crop removal of K_2O on the silt loam averaged 33 lb K_2O per acre and 15 lb K_2O per acre on the fine sand soil.

Cotton yields decreased during longer buildup programs. 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.

The cost of 1-yr K buildups was $45 per acre higher than 8-yr K buildups. Despite the increased cost for K fertilizer, 1-yr buildup treatments grossed $53 above check plots. The highest grossing treatment was the 2-yr buildup at $528 per acre after the cost of K fertilizer. Fertilizer costs were lower for the 6 and 7-yr buildups. However, decreased yields caused them to gross less than check plots. Eight year buildup treatments grossed higher than check plots.

Potassium fertilizer recommendations at the University of Missouri soil testing lab are based on target K level, crop removal, and buildup. Although fertilizer costs were higher for short K buildup programs, gross returns increased due to higher yields. One year K fertilizer buildup on the fine sand soil failed to reach target K soil levels of 239 lb K per acre, suggesting that either insufficient K was applied or K^+ may have leeched below the 6-inch soil depth.