POTASSIUM FERTILIZER PLACEMENT EFFECTS ONUPTAKE AND ROOT LENGTH DENSITY OF COTTON: THREE YEAR SUMMARY

G.L. Pate
USDA-ARS National Soil Dynamics Laboratory
Auburn, AL
G.L. Mullins
Auburn University, Department of Agronomy & Soils
Auburn University, AL
C.H. Burmester
Auburn University, Tennessee Valley Substation
Belle Mina, AL

Abstract

Recent studies of potassium (K) fertilization of cotton (*Gossypium hirsutum L.*) have concentrated on the deep placement of K fertilizer to deter late season K deficiencies. Little is known, however, about the efficiency of the cotton plant in removing K from various positions in the soil profile. In 1992 field studies were initiated on a Decatur silt loam (clayey, kaolinitic, thermic, Rhodic Paleudults) in North Alabama and on a Lucedale fine sandy loam (fine-loamy, siliceous, thermic, Rhodic Paleudults) in Central Alabama. The objectives of the studies were i) determine the proportion of the soil profile that needs to receive K fertilizer in order to maximize K uptake, ii) evaluate the efficiency of cotton at extracting K from different soil depths, and iii) determine the effects of K fertilizer placement on root length density and distribution in the soil. Deltapine 5690 was grown in 40 inch rows and the treatments were applied the day after planting. Each treatment area consisted of 40 inches of row extending to the inter-row center on each side of the row. A test rate for K of 120 lb K_2O/A was applied. A grid was placed over the treatment area and potassium as a KCl solution and rubidium (Rb) as a RbCl solution was injected into the mini-plots by making 36 injections per plot. Depths of 0, 3, 9, 15, and 21 inches were used for single injection treatments. Select combinations of each depth were also included in which increasing proportions of the soil profile were effectively fertilized. Banded applications of the K solution were made approximately 4 inches from the row and placed on the surface and at 3 and 9 inches deep in the soil. In 1993, three foliar treatments were added at both locations. Potassium as KNO_3 was applied at a rate of 4.4 lb K_2O/A, four times, at 2 week intervals beginning at first bloom. Two of the foliar treatments also received soil applied K injected at 3 and 9 inches. Rubidium treatments were included as a tracer for K. The RbCl solution was injected at 3, 9 and 15 inches. Just prior to leaf shed, whole plants were harvested from each plot, partitioned into parts, dried and weighed. Bolls were counted and separated into burs, seed and lint. Subsamples of each plant part were ground, ashed and digested in 0.1 N HNO_3 and 0.1 N HCl. Potassium and Rb were analyzed by ICAP and Flame Emission, respectively, and total K uptake was calculated. Four 1.25 inch diameter soil cores were taken per plot at positions relating to 0, 5, 10, and 20 inches from the row. Subsamples were made by cutting the cores into 6 inch increments from the surface to 24 inches. The soil was washed from the roots and root length density of each sample determined using the Modified Line Intercept Method.

Potassium uptake for surface applied and single injection treatments were not different. Consistent, significant differences were observed only among surface and combination injection treatments on both soils. Effectively fertilizing the soil to a depth of 21 and 15 inches for the Decatur sil and the Lucedale fsl, respectively, increased K uptake over surface applied K treatments. Total K uptake for band application of K fertilizer was not greater than surface applied K. The Decatur sil did not respond to foliar applications of K but the Lucedale fsl did show an increase in total K by foliar treatments when applied in conjunction with 120 lb K_2O/A soil applied K. Maximum Rb uptake was observed on the Decatur sil when injected at a depth of 3 inches. Injection of the RbCl solution at 9 inches increased total Rb uptake for the Lucedale fsl. Increases in total Rb uptake did not translate into increases in the percent Rb translocated to bolls for either soil. Root length density data for both locations failed to reveal any consistent significant differences among surface applied K and treatments in which K was placed at a single depth. Increases in root length density came only by effectively fertilizing the soil profile to 21 inches for the Decatur sil and 15 inches for the Lucedale fsl. Results from this study show that deep placement of K at a particular depth was not superior to surface applied K for increasing K uptake or root length density of cotton. Only when a large proportion of the soil profile was effectively fertilized was K uptake and root length density of cotton significantly increased as compared to surface K applications. Potassium uptake data for this three year study suggests that surface application of K or incorporation of K into the plow layer is sufficient for cotton.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:610-611 (1997)
National Cotton Council, Memphis TN