SOIL FACTORS INFLUENCING POTASSIUM AVAILABILITY AND PLANT UPTAKE

K. Lewis
Texas A&M AgriLife Research & Texas Tech University
Lubbock, TX
N. Kusi
Texas Tech University
Lubbock, TX
G. Morgan
Texas A&M AgriLife Extension
College Station, TX
H. Frame
Virginia Tech
Suffolk, VA
R.L. Nichols
Cotton Incorporated
Cary, NC

Abstract

Modern cotton varieties have increased yield potentials, and thus greater demands are being placed on the cotton root systems to take up sufficient water and nutrients, with potassium (K) uptake being of particular concern. Approximately two-thirds of K uptake occurs during a 6-week period beginning at early flowering. Insufficient plant K during the reproductive stage may decrease yields and lint quality and consequently decrease grower profits. Potassium is transported to root surfaces by both diffusion and mass flow, and the degree to which K is transported by either mechanism is related to water-soluble K in soil solution, which is only a small percentage of total soil K. Compared to diffusion, mass flow is a much faster transport mechanism and would be more likely to keep pace with K demands of higher yielding cotton. For this reason, in-season split K fertilizer applications prior to first flower could increase K transport to roots via mass flow, leading to more timely plant absorption. Furthermore, K has been reported to alleviate biotic and abiotic stress, such as drought stress, and thus, greater rates and more efficient application timing of K fertilizer in deficit irrigated or dryland farming may improve cotton lint and seed yield and fiber quality, especially in drought-affected years.

The objective of this research was to determine optimum potassium (K) management strategies for multiple cotton varieties. Research was conducted at the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) in Lamesa, TX (Amarillo fine sandy loam), and the Texas A&M AgriLife Research Center in Lubbock, TX (Pullman clay loam). Soil at both locations have K concentrations greater than the critical level (150 mg/kg K). Preliminary results indicate varieties respond differently to K fertilization coupled with irrigation. Under limited irrigation at AG-CARES, the in-season, side-dressed K application (80 lb/acre) increased yield of DP 1518 B2XF compared to the check (0 lb/acre K). Pre-plant applied K at 80 and 160 lb/acre under high irrigation increased lint yield of DP 1518 B2XF compared to the check. Yield differences did not exist for DP 1612 B2XF under high and low irrigation. At the Lubbock location, lint yield differences existed for DP 1518 B2XF but not DP 1612 B2XF, DP 1522 B2XF, and DP 1321 B2RF. Lint yield increased with 80 lb/acre pre-plant applied K and 160 lb/acre side-dressed K compared to the check. Trends were similar for DP 1518 B2XF and DP 1522 B2XF. Split applications of K at either rate did not increase lint yield compared to the check for all varieties or at either location.

Preliminary results suggest that soil K dynamics and cotton uptake are not well understood and continued investigation is necessary. Of the four varieties planted, only DP 1518 B2XF responded to added K in soil that was well above the critical soil test level of K. Side-dressed application of K increased DP 1518 B2XF lint yield under low irrigation, while pre-plant applied K increased yield under high irrigation compared to the check. Modern cotton varieties may have greater (or lesser) nutrient requirements than older varieties and only by evaluating newer varieties will we understand how improved genetics and increased yield potential affect plant nutrient dynamics.