

**GROWTH AND NUTRIENT UPTAKE BY
COTTON ROOTS UNDER FIELD CONDITIONS**

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Abstract

The relationship between nutrient uptake and root growth of cotton (*Gossypium hirsutum*) under field conditions has not been studied. This field study was conducted to evaluate cotton root growth and nutrient influx by cotton roots throughout the growing season. The study was conducted in 1994 on a long-term K rate study located on a Dewey silt loam (clayey, kaolinitic thermic Typic Paleudult) in North Alabama. The experiment had a randomized complete block design with 4 replications. All measurements were taken from the 4 replicated field plots of a treatment that had received annual applications of 60 lb K₂O/acre since 1987. Whole plants were harvested (by plot) at approximately 10 day intervals beginning at 37 days after planting (cumulative heat units (CHU) = 211). A total of 9 samplings were collected during the 1994 growing season. Harvested plants were analyzed for dry matter production and nutrient (N, S, K, P, Ca, Mn, Cu, Fe, Mn and Zn) content. At each sampling, a total of 5 soil cores were collected per plot for the determination of root length. The first core was taken directly over the plant and a second core was taken in-row half way between the next adjacent plant. Three additional cores were collected perpendicular to the row at distances of 5, 10 and 20 inches from the in-row position. Each core was subdivided into depth increments of 0-6, 6-12, 12-18 and 18-24 inches prior to the collection of roots by washing. Nutrient uptake data were combined with the root length data to calculate average nutrient influx rates ($\mu\text{mol}/\text{meter}$ of root/day) for each sampling interval using the Williams equation.

The highest root length density of 1.6 cm cm³ was observed in the surface 0-6 inch layer in the in-row position at 93 days after planting (CHU = 912). Maximum root length was obtained at 117 days after planting (CHU = 1174), while dry matter continued to increase until a maximum was obtained at 128 days after planting (CHU = 1317). Thus, root extension peaked approximately 10 days earlier than dry matter production. Average influx rates for K, P, and most of the micronutrients increased with plant age until approximately 1317 CHU, first open boll, after which influx declined. Peak average influx rates for N, Ca, Mg and Fe occurred earlier in the growing season at approximately first

bloom and then decreased with plant age. A comparison of average influx rates measured in this study with values reported for other crops suggests that the cotton root system is less efficient per meter of root than corn (*Zea mays* L) or soybean (*Glycine max*). Peak average influx rates for most of the nutrients occurred during the period of exponential root growth. Average influx rates for the micronutrients were approximately 100 to 5000 times lower as compared to the macronutrients. At its maximum extension, the cotton root system in this test was approximately 12,500 miles/acre. After first bloom and throughout the remainder of the growing season approximately 70% of the cotton roots were in the surface 12 inches of soil. For K fertilizer management, the results from this study suggest that high soil K fertility will be needed throughout the entire growing season to ensure the K needs of the cotton plant are met.