NUTRIENT UPTAKE BY COTTON IN RELATION TO IRRIGATION FREQUENCY

K. Lewis
Texas A&M AgriLife Research
Lubbock, TX
J. Burke
USDA – ARS
Lubbock, TX
T. Witt
G. Ritchie
Texas Tech University
Lubbock, TX

Abstract

The increased use of subsurface drip irrigation for cotton production in the Texas Southern High Plains has resulted in questions concerning irrigation frequency. Unlike center-pivot irrigation, subsurface drip systems provide cotton producers the opportunity to irrigate more frequently using less water per irrigation event. Frequent irrigations maintain relatively constant soil moisture content with time, and thus, may reduce water stress occurring in plants irrigated less frequently. Soil water is the driving force for nutrient transport and movement to root surfaces for plant uptake. Nitrogen (N) is moved primarily by mass flow, whereas phosphorus (P) and potassium (K) are moved by diffusion. Since nutrient movement, specifically by mass flow, is directly related to soil water content, it was hypothesized that low irrigation frequency (weekly irrigation) would result in a greater cotton seed N, P, and K concentration. The objective of this research was to determine cotton seed concentrations of N, P, and K in relation to irrigation frequency in order to optimize fertilizer inputs.

The study was arranged as a factorial within a randomized complete block design with four replications. Treatments were combinations of two factors: cotton variety (All-Tex Edge B2RF, PHY 72, PHY 367 WRF, and FM 2484 B2F) and irrigation frequency (17.5 mm weekly irrigation and 2.5 mm daily irrigation). Subsurface drip irrigation was initiated 1 July 2014 and terminated 10 September 2014, during which time total irrigation equaled 17.5 mm wk^{-1}. The soil was an Amarillo fine sandy loam, and the fields were located in Lubbock, TX. Fertilizer was applied prior to planting equally across plots in accordance to soil test recommendations. Eight 15 m rows of FM 2484 B2F, PHY 367 WRF, PHY 72, and All-Tex Edge B2RF cotton were planted on 20 May 2014. The field was part of an annual sorghum-cotton rotation. Samples were harvested on 3 November 2014 from the center 4 rows of the 8 row zones. After ginning and delinting, seed was analyzed for total N, P, and K.

Cotton seed N concentration of PHY 367 WRF was greater than All-Tex Edge B2RF and FM 2484 B2F but not greater than PHY 72. Phosphorus seed concentrations of PHY 72, PHY 367 WRF, and FM 2484 B2F were equally significant and greater than All-Tex Edge B2RF. No differences existed for K concentrations of PHY 72, PHY 367 WRF, and FM 2484 B2F, and only PHY 367 WRF was greater than All-Tex Edge B2RF. Seed N was greater for the daily irrigation; however, differences did not exist between daily and weekly irrigation for P and K concentrations. Irrigating daily may have maintained more N moving to plant roots via mass flow compared to weekly irrigation resulting in greater seed N. Also, weekly irrigation may have caused some N leaching, consequently reducing the quantity of plant available N in the root zone. Phosphorus which moves to plant roots via diffusion may have had greater seed assimilation when irrigated weekly. Variety x irrigation frequency had a significant effect on P concentration but did not have a significant effect on N and K concentrations. FM 2484 B2F was the only variety to have significantly greater seed P when irrigated weekly compared to daily.

Overall, seed N was consistently greater with high frequency irrigation while yield (data not presented) was mostly greater with weekly irrigation. Based on yield results, it was expected that K seed assimilation would be greater when irrigated weekly specifically for higher yielding varieties. In conclusion, irrigating daily may potentially cause plants to absorb nutrients, specifically N and K in excess of what would be needed to attain a given yield, and thus reducing use efficiency; therefore, N and K may be used more efficiently when cotton is irrigated weekly rather than daily. Further research should focus on correlating nutrient assimilation in seed with yield.