IN-SEASON ESTIMATION OF LINT YIELD POTENTIAL USING CANOPY REFLECTANCE

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Abstract

Soil tests have not been shown to be predictive of crop N fertilizer requirements in Louisiana, creating uncertainty as to optimal N fertilizer rates for cotton (*Gossypium hirsutum* L.) production. If remotely-sensed cotton canopy reflectance characteristics are indicative of cotton crop N status, they may allow in-season N applications that closely approximate actual crop requirements in the specific location sensed. Our objective was to determine whether lint yields were related to remotely sensed normalized difference vegetation index (NDVI) measurements under a series of N fertilizer rates. Experiments were established in 2008 and 2009 on Gigger silt loam at the LSU AgCenter Macon Ridge Research Station in Winnsboro, LA and on Sharkey clay at the LSU AgCenter Northeast Research Station in Saint Joseph, LA. An additional location was established on a Commerce silty clay loam at the Northeast Research Station in 2009. The experimental designs were randomized complete blocks with factorial arrangements of early-season N rates (0 to 150 lb N/A in 30-lb increments) and plant growth regulator (PGR) rates (applied or not applied). Two additional treatments with midseason N applications were included as well. Hand-held Greenseeker™ NDVI sensor readings were made at four growth stages: early square, early bloom, two weeks after early bloom, and four weeks after early bloom. Using all data points from the factorial early-season N rate and PGR treatments, models were fit relating cotton lint yield to NDVI readings from single sensing periods. Variants of NDVI used as explanatory variables were unadjusted NDVI and NDVI further normalized by division by days after planting (DAP) or cumulative growing degree days after planting (GDD). Best-fit models were considered to be those with highest coefficient of determination (R^2).

When the 2008 data were considered alone, highest model R^2 values were generally associated with NDVI when sensed two weeks after planting. Unadjusted NDVI was best related to lint yield by a power model with R^2=0.40. When divided by DAP, NDVI was best related to lint yield by an exponential model with R^2 = 0.74. For 2008 and 2009 data combined, relationships of lint yield and NDVI were strongest four weeks after early bloom. The best fits were found from exponential models with R^2 of 0.33, 0.20, and 0.50, respectively, for models with explanatory variables of unadjusted NDVI, NDVI divided by DAP, or NDVI divided by GDD. In both years, but particularly in 2008, weather-related factors strongly influenced yields of one or more locations. Because this effect was independent of N rate and in-season NDVI, typical relationships between NDVI and lint yield may have been altered.

In summary, in many cases normalization of NDVI by DAP or GDD was effective in increasing the degree to which lint yield could be predicted by NDVI. Early-season relationships between NDVI and lint yield were not strong by the means of analysis discussed here. However, finding such relationships is critical to a system which guides in-season cotton N fertilizer applications through canopy NDVI. Further analyses of the data, perhaps including the use of relative lint yields to adjust for test-wide lint yield influences, may be warranted.