RELATIONSHIP OF FIELD SCALE NITROGEN VARIABILITY TO SOIL PROPERTIES AND REMOTELY SENSED CHARACTERISTICS

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Abstract

Spatial distribution of soil available nitrogen was related to total soil nitrogen, total soil carbon, % sand, % clay, Normalized Difference Vegetation Index (NDVI), plant height and yield. Soil samples were taken from 72 points on a 1 acre grid in an irrigated cotton (*Gossypium hirsutum*)field. Field areas with greater clay content had lower available nitrogen, shorter plants, and greater total soil nitrogen and carbon. Normalized Difference Vegetation Index was positively correlated with soil available nitrogen, plant height, and yield.

Introduction

Nitrogen is one of the major nutrients influencing crop growth and yield. Variable rate fertilizer N application could be based on soil nitrate concentration, and soil physical and chemical properties. The assessment of available nitrogen variability, its relationship to other soil characteristics, and crop growth images could be a valuable aid for decision support in variable rate N fertilization of cotton. The objectives of this study were to evaluate the relationship between spatial variability in soil properties and soil available nitrogen; and to determine the effects of spatial variability in soil properties on cotton growth, NDVI, and yield.

Materials and Methods

The study was conducted on an irrigated cotton field in Bolivar County, Mississippi. Cotton variety PM 1220 BGRR was planted at a rate of 40,000 seed/acre and 60 lb N/acre was applied soon after planting. A side dress N fertilization of 40 lb N/acre was applied at early square. Soil samples (0 to 6", 6 to 12", 12 to 24" and 24 to 36" depths) were taken before planting from 4 transects running the length of the field. Eighteen grid points were established within each transect at intervals of 210 feet (equivalent to one acre gird). Soil available nitrogen and texture were determined for each depth. Total nitrogen and carbon were determined for the first sampling depth. Leaf N concentration was measured for the most recently matured leaf at early square. Plant height was measured on a one meter length on four separate rows. Plant measurements were taken five days before side dressing. Yield was measured by harvesting a 210 ft. length centered at each grid point using a 4 row cotton picker and weigh wagon to determine seed cotton weight. A multispectral aerial image, using green (G = 540 nm) red (R = 695 nm) and near infrared (NIR = 840 nm) was taken from an aerial platform, and coincided with plant parameters measured. An NDVI (NDVI = NIR-R/NIR+R) was determined and was centered around each grid point.

Results and Discussion

Total soil nitrogen and total soil carbon for the 0-6" depth were inverse correlated with sand content (Pearson Correlation Coefficient, $r = -0.77$, $p = 0.0001$ and $r = -0.76$, $p = 0.0001$, respectively) and plant height ($r = -0.46$, $p = 0.0001$ and $r = -0.52$, $p = 0.0001$, respectively). Soil available nitrogen for the 0 to 6" depth ranged from 1.9 lb N/acre to 28.8 lb N/acre. Soil available nitrogen for this depth was found to be inversely related with total soil nitrogen, total soil carbon, and clay content. These relationships suggest that greater cotton residue mineralization occurs in lighter soils.

Soil available nitrogen for the first depth was positively correlated with NDVI and plant height ($r = 0.32$, $p = 0.0062$ and $r = 0.41$, $p = 0.0004$, respectively). Areas with taller plants were associated with areas of greater soil available nitrogen and sandier texture. This suggests that soil available nitrogen in the surface soil may be linked to yearly cycling of N in cotton residues. Soil available nitrogen in the soil profile was directly related to lint yield. Plant height and NDVI were found to be linearly related (height = 41.87 + 108.67 (NDVI), $r^2 = 0.70$, $p = 0.0001$). Leaf N concentration was positively correlated with plant height ($r = 0.31$, $p = 0.0076$) and NDVI ($r = 0.32$, $p = 0.0032$). Yield was positively correlated with plant height and NDVI ($r = 0.32$, $p = 0.0058$ and $r = 0.36$, $p = 0.0018$, respectively). The resulting weak relationships found may be due to the masking effect of uniform N fertilization.

Conclusions

Spatial variability in available N is linked to soil to texture with areas of greater clay content having lower available N. The similar spatial structure observed for cotton growth (plant height + NDVI), yield, and soil characteristics suggests a linkage between yearly cycling of N in cotton residues and soil N availability.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1282-1283 (1999)
National Cotton Council, Memphis TN