NITROGEN AND CULTIVAR EFFECTS ON YIELDAND EARLINESS OF COTTON ON CLAY SOILS

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Abstract

Defining the maturity of cotton during the season could allow timely alterations in production practices and help reduce risks associated with a late crop. Standard measures of maturity require end-of-season harvest and are therefore not suitable as a tool to help adjust crop management. Recently developed cotton monitoring techniques using nodes above the uppermost first position white flower (NAWF) measurements have been shown to define the potential maturity of a crop during the season.

Three contrasting cotton cultivars were evaluated across 5 nitrogen rates on a Sharkey silty clay soil at the Northeast Research and Extension Center in Keiser, AR. Measurements of maturity, including mean maturity date, % of crop harvested in the first harvest, days to 60 % Open, and days to nodes above white flower = 5.0 were taken on all cultivars at the different nitrogen rates. Analysis indicated that all measurements were sensitive enough to detect maturity differences among both cultivars and nitrogen rates. Correlation analysis suggested that all measurements were significantly similar in detecting maturity differences. These data suggest that NAWF 5 is an accurate measurement of maturity. NAWF 5 could therefore, be used as a tool for defining changes in crop management practices during the season to address potential maturity problems.

Introduction

Development of cotton (*Gossypium hirsutum L.*) varies greatly due to its indeterminate growth habit. Variation in cotton’s growth can be attributed to cultivars, environment, chemical treatments, and pest densities, as well as their interactions (Tharp 1960). The effects of these factors on cotton's indeterminate fruiting habit often cause variation in maturity (Wells and Meredith, 1984a; 1984b; 1984c). Cultural practices, including nitrogen fertilization (McConnell et al., 1993), can delay maturity in cotton. Such maturity delays often reduce profitability in cotton production, especially in northern areas of the cotton belt.

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Detection of potential maturity delays early in the season could allow timely management alterations in production practices, and help reduce risks associated with a late crop.

Crop maturity has most commonly been measured as a percentage of open bolls (e.g., 60% open), percentage of total harvest in the first harvest (% 1st harvest), or when sufficient data are available, by mean maturity date (MMD) (Christides and Harrison, 1955). Although these measures can define maturity, data are collected too late in the season for any management adjustments to be implemented.

Recent research has suggested that counting the nodes above the uppermost first position white flower (NAWF) is an adequate measure of maturity (Bourland et al., 1992). Using NAWF, maturity can be expressed as days from planting to NAWF = 5.0 (NAWF 5) (Bourland et al., 1991). Benson et al., (1995) found different growth patterns and showed that maturity differences among contrasting cultivars could be detected using NAWF measurements. Significant correlations between NAWF 5 and MMD were found in studies comparing measures of earliness, supporting the use of nodal development as a measure of maturity (Danforth et al., 1993). The ease of data collection and the timeliness associated with NAWF measurements makes it an appropriate tool to define the maturity status of a cotton crop.

The objectives of this study were 1) to define maturity of three contrasting cotton cultivars across five nitrogen rates, and 2) to correlate NAWF 5 measurements with yield and other measures of earliness.

Materials and Methods

Three cotton cultivars, 'Tamcot HQ95’, 'Deltapine 20’, and 'Stoneville LA887’ were planted on May 12, 1994 at the Northeast Research and Extension Center at Keiser, AR. These cotton cultivars represent early, medium, and late maturing, respectively. Liquid N (32% N) was applied at rates of 0, 50, 100, 150, and 200 lb N/acre. Prior to planting , 50 lb N/acre was knifed into the side of the bed to all plots except the control (0 lb N/acre). An additional 50 lb N/acre was applied to the 100, 150, and 200 lb N plots during squaring. The remainder of the 150 and 200 lb N/acre rate was applied at early flower.

N rate treatments were arranged in a Latin square design with the three cultivars randomized within each N rate. Plots were four rows (38 in. centers) and 50 ft long. All plots were irrigated as needed and maintained in accordance with the University of Arkansas recommendations for cotton production.

Measurements of NAWF were made as described by Bourland et al. (1992). Weekly NAWF measurements began at approximately first flower. Within each plot, NAWF were counted on a random sample of five consecutive plants from each of the center two rows, and continued until one week after NAWF values = 5.0.

Days to NAWF = 5.0 were calculated as outlined by Bourland et al. (1991). Means for the sequential dates of NAWF values were regressed on days after planting. Using these regression equations, the number of days required from planting to attain NAWF = 5.0 was calculated.

Bi-weekly sequential-hand harvests and counts of total and green bolls were made on a 3 ft section of one of the outside rows of each plot. These data were used to calculate MMD (Christides and Harrison, 1955) and % open bolls. The % open bolls data were used to interpolate the days from planting to 60 % open bolls (60 % Open) for each plot. The center two rows of each plot were machine harvested on October 7, 1994 and again on October 28, 1994. The % 1st harvest was then calculated as the percentage of total seedcotton harvested on October 7, 1994. Total yield was converted to a per acre basis and all factors were analyzed across cultivars and nitrogen rates using analysis of variance statistical procedures. All means were separated using Fisher's Protected LSD test at the 0.05 level of probability. Correlation coefficients were used to compare NAWF 5 with yield and other measurements of maturity.

Results and Discussion

Yield

Nitrogen rate, cultivar, and their interaction were significant for seedcotton yield (Figure 1). Seedcotton yields increased as nitrogen rate increased. Even though the interaction indicates that cultivar differences varied among nitrogen rates, Deltapine 20 consistently maintained the highest numeric seedcotton yields while Tamcot HQ95 was the lowest across all nitrogen rates.

Maturity Measurements

Analyses of MMD, % 1st harvest, NAWF 5 and 60 % Open measurements of maturity yielded similar results (Figures 2 – 5, respectively). Although the nitrogen rate by cultivar interaction was only significant for % 1st harvest and NAWF 5, the main effects of nitrogen rate and cultivar were significant with all measurements. As observed with yield, the relative values among the cultivars did not change when the interaction was significant (Figures 3 and 4).

As evident in the graphs, all maturity measurements separated Tamcot HQ95, Deltapine 20, and Stoneville LA 887 as early, medium and late maturing, respectively (Figures 2 - 5). Data representing % 1st harvest showed greater than 90% first harvest for Tamcot HQ95 at all nitrogen rates (Figure 3). The general trend of a flat graph for Tamcot HQ95 was seen with 60% open and MMD measurements as well. Only the NAWF 5 measurements indicated delays in maturity with increased nitrogen rates for Tamcot HQ95 (Figure 4). Although not always statistically different, all measurements suggested a general delay in maturity as nitrogen rates increased.

Correlation Analysis

Highly significant correlations were found among the maturity measurements (Table 1). Even with Keiser's northern location in the cotton belt, seedcotton yield was positively correlated to later maturity in 1994 (Table 1). Though all the correlations were quiet good, NAWF 5 was most highly correlated with % 1st harvest and MMD (Table 1). These correlations support the use of measurements of nodal development for defining maturity.

Conclusions

All measurements detected maturity differences among cultivars and, as expected, tended to show maturity delays with increased nitrogen rates. Correlation analysis indicated NAWF 5 measurements to be an accurate indicator of maturity, similar to the three end-of-season measurements. MMD, 60% open, and % 1st harvest values cannot be completed until final crop harvest, rendering them ineffective as tools for in-season crop management. NAWF 5 values are collected and calculated prior to final crop harvest and should allow in-season crop management practices to be altered to address potential maturity problems.

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Table 1. Pearson correlation coefficients for yield and maturity factors in 1994 cotton study at NEREC, Keiser, AR ($p<0.001$ for all correlations).

	Seedcotton Yield	Days to 60% Open Bolls	Mean Maturity Date	Days to NAWF=5.0	% 1st Harvest
Seedcotton Yield	---	0.474	0.440	0.693	-0.609
Days to 60% Open Bolls	0.474	---	0.927	0.684	-0.817
Mean Maturity Date	0.440	0.927	---	0.703	-0.816
Days to NAWF=5.0	0.693	0.684	0.703	----	0.859
% 1st Harvest	-0.609	-0.817	-0.816	-0.859	---

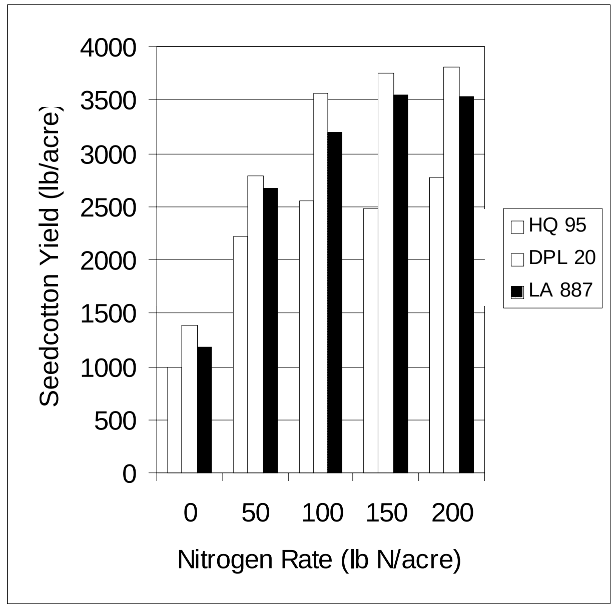

Figure 1. Seedcotton yield in 1994 cotton study at NEREC, Keiser, AR.

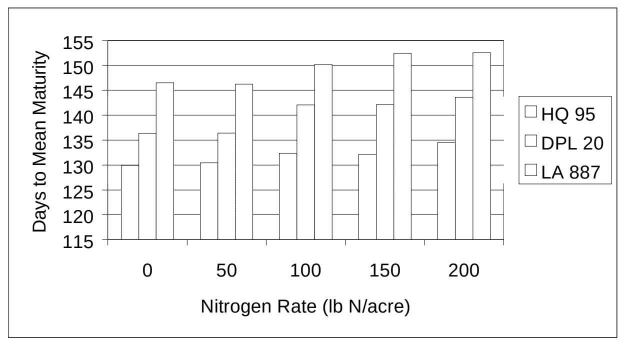

Figure 2. Days to mean maturity in 1994 cotton study at NEREC, Keiser, AR.

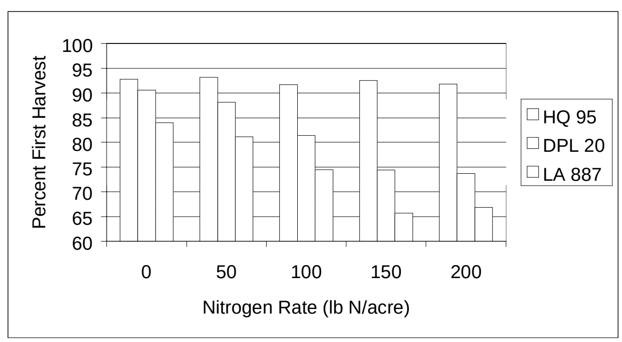

Figure 3. Percent first harvest in 1994 cotton study at NEREC, Keiser, AR

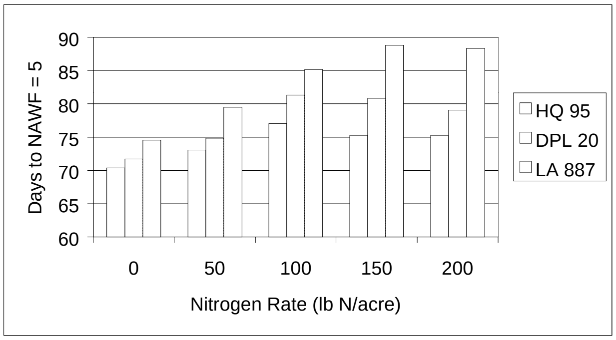

Figure 4. Days to NAWF = 5.0 in 1994 cotton study at NEREC, Keiser, April 10, 1998AR.

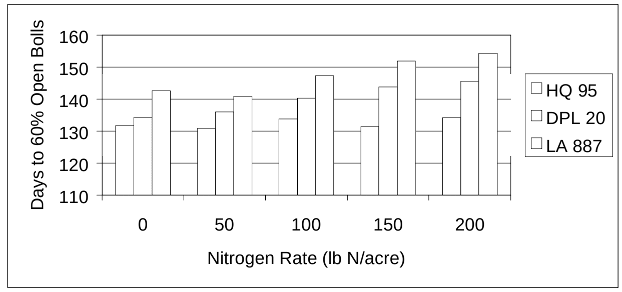

Figure 5. Days to 60% open bolls in 1994 cotton study at NERC, Keiser, AR.