EFFECTS OF MULTIPLE YIELD ENVIRONMENTS ON RELATIVE MATURITY

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Abstract

Cotton fruit production and retention vary substantially by cultivar, geography, and environmental factors. Furthermore, differences in boll distribution affect crop maturity characteristics, response to stress, and environmental suitability. One of the challenges in choosing cotton cultivars for maturity characteristics is that there is not a single, consistent method for determining cotton crop maturity; however, plants can be mapped to determine crop maturity. The oldest bolls are formed near the base of the plant, and new bolls are progressively produced up the plant. This study was initiated to compare the maturity characteristics of 7 common cotton cultivars in multiple locations of the cotton belt using plant mapping. The cultivars were grown under irrigated conditions in Texas, Tennessee, and Georgia. Nodes above white flower were counted weekly, and then subplots were harvested for boll mapping and boll weight. Estimates of maturity differed significantly between boll distribution measurements and NAWF measurements at all locations. Maturity also varied between cultivars based on the environment in which they were grown. Additional work is being conducted to further characterize these differences.

Introduction

Quantifying maturity in cotton cultivars can be vital in cotton production for a variety of reasons. Planting date, variety, and irrigation techniques for a specific location or environment can be better selected when maturity of common cultivars has been accurately assessed. Maturity has historically been evaluated by using height, total nodes, and nodes above white flower (NAWF). This method of determining maturity may however not be consistent over multiple cultivars. Other approaches, such as mapping the boll distribution, may be more dependable in determining crop maturity.

Plants can be mapped to determine crop maturity. The oldest bolls are formed near the base of the plant, and new bolls are progressively produced up the plant. Bednarz and Nichols (2005) found the following: fruiting interval for adjacent nodes ranged from 2.1-2.7 days; interval for horizontal fruiting position at a fruiting node was 3.2 to 4.4 days; and, fruiting interval depended upon environment and the location of the fruit on the plant.

This study was initiated to compare the maturity characteristics of 7 cotton cultivars in multiple locations of the cotton belt. Specifically, we tried to determine the efficacy of in-season maturity estimates (NAWF) for determining cultivar maturity characteristics and compare relative maturity of cultivars among environments in Texas, Tennessee, and Georgia. Techniques for box picking and plant mapping followed protocols established in previous research (Ritchie et al., 2009; Ritchie et al., 2011).

Materials and Methods

Seven cotton cultivars (DP0912B2RF, DP0949B2RF, DP1050B2RF, DP104B2RF, PHY755WRF, PHY375WRF, and FM1740B2RF) were grown in West Texas, Tennessee, and Georgia, in randomized complete block designs with four replicates in each location in 2012. Plant densities ranged from 11-14 seeds m^{-2}. Management was based on extension guidelines in each environment.

In-season measurements included plant height, total nodes, NAWF and nodes above cracked bowl at regular intervals. The plots were all irrigated, and had minimal PGR applied. At the end of season, 1-m samples were hand-harvested, plant mapped and box-picked by fruiting site. Fiber quality analysis by fruiting site maturity classification is ongoing at the time of this paper, and is therefore not presented for any of the locations.

In-season measurements were used to illustrate basic maturing characteristics. Distribution of boll numbers and mass were compared with in-season NAWF measurements. Relative maturities of the cultivars in all environments based on boll distribution were also compared. Where appropriate, data were subjected to regression analysis.

Results and Discussion

According to conventional wisdom, late-maturing cultivars will typically be taller and have more total nodes towards the end of the growing season. In Texas DP0949B2RF was an evident later maturing cultivar, as well as PHY755WRF and PHY375WRF in 2012. DP1050B2RF showed characteristics that would normally be indicative of an earlier maturing cultivar.

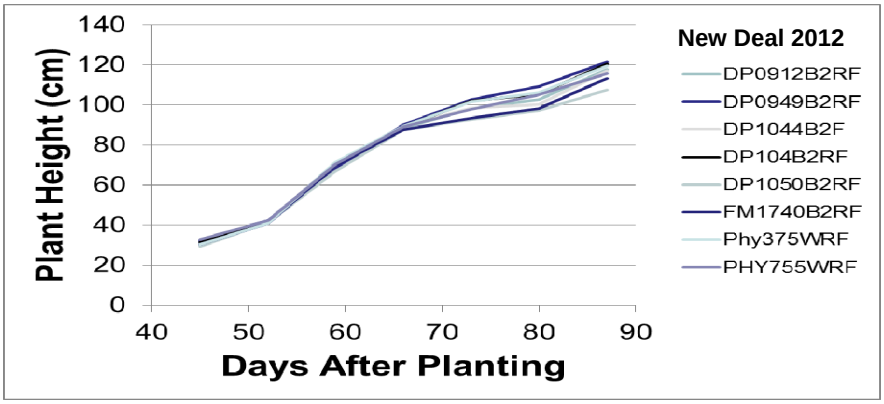

Figure 1. Relationship between plant height and cultivar maturity throughout the growing season in Texas.

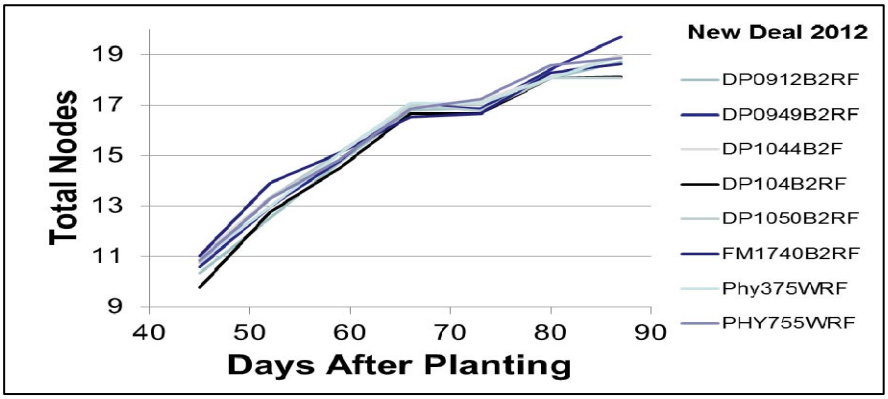

Figure 2. Relationship between total nodes and cultivar maturity throughout the growing season in Texas.

The NAWF measurements suggested that there were differences in maturity by cultivar in all locations. In Tennessee and Georgia, the cultivars with the latest decline in NAWF were DP0949 and DP1050. In Tennessee, PHY755 also had a late decline in NAWF, as did FM1740 in Georgia. In Texas, the latest declines in NAWF were noted in DP1050, DP104, and FM1740 (Figure 3).

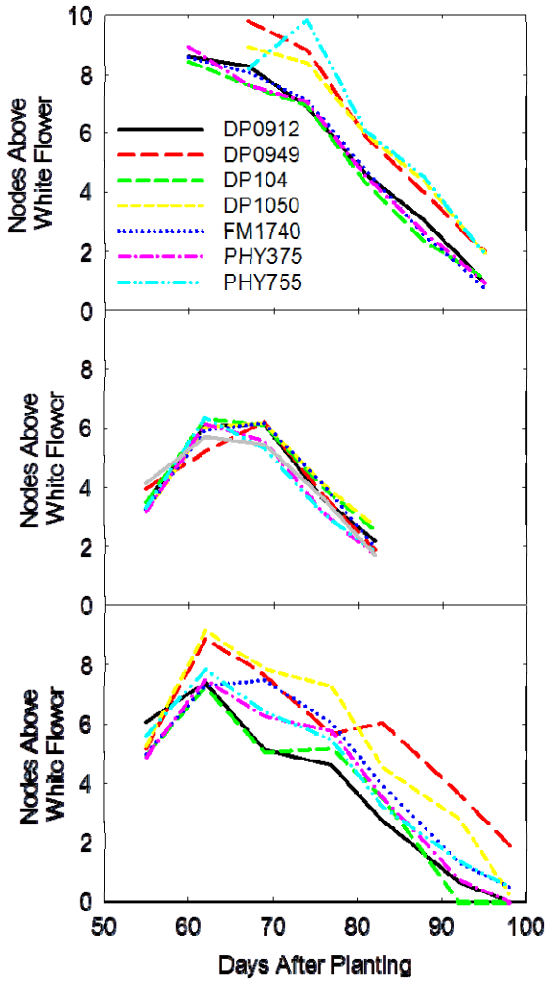

Figure 3. Nodes above white flower (NAWF) by days after planting in Tennessee (top), Texas (middle), and Georgia (bottom) in 2011.

In 2012, at both Texas locations, Phy375 was the latest maturing cultivar. DP1050 was the earliest maturing cultivar at the New Deal location while DP0912 was the earliest maturing cultivar at the Quaker location in 2012 (Figures 4).

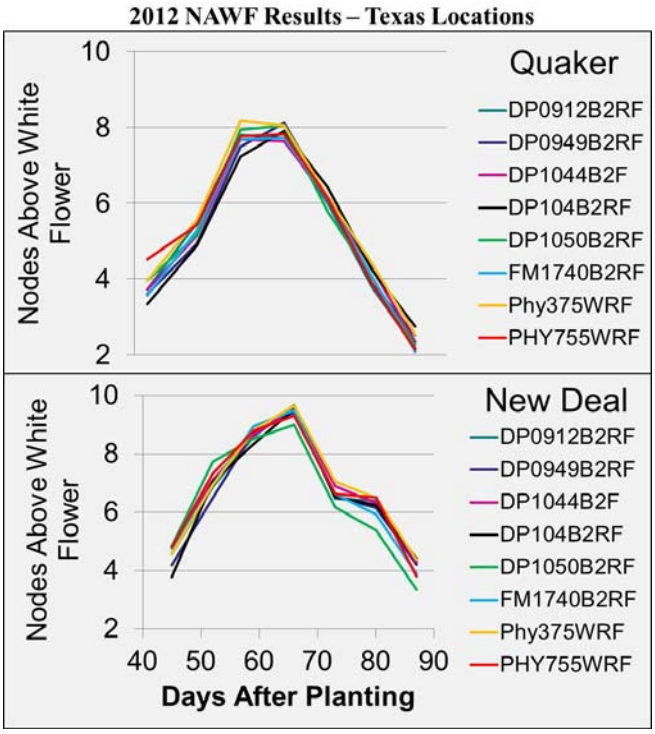

Figure 4. Nodes above white flower (NAWF) by days after at both locations in Texas in 2012.

Differences in boll distribution were distinct among locations (Figure 5). In Tennessee, DP0912, PHY755, and DP104 had the latest fruiting characteristics. DP0949 started late, but reached total yield relatively early. FM1740, PH375, and DP1050 were earliest, based on boll accumulation by node. In Texas, DP0949 and PHY755 exhibited the latest boll accumulation, while DP104 was substantially earlier than the other cultivars. In Georgia, PHY755 and DP0949 were the latest cultivars, but there was little separation between the other cultivars. PHY375 had more early fruit than other cultivars, but exhibited later fruiting characteristics at the top of the plant. Nodes above white flower and boll distribution were not consistent with each other when comparing cultivars.

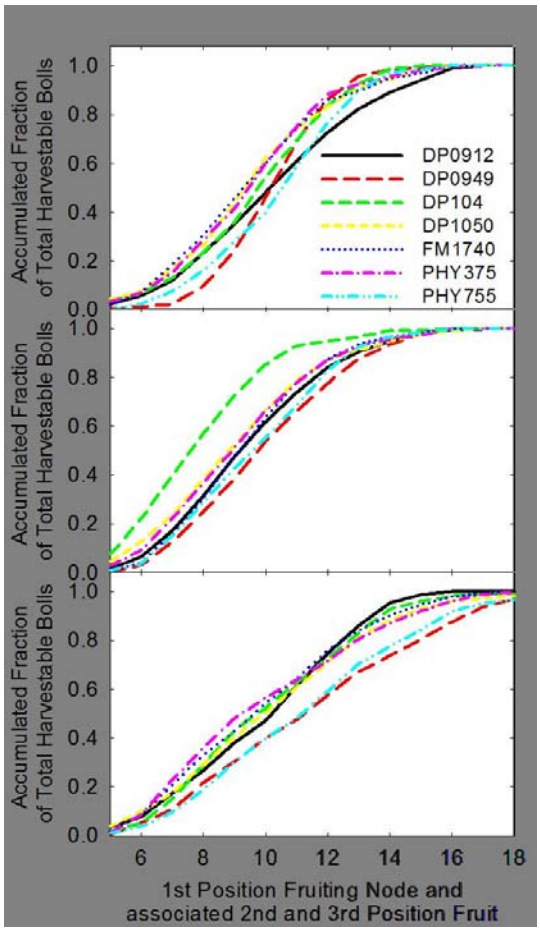

Figure 5. Boll accumulation by fruiting node for all cultivars in Tennessee (top), Texas (middle), and Georgia (bottom) in 2011.

Differences in boll distribution were also evident in Texas in 2012 (Figure 6). In both locations DP0949 was a later maturing variety as well as PHY755. DP1050 matured earlier than the other cultivars. FM1740 generally matured earlier similarly. Box and whisker plots such as the one shown in Figure 6 help to show how maturity, which has many facets, can be summarized into a single metric.

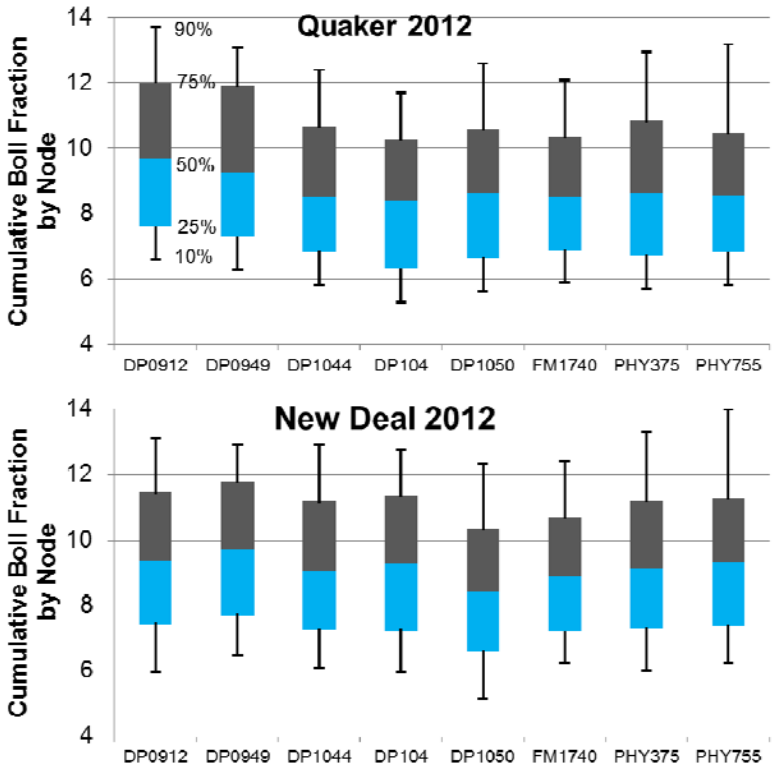

Figure 6. Cumulative boll fraction by node for each variety at both Texas locations in 2012.

Summary

Estimates of maturity differed significantly between boll distribution measurements and NAWF measurements at all locations. In-season estimates of maturity do not always correlate with boll distribution. Maturity also varied between cultivars based on the environment they were grown in; relative maturity of a specific variety may often bee site specific. Maturity based on boll distribution can be summarized using a box and whiskers plot. Additional work is being conducted to further characterize these differences.

Acknowledgements

This research was funded by Cotton Inc. Several graduate students, technicians, and other personnel contributed significant amounts of time to the research for this project. We appreciate their help, without which we would not have been able to do this work.

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