PLANTING AND DEFOLIATION TIMING IMPACTS ON COTTON YIELD AND QUALITY

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Abstract

Timing of defoliation and planting can affect both cotton yield and cotton quality, impacting net returns from cotton production. Typically, previous research has focused on examining these factors separately, which can be further complicated by using a conservation system. An experiment was initiated in the fall of 2006 at the E.V. Smith Research Center, Field Crops Unit near Shorter, AL on a Compass sandy loam (coarse-loamy, siliceous, subactive, thermic Plinthic Paleudults). The experimental design was a strip-plot treatment restriction in a randomized complete block design with three replicates. Horizontal plots consisted of three planting dates, and the vertical plots were defoliation times that corresponded to 40%, 60%, 80%, and 100% open boll. In 2007, an interaction was observed between planting dates and defoliation percentages for cotton lint yields and uniformity. In 2008, an interaction between planting dates and defoliation percentages was also observed for lint yields. Length, micronaire, and strength were only affected by planting date in 2007, but planting date affected the fiber properties differently. Fiber properties measured in 2008 were not affected by planting dates or defoliation percentages. Seed cotton yields measured in 2009 were affected by planting date and defoliation percentages, but there was no interaction between factors. Gross returns were variable across years, an indication of the variability in climate between those years. As this experiment progresses, multiple years should allow trends to become more apparent and enable different management strategies to be tested across various climatic and market conditions.

Introduction

Cotton yield and quality can be affected by timing of defoliation and planting impacting net returns from cotton production. Early planting dates can extend the growing season and previous studies have also indicated increased yields (Galanopoulou-Sendouka et al., 1980; Guthrie, 1991). Extending the growing season is particularly beneficial for growers with large acreages. The disadvantage of planting early can result in slow plant development, seedling disease pressure, and in the worst scenario, a total loss of stand (Christiansen and Thomas, 1969). Conversely, late plantings increase the potential for weather complications at harvest, such as, damage associated with hurricanes. Typically, defoliation timing is usually recommended when cotton is at 60 percent open boll; however early defoliation times are favored by producers. The earlier the defoliation, the more likely that weather conditions will be most favorable, which enables defoliation chemicals to work efficiently. The earlier that cotton can be defoliated and subsequently harvested, the less time that cotton is exposed to inclement weather that can potentially degrade cotton quality. However, defoliating too early can decrease yields and result in immature fibers, all of which contribute to reduced profits (Bednarz et al., 2002).

Planting and defoliation timing can be further complicated by using a conservation system. Cotton planting in conservation systems with cover crops is typically delayed to avoid cool and wet soil conditions, which can inhibit crop establishment. Most previous research related to early planting in conservation systems has focused on starter fertilizer use (Bednarz et al., 2000). Defoliation timing in conservation systems is usually different compared to conventional tillage systems because cotton maturity is usually delayed in conservation systems (Balkcom et al., 2006). In the past, previous research has focused on examining these factors separately. Therefore, the purpose of this study was to determine the economically optimal planting and defoliation dates for cotton in a conservation system that maximizes net returns. The first two years of this study are complete, but, by combining these results across multiple years, trends should become more apparent, enabling different management strategies to be examined across different climatic and market conditions.

Materials and Methods

This experiment was initiated in the fall of 2006 at the E.V. Smith Research Center, Field Crops Unit near Shorter, AL on a Compass sandy loam (coarse-loamy, siliceous, subactive, thermic Plinthic Paleudults). The experiment was rotated to a different location each year, but the soil type was the same.

The experimental design contained a strip-plot treatment restriction in a randomized complete block design with three replicates. All plots were 24 ft. wide and 75 ft. long in 2007 and 50 ft. long in 2008 and 2009. The horizontal plots consisted of three planting dates (planting date 1 – 4 weeks before optimal; planting date 2 – optimal; planting date 3 – 4 weeks after optimal), and the vertical plots were defoliation times that corresponded to 40%, 60%, 80%, and 100% open boll. A rye cover crop was drilled across the experimental area each fall at 90 lb/ac. An in-row subsoiling operation was performed, prior to each planting date, with a KMC Rip Strip®.

A starter fertilizer application was applied across the experimental area to supply 40 lb N/ac, 11 lb P205/ac, and 40 lb K20/ac. Cotton (DPL 454®) was planted (73,000 plants/ac.) in 36-in. rows with an in-furrow application of Temik® (7 lb/A) and Terraclor® (10 lb/ac). Nitrogen applied as a UAN solution at 70 lb/ac was sidedressed by early square for each corresponding planting date. A POST application of Roundup® (1.5 pts/ac) was applied after each corresponding planting date at the 4-leaf stage that was followed by a layby application of Roundup® (1.5 pt./ac) plus Caparol® (1.5 pt/ac). For each defoliation time, all corresponding cotton was defoliated with Def 6® (8 oz/ac), and Dropp® (3 oz/ac). Four rows of the subsequent plots were harvested with a spindle picker equipped with a bagging attachment approximately 2 weeks following defoliation. A large sub-sample (approximately 30 lbs) was sent to the University of Georgia's Micro-Gin Facility to determine ginning percentages. After the ginning process, another sub-sample of the lint from each plot was sent to the USDA Classing office in Macon, GA to determine cotton quality from all plots with HVI-fiber analysis. Initial plant populations were recorded approximately 4 weeks after each planting date by counting all the plants from four 5 ft. sections across four harvest rows within each plot.

All response variables were analyzed using the MIXED procedure (Littell et al., 2006) and the LSMEANS PDIFF option to distinguish between treatment means (release 9.2; SAS Institute Inc.; Cary, NC). Data were analyzed by year with planting date, defoliation time and their interactions as fixed effects in the model, while replication, replication X planting date, and replication X defoliation time were considered random. Treatment differences were considered significant if $P \leq 0.05$.

Results and Discussion

Plant Populations

In 2007, plant populations were influenced by planting date. The plant populations were 45,400, 37,900, and 67,000 plants/ac. for planting dates 1, 2, and 3, respectively. These values reflect the climate for the 2007 growing season. Early in the spring, the weather was cool, affecting cotton germination, followed by extremely dry weather. The dry weather forced the cotton for the 2nd planting date to be "dusted" in. No rainfall occurred after the 2nd planting date and the cotton stayed in the ground until the field was irrigated approximately 3 weeks later. As a result, the lowest plant populations were recorded from the 2nd planting date. Excellent planting conditions and subsequent moisture resulted in the highest plant stands recorded for the 3rd planting date.

In 2008, the growing season was much cooler initially, which delayed all three planting dates. However, differences among the plant populations were observed and, as the planting dates progressed, the subsequent plant populations increased. Plant populations were 42,800, 50,500, and 57,300 for planting dates 1, 2, and 3.

Cotton Lint Yields

An interaction was observed between planting dates and defoliation percentages for cotton lint yields in 2007 (Fig. 1). This interaction can be attributed to 33% lower lint yields measured from the 2nd planting date compared to planting date 1 and 3. The lower lint yields for planting date 2 resulted from dry conditions at planting, which suppressed cotton emergence and subsequent growth. In addition, cotton lint yields were more variable across the different defoliation percentages from planting date 1 compared to lint yields across defoliation percentages for planting date 3 (Fig. 1). These yields indicate that for early planted cotton, there may be a yield advantage to defoliating the cotton slightly later.

As previously mentioned, extreme cool weather at the beginning of the 2008 growing season pushed all the planting dates back approximately 1 month. This weather combined with cool weather in early fall of 2008 did not allow for cotton harvest of the 3rd planting date. There was an interaction between planting dates and defoliation dates for the 2008 lint yields, illustrated in Fig. 1. Lint yields from planting date 1 were numerically higher than values from planting date 2 with the exception of the 100% defoliation time. Yields from the 100% defoliation of planting date 1 were significantly lower than the 40% and 80% defoliation times of planting date 1. Lint yields from planting date 2 were equivalent across defoliation times; however, yields from the 40% and 80% defoliation dates for planting date 2 were lower than yields from the 80% defoliation of planting date 1.

Based solely on seed cotton yields for 2009, there was no interaction between planting date and defoliation time for the 2009 crop year; however, each of the main effects were significant. The optimal planting date produced superior seed cotton yields compared to planting date 1 and planting date 3, while the typically recommended 60% defoliation date produced optimal seed cotton yields (Fig. 1).

Fiber quality

Length, micronaire, and strength were only affected by planting date in 2007, but planting date affected the fiber properties differently (Table 1). Planting date 1 produced the longest fibers followed by planting date 3 and planting date 2. This indicates that cotton from planting date 1 was not stressed as much as cotton in the other planting dates. On the other hand, micronaire values for planting date 1 were in the discount range for low micronaire. This would indicate more immature bolls at cotton harvest. This is supported by the lower gin turnout for this planting date (data not shown). Micronaire values for the planting date 2 were in the premium range, but due to low yields, this seems more due to chance.

The highest micronaire values were for planting date 3, which were just below the discount range for high micronaire. Fiber strength values were equivalent for planting dates 1 and 2, but approximately 10% greater for planting date 3. Uniformity values for different defoliation percentages within each planting date were not consistent, which resulted in an observed interaction ($Pr > F = 0.0392$) across planting dates and defoliation percentages. Although uniformity values were not below discount thresholds, planting date 3 produced higher uniformity values (data not shown). Uniformity values for planting date 3 were superior to at least one of the other planting dates across most defoliation times.

Neither planting date nor defoliation percentage had any effect on cotton fiber properties observed during the 2008 growing season (Table 1).

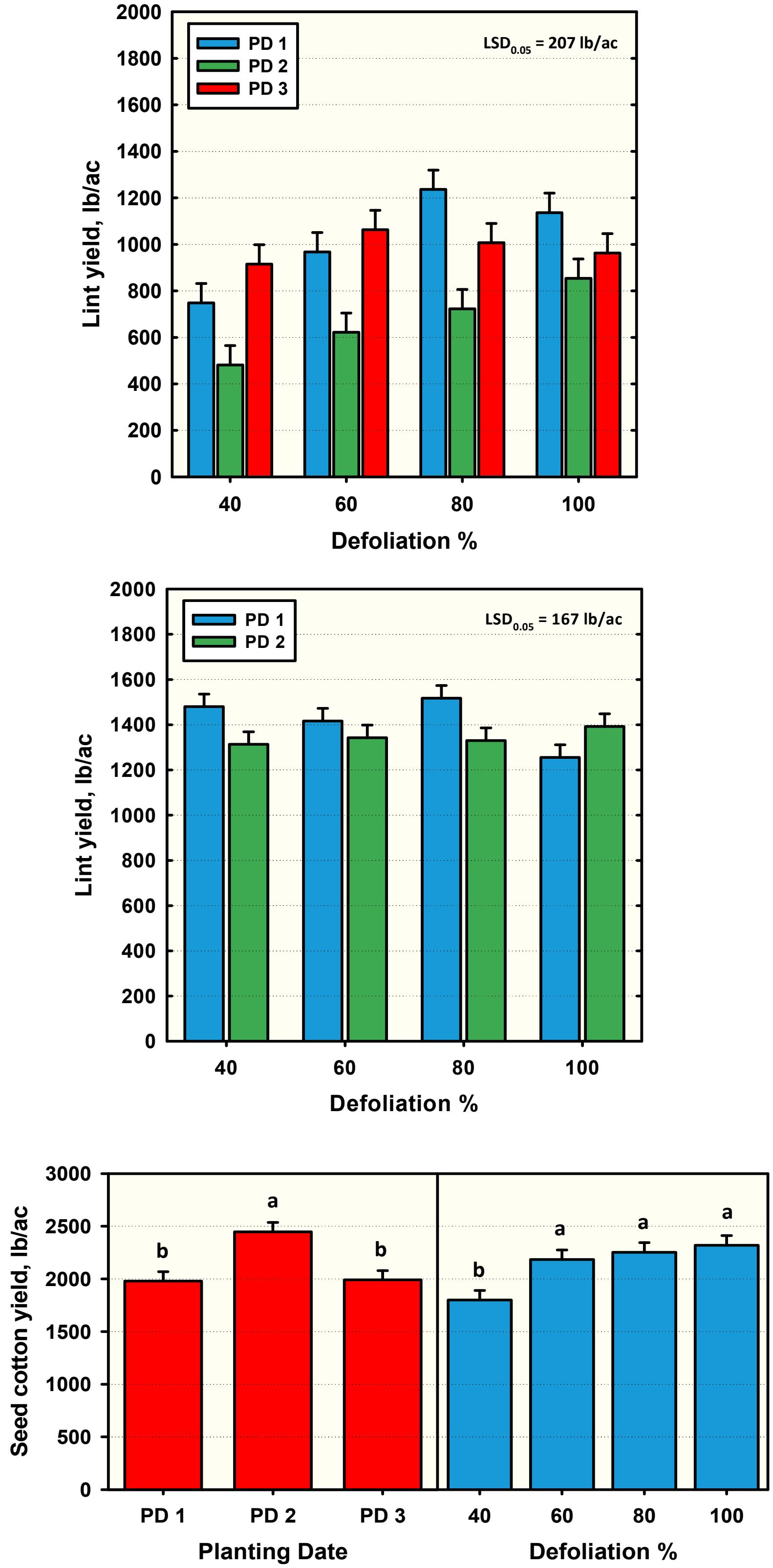

Figure 1. Cotton yields measured across planting dates and defoliation times during the 2007-2009 growing seasons at the Field Crops Unit of E.V. Smith Research Center in Shorter, AL.

Table 1. HVI fiber properties (length, micronaire, strength, uniformity) measured across three planting dates and four defoliation times during the 2007 and 2008 growing season at the Field Crops Unit of E.V. Smith Research Center in Shorter, AL.

	2007 crop year				2008 crop year			
	Length	Mike	Strength	Uniformity	Length	Mike	Strength	Uniformity
	inches		kN m/kg	%	inches		kN m/kg	%
PD1	1.10	34	281.8	80.8	1.05	3.9	279.8	81.4
PD2	1.01	39	282.6	80.7	1.06	4.0	279.0	81.8
PD3	1.04	48	310.5	82.0	---	---	---	---
Def-40	1.05	40	293.7	81.2	1.06	4.0	282.7	81.5
Def-60	1.05	41	293.3	81.6	1.05	3.9	278.7	81.7
Def-80	1.05	41	290.8	81.3	1.05	4.0	278.7	81.7
Def-100	1.05	40	288.7	80.7	1.05	4.0	277.5	82.1
PD	0.0000	0.0000	0.0041	0.0165	0.4078	0.1320	0.8145	0.0808
Def	0.9903	0.8192	0.7054	0.1116	0.8190	0.7443	0.6759	0.2355
PD x Def	0.9535	0.2262	0.3761	0.0392	0.2738	0.9382	0.8325	0.1356

Profitability

Figure 2 presents the gross returns across each planting date and defoliation percentage combination for the 2007 and 2008 growing seasons. No statistical comparisons are present on this figure. Dollar amounts for each treatment account for the lint yields, ginning percentages, and premiums and discounts associated with the fiber properties from each treatment. In 2007, there seemed to be a slight advantage for defoliating later if the cotton was planted earlier, but no trend existed in 2008 (Fig. 2). The difference in years is apparent when you compare dollar values across years, which illustrates that 2008 was much more profitable. The increase in profitability can be attributed to higher lint yields in 2008. The benefit of this type of information will be more apparent across multiple years than for individual years.

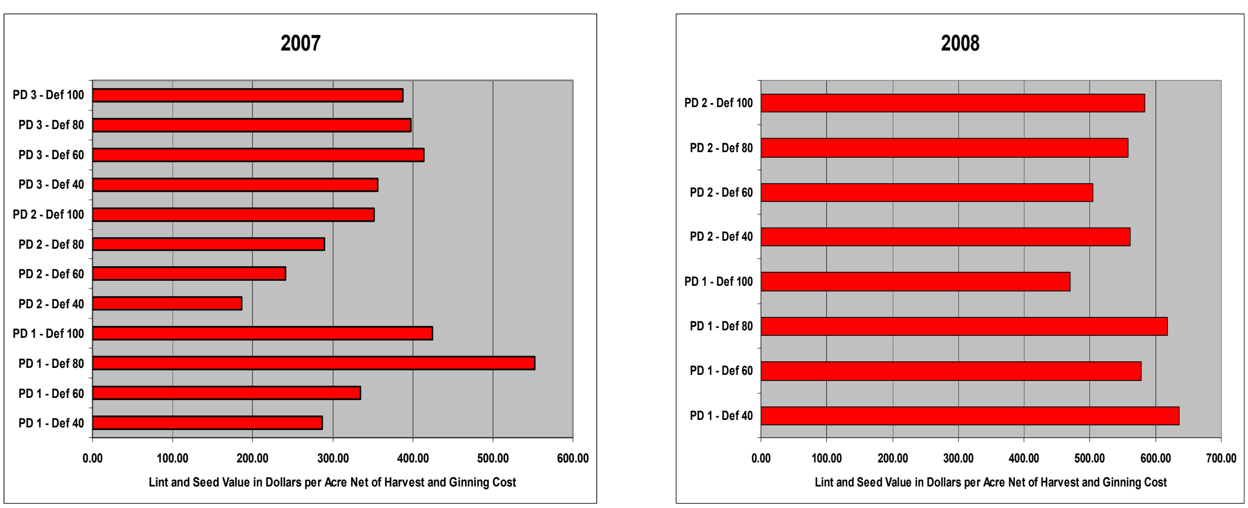

Figure 2. Gross returns measured across planting dates and defoliation times during the 2007 and 2008 growing seasons at the Field Crops Unit of E.V. Smith Research Center in Shorter, AL.

Summary

Preliminary conclusions indicate that lint yields were influenced by planting date and defoliation date simultaneously. However, the climate for each growing season probably influenced which combination was superior. Planting date strongly influenced fiber properties in 2007, but had no effect in 2008. In 2007, gross returns benefited from more open bolls (higher open %) at defoliation, but little difference in 2008. This report represents only two complete growing season, and a minimum of four growing seasons will be included in the final analysis. Combining these results across multiple years should allow trends to become more apparent and enable different management strategies to be tested across various climatic and market conditions.

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