Increasing Cotton Yield, Fiber Quality, and Profit Through Improved Defoliation and Harvest Timeliness

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Introduction

The fiber quality of Georgia cotton has declined in recent years. An examination of data from the USDA Cotton Classing Office in Macon shows the most persistent problems have been Staple, Uniformity, and Color (these and other quality parameters from USDA are referred to as HVI- High Volume Instrument data). More specifically, when Georgia cotton is compared with other Southeastern states and with Mid-South states, the quality problems and concerns are (1) a higher proportion of the state's crop having a Staple less than 34, (2) lower fiber length Uniformity, and (3) a lesser proportion of the crop with Color 31 and higher proportion of Color 32 and 42.

Georgia cotton producers have lost an estimated average of $24.5 million in farm income annually due to price discounts for low fiber quality during the 4-year period 2000-2003. Losses ranged from a high of $42.4 million in 2002 to a low of $10.4 million in 2003. Moreover, some US textile mills now indicate they will either not buy Georgia cotton or will purchase Georgia cotton only if meeting strict quality standards. Quality problems may now result in lost markets unless corrected.

Mill representatives have indicated several problems with Georgia cotton including (1) above normal short fiber content (SFC) – fiber equal to or less than ½" in length, (2) dust and trash, and (3) it "runs rough" in the spinning process. These problems are not directly reflected in the HVI measurements producers receive on their cotton, thus this creates a challenge in finding solutions to the problems. Although most US cotton is now exported, fiber quality concerns of US mills will likely be passed on to foreign mills as well.

Problem Statement

The causes for the state's fiber quality problems are not yet specifically known. Previous research, however, indicates that yield and fiber quality can be effected by variety choice, insect and nematode pressure, weed management, and defoliation and harvest timing.

Yield and quality are also impacted by weather and soil type. Georgia cotton producers have suffered through drought in recent years. In 2003, however, the state in general enjoyed mostly very favorable growing and harvest conditions yet 22% of the state's crop was below 34 in Staple and fiber length Uniformity was the lowest in the US. Therefore, there are very likely factors other than weather that are having a negative impact on the states' fiber quality.

Peanuts and cotton are both economically important on many Georgia farms. Both are indeterminant crops (continue to flower and mature over a period of time) and compete for planting and harvest resources during roughly the same time of the season. Georgia cotton producers generally enjoy long growing and harvest seasons. On farms producing both crops, cotton harvest is often delayed until labor and machinery resources are freed from peanuts. Even on farms without peanuts, the temptation is often to delay defoliation and harvest to allow as many bolls to mature as possible.

Research

A cotton plant will open bolls for a period of approximately 6 weeks. Some bolls will be open while others continue to mature. The objective of crop termination is to apply harvest aids at such a time that as many bolls as possible can be harvested (can contribute to yield and income) without suffering offsetting losses in yield and quality due to weathering and delay in harvest of bolls already mature.

A 3-year (1998-2000) study was conducted at the Coastal Plain Experiment Station in Tifton to determine the relationship between defoliation and harvest timeliness and cotton yield, fiber quality, and net returns. There were 13 treatments each year and each was replicated 4 times. Maturity was determined using the "percent open bolls" method. Each year harvest aid application began when the crop was approximately 10% open bolls (OB) and continued for 13 weeks (Table 1). Harvest aid application was the same for each treatment. The crop was spindle picker

harvested 2 weeks after harvest aid application. All other inputs and costs were also the same for each treatment. All treatments were irrigated.

Table 1. Variety, Planting Date, First and Final Defoliation and Harvest Dates for Treatments.

	1998	1999	2000
Variety	Suregrow 501	DPL 33B	DPL 33B
Date Planted	04/27/98	05/10/99	05/01/00
Week 1 Date Defoliated	08/11/98	08/26/99	08/22/00
Week 1 Date Harvested	08/25/98	09/09/99	09/11/00
Week 13 Date Defoliated	11/03/98	11/17/99	11/15/00
Week 13 Date Harvested	11/17/98	12/03/99	11/28/00

Because costs were the same for each treatment within a year, it was necessary to compare income only. The Adjusted Gross Income (AGI) was calculated for each treatment. AGI was the treatment yield times the cash market price for cotton adjusted for quality premiums and discounts minus the net ginning, warehousing, and marketing charges adjusted for the value of cottonseed.

Results

In 1998, yield was maximized by defoliating at the first week of 100% OB (Table 2). For each week delay in defoliation and harvest after that, yield declined an average of 18 lbs/ac. AGI, however, was maximized by defoliating at 61% OB and AGI declined an average of $15.50 per acre per week thereafter. Rainfall resulted in yield and quality losses as the harvest season progressed.

Table 2. Percent Open Bolls That Maximized Yield and Adjusted Gross Income and Yield and Income Losses Per Week After Maximum.

	Yield		AGI	
	%OB	Loss/Week	%OB	Loss/Week
1998	100	18 lbs/ac	61	$15.50/ac
1999	77	14 lbs/ac	78	$6.74/ac
2000	89	57 lbs/ac	85	$28.32/ac

In 1999, yield was maximized at 77% OB and AGI maximized at 78% OB. In 2000, yield was maximized at 89% OB and AGI maximized at 85% OB. In 2000, AGI declined an average of $28.32 per acre per week due to lower yield and discounts for fiber quality.

During the 3 years of the study, yield was maximized only once by waiting until 100% OB to defoliate and harvest. AGI, however, was never maximized by waiting until 100% OB to defoliate and harvest.

Both yield and quality can be impacted by the timing of defoliation and harvest. Color grade can be reduced due to excessive weathering resulting in a higher proportion of light-spotted grades (32 and 42 Color). In all 3 years of the study, Color grades declined when defoliating and harvesting after 80 to 100% OB.

Staple length did not differ significantly in 1998 and 1999 due to defoliation and harvest timing. In 2000, Staple was greatest when defoliating before 80% OB (Table 3). Price discounts were received for 33 Staple.

Short Fiber Content (SFC) was measured on the 1999 and 2000 treatments. Defoliation and harvest timing influenced SFC. SFC is fiber equal or less than ½" length and is expressed as a % of the sample by weight. Mills have indicated they desire SFC of 10% or less. Table 3 shows the average SFC and average %OB by week for 1999 and 2000. Although all treatments averaged less than 10% SFC, the results do show that SFC was minimized at 60 to 90% OB. SFC increased as harvest was delayed.

The base value for fiber length Uniformity is 80 to 82. For 1999 and 2000, Uniformity (UI) was reduced if harvesting at less than 60% OB, was generally highest at 60 to 90% OB, and then declined again as harvest was delayed.

Strength also declined with delay in harvest. The study showed a relationship between fiber Strength and fiber length Uniformity. It is believed that defoliation and harvest too early may terminate the process of fiber elongation thus decreasing Uniformity. Further, lower Strength as the harvest season progresses may result in higher SFC and lower Uniformity after ginning.

Table 3. Selected Fiber Quality Characteristics Effected By %OB at Defoliation and Harvest.

	2000		1999-2000			1998-2000	
Week	%OB	Staple	%OB	%SF	UI	%OB	Strength
1	9	34.0	13	7.39	81.2	10	29.8
2	30	33.9	31	7.25	81.4	34	29.5
3	57	34.0	56	7.07	81.6	60	28.8
4	58	34.1	61	7.02	81.9	65	28.7
5	76	33.9	68	7.12	81.9	76	28.5
6	80	33.9	81	7.19	82.0	88	28.1
7	88	33.8	84	7.33	81.7	89	28.0
8	94	33.4	95	7.59	80.9	97	27.1
9	100	33.6	100	7.86	81.2	100	28.1
10	100	33.4	100	7.95	81.3	100	27.2
11	100	33.8	100	8.18	81.6	100	27.4
12	100	33.5	100	7.91	81.4	100	26.8
13	100	33.4	100	8.21	81.1	100	27.3

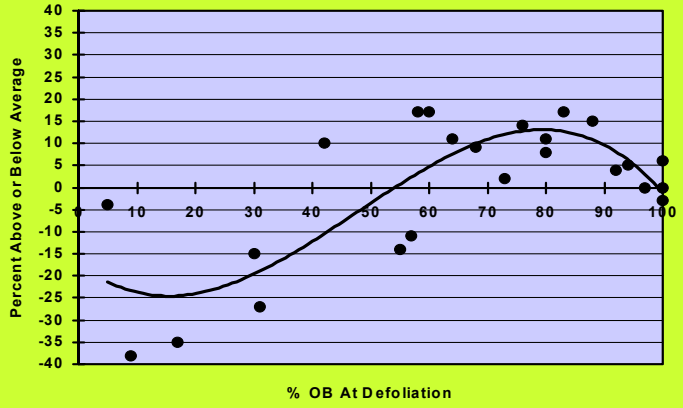
Summary and Conclusions

Applying harvest aids and harvesting too early can result in lower yield and quality. Harvesting too late can result in yield losses and reduced quality. This study shows that maximum yield and highest quality can occur at different stages in crop maturity. The challenge is to provide the market with the highest quality fiber possible without sacrificing yield.

In this study, harvest took place in a timely manner after defoliation. In reality, Georgia cotton may be defoliated in a timely manner but then not harvested in a timely manner. This may actually result in income losses in excess of those shown in this study because the crop is standing "naked" in the field for a longer period of time. In this study, income losses averaged $16.86 per acre per week for each week that harvest was delayed past the optimum time (Table 1).

The summary implications of the study can be seen in Figure 1. From 30% to 80% OB the trend in income is up. After 80% OB, the trend is down. Given the unpredictable nature of weather and harvest field conditions, cotton income should be maximized by timely defoliation and harvest at 60 to 80% OB. Based on the 3 years 1998-2000, this would likely result in highest average yield, improved Color grade, improved fiber length Uniformity, higher fiber Strength, and lower Short Fiber Content (SFC).

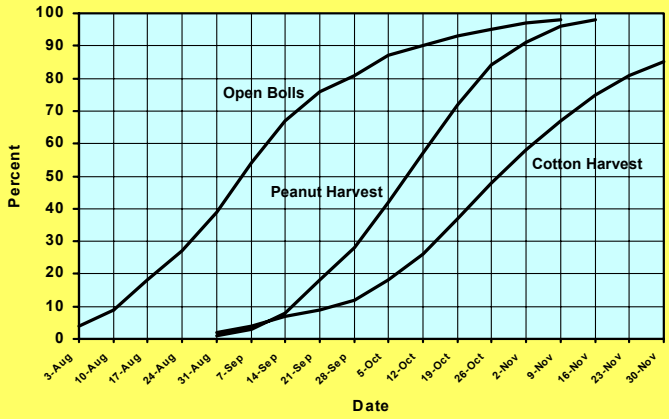
Figure 1. Adjusted Gross Income, Percent Above or Below Average By Percent OB at Defoliation, 1998-2000



Most cotton in Georgia is not picked until after the majority of peanuts have been harvested (Figure 2). Cotton is not 50% harvested, for example, until about 85% of peanuts are harvested. Approximately 20-25% of cotton harvest takes place after peanut harvest is complete.

Based on crop progress data from the 5-year period 1999-2003, it is believed that perhaps as much as 70-80% of Georgia cotton is harvested after the optimum time. For example, even at 80% OB – the crop averaged 80% OB

Figure 2. Cotton Progress and Peanut Harvest, Georgia 5-Year Average, 1999-2003.



around September 28th. If defoliated then and harvested 2 weeks later on or around October 12th, over 70% of the state's cotton had not been harvested by that time.

Peanuts and cotton are both important on many Georgia farms. Quality penalties can be severe for both crops so harvest timeliness is critical in both. On farms with both crops, producers should investigate ways to improve cotton harvest timing that would maximize the total income from both crops. This could include harvesting some cotton before peanuts and/or hiring additional resources to meet the needs of both crops. On farms without the competition from peanuts, timeliness may be largely just a function of getting started earlier than in the past.

Mills have indicated their problems with Georgia cotton and Georgia producers are now under pressure to improve fiber quality. Quality penalties can be severe and producers need to evaluate ways to improve quality. The penalty for reduced yield is also severe and producers need to evaluate and make decisions on the basis of both yield and quality.

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