EFFECT OF DEFOLIATION TIMING ON YIELD, QUALITY, AND PROFIT: A SUMMARY OF TWO YEARS RESEARCH

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Abstract

The objectives of this research are to quantify the relationship between defoliation and harvest timeliness and cotton yield and grade and to determine the optimum stage of defoliation and harvest that would maximize net returns. Cotton (Suregrow 501) was planted April 27, 1998 and DPL 33B was planted May 10, 1999 at the University of Georgia Coastal Plain Experiment Station Ponder Farm in Tift County. Each plot was replicated 4 times. Maturity was determined using the "percent open boll" method. Each year, harvest aid applications began when the crop was approximately 10% open bolls (OB) and continued for 13 weeks. In 1998, highest income was achieved when the crop was defoliated at 50 to 60 percent open boll. In 1999, income was maximized by defoliating at approximately 75% to 80% OB. Over the first 2 years of the study (1998 and 1999), income was maximized at approximately 70% OB. If defoliating too early, there are fewer harvestable bolls which may result in lower yield. Further, Micronaire and Staple may be reduced. If defoliating and harvesting too late, income may be reduced due loss of yield and quality. In Georgia, it is estimated that approximately 30% of the cotton is likely harvested after 100% OB. In 1999, harvest conditions were favorable and delaying defoliation and harvest was not costly. In 1998, harvest was hampered by rainfall. Each week delay in defoliation and harvest after 100% OB resulted in $13.62 per acre per week decline in income.

Introduction

Peak maturity for a cotton boll occurs the day it opens. Once open, a boll will decline in quality and yield loss can also occur. A cotton plant will open bolls for a period of approximately 6 weeks. Therefore, some bolls on the plant will be open and subject to decline in yield and quality 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 while not suffering offsetting losses in yield and quality.

Unlike many other cotton producing states, in Georgia both peanuts and cotton are typical farming enterprises. More succinctly, both are economically vital to the farm's profitability and acreage of both is typically large. Unfortunately, both crops are similar in their planting and harvest dates and both require approximately 150 days to mature. This causes cotton and peanuts to compete for labor and machinery resources both at planting time and at harvest.

The 5-year average for the period 1995-99 shows that the majority of the state's cotton acreage is typically not harvested until peanuts are 80% or more harvested and when 90% or more of bolls are open (Figure 1).

Objectives and Methodology

This study has been ongoing for 3 years, 1998-2000. The 1998 results have been previously published (Shurley and Bednarz 2000). This paper presents 1999 results and a summary of 2 years, 1998-99. Data from the 2000 crop is incomplete at this time.

The objectives of this research are (1) to quantify the relationship between defoliation and harvest timeliness and cotton yield and grade and (2) to determine the optimum stage of defoliation and harvest that would maximize net returns.

Cotton (Suregrow 501) was planted April 27, 1998 and DPL 33B was planted May 10, 1999 at the University of Georgia Coastal Plain Experiment Station Ponder Farm in Tift County. Each plot was replicated 4 times. Maturity was determined using the "percent open boll" method. Each year, harvest aid applications began when the crop was approximately 10% open bolls (OB) and continued for 13 weeks. Harvest aid followed University of Georgia recommendations (Brown et. al. 1998) . And was 4 oz DEF/Folex plus .14 lb Dropp plus 21 ounces of Prep per acre and was the same each year for each treatment.

All other inputs and cultural practices were the same for each treatment. Each plot was mechanically harvested 2 weeks after harvest aid application.

Net return was calculated for each of the 13 treatments or harvest weeks. Because all production practices, inputs, and costs were the same for each treatment, costs need not be considered and it is only necessary to compare income per acre. The measure of comparison used for this study was defined as the "Adjusted Gross Income" which considers differences in yield and quality. This was calculated as:

AGI = Y x (P + TPD - NGC)

where:

AGI = Adjusted Gross Income

Y = the average yield per acre for the treatment

P = the average of the November 1 and February 1 Southeast spot market price per pound for Strict Low Middling cotton (USDA/AMS).

TPD = the average total premiums and discounts or "spot market differences" per pound for color, leaf, staple, micronaire, and strength on November 1 and February 1 (USDA/AMS).

NGC = net ginning and warehouse charges per pound after cottonseed.

Results

In the 1999 study, defoliation began on August 26 when the crop had 17% open bolls then harvested 2 weeks later on September 9. Defoliation and harvest then continued weekly for a total of 13 weeks. The last treatment was defoliated on November 17 and harvested December 3 (Table 1).

Maximum cotton yield of 1,456 pounds per acre was achieved when defoliating at 83% open boll (OB). This occurred on September 30 and the cotton was harvested on October 14.

Unlike 1998, the 1999 harvest period was drier with less frequent and smaller rainfall amounts. Although the harvest period was favorable, yields and declined as the cotton was defoliated at higher %OB and harvest was delayed. Color grade was predominately 31 up to about 80-85% OB then declined to mostly 41 thereafter. There was no significant change in Leaf grade and Staple. Micronaire increased but was within the acceptable range. Fiber Strength tended to decline as defoliation and harvest was delayed.

Unlike 1998, no treatment was discounted for quality factors. Maximum yield was achieved at 83% OB. Income at 60% OB was essentially the same as at 83% OB, however. Although yield was slightly lower, the 60% OB treatment received price premiums for Color and Staple.

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Income losses of $55.56 to $102.93 occurred after the optimum defoliation/harvest date. The average loss was $61.10 per acre. The average income loss due to delay in defoliation and harvest past the optimum time was $28.91 per acre per week.

In Figure 2, Adjusted Gross Income for each of the 13 treatments is shown by Percent Open Boll at the time of defoliation for that treatment. A trend line through the data illustrates the average relationship between income and defoliation timing for the 1999 study. Conditions of the 1999 harvest season suggest that maximum income is achieved at approximately 75% to 80% OB at the time of defoliation.

Because the price level of cotton changes each crop year, it would be impossible to draw any conclusions from data over multiple years if simply looking at absolute dollars (i.e. 60% OB in one year may result in higher income than 70% OB in another year simply due to a change in the price of cotton). To combine the first 2 years of the study, each treatment each year is compared to the average for all 13 treatments for that year. For each year, the Adjusted Gross Income of each treatment was divided by the average Adjusted Gross Income for all 13 treatments for that year and this was expressed as a percentage.

In 1998, highest income was achieved when the crop was defoliated at 50 to 60 percent open boll and harvested in a timely manner afterward (Shurley and Bednarz 2000). In 1999, income was maximized by defoliating at approximately 75% to 80% OB. Over the first 2 years of the study (1998 and 1999), income was maximized at approximately 70% OB (Figure 3).

Combining both years, Figure 3 illustrates some important relationships. Each year of this study has shown somewhat different results and, likewise, farmers know that plant maturity and weather conditions vary from year to year. If defoliating too early, there are fewer harvestable bolls which may result in lower yield. Further, Micronaire and Staple may be reduced. Results from very early defoliation are very unpredictable (the trend line in Figure 3 is actually downward). From 20 to 30% OB and higher to 60 to 80% OB the trend in income is unquestionably higher. After 80% OB, income trends downward but again may be unpredictable depending on weather. If defoliating and harvesting too late, income may be reduced due loss of yield and quality.

In Georgia, it is estimated that approximately 30% of the cotton is likely harvested after 100% OB (Figure 1). There is no data to indicate when this cotton was defoliated. Georgia has a long growing season and if harvest conditions are favorable (relatively dry and without an early frost), yield and quality declines are not severe. In 1999, harvest conditions were favorable and delaying defoliation and harvest was not costly (Figure 4). In 1998, harvest was hampered by rainfall. Each week delay in defoliation and harvest after 100% OB resulted in $13.62 per acre per week decline in income.

Summary and Conclusions

Georgia cotton farmers face the challenge of allocating limited labor and machinery time. Cotton and peanuts compete for labor availability particularly during the harvest months.

It cotton defoliation and harvest decisions, there is a trade off between the number of bolls that can be matured and harvested and the potential loss of bolls already harvestable. Defoliating and harvesting either too early or too late can result in both yield and quality losses. Because weather conditions can impact yield and quality and because weather is largely unpredictable, guidelines must nevertheless be developed to assist producers in knowing the most profitable time to defoliate and harvest.

In 1998, the most profitable time to defoliate in the study was at 50 to 60% OB. Later harvest resulted in yield and quality losses, In 1999, the most profitable time to defoliate in the study was at 75 to 80% OB. Over the first 2 years of the study combined, the most profitable time to defoliate was at approximately 70% OB.

Continuing this research will hopefully help farmers determine the value of harvest timeliness and improve allocation of labor and machinery resources. The third year of the study (2000 crop) will be added and analysis updated. Further study may include the effect of various planting dates and the effects of timely defoliation but delayed harvest.

References

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Table 1. Cotton Yield and Grade By Defoliation and Harvest Date, Coastal Plain Experiment Station, Tifton, GA. 1999.

Def Date	% OB	Yield	Grade	Staple	Mic	Strength	Adjusted Income
Aug 26	17	795	31-3	34	4.0	27.6	$377.43
Sep 2	31	881	31-3	35	4.0	28.0	$427.06
Sep 9	55	1054	31-3	34	4.4	28.0	$499.33
Sep 17	64	1343	31-3	35	4.5	27.5	$649.68
Sep 22	60	1412	31-3	35	4.4	27.4	$683.06
Sep 30	83	1456	41-3	34	4.6	27.2	$684.32
Oct 6	80	1297	31-3	35	4.6	27.1	$627.42
Oct 14	97	1237	41-3	34	4.8	25.9	$581.39
Oct 19	100	1275	41-3	34	4.6	27.1	$599.25
Oct 27	100	1314	41-3	34	4.7	26.0	$617.58
Nov 4	100	1327	41-3	34	4.6	26.5	$623.69
Nov 11	100	n/a	41-3	34	4.7	25.7	n/a
Nov 17	100	1338	41-3	34	4.7	26.1	$628.86