IMPACTS ON COTTON FIBER QUALITY FROM MULTI-PICKINGS COMPARED TO TRADITIONAL SINGLE PASS HARVEST SYSTEMS

James Griffin
Gaylon D. Morgan
Texas A&M University
College Station, TX
Emi Kimura
Texas A&M AgriLife Extension Service
Vernon, TX
John Snider
University of Georgia Cooperative Extension
Tifton, GA
Ed Barnes
Cotton Incorporated
Cary, NC

Abstract

Cotton producers annually struggle with removing seed cotton from production fields due to weather conditions, harvest capacity, and logistics. These delaying harvest factors often devalue lint quality and value. To resolve this issue, Cotton Incorporated has initiated a research initiative of developing autonomous robotic cotton harvesters. These robotic harvesters will have the capability to perform multiple harvest events gathering lint from mature open bolls each time they are deployed. The objective of this study was to determine the economic value, either from yield increases and/or improved lint value comparing three different harvest methods. The study was conducted near College Station, Texas A&M Research Farm located along the Bravos River. Three harvest methods were used, a multiple hand harvest, a traditional single pass machine picker and a onetime end-of-season hand harvest. All harvested samples were ginned on a ten saw table top gin at the end of the season and analyzed with HVI. Two cotton varieties, DeltaPine 1612B2XF and 1646B2XF, were used in the experiment to evaluate a range in maturities. Yields were not statistically different among the three harvest methods. However, the multiple hand harvest method resulted in superior lint loan value, approximately ten cents per pound, compared to the single pass machine harvest. Color grades were preserved with the multi-harvesting and had the most influence on the loan values.

Introduction

In 2018, much of the Cotton Belt received record rainfall during the harvest season causing delayed harvest. Cotton acres have increased across the cotton belt the past two years with more acres anticipated for the 2019 growing season. This acre increase causes an amplified strain on harvest equipment leading to more mechanical failures and downtime. Even with the most efficient harvesters operating in the timeliest manner, lower positioned mature cotton bolls are left exposed to weathering for over 30 days while the top position bolls remain open. In traditional production systems, cotton harvest aids are routinely applied when sixty percent of cotton bolls are open and then harvested approximately 1-2 weeks later in the best of scenarios. Robotic harvesting would allow for a timely seed cotton harvest while preserving yield, fiber quality, and ultimately boosting profitability. Multi timing harvesting events will also allow for a greater uniformity of cotton lint grades. Research has shown that cotton lint varies in classification parameters as bolls develop higher on the plant (Kothari, 2015).

Materials and Methods

Two cotton varieties with a range of maturities, DeltaPine 1612B2XF and 1646B2XF, were planted in a randomized complete block design with 5 replicates at the Texas A&M Farm near College Station (GPS coordinates= 30°32'57"N 96°26'11"W) on a Ships Clay soil. The total (Kothari, 2015)size of the ten individual plots was eight 40 inch rows and 45 feet long. Plots were managed for three bale yield potential with furrow irrigation, the recommended nutrient levels, and insect management. Weather data (day lengths, daily temperatures, solar radiation) and total water received were measured. Plot layout design and data to be collected, rows were arranged left to right:

Rows 1, 5 and were 8 buffer rows

Rows 2 and 3 were spindle picker harvested at 60% open bolls. The machine harvest date was October 3rd. Row 7 was also plastic covered to eliminate any potential harvest aid application.

Row 4 was utilized to harvest two meters of whole plants the day before machine harvest.

Row 6 was used to measure dates of planting, seedling emergence, first square, first flower, and node of first fruiting branch; weekly measurements after first flower, date of first cracked boll and number of open bolls. Ten consecutive plants from each plot will be used to measure the previously mentioned data.

Row 7 was used to hand harvest seed cotton every 3 days (Monday and Thursday), weather permitting, starting at first mature open boll through the end of boll opening. Each harvest date was recorded, along with any weather events during the harvest period. The nine hand harvest events occurred from August 16 through September 24th. Picked seed cotton samples were compiled weekly and stored in a dark room at room temperature, low humidity area to preserve fiber quality. Samples were sorted by hand harvest dates and fruiting position. Each week harvested nodes were documented.

All samples were ginned on the same 10 saw table top gin in College Station, TX and HVI and AFIS were used to measure fiber quality properties. All samples were ginned at the end of the harvest season. Two meters of the machine harvest rows were hand harvested just prior to spindle picker harvest. Data utilized from fiber analysis included fiber length distribution, strength, uniformity, fiber perimeter/fineness, short fiber content, number of neps, seed coat neps, trash, and maturity. Accumulated data were statically analyzed using Analysis of Variation (ANOVA) and Fisher's Protected Least Significant Difference to determine treatment difference in fiber qualities, yield, and economic value.

Results and Discussion

No statistically yield differences between harvest methods were observed, although DP1646 B2XF statistically yielded higher by 136 pounds of lint per acre. Cumulative percentage of lint weight for each harvest date and positions are noted in Figure 1. First position bolls represented fifty two percent, second position twenty five percent, third position and vegetative bolls twenty three percent of the total weight that were hand harvested averaged across varieties. Cotton fiber quality from the machine harvested timing created inferior grades compared to the two meters of row, which were harvested merely a day apart. Both of the single harvest methods and timings produced lower fiber grades than the multi picking method. The machine harvest method was approximately ten cents and five cents per lint pound lower than the multiple handpicked and two meters of row harvest method, respectively. See Figure 2. The combined lint value discounts and premiums for each individual hand harvest event, nine total, resulted in a higher improved loan value compared to the loan value of the end of the season machine harvested (October 3) samples. See Figure 3. Cumulative rainfall showed a strong correlation to the effect on loan values. Although some of this correlation can be attributed to harvesting higher positions on the plant. Higher on the cotton plant fruiting positions do not receive the same allocated resources and often go through harsher developmental weather conditions, namely heat in south Texas.

Summary

Based on this location and 2018 season, the multiple hand harvesting method would offer producers a ten cent increase over the conventional single pass harvester method. Machine picked cotton cost a potential discount of five cents compared to the end of the season hand harvest method. Rainfall events and fiber harvested on higher nodes and vegetative branches reduce fiber quality. Color grade resulted in the largest discount when comparing the machine harvest and multi-handpicked methods. Micronaire, uniformity, strength, and length consistently decreased as later hand picking events, suggesting that cotton plants do not uniformly allocate resources to the boll architecture. Further research and data analysis needs to occur in order to accurately determine if weather events or boll disbursement have a greater effect on fiber quality from the later hand harvest timings.

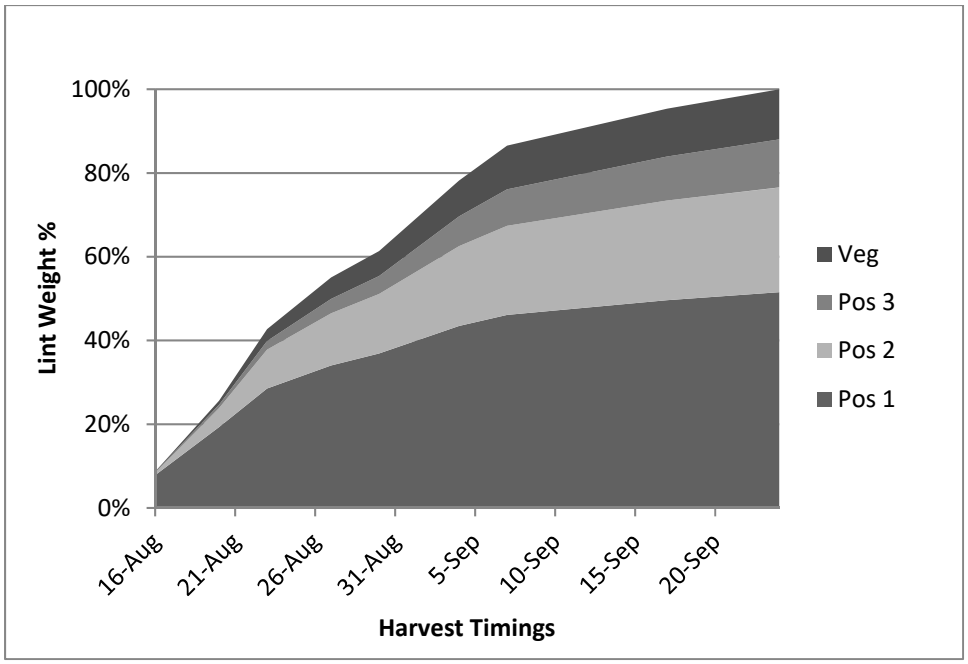

Figure 1: Cumulative Percentage of Lint Weight per Picking by Date and Positions

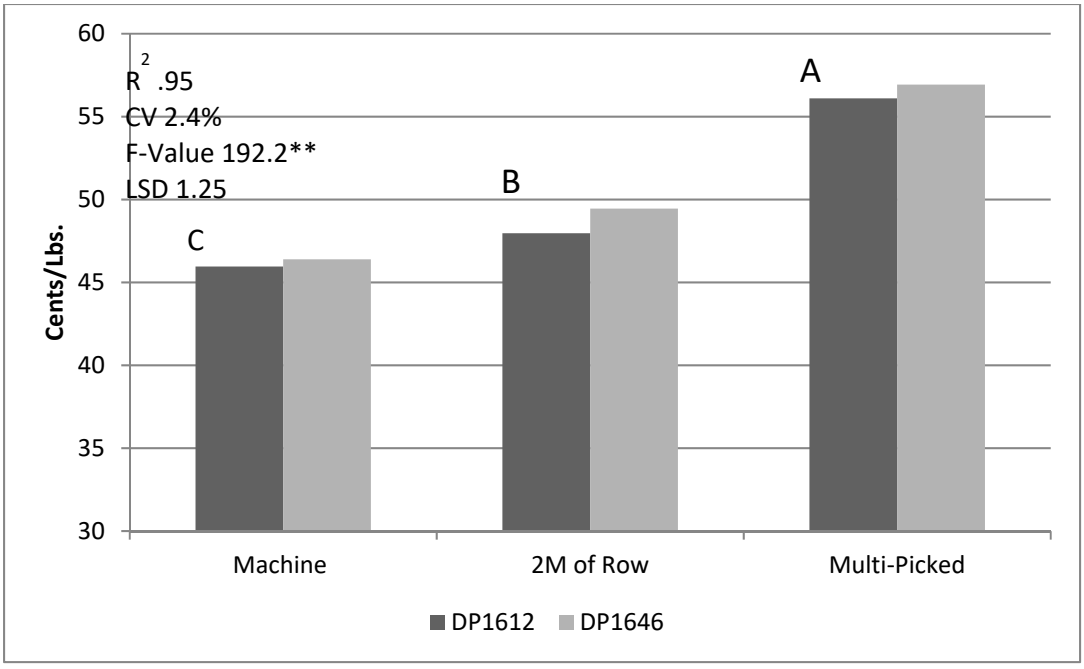

Figure 2: Loan Value by Harvest Method and Variety.

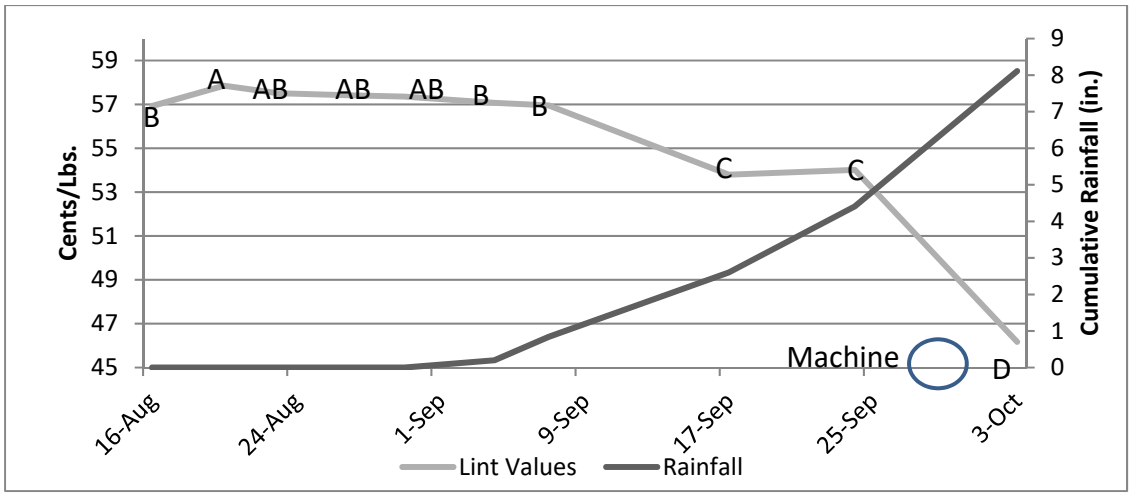

Figure 3: Rainfall Effect on Loan Values of Harvest Timings. The letterings represent significant differences amongst the first nine hand harvest events and the final machine harvest event circled on the far right.