Spindle Speed Effects on Cotton Quality

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Abstract. Three cotton varieties were grown under furrow-irrigated conditions in southern New Mexico and harvested at three different spindle speeds (1500, 2000, and 2400 rpm). Results for stalk losses, trash content, and fiber quality are presented.

Keywords. Cotton ginning, harvesting
Introduction

Spindle picking of cotton was developed in the 1940's as a means to speed up and reduce the cost of harvest. Prior to this, all cotton was hand-harvested. Over time, spindle picking has become the preferred method of harvesting most cotton in the U.S. Improvements to spindle pickers over the years have primarily focused on increasing the number of rows that can be harvested with 1 pass of the machine from 1 row to up to 6 rows; as well as increasing the travel speed of the harvester from around 1.5 to up to 4 miles per hour.

Improvements to the cotton harvester have primarily focused on increased capacity in order to reduce the cost of harvesting. As cotton harvesters have gotten bigger and faster, spindle speeds have increased. As the speed has increased, cotton fibers can wrap more tightly around the spindle. Spindle sizes have also decreased in both diameter and length in order to reduce the weight of the picker head. As spindle diameter decreases, cotton fibers will wrap around the spindle more and become tighter on the spindle. As spindle length decreases, cotton plants must be further compressed as they pass through the picking zone. These changes have resulted in a general decrease in cotton fiber quality, particularly regarding spindle twists, preparation, and neps.

Spindle pickers require meticulous adjustment in order to minimize harvest losses and to maximize fiber quality (Williford et al, 1994). Avoiding the harvest of high moisture cotton is another requirement to minimize harvest losses and to maximize fiber quality (Mayfield et al, 1998). Deviations from these highly recommended practices will result in significant quality degradation and increased harvest losses, both of which can cost the grower.

Objective

The objective of this study was:

- To compare fiber quality, harvest losses, and trash content of three varieties of spindle-picked cotton using three machine/speed harvest combinations.

Methods and Materials

Test plots approximately 1.5 acres in area of each of three cotton varieties were grown during the 2005 growing season at the Leyendecker Plant Science Research Center, Las Cruces, New Mexico. The three cotton varieties grown were: Delta Pine 565, a conventional upland cotton; Acala 1517-99, an upland cotton with enhanced staple length; and Delta Pine Pima 744, a conventional Pima cotton. The Pima cotton was planted on April 29 and the upland varieties were both planted on May 4. All cotton was grown on ridged 40 inch rows and furrow irrigated as needed during the growing season. Chemical herbicides and insecticides were applied as needed and in accordance to customary practice for the growing region; however, no defoliation chemicals were applied.

All cotton was harvested during February 21 – March 1, 2006. A modified International Harvester model 120 1-row spindle picker was used to harvest the cotton. Each test lot consisted of 2 adjacent rows of cotton, each about 600 feet long. Four replications of each combination of test conditions were conducted. Seed cotton harvested from each lot was dumped into a trailer for temporary storage. Two seed cotton samples of about 60 grams each were randomly selected and placed in sealed metal cans for subsequent seed cotton moisture determination. Black plastic sheeting was placed on top of each lot in order to keep the lots separated for subsequent ginning and fiber quality analysis. Ambient air temperature and
relative humidity in a shaded location were measured with a digital psychrometer during the five
to ten minutes required to harvest each lot.

The 1-row picker used 9/16 inch spindles that had 2 3/4 inches of the spindle tip extend into the
picking zone. Picking zone width was adjusted to 2 7/8 inches at the narrowest part. The picker
was modified by separating the standard picker drive from the spindle and doffer drive chain. A
separate hydraulic motor was used to drive the spindles and doffers, but not the drum. This
allowed the drum speed to remain constant with ground speed while the spindle and doffer
speeds could be varied.

Harvest losses were measured using an area frame that measured 40 inches wide (the row
width) by 78.5 inches long and enclosed an area of 0.0005 acre. Before the cotton picker
passed, the frame was placed across 1 row, with the center of the frame n the row, and any
cotton on the ground was cleaned out of the way. The area was marked and the frame
removed. After the picker passed, the frame was returned to the same location. Cotton
remaining on the plant was hand-picked and collected as a sample and cotton that was on the
ground was hand picked and collected as another sample. All samples were weighed, and
harvest losses were computed as a percent of the total harvested yield.

Individual seed cotton lots were unloaded from the trailers using a suction pipe. The trailer was
weighed before and after each lot in order to determine lot weight. Seed cotton cleaning
equipment included a green boll trap, three separators, two cylinder cleaners, and a stick
machine. Dryers in the system were not operated. The cylinder cleaners and stick machine
were in a cylinder – stick – cylinder arrangement. All trash removed from the seed cotton was
collected and weighed. Weights from each machine from each test lot were recorded so that
any possible differences among harvest treatments could be determined. Before cleaning, two
seed cotton samples of about 60 grams each were randomly selected and placed in sealed
metal cans for subsequent seed cotton moisture determination and an additional two samples of
about 250 grams were randomly selected and placed in plastic bags for subsequent
fractionation analysis.

Upland cotton test lots (the varieties Delta Pine 5690 and Acala 1517-99) were ginned using a
saw gin stand fed by an extractor-feeder. One saw lint cleaner was used. Between the feeder
and the gin stand, two seed cotton samples of about 60 grams each were randomly selected
and placed in sealed metal cans for subsequent seed cotton moisture determination and an
additional two samples of about 250 grams were randomly selected and placed in plastic bags
for subsequent fractionation analysis. Two samples of the seed were collected from the seed
conveying pipe and placed in sealed moisture cans for subsequent seed moisture, seed
germination, seed trash, and seed damage analysis. Just before the ginned lint entered the
bale press, two lint samples of about 30 grams each were randomly selected and placed in
sealed metal cans for subsequent cotton lint moisture determination. Ginned lint was packaged
into bales and shipped to the USDA, ARS, Cotton Quality Research Unit in Clemson, S.C. for
HVI, AFIS, trash, rotor spinning, and vortex spinning tests.

**Results and Discussion**

The model 120 1-row picker operated at an engine speed of 1560 rpm at a ground speed of 1.9
miles per hour. The hydraulic motor was driven by a 34 hp diesel-powered hydraulic power unit.
Engine speed was adjusted to achieve one of three spindle speeds, 1500, 2000, or 2400 rpm.

Harvest generally began around 9:00 each morning and proceeded until 2:00 each afternoon,
with a ½-hour lunch break. Ambient air temperature (shade) for the harvest period ranged from
55 to 77 degrees Fahrenheit and relative humidity (shade) ranged from 7 to 14 percent (Table
Seed cotton moisture when the cotton was picked was relatively low, ranging from 3.8 to 4.9 percent, dry basis and from 4.8 to 5.6 for the upland and Pima varieties, respectively. Variability in air temperature and relative humidity and seed cotton moisture followed typical diurnal patterns, with lower air temperature and higher relative humidity and seed cotton moisture in the morning than in the afternoon (Table 1).

Table 1. Harvest dates, air conditions, and cotton moistures.

<table>
<thead>
<tr>
<th>Cotton variety</th>
<th>Harvest dates</th>
<th>Air temperature, degrees F</th>
<th>Air relative humidity, percent</th>
<th>Seed cotton moisture at harvest, percent d.b.</th>
<th>Lint yield from harvested seed cotton, bales/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta and Pine Land 565</td>
<td>2/22 - 23</td>
<td>61 – 64</td>
<td>7 – 12</td>
<td>3.9 – 4.9</td>
<td>2.35</td>
</tr>
<tr>
<td>Acala 1517-99</td>
<td>2/21 - 22</td>
<td>55 – 64</td>
<td>10 – 14</td>
<td>3.8 – 4.8</td>
<td>2.25</td>
</tr>
<tr>
<td>Delta and Pine Land 744 (Pima)</td>
<td>3/1</td>
<td>66 - 77</td>
<td>7 - 13</td>
<td>4.8 – 5.6</td>
<td>2.05</td>
</tr>
</tbody>
</table>

Results of the harvest losses, gin trash removed, and fiber quality analyses were not yet available at the time this manuscript was written. The meeting presentation will contain further information. Contact the author for additional information.

Conclusion

Specific conclusions will be provided in the meeting presentation. Contact the senior author for further details.

References


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