

**Effects of Deferred Ginning of Cotton
on Cotton Fiber Quality
as Reflected in Certain Fiber Properties**

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SUMMARY

This research investigated the effect of different harvest periods and ginning treatments on moisture content and selected fiber properties of machine-picked cotton. The harvest periods and ginning treatments were (1) morning harvest followed by either immediate or deferred ginning and (2) afternoon harvest followed by either immediate or deferred ginning. Fiber samples were obtained at the lint slide throughout the ginning of each bale of cotton in each of the four ginning treatment periods. Statistical analyses of moisture and fiber property measurements made on these samples revealed that cotton ginned 1 day after harvest was not of significantly lower quality in any of the fiber property measures. However, this deferred ginning treatment did significantly improve the fiber length and length distribution.

It was concluded that deferred ginning of cotton would not change the immediate value of the cotton to producers or ginners. However, this treatment would significantly improve the spinability of the cotton to mills and thereby strengthen the markets for such cotton in the future.

Contents

Introduction.....	3
Moisture Content.....	3
Quality Characteristics.....	3
Purpose.....	4
Procedure.....	5
Results of Analyses, 1962 and 1963 Data.....	6
Moisture Relationships.....	6
Digital 2.5 percent span length.....	6
Digital 50 percent span length.....	7
Percentage of fibers shorter than one-half inch in fiber array.....	7
Coefficient of fiber length variation in a fiber array.....	7
Interpretations and Implications.....	7
Acknowledgments.....	8
Literature Cited.....	8

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THE GINNER OF AMERICAN UPLAND COTTON has to cope with seed cotton with wide variations in moisture content making it necessary to install costly moisture-control devices in his gin. These moisture controls cannot always compensate for wide variations in seed cotton moisture and frequently result in overheated cotton and damaged fiber. Overheating diminishes the natural oils and waxes in the fibers and subjects them to excessive breakage (1). The full spinning potential of cotton can be realized only if its delicate surface properties are not damaged throughout harvesting, ginning and storing (2).

Recent research in the Mississippi Delta revealed that when early morning-picked and afternoon-picked cotton were stored in trailers for an extended period of time before ginning and given equal drying in the gin, the morning-picked bales lost almost a full grade in quality. A major part of the grade difference was associated with color loss while the cotton was stored in the trailers. Tests on cotton picked throughout the day showed that lint quality was not affected measurably when seed cotton contained excessive moisture, provided the cotton was carried directly to the gin and dried thoroughly (3).

A study was initiated in 1961 at the Texas A&M University Plantation in the Brazos River Valley of Burleson County to determine the effect of field moisture content of seed cotton on selected fiber properties. This report analyzes gin plant and fiber laboratory data for the second and third years of a 3-year study. Data collected the first year were not adequate for meaningful analysis.

The cotton sampled was machine harvested with spindle-type pickers. Some of the samples were from fields not defoliated, as prolonged dry weather prior to harvest hastened maturity of the plants and promoted natural shedding of the leaves.

The following characteristics were examined from samples of cotton harvested in August and September 1962 and 1963: moisture content at the trailer, extractor feeder and lint slide; digital fibrograph 2.5 and 50 percent span lengths; percentage of fibers shorter than $\frac{1}{2}$ inch in a fiber array; the

coefficient of variation of fiber-length array; nonlint content and lint color.

Moisture Content

Moisture levels were determined with a Hart moisture meter¹ for seed cotton on the trailers and at the extractor feeder and for the lint at the lint slide. Samples were obtained for moisture readings continuously throughout the ginning process.

Half of each seed cotton sample was ginned immediately, and the other half was ginned after being stored 18-24 hours. Since moisture transfer within seed cotton occurs during early stages of storage, the meter readings of the deferred ginned lots tend to be more accurate than the moisture measurements of the immediately ginned lots (5).

Quality Characteristics

The 2.5 percent span length measured on a digital fibrograph refers to the length of the longest 2.5 percent of the fibers in the test specimen. The fibers are measured as if they had been caught by a pair of rolls in the first draft zone at a yarn mill. They are parallel, randomly distributed, and the percent is determined by number count. Therefore, the 2.5 percent span length is really a distribution of length measurement relating the length of fibers to the number of fibers (6). Span lengths are fiber extension distances measured in an arrangement similar to fibers in yarn processing machinery. The "beard" which extends from the fibrograph comb is essentially the same as the "beard" which extends into machinery zones of fiber transfer (7). Fiber extension distance encompasses fiber length, distribution of length and state of randomness. The length measurement most closely associated with high yarn strength is the 2.5 percent span length (8). The average digital 2.5 percent span length and the classer's staple on a 100-bale lot of even-running cotton usually correspond within a tolerance of $\pm .02$ inch (9).

¹Due to the changing moisture conditions of the cotton at the different sampling points, there was some error associated with the meter readings. During periods of moisture addition, the meter tends to read high; during drying, the meter reads low (4).

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The digital 50 percent span length is a measurement similar to the 2.5 percent span length. The 50 percent span length means that 50 percent of the number of fibers are as long or longer than the length indicated. One of the best predictors of ends down in the spinning process is the 50 percent span length. *Ends down* is a measure of breakage of yarn during the spinning process (8).

Array tests were performed on the Suter-Webb fiber sorter. Briefly, this method consists of paralleling the fibers in a representative 75-milligram specimen of cotton through a series of combs, separating fibers into length groups at 1/8-inch intervals and weighing the fibers in each length group.

Although the Suter-Webb array measurement of fiber length and length distribution is time consuming, it is the most accurate and consistent method of determining length and length distribution currently available. Fiber-length distribution is optimized when the low, or short end, of the fiber array is minimized. Therefore, a desirable Suter-Webb array is one in which the gradation from the long to the short fiber groups occurs evenly and the percentage of fibers shorter than 1/2 inch is low.

The percentage of fibers shorter than 1/2 inch indicates the ratio of the weight of the four shorter 1/8-inch length groups to the total weight of the specimen.

The array coefficient of length variation is a measure of the relative variability of fiber length in the sample tested. It represents the standard deviation of the weight-length frequencies expressed as a percentage of the mean length. Larger coefficients indicate less uniform fiber length distributions. Excessive fiber length variation tends to increase manufacturing waste, make processing more difficult and lower the quality of the final product (10).

Fiber length distribution now is recognized as being as important as conventional staple length in its effects on mill operations and costs and on the quality and value of cotton yarns (11). Poor fiber length distribution limits speed of operation and quality of the finished product (12). Fiber length distribution and the short fiber content of cottons can be altered adversely in the ginning process. This report analyzes the causes and suggests remedies for adverse changes in fiber-length distribution.

Purpose

The purpose of this study was to determine if the time of harvest, the moisture content of the cotton or the type of ginning treatment had any significant effect on selected fiber properties. Cotton moisture content was obtained for the harvest periods of morning and afternoon and related to immediate and deferred ginning treatments. The fiber properties examined included 2.5 and 50 percent span

TABLE 1. MOISTURE CONTENT OF MACHINE-PICKED COTTON AT THREE SAMPLING POINTS FOR TWO GINNING TREATMENTS, MORNING AND AFTERNOON, TEXAS A&M UNIVERSITY PLANTATION, 1962 AND 1963

Sampling point	Harvest period	Ginning treatment	Average moisture				Range of moisture				
			1962		1963		1962-63		1962		1963
			percent								
Trailer	Morning	Immediate	11.6		13.2		12.3	8.6-16.0			8.1-16.0
		Deferred	11.9		13.3		12.5	8.6-16.0			9.3-16.0
	Afternoon	Immediate	11.6		12.6		12.0	8.1-15.5			6.0-16.0
		Deferred	10.9		12.1		11.4	6.4-16.0			7.8-16.0
	Morning and Afternoon	Immediate	11.6		13.0		12.2	8.1-16.0			6.0-16.0
		Deferred	11.4		12.7		12.0	6.4-16.0			7.8-16.0
Extractor	Morning	Immediate	6.7		7.8		7.2	5.0- 9.3			5.2-16.0
		Deferred	6.2		7.9		7.0	5.2- 9.0			5.5-14.5
	Afternoon	Immediate	6.0		6.9		6.4	4.6-10.0			5.4-15.0
		Deferred	5.9		7.6		6.7	5.0- 9.8			5.6-15.5
	Morning and Afternoon	Immediate	6.3		7.4		6.8	4.6-10.0			5.2-16.0
		Deferred	6.0		7.7		6.8	5.0- 9.8			5.5-15.5
Lint slide	Morning	Immediate	6.2		6.2		6.2	5.0- 8.1			5.0- 7.3
		Deferred	6.5		6.9		6.7	5.3- 9.0			5.0- 8.2
	Afternoon	Immediate	5.9		5.8		5.9	5.0- 7.6			4.2- 6.8
		Deferred	6.3		6.3		6.3	5.0- 8.5			5.4- 8.0
	Morning and Afternoon	Immediate	6.0		6.0		6.0	5.0- 8.1			4.2- 7.3
		Deferred	6.4		6.6		6.5	5.0- 9.0			5.0- 8.2

length, percentage of fibers in an array shorter than $\frac{1}{2}$ inch and coefficient of variation of fiber-length array.

If significantly higher quality lint cotton can be obtained from deferred ginning, mills could afford to pay premiums for such cotton. Even though loan values through government programs may be based upon other measures of quality, the true worth of cotton to mills is indicated by the value of their finished products less manufacturing cost. Optimum ginning methods allow cotton to maintain the highest possible value for manufacturing, independent of artificial prices assigned through price support programs.

Procedure

Individual trailer lots of machine-picked seed cotton were sampled and ginned in 1962-63. In 1962, data were obtained from cotton harvested August 21-23 and September 5 and 19; the 1963 data were taken from cotton harvested August 12, 13, 14 and 30. One trailer load of seed cotton was harvested during each morning and midafternoon of each day. One-half of each load was ginned immediately, and the remainder was placed under cover and ginned 18-24 hours later. The deferred ginned cotton was compared with that ginned immediately to determine the effect of trailer storage on fiber quality.

Eight or more moisture readings were taken from trailers in the field immediately following

harvesting. Moisture observations on the deferred lots were made again just before ginning. Moisture content of the cotton was recorded at the extractor-feeder apron and at the lint slide. Table 1 shows the averages and ranges of the observations made at each sampling point. Samples drawn at the lint slide were combined into a composite sample and tested in a fiber laboratory to measure fiber length, fiber length distribution, color and nonlint content.

Data on moisture and fiber properties were analyzed by a nested analysis of variance treatment to determine if there was a significant difference between days, periods (morning and afternoon) and immediate or deferred ginning treatments. A summary of the variance analyses for the 1962-63 observations is presented in Table 2.

By grouping the samples into pairs of bales harvested at the same time and by comparing those ginned immediately with those ginned 18-24 hours later, it was possible to determine significant differences due to ginning treatments. The t-test was used to determine if differences in moisture and fiber properties were due to chance or to the ginning treatment. The technique of pairing observation into bales picked at the same time and location allows differences in moisture and quality from factors other than ginning treatments to be minimized within each pair. The variation from one pair to another does not influence this test of the effects of deferred ginning. The results of the test of dif-

TABLE 2. SUMMARY OF VARIANCE ANALYSES FOR MOISTURE CONTENT AND FIBER PROPERTIES OF MACHINE-PICKED COTTON, BRAZOS RIVER VALLEY, 1962 AND 1963

Source of variation	Trailer moisture	Extractor moisture	Lint slide moisture	Digital 2.5 span length	Digital 50 percent span length	Array percent of fibers shorter than $\frac{1}{2}$ inch	Array coefficient of fiber length variation
	Mean D.F. square	Mean D.F. square	Mean D.F. square	Mean D.F. square	Mean D.F. square	Mean D.F. square	Mean D.F. square
1962							
Day	4 57.2896*	4 7.2784	4 7.5925	4 .0008	4 .0022*	4 10.6885	4 21.9471
Day x period	5 10.6089	5 2.9459	5 1.5820	5 .0009	5 .0003	5 5.9284	5 6.3472
Day x period x ginning	10 11.6707**	10 2.0864**	10 3.0144**	10 .0006**	10 .0003**	10 3.9034*	10 9.2926**
1963							
Day	3 150.01	3 59.67	3 2.13	3 .0067	3 .021*	3 57.23	3 72.65
Day x period	4 53.26*	4 10.28	4 9.13	4 .0021*	4 .0016*	4 15.21	4 18.17
Day x period x ginning	8 7.81*	8 9.83*	8 6.82**	8 .00054	8 .000316	8 7.56**	8 9.59**

*Significant at 5 percent probability level.

**Significant at 1 percent probability level.

Mean squares not significant at 5 percent level were not starred.

TABLE 3. EFFECT OF DEFERRED GINNING TREATMENT ON SELECTED COTTON FIBER PROPERTIES, TEXAS A&M UNIVERSITY PLANTATION COTTON GINNED IN 1962 AND 1963

Year	Ginning treatment	Digital 2.5 per- cent span length	Digital 50 per- cent span length	Array percent of fibers shorter than 1/2 inch	Array coeffi- cient of fiber length variation
		mean length	mean length	mean percent	mean coeffi- cient
1962	Immediate	1.087	.487	10.03	31.52
	Deferred	1.086	.484	9.50	31.54
	Change	— .001	— .003	— .53	+ .02
1963	Immediate	1.051	.455	11.63	33.36
	Deferred	1.059	.462	10.51	32.13
	Change	+ .008*	+ .007**	— 1.12*	— 1.23*
1962 and 1963	Immediate	1.071	.473	10.74	32.34
	Deferred	1.074	.474	9.95	31.80
	Change	+ .003	+ .001	— .79*	— .54

Significance of differences tested by paired t-test.

*Difference in means significant at 5 percent probability level.

**Difference in means significant at 1 percent probability level.

If means not significantly different at 5 percent level, no stars are shown.

ferences between ginning treatments on the paired data are presented in Table 3.

The results of the analysis of changes in fiber color and nonlint content are not reported in this publication because the deferred ginning treatment had no significant effects on fiber color or nonlint content.

Correlation analysis was used to determine the relationship of the moisture content of cotton at the trailer, extractor or lint slide to fiber properties. Since no significant relationship was evident, the results of the correlation analysis are not presented here.

Results of Analyses, 1962 and 1963 Data

Moisture Relationships

The lint slide fiber moisture level was significantly higher in both 1962 and 1963 for the deferred ginned cotton. Cotton picked one morning and

not ginned until the following morning absorbed moisture from cotton seed and trash. There was less moisture variation within each bale of the deferred ginned cotton than within each bale of the immediately ginned cotton, even though the range between bales was high in both cases, Table 1. The average moisture levels were significantly different between bales only when the deferred and immediate ginning treatments were compared, Table 2. In other words, the differences between average moisture levels at the trailer, extractor and lint slide were not significant from day to day or between mornings and afternoons, only between immediate and deferred ginned cotton. The lint slide moisture averaged slightly higher for the deferred ginned cotton since less drying was required to maintain smooth ginning operations.

It was concluded from the analysis of moisture relationships at the trailer, extractor feeder and lint slide that, by deferring ginning for 24 hours, less moisture variation existed within each bale. Since less drying was required to maintain gin plant efficiency, lint slide moisture levels were slightly higher for the deferred ginned cotton.

Digital 2.5 Percent Span Length

Differences between means of the digital 2.5 percent span lengths were tested by analysis of variance. The results (presented in Table 2) indicated that in 1962 the differences between the mean 2.5 percent span lengths were not significant from day to day or from morning to afternoon. However, there was a highly significant difference between means when they were compared separately by days, harvest periods and ginning treatments in 1962. This difference between means was not significant for 1963 data, but there was a significant difference between means for morning and afternoon periods in 1963.

The mean digital 2.5 percent span lengths for the immediate and deferred ginning treatments are presented in Table 3. The deferred ginned cotton had an insignificant change in mean length for 1962, but in 1963 an increase in mean length of .008 inch was significant at the 5 percent level. The change for both years combined was positive but not significant at the 5 percent level.

From the paired t-test it can be concluded that deferring the ginning of cotton 18-24 hours did not significantly reduce the digital 2.5 percent span length in either year but actually improved the 2.5 percent span length by a significant amount in 1963. This change would have no influence on the government loan price but would mean a significant improvement in the spinability of the cotton fiber. The increased digital 2.5 percent span length means that the length of the longest 2.5 percent of the

fibers is slightly greater, and less breakage would occur in spinning.

Digital 50 Percent Span Length

The results of the analysis of variance treatment on the 50 percent span length shown in Table 2 are similar to those for the 2.5 percent span length. There was a highly significant difference in all of the mean lengths for 1962 but not for 1963. Part of the explanation for this degree of significance is that there was considerable variation from day to day in 1962-63. This day-to-day variation is eliminated from the analysis by pairing the observations as shown in Table 3. Since there was not as great a variation in the 50 percent span length from morning to afternoon in 1963 as in 1962, the overall difference in the means in 1963 (day x period x ginning) was not significant.

Table 3 shows that by comparing only changes in ginning treatments, there was a highly significant increase in the digital 50 percent span length for deferred ginned cotton over immediate ginned cotton in 1963. The slight changes in 1962 and for both years combined were not significant, however. Deferred ginning did not significantly lower the 50 percent span length but did raise it in 1963.

It was concluded that by delaying the ginning for 24 hours after harvesting, the digital 50 percent span length could be improved slightly on the average. This means that there would be fewer ends down during the spinning of the deferred ginned cotton than the cotton ginned immediately after harvesting.

Percentage of Fibers Shorter Than one-half Inch in a Fiber Array

The percentage of fibers shorter than $\frac{1}{2}$ inch in a fiber array is one measure of damage to cotton fibers during ginning. Over-drying and over-cleaning cause fiber breakage and result in a higher percentage of fibers shorter than $\frac{1}{2}$ inch. There was a significant difference in the means of this measurement only when the ginning treatment was brought into the analysis of variance model, Table 2. In 1962, this difference in mean percentages was significant at the 5 percent level, and in 1963 it was significant at the 1 percent level.

As can be seen from Table 3, deferred ginning decreased the average array percent of fibers shorter than $\frac{1}{2}$ inch for both years. This change was significant at the 5 percent probability level for 1963 and for both years together.

It was concluded that deferred ginning did significantly reduce the percentage of fibers shorter than $\frac{1}{2}$ inch in a fiber array and would thereby reduce the waste to mills in spinning.

Coefficient of Fiber Length Variation in a Fiber Array

The array coefficient of fiber length variation is an indication of the uniformity of the length of cotton fibers in the sample. Lower coefficients mean less variability in the fiber length and hence more desirable cotton for spinning.

The analysis of variance tests showed that the means of the array coefficient of fiber length variation were significantly different at the 1 percent probability level for both the 1962 and 1963 samples only when the ginning treatment was brought into the analysis. From day to day and from period to period the difference in mean coefficient levels was not significant at the 5 percent probability level (Table 2).

By pairing the observations and analyzing the differences, the 1963 samples of deferred ginned cotton were found to have a mean coefficient of 1.23 less than the immediately ginned cotton for that year. This difference was significant at the 5 percent level, meaning that the probability was only 1 in 20 that the difference was due to chance and not to different ginning treatments. In 1962, the mean coefficients were almost exactly the same, and for both years combined the slight improvement in the array coefficient was not significant at the 5 percent level (Table 3).

It was concluded that coefficient of fiber length variation in a fiber array was lowered slightly by deferred ginning treatments. Less variation in fiber length would mean less waste and delay in spinning operations.

Interpretations and Implications

This study revealed that a more desirable length distribution of ginned cotton fiber was found in cotton which was stored for 18-24 hours before ginning. The moisture levels at the extractor feeder apron were more uniform due to a transfer of moisture from the seed and trash to the fiber of the seed cotton during the deferred storage period. This uniformity allowed the cotton to be ginned with less drying and, as a result, less fiber damage. The deferred ginning treatment produced significantly more uniform length distribution in the lint cotton.

A study of the effects of storing seed cotton prior to ginning was conducted in Arkansas and Missouri in 1961; no adverse effects of storing seed cotton were observed in those tests (14). Tests of the effects of cleaning and drying cotton at selected gins in California and Mississippi indicated that such practices damaged fiber properties even though the grade was improved (11).

Seed cotton ginned with lower drying temperatures has less waste during processing at the mill and produces a yarn of more uniform quality with less delay from breakage. This study indicated that storing seed cotton for 1 day prior to ginning preconditioned it sufficiently to allow less drying during ginning which resulted in improved quality. Unfortunately, current pricing methods do not reflect these improvements in cotton quality, but improved ginning techniques must eventually be recognized in stronger markets. Recent studies by the U. S. Department of Agriculture found that improvements in fibrograph length uniformity ratios increased the spinning potential yarn number considerably more than did increases in the classers grade (13).

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