MARKETING RESEARCH REPORT NO. 666

Some Effects of

Gin Drying and Cleaning of Cotton on Fiber Length Distribution and Yarn Quality

U.S. DEPARTMENT OF AGRICULTURE • ECONOMIC RESEARCH SERVICE • AGRICULTURAL MARKETING SERVICE

PREFACE

This study of the effects of conditioning and cleaning practices at cotton gins on fiber properties and spinning performance of fibers is one of a group conducted by the Department of Agriculture during the last decade. The study was undertaken by the Economic Research Service, the Agricultural Marketing Service, and the Agricultural Research Service in cooperation with the National Cotton Council, gin machinery manufacturers, ginners, and producers.

Results of related studies are given in the following reports:

Effects of Lint Cleaning of Cotton--An Economic Analysis at California Gins. By James St. Clair and Arthur L. Roberts. Mktg. Res. Rpt. 238. May 1958.

Effects of Cleaning Practices at Gins on Fiber Properties and Mill Performance of Cotton. A Progress Report. By Marketing Research Division, Agricultural Marketing Service. Mktg. Res. Rpt. 269. August 1958.

Effects of Tandem Lint Cleaning on Bale Values, Weight Changes, and Prices Received by Farmers. By Zolon M. Looney and Joseph L. Ghetti. Mktg. Res. Rpt. 397. May 1960.

Cotton Fiber and Spinning Properties as Affected by Certain Ginning Practices San Joaquin Valley, California, Season 1958-59. By John E. Ross, Clarence G. Leonard, and Edward H. Shanklin. Mktg. Res. Rpt. 486. July 1961.

Seed Cotton and Multiple Lint Cleanings at Gins--Effect on Grade, Price, and Bale Value--A Progress Report. By Zolon M. Looney and Edsel A. Harrell. ERS-43. Dec. 1961.

Effects of Cotton Ginning Practices on Market Quality of Cotton--A Mississippi Delta Variety, 1958-59. By Edward H. Shanklin, E. W. Calkins, and Oliver L. McCaskill. Mktg. Res. Rpt. 576. Jan. 1963.

Multiple Lint Cleaning at Cotton Gins--Effects on Bale Value, Fiber Properties, and Spinning Performance. By Zolon M. Looney, L. D. LaPlue, Charles A. Wilmot, Walter E. Chapman, Jr., and Franklin E. Newton. Mktg. Res. Rpt. 601. May 1963.

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SUMMARY

Fiber length and length distribution, along with many other properties of cotton, can have significant effects upon mill operating costs and upon quality and value of the finished product. In addition to such conventional measures of fiber length as classer's designation and mean or upper half mean determinations derived from fibrograph readings, considerable attention recently has been focused upon short fiber content of cotton. It has become increasingly clear, however, that other segments of the length distribution are of equal importance to the short fiber portion, and differences in other segments may not be directly correlated with differences in short fiber content.

In order to evaluate more fully the effects of various gin cleaning and conditioning practices upon fiber length distribution, the results of three tests previously run in the Department's Pilot Plant at Clemson, S.C., were reanalyzed. The objective was to determine the effect of gin drying and tandem or double lint cleaning, separately and in combination, upon both the long and short fiber segments and upon yarn quality. The three tests selected included both rain-grown and irrigated cotton.

The effects of the cleaning and conditioning practices upon the fiber length distribution of the rain-grown cotton differed somewhat from that of the irrigated cotton. However, in both instances the results indicate that changes in the short fiber segment did not always reflect fully changes in the proportion of fibers in the long fiber segment. The results also suggest that both the long and short fiber segments need to be considered in evaluating cotton quality and in predicting yarn quality.

In the test involving rain-grown cotton, the amount of fibers shorter than one-half inch increased from 7.8 to 11.2 percent (44 percent) by drying from 6 to 2.6 percent moisture in the ginned lint and double lint cleaning. About two-thirds of this increase was caused by drying alone. At the high-moisture level, lint cleaning increased short fiber by 1 percentage point and half again as much at the low-moisture level.

Both practices reduced fibers longer than 1 inch by 10 percentage points, or a proportionate reduction of 15 percent. Drying accounted for two-thirds of this decrease. The two lint cleaners had equally adverse effects on short and long fibers at a lint-moisture level of 6 percent, while the adverse effect of the second lint cleaner was substantially greater at a low-moisture level.

Yarn strength was reduced by approximately 225 break factor units by both practices. About 85 percent of this reduction was caused by overdrying. Yarn appearance index was reduced by one-half grade; double lint cleaning was responsible for most of this reduction. At the high-moisture level, yarn appearance index was reduced from 99 to 88 by two lint cleaners as compared with a reduction from 92 to 89 at the low-moisture level.

In the test involving irrigated cotton, short fibers increased from 7.6 to 9.8 percent and long fibers decreased from 68.4 to 60.6 percent by drying and double lint cleaning. Drying accounted for one-half of this change in both short and long fibers. At the undried level of 4.8 percent and at 3.3 percent lint-moisture levels, short fibers increased by 1 percentage point. Lint

cleaning reduced the amount of fibers longer than 1 inch from 68.4 to 64.1 at the high-moisture level and from 62.5 to 60.6 percent at the low-moisture level.

Drying and tandem lint cleaning reduced break factor 246 units. Drying accounted for one-half of this decrease. Lint cleaning caused an equal reduction of approximately 100 units at both high- and low-moisture levels.

Both ginning practices reduced yarn appearance index from 98 to 92. Each practice was responsible for half of this reduction.

Clearly the textile manufacturers, by following pricing policies emphasizing grade improvement, encourage the use of ginning practices that reduce foreign matter but, at the same time, damage fiber properties. Research may be expected ultimately to develop means of evaluating cotton that will better reflect its end-use value and permit more effective pricing. However, such a development is a long involved process.

Meanwhile, textile manufacturers should give some thought to utilizing premiums and discounts to more nearly reflect the use value of cotton as a practical means of combating fiber damage at the gins. If premiums paid for the removal of foreign matter now are such as to encourage practices that adversely affect staple length and length distribution, the logical solution is to place more emphasis, pricewise, on the preservation of staple length and less emphasis on removal of foreign matter. In modern textile manufacturing, one of the first requisites is length and length distribution that has not been altered significantly from its basic nature. Any pricing structure used now or later must preserve these characteristics if cotton is to compete more effectively with other fibers in markets at home and abroad.

SOME EFFECTS OF GIN DRYING AND CLEANING OF COTTON ON FIBER LENGTH DISTRIBUTION AND YARN QUALITY

by

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INTRODUCTION

In recent years cotton producers, ginners, marketing firms, and textile manufacturers have adopted many technological improvements in the production, marketing, and processing of cotton. Producers have improved cultural practices, accepted new and better varieties, and mechanized the harvesting of cotton. Ginners have installed equipment to cope with the increased rate of harvest and to maintain or improve grades obtained from the increased volume of rough-harvested cotton which accompanies mechanization. Mills have modernized their equipment and eliminated some steps in processing. These and other changes have been made to increase efficiency, to offset rising wage rates and other increases in costs, and to improve the rate of returns to both growers and business firms. These changes were made in response to the pressing need to find effective means of improving the competitive position of cotton in domestic and foreign markets.

The technical and other improvements adopted by the cotton industry have done much to increase efficiency in all segments of the industry. However, they have created serious problems in quality evaluation and pricing. These changing conditions have altered historical quality relationships. They have required mills to maintain very accurate control of such factors as fiber length and length distribution, fineness, and fiber strength. Such traditional measures of quality as grade and staple length are no longer sufficient to predict accurately the processing potential and use value of cotton in textile manufacturing. In the past, growers and ginners, in efforts to improve grades and thereby increase returns, increasingly have stepped up drying and lint cleaning. This occurred despite repeated warnings that these processes seriously damage spinning qualities of cotton and, at the same time, that changes in mill operating practices and shifts in consumer demands placed increasingly stringent demands on cotton.

As a result, both domestic and foreign mills as well as others in various segments of the industry have repeatedly made the following complaints. First, cotton prices and differentials based primarily on grade and staple length no longer accurately reflect differences in use value of cotton. Second, these prices and differentials are not effective economic guides to growers, mills, and others in making business decisions. Third, the present system of pricing and grading encourages farmers and ginners to adopt drying and cleaning

practices that may seriously damage the inherent qualities of cotton, increase mill operating problems and costs, and adversely affect the competitive position of cotton in relation to other fibers.

In response to these complaints and persistent demands for scientific information on this problem, the U.S. Department of Agriculture, in cooperation with the cotton industry, undertook an expanded program of cotton quality evaluation. This report deals with only a small part of this program, which pertains to a group of three closely related studies of the effects of gin drying and lint cleaning on three measures of cotton quality: (1) fiber length distribution, (2) yarn strength, and (3) yarn appearance.

The findings and conclusions in this report were derived from fiber and spinning tests conducted in 1959 and 1960 at the Cotton Quality Research Station in Clemson, S.C. One test was made on Acala 4-42 cotton grown in the San Joaquin Valley, Calif., in 1959. The other two tests were made on DPL cotton grown in the Delta area of Mississippi in 1958 and 1959.

Although the designs of the three tests differ slightly, they are essentially similar. In each test every possible effort was made to hold constant all conditions involved in growing, harvesting, ginning, handling, and spinning of the cotton with the exception of the specific treatments or practices under study. These treatments were carefully controlled at selected gins.

EFFECTS OF DRYING AND LINT CLEANING ON FIBER LENGTH DISTRIBUTION

Fiber length distribution is now recognized as being as important, if not more so, than conventional staple length in its effects on mill operations and costs, and on the quality and value of cotton yarns. Particular attention is being given to both the short and long fiber content of cotton. In effect, this indicates that attention is being focused on deviations from normal length distribution for the particular variety of cotton or area of growth.

The short fiber content of cotton is defined in this study as the percentage of fibers (by weight) shorter than one-half inch as determined by the Suter-Webb Array method. The long fiber content is defined as the percentage of fibers 1 inch long and longer.

Seed cotton drying has been considered as the one factor of major importance which adversely affects staple length as well as other quality attributes when research recommendations are not followed. It was generally agreed that drying aided in improving grade but, if improperly used, could have adverse effects on other quality attributes. However, little attention has been given to the effects of gin cleaning devices upon length and length distribution if they were not used in combination with overdrying. This report presents the effects of both drying and lint cleaning, separately, in combination, and at varying moisture levels, upon measures of fiber length and yarn quality.

In the tests made on cotton grown in the Mississippi Delta in 1958 and 1959, the short fiber content of the ginned lint increased, on the average, about 44 percent under the combined impact of extreme drying and two stages of lint cleaning. Cotton with an average lint-moisture content of 6 percent and no lint cleaning had a short fiber content of 7.8 percent (table 1). But comparable cotton dried to a low lint-moisture level of 2.6 percent and lint cleaned twice had a short fiber content of 11.2 percent. The increase in short fiber was moderately larger in the 1959 test than in 1958, but in both tests the sharp increase was statistically significant (appendix tables 5 and 6).

Table 1.--Fiber length groups: Proportion by weight in ginned lint and card sliver, by moisture and lint cleaning treatments, Yazoo-Mississippi Delta, seasons 1958 and 1959 1/

Lint cleaning treatment	Fibers shorter than 1/2-inch			Fibers 1-inch and longer		
	Moisture of ginned lint		All moisture levels	Moisture of ginned lint		All moisture levels
	6.0 percent	2.6 percent		6.0 percent	2.6 percent	
	Percent	Percent	Percent	Percent	Percent	Percent
Ginned lint						
No lint cleaning	7.8	9.8	8.8	70.5	64.2	67.4
1 lint cleaning	8.3	10.4	9.4	69.6	62.9	66.2
2 lint cleanings	8.7	11.2	10.0	67.8	60.6	64.2
Average	8.3	10.5	9.4	69.3	62.5	65.9
Card sliver						
No lint cleaning	11.9	14.9	13.4	58.3	52.1	55.2
1 lint cleaning	12.6	15.0	13.8	57.2	52.4	54.8
2 lint cleanings	12.9	15.9	14.4	56.3	49.5	52.9
Average	12.5	15.3	13.9	57.2	51.3	54.3

1/ Data for elaborate and moderate overhead seed cotton cleaning combined.

On the average, for all conditions and tests, about two-thirds of the increase in short fibers resulted from drying from 6.0 to 2.6 percent and about one-third from double lint cleaning. However, the two practices have an interacting effect. That is, double lint cleaning had half again as much effect on the increase of short fibers at a low-moisture level as at a high-moisture level.

In the 1958 season, drying from 6.0 to 2.6 percent and lint cleaning reduced the amount of fibers longer than 1 inch in the ginned lint by 8.6 percentage points. This decrease amounted to a 12-percent reduction and compares with a proportionate reduction of 15 percent for 1959. For the 2 years combined, overdrying accounted for three-fifths of the decrease in long fibers, while lint

cleaning accounted for the remainder. Double lint cleaning caused only slightly greater reductions in low-moisture cotton than in cotton dried to a level of 6 percent.

On card sliver, the combined effect of drying lint from 6.0 to 2.6 percent and double lint cleaning increased short fiber content in cotton by 4 percentage points. Of this increase, about three-fourths was attributable to drying. At either moisture level, short fiber content increased 1 percent from two lint cleanings.

Processing through carding at the mill resulted in about the same increase in short fibers as did drying and double lint cleaning combined. Subsequent research indicates that perhaps the increase may be less with metallic cards. The test cottons in this report were on fillet clothed cards.

For both years, drying and lint cleaning accounted for a 15-percent reduction in long fiber content in card sliver. Drying accounted for two-thirds of this decrease. At the 6 percent moisture level, each of the two lint cleaners accounted for equal amounts of decreases in long fiber content, or a total of 4 percent. At the 2.6 percent moisture level, all of the decrease of 5 percent resulted from the second stage of lint cleaning.

CALIFORNIA COTTON

The tests made on Acala 4-42 cotton grown in the San Joaquin Valley, Calif., in 1959 produced results somewhat similar to those obtained in the Mississippi tests. As in the Mississippi tests, drying and lint cleaning sharply increased the short fiber content in both ginned lint and card sliver and decreased the amount of fibers 1-inch and longer (table 2 and appendix table 7). In the California tests, drying from 4.8 to 3.3 percent accounted for only one-half of this change and lint cleaning the remainder, as compared with two-thirds and one-third, respectively, in the tests on Mississippi cotton. This seemingly less impact of drying on fiber length on California cotton may be the result of less drying where lint moisture content ranged from 4.8 percent with no drying down to 3.3 percent, compared with 6.0 to 2.6 percent for Mississippi cotton.

Of particular importance is that the results of all three tests are consistent in that the impact of lint cleaning on measures of fiber length distribution increases as the moisture level of the lint cotton decreases. However, it is equally important that even at the lint-moisture level of 6 percent for Mississippi cotton and 4.8 percent for California cotton, the use of lint cleaners has a large and significantly adverse effect on length distribution. The use of two lint cleaners in both areas increased short fibers 1 percent and decreased long fibers 2.5 to 4.3 percent under the best conditions included in the test.

Some idea of the magnitude of change in the proportion of fibers 1 inch and longer from lint cleaning at the best lint moisture conditions may be obtained if its effect on a mill mix is examined. Specifically, a 40-bale lot of California cotton that has had no lint cleaning would contain 11,696 pounds of long fiber (based on 68.8 percent fibers 1 inch and longer and allowing for a waste factor of 15 percent). If the bales in this lot were subjected to double saw-type lint cleaning, there would be 731 pounds, or approximately 1-1/2 bales less, of fiber 1 inch and longer in the lot (based on 64.5 percent).

Table 2.--Fiber length groups: Proportion by weight in ginned lint and card sliver, by moisture and lint cleaning treatments, San Joaquin Valley, Calif., 1959 season 1/

Lint cleaning treatment	Fibers shorter than 1/2 inch				Fibers 1-inch and longer			
	Moisture of ginned lint			All moisture levels	Moisture of ginned lint			All moisture levels
	4.8 pct.	4.3 pct.	3.3 pct.		4.8 pct.	4.3 pct.	3.3 pct.	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Ginned lint								
No lint cleaning	7.6	8.4	8.9	8.3	68.4	63.5	62.5	64.8
1 lint cleaning	8.2	8.9	9.1	8.7	65.8	62.4	61.9	63.4
2 lint cleanings	8.6	9.4	9.8	9.3	64.1	62.2	60.6	62.3
Average	8.1	8.9	9.3	8.8	66.1	62.7	61.7	63.5
Card sliver								
No lint cleaning	8.8	9.6	11.0	9.8	64.8	58.9	57.8	60.5
1 lint cleaning	9.3	10.0	10.9	10.1	62.2	60.0	57.3	59.8
2 lint cleanings	10.0	10.8	11.9	10.9	60.0	57.8	55.2	57.7
Average	9.4	10.1	11.3	10.3	62.3	58.9	56.8	59.3

1/ Data for elaborate and moderate overhead seed cotton cleaning combined.

Both the lint-cleaned and nonlint-cleaned cotton may be assigned the same staple length by the classer. The lint-cleaned cotton, though, would have a lower proportion of long fibers which contribute to strength, appearance, and spinnability of fiber. The short fiber content, which adversely affects these qualities, would be increased.

The importance of long fibers in cotton is becoming increasingly recognized by both carded and combed yarn manufacturers. Carded yarn manufacturers are placing increased emphasis on length and length distribution for efficient mill operation as well as for better cotton products. Combed yarn manufacturers are also emphasizing these factors as well as striving for lower waste in combing. In addition, considerable evidence exists that increased amounts of medium staple lengths are now being used in combed yarn manufacturing. For example, between 1956 and 1960, reports of mills indicate an increase of almost one-fourth in the proportion of yarn consumed in broad woven goods and thread yarns which was accounted for by combed yarns. 1/ Yet the annual supply of the longer staple lengths has remained relatively stable. The difference must have been made up by increasing use of medium staple length.

1/ Correspondence with American Cotton Manufacturers Institute (in files) dated August 17, 1961.

EFFECTS OF DRYING AND LINT CLEANING ON YARN QUALITY

In each of the three tests included in this study, the cottons were spun into 40s yarn, and evaluations made of yarn strength and yarn appearance. The results indicate that the effect of drying and lint cleaning in both Mississippi and California are somewhat similar (tables 3 and 4).

Break factor for 40s yarn from Mississippi Delta cotton was 2,047 for cotton ginned at 6-percent moisture with no lint cleaning. On the other hand break factor for cotton ginned at a moisture level of 2.6 percent and twice lint cleaned was 1,827. This is a decline of 220 break factor units, or nearly 11 percent. Overdrying was responsible for about 85 percent of this decrease. Although lint cleaning reduces yarn strength somewhat at a high-moisture level, its effect is much greater at a low level of lint moisture.

On California cotton, drying to a level of 3.3 percent and using two lint cleaners reduced the break factor from 2,464 to 2,218. About half this reduction was caused by drying. At either lint-moisture level, two lint cleaners caused a reduction about 100 break factor units.

In both the Mississippi and the California tests, yarn appearance index decreased as the result of overdrying and lint cleaning. The index decreased from 99 to 89 over the full range of treatments on Delta cotton, or about one-half grade. Lint cleaning was responsible for more of the total adverse effect than was drying. For California cotton, the decline in appearance index was much smaller, or from 98 to 92, with drying and cleaning each responsible for about half the reduction.

ECONOMIC IMPLICATIONS

The results of these tests indicate clearly the adverse effects of overdrying as well as lint cleaning at both drying levels on fiber length distribution and yarn quality. Questions are then raised regarding the soundness of pricing policies and some ginning practices. Under price differentials emphasizing grade that have prevailed during most recent seasons, growers have had strong financial incentives to overdry and overclean cotton even when these practices might decrease the use value of their cotton to domestic and foreign mills. Moreover, ginners in mechanized areas particularly, can use cleaning equipment to achieve relatively high grade levels consistent with the color characteristics of the seed cotton as received. In addition, ginners universally recognize that drying not only enhances the capabilities of cleaning machinery to remove foreign matter, but it also imparts a real or apparent improvement in brightness to the color element of grade.

Thus in the short run, growers, individually, actually may increase their net returns by such ginning practices which also lower the end-use value of cotton. If these practices continue for any substantial period, whether justified from a pricing standpoint or not, the demand for cotton may be reduced and prices may be lowered. It is equally difficult under present conditions to guide production and marketing of cotton so that the qualities needed and wanted by mills and consumers are supplied by farmers and intermediate marketing firms.

Table 3.--Yarn strength and appearance: Break factor of 40s yarn and yarn appearance index by moisture and lint cleaning, Yazoo-Mississippi, seasons 1958 and 1959 1/

Lint cleaning treatment	Break factor of 40s yarn			Appearance of 40s yarn		
	Moisture of ginned lint		All moisture levels	Moisture of ginned lint		All moisture levels
	6.0 percent	2.6 percent		6.0 percent	2.6 percent	
	Units	Units	Units	Index	Index	Index
No lint cleaning	2,047	1,877	1,962	99	92	96
1 lint cleaning	2,060	1,871	1,966	88	88	88
2 lint cleanings	2,032	1,827	1,930	88	89	88
Average	2,046	1,858	1,952	92	90	91

1/ Data for elaborate and moderate overhead seed cotton cleaning combined.

Table 4.--Yarn strength and appearance: Break factor of 40s yarn and yarn appearance index by moisture and lint cleaning treatments, San Joaquin Valley, Calif., season 1959 1/

Lint cleaning treatment	Break factor of 40s yarn				Appearance of 40s yarn			
	Moisture of ginned lint			All moisture levels	Moisture of ginned lint			All moisture levels
	4.8 pct.	4.3 pct.	3.3 pct.		4.8 pct.	4.3 pct.	3.3 pct.	
	Units	Units	Units	Units	Index	Index	Index	Index
No lint cleaning	2,464	2,342	2,308	2,371	98	100	97	99
1 lint cleaning	2,423	2,356	2,312	2,364	98	96	95	96
2 lint cleanings	2,372	2,340	2,218	2,310	95	90	92	92
Average	2,420	2,346	2,279	2,348	97	95	95	96

1/ Data for elaborate and moderate seed cotton cleaning combined.

The only solution to this problem is altering the standards to reflect true end-use value. The basis for this approach is now being developed through the tests reported in this publication and in other closely related studies. Much additional research is needed to determine the relationships existing between properties and end-use values of cotton, to develop instruments that can readily measure these attributes, and to introduce the use of these instruments into the marketing system.

However, the cotton trade, and especially domestic and foreign mills, are not helpless in the present situation. Research results to date indicate that in relation to values for mill purposes, grade-price differentials of cotton may be too large, and differentials for staple length may be too small.

This is particularly true where grade has been raised substantially by ginners through overdrying and overcleaning. Although grade is improved, staple length and, more importantly, length distribution, are likely to be adversely affected. Progressive mills are even now taking advantage of certain laboratory instruments to measure these length properties. They are using this information in laying down mixes in the mill. Selecting cotton with suitable length characteristics and controlling fiber length and length distribution in mill mixes pay off in more uniform product quality, in more efficient and economical manufacturing, and sometimes in lower raw cotton costs. Therefore, it is logical that buyers should try to obtain cotton whose fiber length and length distribution are normal for that variety of seed planted under the growing conditions that existed in a given location and season. Thus, more attention would be given to the color element of grade with smaller premiums based on foreign matter differences.

This is not to say that lint should not be cleaned or dried. Cleaning and drying, within certain limits, are necessary. Excessive trash in lint will result in poor spinning performance and ends-down, while underdrying at the gin will result in rough preparation causing excessive losses for the producer and increased manufacturing waste for the spinner.

Farmers and ginners are capable of responding quickly, within limits, to changes in the pricing system. If price differentials were narrowed for grade and widened for staple length, growers and ginners would adjust in the use of drying and cleaning. In the process, growers could receive higher returns per bale while mills may be able to operate cheaper and more efficiently and manufacture better cotton products. Thus, the competitive position of cotton in domestic and foreign markets would be enhanced.

APPENDIX

Table 5.--Effects of ginning treatments on fiber length distribution and yarn quality, Yazoo-Mississippi Delta, season 1958

Ginning treatment	Lint moisture	Fiber length distribution						Yarn quality	
		Ginned lint			Card sliver				
		Fibers shorter than 1/2"	Fibers 1/2"-1"	Fibers 1" and longer	Fibers shorter than 1/2"	Fibers 1/2"-1"	Fibers 1" and longer	40s break factor	40s yarn appearance
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Units	Index
Elaborate overhead:									
No lint cleaning	6.4	8.5	22.6	68.9	12.6	30.3	57.1	1,984	93
1 lint cleaning	6.2	8.6	21.3	70.1	13.3	30.1	56.6	2,083	87
2 lint cleanings	6.0	8.9	23.3	67.8	13.0	31.3	55.7	2,121	90
Average	6.2	8.7	22.4	68.9	13.0	30.6	56.4	2,063	90
No lint cleaning	2.6	10.4	25.2	64.4	15.0	32.1	52.9	1,913	90
1 lint cleaning	2.5	10.7	25.0	64.3	15.7	31.3	53.0	1,877	90
2 lint cleanings	2.7	11.5	28.0	60.5	16.8	33.8	49.4	1,824	87
Average	2.6	10.9	26.1	63.0	15.8	32.4	51.8	1,871	89
Moderate overhead									
No lint cleaning	6.1	9.2	23.4	67.4	13.0	32.3	54.7	2,037	100
1 lint cleaning	6.3	8.6	22.2	69.2	12.2	29.7	58.1	2,060	90
2 lint cleanings	5.5	10.3	25.4	64.3	15.0	31.1	53.9	1,975	83
Average	6.0	9.4	23.6	67.0	13.4	31.0	55.6	2,024	91
No lint cleaning	2.4	10.3	25.1	64.6	15.1	32.8	52.1	1,879	90
1 lint cleaning	2.5	10.8	26.7	62.5	15.3	32.6	52.1	1,899	87
2 lint cleanings	2.7	12.3	29.0	58.7	16.5	34.8	48.7	1,837	87
Average	2.5	11.1	27.0	61.9	15.6	33.4	51.0	1,872	88
	Measure of significance								
Moisture 1/	NS	*	*	*	*	*	*	NS	
Lint cleaners	**	**	**	**	NS	*	*	**	
Moisture x lint cleaners	NS	*	NS	NS	NS	NS	**	NS	
Lint cleaners x overhead	NS	NS	NS	NS	NS	NS	*	NS	
LC x OH x M 2/	NS	NS	NS	NS	NS	NS	**	NS	

*Significant at 5 percent level. **Significant at 1 percent level. NS - Not significant.

1/ Significant at 10 percent level.

2/ Lint cleaners x overhead x moisture.

Table 6.--Effects of ginning treatments on fiber length distribution and yarn quality, Yazoo-Mississippi Delta, season 1959

Ginning treatment	Lint moisture	Fiber length distribution						Yarn quality	
		Ginned lint			Card sliver				
		Fibers shorter than 1/2"	Fibers 1/2"-1"	Fibers 1" and longer	Fibers shorter than 1/2"	Fibers 1/2"-1"	Fibers 1" and longer	40s break factor	40s yarn appearance
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Units	Index
Simple overhead									
No lint cleaning		8.0	22.4	69.6	11.5	29.5	59.0	2,058	103
1 lint cleaning	6.4	9.2	24.7	66.1	13.6	31.3	55.1	2,012	97
2 lint cleanings		8.0	22.9	69.1	13.6	30.3	57.1	2,004	90
Average		8.4	23.3	68.3	12.9	30.4	57.1	2,025	97
No lint cleaning		9.2	25.3	65.5	13.8	33.3	52.9	1,932	93
1 lint cleaning	4.1	8.7	25.0	66.3	14.0	32.4	53.6	1,909	90
2 lint cleanings		9.6	26.0	64.4	14.8	33.3	51.9	1,852	90
Average		9.2	25.4	65.4	14.2	33.0	52.8	1,898	91
No lint cleaning		9.2	25.1	65.7	14.3	33.8	51.9	1,909	93
1 lint cleaning	2.6	9.0	26.1	64.9	14.6	34.8	50.6	1,840	90
2 lint cleanings		11.3	29.9	58.8	16.7	37.2	46.1	1,791	90
Average		9.8	27.1	63.1	15.2	35.3	49.5	1,847	91
Moderate overhead									
No lint cleaning		6.8	20.6	72.6	10.6	28.6	60.8	2,100	103
1 lint cleaning	6.0	6.9	20.1	73.0	11.4	29.1	59.5	2,068	90
2 lint cleanings		7.8	21.7	70.5	11.7	29.5	58.8	2,035	90
Average		7.2	20.8	72.0	11.2	29.1	59.7	2,068	94
No lint cleaning		8.4	25.6	66.0	13.1	31.3	55.6	1,988	100
1 lint cleaning	3.9	9.3	25.4	65.3	12.9	31.2	55.9	1,948	93
2 lint cleanings		9.8	27.9	62.3	13.9	34.3	51.7	1,933	80
Average		9.2	26.3	64.5	13.3	32.3	54.4	1,956	91
No lint cleaning		9.1	26.4	64.5	15.3	33.9	50.8	1,840	93
1 lint cleaning	2.5	10.0	27.8	62.2	14.7	34.8	50.5	1,880	90
2 lint cleanings		10.7	28.7	60.6	15.7	36.6	47.7	1,776	87
Average		9.9	27.6	62.5	15.2	35.1	49.7	1,832	90

Table 6.--Effects of ginning treatments on fiber length distribution and yarn quality, Yazoo-Mississippi Delta, season 1959--Continued

Ginning treatment	Lint moisture	Fiber length distribution						Yarn quality	
		Ginned lint			Card sliver				
		Fibers shorter than 1/2"	Fibers 1/2"-1"	Fibers 1" and longer	Fibers shorter than 1/2"	Fibers 1/2"-1"	Fibers 1" and longer	40s break factor	40s yarn appearance
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Units	Index
Elaborate overhead:									
No lint cleaning		6.8	20.3	72.9	11.3	28.1	60.6	2,068	100
1 lint cleaning	5.9	9.2	24.6	66.2	13.7	31.9	54.4	2,029	87
2 lint cleanings		7.8	23.8	68.4	11.9	31.1	57.0	1,997	90
Average		7.9	22.9	69.1	12.3	30.4	57.3	2,031	92
No lint cleaning		8.2	23.6	68.2	12.8	32.2	55.0	1,972	90
1 lint cleaning	4.0	9.4	27.0	63.6	15.4	35.4	49.2	1,901	90
2 lint cleanings		9.4	25.5	65.1	13.9	31.9	54.2	1,885	90
Average		9.0	25.4	65.6	14.0	33.2	52.8	1,919	90
No lint cleaning		9.5	27.3	63.2	14.3	33.3	52.4	1,876	93
1 lint cleaning	2.6	10.1	27.4	62.5	14.1	31.6	54.3	1,829	87
2 lint cleanings		10.4	27.3	62.3	14.5	33.4	52.1	1,871	97
Average		10.0	27.3	62.7	14.3	32.8	52.9	1,859	92
		Measure of significance							
Lint moisture		**	**	**	**	**	**	**	NS
Overhead		NS	NS	NS	**	NS	*	*	NS
Overhead x moisture		*	*	*	**	**	**	*	NS
Lint cleaners		**	**	**	**	**	**	**	**
Lint cleaners x moisture		*	NS	*	*	*	*	NS	**
Lint cleaners x overhead		NS	**	*	*	*	*	NS	**
LC x O x M 1/		NS	**	**	NS	**	*	*	**

* Significant at 5 percent level. ** Significant at 1 percent level. NS - Not significant.

1/ Lint cleaners x overhead x moisture.

Table 7.--Effects of ginning treatments on fiber length distribution and yarn quality, San Joaquin Valley, Calif., season 1959

Ginning treatment	Lint moisture	Fiber length distribution						Yarn quality	
		Ginned lint			Card sliver				
		Fibers shorter than ½"	Fibers ½" to 1"	Fibers 1" and longer	Fibers shorter than ½"	Fibers ½" to 1"	Fibers 1" and longer	40s break factor	40s yarn appearance
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Units	Index
Elaborate overhead									
No lint cleaning	4.8	7.8	23.5	68.8	8.5	26.1	65.5	2,480	100
1 lint cleaning		8.4	27.0	64.6	9.2	27.6	63.1	2,447	97
2 lint cleanings		8.3	27.2	64.5	9.4	29.3	61.3	2,403	93
Average		8.2	25.9	66.0	9.0	27.7	63.3	2,443	97
No lint cleaning	4.3	8.2	29.0	62.8	9.4	33.3	57.3	2,316	100
1 lint cleaning		8.8	28.7	62.5	10.2	30.7	59.1	2,391	90
2 lint cleanings		9.3	28.5	62.2	11.2	32.3	56.5	2,344	90
Average		8.8	28.7	62.5	10.3	32.1	57.6	2,350	93
No lint cleaning	3.3	8.7	27.9	63.5	10.8	30.9	58.3	2,313	97
1 lint cleaning		9.2	28.5	62.3	10.5	31.0	58.5	2,372	97
2 lint cleanings		9.7	28.9	61.3	12.1	33.5	54.6	2,249	93
Average		9.2	28.4	62.4	11.1	31.8	57.1	2,311	96
Moderate overhead									
No lint cleaning	4.9	7.5	24.4	68.1	9.0	26.9	64.1	2,448	97
1 lint cleaning		8.0	25.0	67.0	9.4	29.4	61.2	2,399	100
2 lint cleanings		8.8	27.5	63.7	10.7	30.6	58.6	2,340	97
Average		8.1	25.6	66.3	9.7	29.0	61.3	2,396	98
No lint cleaning	4.2	8.7	27.1	64.2	9.9	29.5	60.5	2,369	100
1 lint cleaning		9.0	26.6	64.4	9.7	29.5	60.8	2,320	103
2 lint cleanings		9.5	28.2	62.3	10.5	30.4	59.0	2,335	90
Average		9.1	27.3	63.6	10.0	29.8	60.1	2,341	98
No lint cleaning	3.3	9.1	29.3	61.5	11.3	31.4	57.3	2,304	97
1 lint cleaning		9.1	28.8	62.1	11.5	32.5	56.1	2,253	93
2 lint cleanings		9.9	30.3	59.8	11.7	32.5	56.0	2,328	90
Average		9.4	29.5	61.1	11.5	32.1	56.5	2,295	93
		Measure of significance							
Lint moisture		**	**	**	*	*	*	**	NS
Lint cleaning		**	**	**	**	*	**	**	**
Lint cleaners x moisture		NS	*	NS	NS	NS	*	**	NS
Overhead		NS	NS	NS	*	NS	NS	*	NS
Overhead x moisture		NS	NS	NS	*	*	*	NS	NS
LC x OH x LM 1/		NS	NS	NS	*	NS	*	**	NS

*Significant at 5 percent level. **Significant at 1 percent level. NS - Not significant.

1/ Lint cleaners x overhead x moisture.