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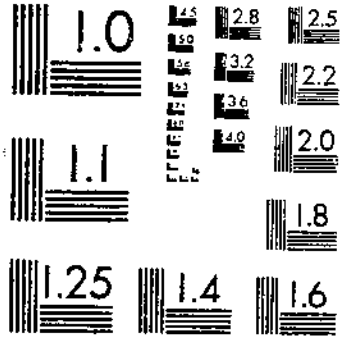

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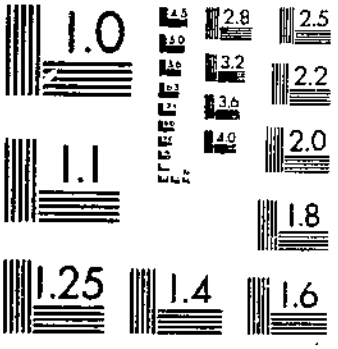

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MULTIPLE LINT-COTTON CLEANING: ITS EFFECT ON BALE VALUE, FIBER QUALITY, AND WASTE COMPOSITION

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MULTIPLE LINT-COTTON CLEANING: ITS EFFECT ON BALE VALUE, FIBER QUALITY, AND WASTE COMPOSITION

By Gino J. Mangialardi, Jr., *research agricultural engineer, Agricultural Engineering Research Division, Agricultural Research Service*

SUMMARY

A study was conducted with the 1967–68 cotton crop on the effects of lint cleaning on bale value, lint quality, and composition of the lint-cleaner waste. Lint cleaners were the controlled-batt saw-cylinder type, adjusted according to manufacturer's recommendations.

Forty-eight machine-harvested bales were processed in six replications of eight bales each. Each replication included two seed-cotton cleaning levels with none, one, two, and three stages of saw-cylinder lint cleaning.

Increasing the number of lint cleaners increased the grade indexes of the cleaned lint. One cleaner gave a highly significant increase, a second gave a further significant increase, but a third did not increase the grade index significantly.

Use of none, one, two, and three lint cleaners gave average staple lengths of 34.93, 34.70, 34.47, and 34.38 thirty-seconds of an inch, respectively, which were highly significant and progressive decreases.

Greater amounts of waste material were extracted by the lint cleaners from the trashier cottons, which had been subjected to less seed-cotton cleaning. Differences in weight between bales after none and one lint cleaner and between bales after one and two lint cleaners were highly significant, while differences between them after two and three lint cleaners were not significant.

Average bale values for cottons after none, one, two, and three stages of lint cleaning were, respectively, $103.25, $108.32, $110.75, and $109.67 at 1967 prices; and $104.54, $110.34, $112.98, and $111.94 at 1970 prices. Use of one lint cleaner increased the value of 75 percent of the bales processed, use of a second lint cleaner further increased the value of 58 percent, and use of a third lint cleaner increased the value of another 25 percent of the bales.

Cumulative efficiency of the cleaners, as shown by nonlint content of the cleaned cotton, for one, two, and three stages averaged 38.8, 56.9, and 67.4 percent, respectively. The decrease in the nonlint content was highly significant after the first lint cleaner, and also after

the second, but not after the third. Individual unit efficiencies for lint cleaners one, two, and three averaged 38.8, 27.8, and 23.8 percent.

Decrease in fiber length with increase in lint cleaning was highly significant. The percentage of fibers longer than 1 inch was reduced from 63.0 to 56.6 percent. Fibers shorter than one-half inch after none, one, two, and three lint cleaners averaged 8.6, 9.8, 10.0, and 10.4 percent, respectively.

Both 22s and 50s yarns were spun. Lint cleaning produced a highly significant effect on spinning performance.

Picker and card waste from none, one, two, and three lint cleaners averaged 9.8, 7.2, 6.0, and 5.8 percent, respectively. The amount of waste was greater from the cotton that started with the higher foreign-matter content.

Lint cleaners increased the neps in the card web. Nep counts for none, one, two, and three lint cleanings averaged 15.0, 22.2, 28.8, and 30.2, respectively.

Yarns decreased slightly but consistently in skein strength with increase in lint cleaners at the gin. Decrease in average break factor was significant after one lint cleaner and highly significant after two. The decrease in break factor of the yarn between use of one and three lint cleaners was significant, but not the decrease between one and two cleaners.

Yarn appearance showed a small but consistent decline with each stage of cleaning added. The decline was slightly greater for the more finely carded 50s yarn than for the 22s yarn. The average appearance after lint cleaning had decreased one-half grade, from C to D+.

Nonlint content of the lint-cleaner waste for one, two, and three stages of lint cleaning averaged 74.5, 69.6, and 67.1 percent, respectively. This first decrease was highly significant, and the second was also significant.

Lint cleaning shifted the fiber-length distribution of waste material toward the shorter fibers. Percentage of fibers longer than 1 inch decreased from 56.3 to 52.1 percent, and the percentage of fibers shorter than one-half inch increased from 10.4 to 12.8 percent. Upper quartile length of waste material averaged 1.211 inches, as compared with 1.222 inches for ginned lint.

REVIEW OF LITERATURE

Although a lint-cotton cleaning patent was issued to Theodorick James in 1842, until 1947 most cleaning in gins was performed on seed cotton (*1*).[1] In 1947 about 2 percent of the U.S. cotton crop was harvested mechanically.

[1] Italic numbers in parentheses refer to Literature Cited, p. 33.

Recognizing the potential for mechanical harvesting and its demand for additional cleaning at gins, the United States Ginning Research Laboratory at Stoneville, Miss., began work on lint cleaning in 1939 (*18*). In 1945 a saw-type cleaning apparatus was built and tested with the 1945 crop. The project leaders, in a laboratory report covering that year's work, described the device as a "vertical transfer gin" and stated that it "comprises two cylinders of closely spaced gin saws mounted in vertical relation, with the saw discs interposed. The lower saw cylinder receives lint cotton from the gin, carries the lint across bar-grid cleaners and into contact with the upper saw cylinder. The lint is then removed or transferred by the upper saw cylinder and subjected to additional mechanical cleaning. The cleaned lint is doffed from the upper saw cylinder by a revolving brush for conveyance to a cotton condenser."

This work resulted in proof testing of a flow-through saw-type lint cleaner during the 1948–49 ginning season. Consistent and significant grade improvements were obtained, but the experiments emphasized that lint cleaning is effective primarily for increasing the value of trashy or machine-harvested cotton. The cleaning process involved blowing the lint past a revolving screen cylinder and delivering it to a saw cylinder, where it was cleaned by a combination of centrifugal force, impact action between saw cylinder and triangularly notched grid bars, and gravity, assisted by an air current. U.S. Public Patent No. 2,569,501 was granted in 1951 to Victor Stedronsky and C. Scott Shaw, employees of the Stoneville Laboratory, for the development of this cleaner.

During this period E. H. Brooks (*2*) developed a controlled-batt unit lint cleaner. The cleaning action of this cleaner is similar to that of the flow-through saw cleaner, except that lint is formed into a batt on the condenser drum. The batt is then fed through one or more sets of compression rollers, passed between a very closely fitted feed roller and feed plate or bar, and fed onto the saw cylinder. Feed roller and feed plate grip the batt so that a combing action takes place as the saw teeth seize the fibers.

By 1951 the amount of the U.S. crop harvested mechanically was 15 percent. This increase in mechanical harvesting was motivated in part by developments in cleaning machinery at gins, particularly lint cleaners.

These advances were followed by the development of the battery type of cleaner by E. E. Moss (*15*). The principle of the battery or bulk cleaner is similar to that of the unit cleaner of Brooks. However, as the name implies, there is one unit machine for each gin stand, whereas the battery cleaner receives lint from two or more gins. The battery cleaner may employ two saw units back-to-back with

a common lint flue. In that way the lint is divided, each saw receiving only half of the cotton. This type of installation is often referred to as a "split stream."

About 1954, D. W. Van Doorn introduced a lint cleaner that relied on air conveyance and was commonly known as an air-jet cleaner (*22*). This flow-through air-type cleaner has no saws, brushes, or moving parts. Air and cotton passing through a duct make a sudden change in direction, and travel across a narrow trash-ejection slot. Foreign matter, which is heavier than lint, is ejected through the slot by centrifugal force.

A study conducted during the 1954–56 seasons in the San Joaquin Valley of California showed that single-stage lint cleaning reduced average bale value when weight losses from lint cleaning were taken into consideration (*17*). This reduction in net bale value from lint cleaning was attributed to the small price differentials between grades during the study seasons. The experiment also showed that saw-type cleaners were more effective in improving the grade of cotton than air-type lint cleaners, but they also removed more weight from the bale. Waste from air-type cleaners contained more than 87 percent actual trash and less than 13 percent lint, while for the controlled-batt saw-type cleaners the ratio was 60:40.

The first tandem saw-cylinder lint cleaner setup consisting of two stages was installed in the Mississippi Delta in the fall of 1955. Tandem lint cleaning results when lint cleaners, either unit or bulk, are placed in series so that the same lint passes through all of them. With two stages of tandem lint cleaning, the fibers do not pass over more than two saw cylinders.

During the 1956–57 season there were 6,836 gin batteries in the United States, of which 51 percent used lint cleaners (*21*). Of the gins using lint cleaners, 79 percent had a single stage, of either the saw-unit or saw-bulk type, 15 percent used a single stage of air-unit lint cleaning, and the remaining 6 percent used two stages of lint cleaning.

Montgomery and Nissing (*14*) conducted two-stage lint-cleaning experiments on the 1956 crop in the Mississippi Delta. Net returns to the producer varied less than $5 per bale between four combinations of two seed-cotton cleaning levels and one and two stages of lint cleaning. However, their calculations did not take into consideration the weight loss of fibers in the lint-cleaning process. The experiments did show a significant increase in nep count and slightly lower yarn appearance attributed to saw-type lint cleaning.

In 1956 Griffin and McCaskill (*8*) obtained results similar to those in the 1954–56 California tests, in that one stage of an air-type lint cleaner was not equivalent to one stage of a saw-cylinder-type lint

cleaner from the standpoint of foreign matter removed and lint grade. In these tests, fiber properties appeared unaffected by an air-type saw-cylinder lint-cleaning combination when compared with saw-cylinder lint cleaning alone.

Looney and Ghetti (*8*), in experiments at east-central Arkansas gins during the 1957–59 seasons, showed that double lint cleaning could give higher returns to growers under certain market and cotton conditions. Their bale values were calculated from grade, staple length, and bale weight. About 60 percent of the total lint-cleaner waste collected during the tests was removed by the first lint cleaner and 40 percent by the second lint cleaner.

In July 1959 total gin batteries in the United States had decreased to 6,368, but 72 percent were now using lint cleaners (*21*). Of those having lint cleaners, 59 percent had facilities for one stage of cleaning, 37 percent had facilities for two stages, and 4 percent of the batteries were processing lint through three stages of lint-cleaning equipment. Machines were now harvesting about one-half of the U.S. cotton crop.

Effects of multiple lint cleaning on bale value, fiber properties, and spinning performance were studied in three major areas during 1960–62 (*9*, *10*, *11*). Lint cleaners in combinations of two or more appeared to be very effective in removing grass from ginned lint. Cyclone collectors were installed at the gins so that waste from each of three saw-cylinder lint-cleaning stages could be collected and weighed separately. These weights were used to calculate bale weights, and the bale weights in combination with grade and staple length were used to determine bale values. Bale values of cotton based on 1961 prices generally remained about constant or tended downward with each successive addition of lint cleaners for the cottons that contained less trash. Bale values were increased by the use of lint cleaners on the cottons that contained a high percentage of foreign matter.

In these studies there was some indication that the staple-length designation increased with lint cleaning. The overall averages of ends-down during spinning indicate that an increase could normally be expected as a result of three stages of lint cleaning. However, the discrepancies in the fiber data and the fact that these effects were not statistically significant indicate that other factors affecting spinning performance were not controlled or measured. Cost for three stages of split-stream cleaning at a ginning rate of six bales per hour and 6,000 bales annual volume was estimated at $2 per bale in 1961. Costs include depreciation, interest on investment, insurance, taxes, power, labor, and repairs. Increases in the price level during the last 10 years would push this cost even higher.

An analysis of these results and a review of other ginning-spinning tests resulted in the adoption of a number of conclusions by the

National Cotton Council's Board of Directors in 1962 (*16*). One of these was, "Therefore, in view of the vital importance of maintaining maximum cotton quality in today's highly competitive textile markets, both here and abroad, no more stages of lint cleaning than are essential to produce maximum bale value should be used."

Effective operation of the lint cleaner depends on, among other things, the condition of the batt, its uniformity and thickness, and the manner in which it is delivered to the saw.

An experiment during the 1964 season showed that lint cleaning was affected by the lint-moisture content (*13*). Experimental results indicated that increasing the fiber-moisture content at lint cleaning decreased the cleaning efficiency of the cleaners. This was also reflected in the grade index. However, the higher moisture contents gave longer staple lengths, and longer 2.5- and 50-percent span lengths.

A 2-year study (1966 and 1967 crops) by Mangialardi (*12*) showed that increasing the lint-cleaner combing ratio by raising the saw-cylinder speed or lowering the feed-roller speed reduced foreign-matter content of the lint significantly and improved classer's grade. However, the increase shifted the fiber-length distribution toward the shorter fibers, gave shorter staple length, and increased neps per 100 square inches of web. For a constant combing ratio, increasing saw speed gave higher lint-cleaning efficiency accompanied by shorter staple lengths and higher nep counts.

In 1967 Griffin and Moore (*4*) demonstrated that two lint cleaners operated in split-stream fashion with twice the normal combing ratio can produce lint of grades equivalent to lint processed on two cleaners in tandem, at no significant increase in fiber damage over that caused by one lint cleaner in conventional operation.

In 1968, 96 percent of the U.S. crop was harvested by machines (*20*). Of the cotton that was mechanically harvested, 71 percent was machine-picked, 28 percent was machine-stripped, and the remaining 1 percent was machine-scrapped.

The total number of gin batteries in the United States had decreased to 4,337 in July 1969 (*21*). Batteries that used lint cleaners numbered 4,278 (99 percent). Of the batteries that had lint cleaners, 22 percent had one stage of cleaning, 60 percent had two stages, 17 percent had three stages, and 33 batteries had facilities for four or more stages of cleaning.

Sale of reclaimed gin motes, a byproduct of cotton ginning that consists of any gin waste usable for its fiber content, may provide increased income for cotton-gin owners. The bedding, automotive, and furniture industries use large quantities of cotton batting composed of about 60 percent linters, and 40 percent cotton waste and motes. Net profits to ginners per 500 pounds during the 1962–63 season

averaged about $13 to $16 for baled motes and $8 for motes sold loose (*6*).

Studies in 1964 (*7*, *23*) showed that cleaning gin-loss cotton on a reclaimer might give higher net returns for this material. Buyers offered an average of 1.5 cents per pound for gin-loss cotton before it was processed and 6.67 cents per pound after it was processed through the reclaimer once. The experimental reclaiming machine used was a commercial saw-type lint cleaner in which the combing ratio and saw were modified. No adverse effect on lint quality could be detected from blending 11 pounds of reclaimed gin-loss cotton into a bale. However, blending reclaimed cotton back into the bale was not deemed feasible as a commercial practice, because it might cause many problems that could more than offset any economic gains. These tests were not designed to consider such problems.

A study of 1966–67 ginnings indicated that if motes must be cleaned to make them marketable, and if the premium is less than 1 cent, the weight loss in cleaning should not exceed 20 percent of the original weight (*5*).

PURPOSE AND SCOPE

The cleaning of lint cotton at the gin is now an accepted practice. Almost 80 percent of gin plants provide facilities for two stages of tandem lint cleaning, while the remainder provide three or four stages. By directional valves, the ginner can control the amount of cleaning he will give a particular cotton.

Research data have shown that, although increasing the number of lint cleaners can give some improvement in grade, the waste removed by the additional cleaning reduces the bale weight and sometimes reduces the bale's cash value. Data on staple length and spinning performance in these experiments showed some discrepancies and were, therefore, nonconclusive.

In view of the penalties imposed on cotton of inferior fiber length and changes in mill requirements, the grower, ginner, and spinner are faced with the problem of determining the amount of lint cleaning that should be specified for their particular requirement. Interest has also been expressed in the value of lint-cleaner waste as additional income to the ginner.

This bulletin provides data for selecting and operating multiple stages of controlled-batt saw-cylinder lint cleaners. This type is used almost exclusively by the ginning industry. The information is needed to predict the extent to which lint cleaning affects bale value, lint quality, and composition of the lint-cleaner waste.

The results presented in this report were obtained from a study on

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the 1967–68 crop conducted at the U.S. Cotton Ginning Research Laboratory, Stoneville, Miss. Cotton used in the experiments was from uniform fields, and all measurements were made using recent research methods.

METHODS

Experimental Procedure

The study used 48 one-bale test lots from the 1967 crop, grown and machine-harvested by the Mississippi Delta Branch Experiment Station and local growers. Harvesting and gin processing were performed in six replications, approximately one replication per week. Harvesting covered a period from October 3 to November 15, which brought in a good representation of the type of cotton normally expected at the gin during a season in the Midsouth. Rains and frost occurred between some of the later replications.

Each replication consisted of eight similar bales of cotton. Two seed-cotton cleaning levels were studied, each of which included none, one, two, and three stages of saw-cylinder lint cleaning (fig. 1).

Two seed-cotton cleaning levels A and B were used to insure that different foreign-matter levels would be available to test the lint cleaning. The ginning sequence for these levels were:

Cleaning level A: Tower drier No. 1, 6-cylinder cleaner, stick machine, tower drier No. 2, extractor feeder, and gin stand.

Cleaning level B: Tower drier No. 1, 6-cylinder cleaner, stick machine, tower drier No. 2, 6-cylinder cleaner, 6-cylinder cleaner, extractor feeder, and gin stand.

An electronic moisture meter aided in adjusting driers for a minimum 6-percent fiber-moisture content at fiber-seed separation.

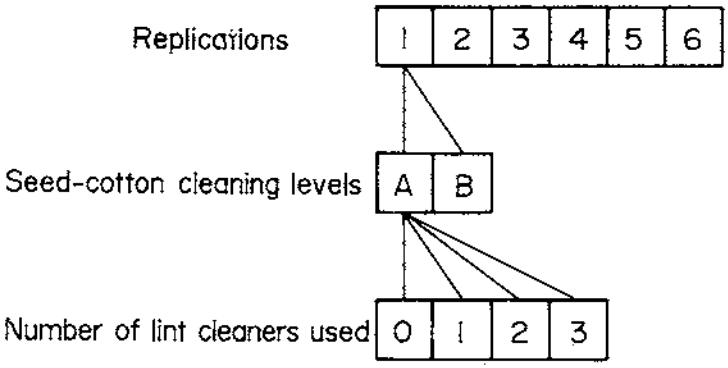

FIGURE 1.—Seed-cotton and lint-cleaner processing plan used in study.

Test lots were assigned to seed-cotton and lint-cleaner treatments in a randomized arrangement to neutralize the effects of processing order. Two commercial models of lint cleaners were used. Where possible each model was assigned to each lint-cleaner combination an equal number of times.

Lint cleaners were adjusted according to manufacturer's recommendations. Saw-cylinder tip speed covered a 3,771- to 4,528-feet-per-minute range, and the combing ratio varied from 23:1 to 25.1:1. Ginning rate was such that feed rate to the lint cleaners varied from 32.1 to 36.1 pounds of lint per hour per inch of saw-cylinder length.

The packaged bales and the waste materials removed by the lint-cleaning treatments were weighed. Waste material was collected at a condenser covered with a 100-mesh screen (fig. 2).

For each lint-cleaner combination, samples were obtained for (1) moisture and foreign-matter contents of the seed cotton before and after cleaning; (2) lint and seed-moisture levels at ginning; (3) nonlint content, grade, staple length, fiber maturity, length tests, and spinning performance; and (4) nonlint content and fiber length of lint-cleaner waste.

Methods of Determination

Bale Value

Bale value was calculated from the cotton's grade and staple length, bale weight, and price per pound. Classing samples were obtained at the lint slide. Bale weights were adjusted so that a 500-pound gross-weight bale would be packaged after three stages of lint cleaning. The price per pound was based on the 1967 and 1970 U.S. Department of Agriculture Commodity Credit Corporation's loan rate for warehouse-stored cotton at selected points. Bale-weight adjustments were based on the weight of the packaged bale, lint sampled, and waste removed by the lint cleaners.

Fiber Quality

Seed-cotton, cottonseed, and lint were sampled for moisture content and the seed cotton for foreign-matter content. This was to determine the level of experimental control maintained before lint cleaning and to record a history of the cotton. Moisture contents were determined by the oven method and seed-cotton foreign-matter content by the fractionation procedure.

Fiber-quality measurements included nonlint content, maturity and fineness, fiber-length distribution, and spinning performance. Nonlint or foreign-matter content were determined by the Shirley Analyzer method, maturity and fineness by Causticaire and Micronaire tests, fiber-length distribution by both the Digital Fibrograph instrument

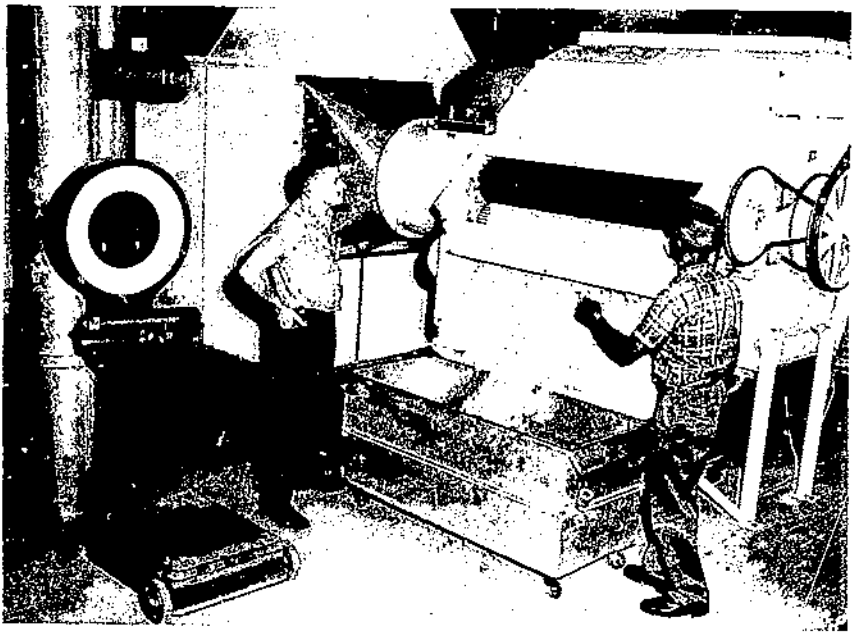

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FIGURE 2.—Collecting lint-cleaner waste material for weighing and sampling.

and Suter-Webb Sorter, and spinning performance by small-scale spinning (5 pounds) in accordance with standard laboratory and ASTM procedures.

From nonlint content was calculated lint-cleaner cleaning efficiency. Cleaning efficiency is the ratio of nonlint material removed from cotton to the nonlint content of cotton as it entered the lint cleaner or combination of lint cleaners.

Fiber and spinning tests were conducted by the U.S. Department of Agriculture's Consumer and Marketing Service at Clemson, S.C. Digital Fibrograph length values obtained were 2.5-percent span length, 50-percent span length, and length uniformity ratio. The array distribution tests produced length measurements for upper quartile length, mean length, coefficient of length variation, percentage of fibers longer than 1 inch, percentage of fibers ½ to 1 inch, and percentage of fibers shorter than one-half inch.

Two laboratory yarn numbers, 22s and 50s, were spun, using a standard organization. A carding rate of 9.5 pounds per hour was used with a twist multiplier of four. Spinning test results were obtained for manufacturing waste, neps in card web, and carded yarn strength and appearance.

Waste Composition

Foreign matter was separated from the lint portion of the lint-cleaner waste by the Shirley Analyzer. Lint contained in the waste was tested by the Suter-Webb Array method for length distribution. Length distribution included upper quartile length, mean length, coefficient of length variation, percentage of fibers longer than 1 inch, percentage of fibers ½ to 1 inch, and percentage of fibers shorter than one-half inch.

EXPERIMENTAL RESULTS

Preprocessing Cotton

Seed-Cotton Data

Moisture determinations showed that the wagon seed-cotton moisture level averaged 12.5, 10.8, 9.7, 11.1, 8.4, and 8.6 percent for replications 1, 2, 3, 4, 5, and 6, respectively (table 12). Corresponding moisture contents at the feeder apron, after the cotton had passed through the seed-cotton drying and cleaning machinery, decreased to 10.9, 9.2, 8.8, 8.4, 8.5, and 8.1 percent (table 13).

Fractionation tests gave wagon seed-cotton foreign-matter contents of 8.0, 7.2, 3.3, 4.3, 5.0, and 11.1 percent for replications 1, 2, 3, 4, 5, and 6, respectively (table 14). Seed-cotton cleaning levels A and B reduced the foreign-matter content at the feeder apron to 2.1 and 1.8 percent, respectively (table 15).

Cottonseed Data

Cottonseed-moisture contents during ginning averaged 12.3, 11.2, 9.5, 9.8, 9.7, and 8.8 percent for samples processed for replications 1, 2, 3, 4, 5, and 6, respectively (table 16).

Lint-Moisture Content

Samples taken between the gin stand and first lint cleaner showed an average lint-moisture level of 7.3, 5.9, 6.0, 4.9, 5.0, and 5.7 percent for lint processed for replications 1, 2, 3, 4, 5, and 6, respectively. These moisture levels are below the 7 to 7.5 percent recommended for maintaining overall cotton quality. When test lots for each replication were assigned to cleaning treatments in a random manner, the results showed no significant individual differences in moisture content of cotton assigned to the different seed-cotton or lint-cleaning series (table 17).

Bale Value

Classer's Grade

Seed-cotton cleaning treatment B gave a slightly higher grade index than seed-cotton cleaning treatment A (tables 1 and 18). Cleaning

TABLE 1.—*Classer's grade index, grade designation, and staple length for ginned lint samples after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 18, 19, and 20 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used				
	None	1	2	3	Average
Grade index:					
A	87.0	91.4	94.7	95.8	92.2
B	88.8	92.8	95.4	96.1	93.3
Average [1]	87.9	92.1	95.0	96.0	----
Grade designation:					
A	LM	LM+	SLM	SLM+	SLM
B	LM+	SLM	SLM	SLM+	SLM
Average	LM+	SLM	SLM	SLM+	----
Staple length (1/32 in.):					
A	34.83	34.60	34.37	34.40	34.55
B	35.03	34.80	34.57	34.37	34.69
Average [1]	34.93	34.70	34.47	34.38	----

[1] Differences attributed to number of lint cleanings are significant at the 1-percent level.

treatment B gave a one-half grade increase over cleaning treatment A at the no-lint-cleaner and one-lint-cleaner stage, but no grade increase at the two- and three-lint-cleaners stages (table 19).

Increasing the number of lint cleaners gave a highly significant increase in the grade index of the cleaned lint. One lint cleaner gave a highly significant grade index increase, and two lint cleaners gave further significant increases. No further significant increase in grade index was obtained by adding the third lint cleaner.

For seed cotton at cleaning level A, the three stages of lint cleaning increased the grade from Low Middling to Strict Low Middling plus. This was an increase of about one-half grade per lint cleaner added. The grade for seed cotton at cleaning level B was Low Middling plus before the lint cleaners were used on it. Treatment with three lint cleaners increased its grade to Strict Low Middling plus, the same grade as was achieved with the treatment A seed cotton after the three lint cleaners.

Classer's Staple Length

Highly significant and progressive decreases in staple length were attributed to increases in number of lint cleaners used (table 20). The no-lint-cleaner and the one-, two-, and three-lint-cleaners treatments gave average staple lengths of 34.93, 34.70, 34.47, and 34.38 thirty-seconds of an inch.

No significant staple-length differences were obtained between no lint cleaners and one lint cleaner. However, two lint cleaners gave a highly significant decrease, and three lint cleaners gave further significant decreases.

Bale Weight

Seed-cotton cleaning level A gave average adjusted bale weights of 537, 516, 506, and 500 pounds for the none, one, two, and three stages, respectively, of lint cleaning (tables 2 and 21). Corresponding bale weights for seed-cotton cleaning level B averaged 533, 514, 505, and

TABLE 2.—*Weight and value per bale of ginned lint after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 21, 23, and 24 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
Weight of bale (pounds):				
A	537	516	506	500
B	533	514	505	500
Average [1]	535	515	506	500
Value at 1967 prices (dollars):				
A	102.04	106.31	109.14	109.67
B	104.46	110.32	112.35	109.67
Average [1]	103.25	108.32	110.74	109.67
Value at 1970 prices (dollars):				
A	103.33	108.46	111.55	111.71
B	105.75	112.21	114.42	112.17
Average [1]	104.54	110.34	112.98	111.94

[1] Differences attributed to number of lint cleanings are significant at the 1-percent level.

500 pounds, the lint cleaners removing a slightly but not significantly smaller amount of material from the cleaner cotton.

Differences in bale weight between none and one lint cleaner and between one and two lint cleaners were highly significant, while differences between two and three lint cleaners were not significant.

Value per Bale

1967 prices.—The 1967 CCC loan price was 20.65 cents per pound for Middling grade and 1-inch staple length (table 22). The average bale values for none, one, two, and three stages of lint cleaning were $103.25, $108.32, $110.75, and $109.67, respectively (table 23). For the 12 bales processed with each lint-cleaner treatment, one lint cleaner increased the bale value on nine bales, or 75 percent of the time, over that of the no-lint-cleaner cotton. Two lint cleaners increased the bale value again for seven bales, or 58 percent of the time, over that of the one-lint-cleaner cotton. Three lint cleaners increased the bale value yet again on three bales, or 25 percent of the time, over that of the two-lint-cleaners cotton (fig. 3).

Statistically the two-lint-cleaners treatment gave highly significant bale-value increases over the no-lint-cleaner cotton. Differences between treatment with one, two, and three lint cleaners were not significant.

1970 prices.—The 1970 loan price was 20.50 cents per pound for Middling grade and 1-inch staple length. Bale values averaged $104.54, $110.34, $112.98, and $111.94 for none, one, two, and three

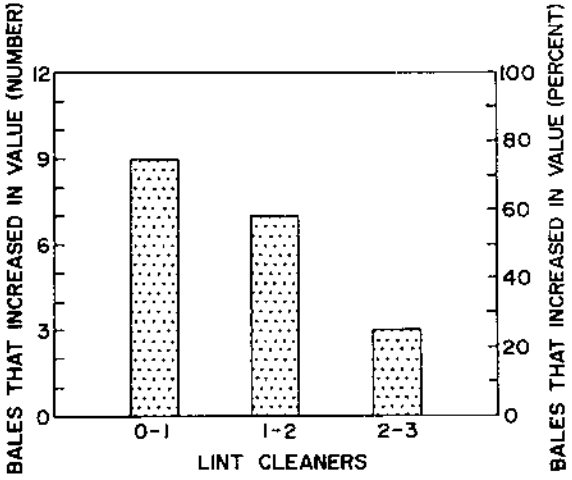

FIGURE 3.—Number and percent of bales of cotton that increased in bale value, according to 1967 and 1970 prices, when another treatment with a saw-cylinder lint cleaner was added to the treatment sequence.

stages of lint cleaning (table 24). Bale-value increases were again obtained 75 percent of the time when using one lint cleaner instead of no lint cleaning, 58 percent of the time when using two lint cleaners rather than one cleaner, and 25 percent of the time when using three lint cleaners rather than two cleaners (fig. 3).

Statistically, one lint cleaner gave significant bale-value increases over those for the no-lint-cleaner cotton. No further significant increase in bale value was obtained when using two or three lint cleaners.

Fiber Quality

Nonlint Content

Nonlint content for the study, as measured by the Shirley Analyzer, averaged 3.92 percent for seed-cotton cleaning level A and 3.38 percent for cleaning level B (tables 3 and 25). The decrease was statistically significant.

One lint cleaner gave a highly significant decrease in the nonlint content, and two lint cleaners gave further highly significant decreases. Nonlint content differences between two and three lint cleaners were not significant.

Cleaning Efficiency

Nonlint content, presented as cleaning efficiency, showed that the cumulative efficiency for one, two, and three stages averaged 38.8 percent, 56.9 percent, and 67.4 percent, respectively (table 26). Efficiency differences between one and two lint cleaners and between two and three cleaners were highly significant.

These data were fitted to the curvilinear regression equation relating cleaning efficiency to total stages of lint cleaning: Log $Y=1.592+0.508 \log X$, where

Y=cumulative cleaning efficiency, and
X=number of lint-cleaning stages.

The correlation coefficient (r) for the equation was found to be 0.998, indicating a very high correlation between the number of stages of lint cleaning and the quantity of foreign matter removed from the cotton (fig. 4).

When three lint cleaners were operated in succession, the cleaning efficiency for the individual lint cleaners declined with each subsequent stage (table 27). Unit efficiencies for lint cleaners one, two, and three averaged 38.8, 27.8, and 23.8 percent, respectively. Although the average unit-efficiency difference between the first and second lint cleaner was not significant statistically, the further decrease for the third cleaner was significant. The average unit cleaning efficiency for all treatments was 30.1 percent.

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TABLE 3.—*Nonlint content in ginned lint samples and lint-cleaner efficiency after experimental saw-cylinder lint cleaning*

[This table is a summary of tables 25, 26, and 27 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
Nonlint content: [1]	*Percent*	*Percent*	*Percent*	*Percent*
A	6.77	4.12	2.67	2.12
B	5.62	3.40	2.61	1.86
Average [2]	6.20	3.76	2.64	1.99
Cumulative cleaning efficiency:				
A		39.1	60.0	68.2
B		38.5	53.8	66.7
Average [2]		38.8	56.9	67.4
Unit cleaning efficiency by lint-cleaner position:				
A		39.1	33.5	20.7
B		38.5	22.0	27.0
Average [3]		38.8	27.8	23.8

[1] Shirley Analyzer.

[2] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

[3] Differences attributed to number of lint-cleaning stages are significant at the 5-percent level.

Fiber Maturity and Fineness

Maturity tests on samples taken from ginned lint indicated that late-season harvestings resulted in lower Causticaire and Micronaire readings. For replications 1, 2, 3, 4, 5, and 6, the Causticaire maturity index averaged 81, 79.4, 77.9, 76.8, 68.9, and 73.9 percent; the corresponding Causticaire fineness averaged 5.2, 5.0, 4.5, 4.4, 3.2, and 3.8 micrograms per inch (table 28); and the corresponding Micronaire readings were 5.0, 4.8, 4.4, 4.1, 3.1, and 3.6.

Fiber-Length Distribution

Both the Digital Fibrograph and Suter-Webb Array methods showed that none of the length parameters measured were significantly

affected by the seed-cotton cleaning treatments. However, all parameters indicated a highly significant decrease in fiber length when the amount of lint cleaning was increased.

Span length 2.5 percent.—The none, one, two, and three stages of saw-cylinder lint cleaning gave average 2.5-percent span lengths of 1.118, 1.114, 1.102, and 1.100 inches, respectively (tables 4 and 29). Decrease in 2.5-percent span length with the use of 1 lint cleaner was not significant statistically, but the further decrease for two cleaners was significant, and the decrease with use of three cleaners was highly significant.

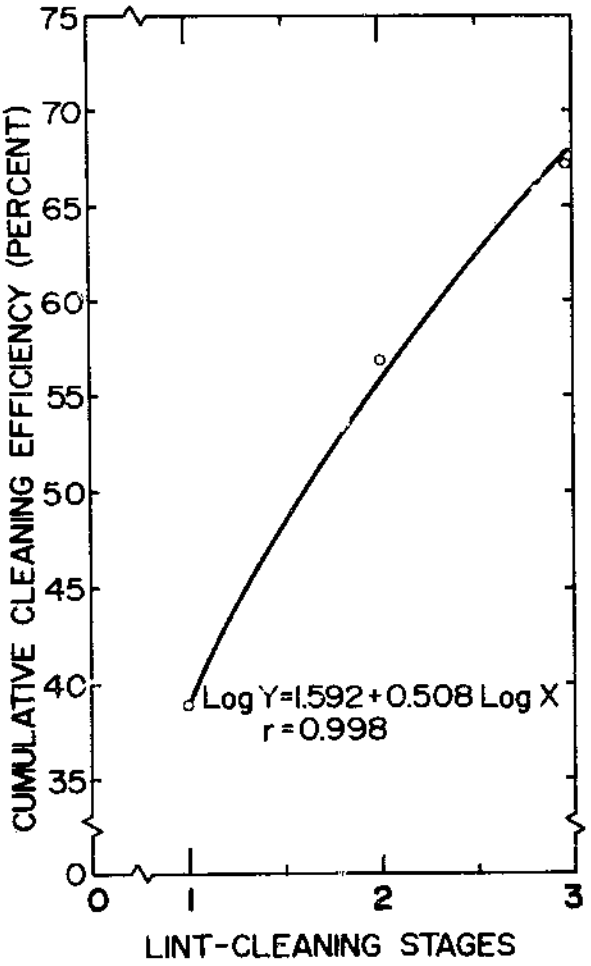

FIGURE 4.—Cumulative cleaning efficiency of number of stages of saw-cylinder lint cleaning in reducing the nonlint content of seed cotton.

TABLE 4.—*Span lengths and uniformity ratio of lengths for lint samples after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 29, 30, and 31 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
2.5 percent span length [1] (inches):				
A	1.127	1.117	1.100	1.097
B	1.110	1.112	1.103	1.103
Average [2]	1.118	1.114	1.102	1.100
50 percent span length [1] (inch):				
A	0.512	0.500	0.485	0.487
B	.503	.495	.482	.485
Average [2]	.508	.498	.484	.486
Uniformity ratio of length (percent):				
A	45.3	44.7	44.2	44.3
B	45.2	44.7	43.7	44.0
Average [2]	45.2	44.7	44.0	44.2

[1] Measured by Digital Fibrograph.

[2] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

Span length 50 percent.—Average 50-percent span lengths obtained were 0.508, 0.498, 0.484, and 0.486 inch for the no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments, respectively (table 30). Length differences between no lint cleaning and one cleaner were significant, differences between one and two cleaners highly significant, and differences between two and three lint cleaners were not significant.

Uniformity ratio.—Uniformity ratio of length averaged 45.2, 44.7, 44.0, and 44.2 percent for the no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments, respectively (table 31). Uniformity ratio differences between the no-lint-cleaning and one-cleaner treatments were not significant, but the further decrease for two cleaners was highly significant. Differences between two- and three-cleaners treatments were not significant.

Upper quartile length.—Upper quartile length of fibers after no lint cleaning, one cleaner, two cleaners, and three lint cleaners averaged 1.236, 1.226, 1.215, and 1.212 inches, respectively (tables 5 and 32). Decrease in these lengths for one lint cleaner was not significant, but the further decrease for two cleaners was highly significant. Length differences between treatments with two and three cleaners were not significant.

Mean length.—The no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments gave average mean lengths of 1.019, 0.996, 0.986, and 0.979 inches, respectively (table 33). Mean length decrease for one lint cleaner was highly significant, the further decrease for two cleaners was not significant, and three lint cleaners gave still further highly significant decreases.

Coefficient of variation in length.—Coefficient of variation data

TABLE 5.—*Upper quartile length, mean length, and coefficient of variation in length for lint samples after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 32, 33, and 34 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
Upper quartile length (inches):				
A	1.243	1.227	1.213	1.213
B	1.230	1.226	1.217	1.210
Average [1]	1.236	1.226	1.215	1.212
Mean length (inches):				
A	1.025	0.998	0.990	0.982
B	1.013	.994	.982	.976
Average [1]	1.019	.996	.986	.979
Coefficient of variation in length (percent):				
A	29.6	31.1	30.8	31.6
B	29.4	31.0	32.1	31.7
Average [1]	29.5	31.0	31.4	31.6

[1] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

indicated some increase in the variability of the length of the fibers with increase in the amount of lint cleaning. Coefficients for no lint cleaning, one cleaner, two cleaners, and three lint cleaners averaged 29.5, 31.0, 31.4, and 31.6 percent, respectively (table 34).

Increase in coefficient of variation in length with one lint cleaner was highly significant. However, the further increases for two and three lint cleaners were not significant.

Percentage of fibers longer than 1 inch.—Increasing the amount of lint cleaning reduced the percentage of fibers longer than 1 inch, from 63.0 to 56.6 percent (fig. 5, tables 6 and 35). The decrease in percentage of long fibers for one lint cleaner was highly significant. Although the further decrease for two lint cleaners was not significant, the greater decrease in long-fiber content for three lint cleaners was significant.

Percentage of fibers ½ to 1 inch.—Percentage of fibers ½ to 1 inch increased with lint cleaning (table 36). The increase in percentage with one lint cleaner was highly significant. The further increase with two cleaners was not significant, but the greater increase with three lint cleaners was significant.

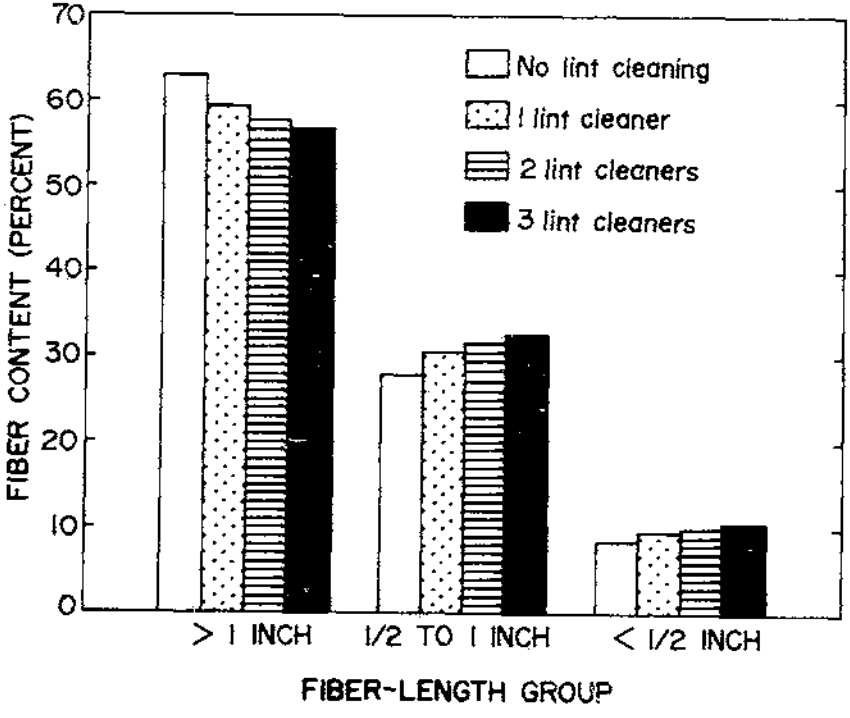

FIGURE 5.—Fiber-length distribution of ginned lint as affected by amount of lint cleaning.

TABLE 6.—*Percentage of fibers longer than 1 inch, ½ to 1 inch, and shorter than one-half inch in lint samples after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 35, 36, and 37 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
Fibers longer than 1 inch:	*Percent*	*Percent*	*Percent*	*Percent*
A	63.4	59.5	58.2	56.8
B	62.5	58.7	57.1	56.5
Average [1]	63.0	59.1	57.6	56.6
Fibers ½ to 1 inch long:				
A	27.6	30.2	31.6	32.3
B	28.2	31.1	31.8	32.4
Average [1]	27.9	30.6	31.7	32.4
Fibers shorter than ½ inch:				
A	8.4	9.8	9.6	10.3
B	8.7	9.7	10.5	10.5
Average [1]	8.6	9.8	10.0	10.4

[1] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

Percentage of fibers shorter than one-half inch.—The short-fiber content after no lint cleaning, one cleaner, two cleaners, and three lint cleaners averaged 8.6, 9.8, 10.0, and 10.4 percent, respectively (table 37). Increase in short-fiber content for one cleaner was highly significant, but the further increases for two and three lint cleaners were not statistically significant.

Spinning Performance

The greater amount of seed-cotton cleaning for level B produced lower 22s yarn appearance indexes and average appearance indexes than those obtained with seed-cotton cleaning level A, and this was highly significant statistically. However, other spinning parameters measured were not significantly affected by seed-cotton cleaning treatment.

All spinning data showed that changing the number of lint-cleaning

stages produced a highly significant effect on spinning performance. Spinning end breakage was observed on 50s carded yarn and classed as *LOW* for all treatments (table 41).

Manufacturing waste.—The percentage of waste extracted by the picking and carding processes averaged 7.4 percent for seed-cotton cleaning level A and 6.9 percent for cleaning level B (tables 7 and 38). This was a slight but not significantly greater amount of waste extracted from the more trashy cotton. Picker and card waste for the no-lint-cleaner, one-cleaner, two-cleaners, and three-lint-cleaners stages averaged 9.8, 7.2, 6.0, and 5.8 percent, respectively. The picking and carding processes again had removed a greater amount of waste from the cotton with the higher foreign-matter content.

Decrease in manufacturing waste for one lint cleaner was highly significant, and two lint cleaners gave further significant decrease. Manufacturing waste difference between the use of two and three lint cleaners was not significant.

Neps in card web.—Increasing the number of lint cleaners gave a consistent and accumulated increase in the number of neps in the card web (fig. 6 and table 39).

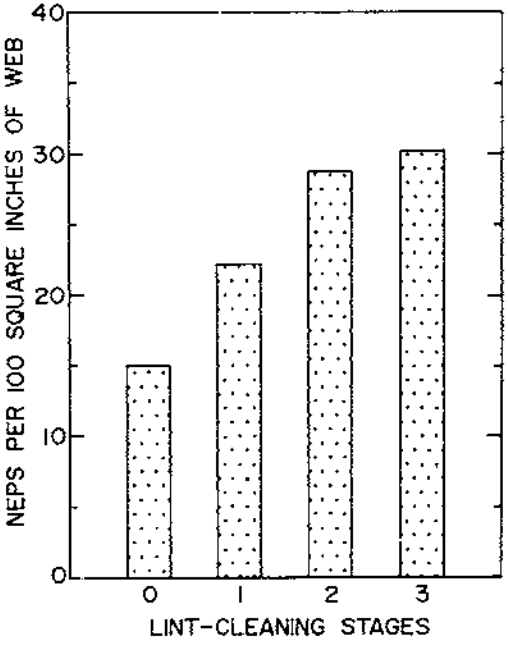

FIGURE 6.—Neps per 100 square inches of card web, as affected by number of lint-cleaning stages.

TABLE 7.—*Manufacturing waste, neps in card web, and strength of carded cotton yarns after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 38, 39, 40, 41, and 42 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
Manufacturing waste [1] (percent):				
A	10.1	7.6	6.1	6.0
B	9.4	6.8	5.8	5.6
Average [2]	9.8	7.2	6.0	5.8
Neps per 100 square inches of card web (number):				
A	12.7	23.2	27.8	30.0
B	17.2	21.3	29.7	30.3
Average [2]	15.0	22.2	28.8	30.2
Skein strength of 22s yarn (pounds):				
A	109.0	105.7	104.8	105.2
B	109.0	107.2	106.0	105.2
Average [2]	109.0	106.4	105.4	105.2
Skein strength of 50s yarn (pounds):				
A	39.5	37.8	36.7	36.7
B	38.7	39.0	37.3	37.2
Average [2]	39.1	38.4	37.0	37.0
Average break factor of yarn: [3]				
A	2,187	2,108	2,070	2,074
B	2,178	2,154	2,099	2,086
Average [2]	2,182	2,131	2,085	2,080

[1] Picker and card waste.

[2] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

[3] Break factor is obtained by multiplying the yarn skein strength by the yarn number and averaging these values for the two standard yarn numbers (22s and 50s) spun.

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Nep count for the no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments averaged 15.0, 22.2, 28.8, and 30.2, respectively.

The number of neps counted after one lint cleaner was not significantly higher than that for no lint cleaner, but the total increase after two lint cleaners was highly significant. Nep count differences between one and three lint cleaners were also significant.

Yarn strength.—Yarns produced in the spinning tests showed a slight but consistent decrease in skein strength with increase in number of lint cleaners used at the gin.

Carded 22s skein strength averaged 109.0, 106.4, 105.4, and 105.2 pounds for the no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments, respectively (table 40). The decrease in skein strength after one lint cleaner was significant, and the larger decrease after two cleaners was highly significant. No further significant decrease was obtained when the third lint cleaner was added.

Skein strength for carded 50s yarn averaged 39.1, 38.4, 37.0, and 37.0 pounds for no lint cleaning, and one, two, and three stages of lint cleaning, respectively (table 41). Decrease in skein strength after one lint cleaner was not significant statistically, but the further decrease after two lint cleaners was highly significant. No significant differences were measured between the skein strengths after two and after three lint cleaners.

Yarn average break factor, obtained by multiplying the yarn strength by the yarn number and averaging these values for the two standard yarn numbers spun, decreased with each stage of lint cleaning added. Break factor for no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments averaged 2,182; 2,131; 2,085; and 2,080, respectively (fig. 7 and table 42).

The decrease in average break factor after one lint cleaner was significant, and the decrease after two lint cleaners was highly significant. Break factor after three lint cleaners was significantly lower than that after one cleaner but not significantly lower than that after two lint cleaners.

Yarn appearance.—Yarn appearance was affected adversely by lint-cleaner treatment. Lint cleaning gave a small but consistent decline in yarn appearance with each stage of cleaning added.

Carded 22s yarn appearance index averaged 91.6, 88.3, 87.5, and 82.5 for the no-lint-cleaning, one-cleaner, two-cleaners, and three-lint-cleaners treatments (tables 8 and 43). Decreases in appearance index after one and two lint cleaners were not significant statistically, but the decrease after three cleaners was highly significant. The overall grade reduction after three stages of lint cleaning was about one-half grade, decreasing from C to D+.

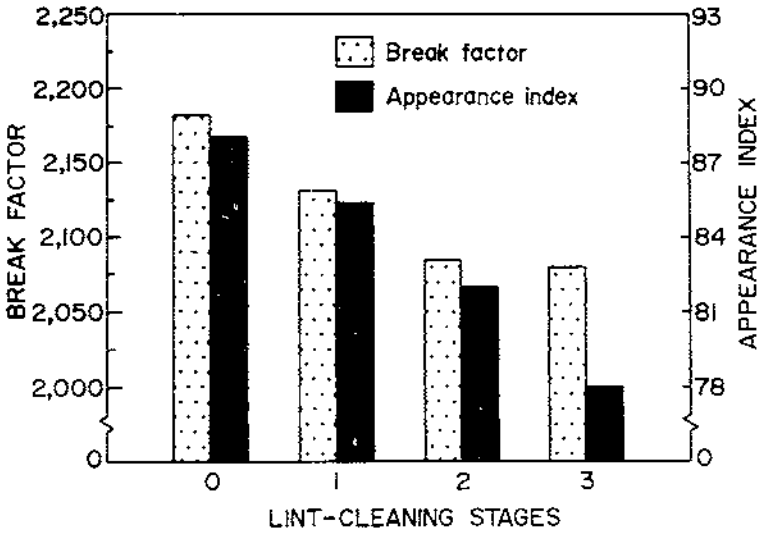

FIGURE 7.—Effect of lint-cleaning stages on the average break factor and average appearance index for the two standard yarn numbers (22s and 50s) spun.

The decline in appearance index with lint cleaning was slightly greater for the finer carded 50s yarn than for the 22s yarn. Appearance index of the 50s yarn averaged 84.2, 82.5, 76.7, and 73.4 after no lint cleaner, one cleaner, two cleaners, and three lint cleaners, respectively (table 45). The average decline in the index after two lint cleaners was highly significant, as was the decline between one and three cleaners. Total grade reduction with lint cleaning was slightly more than one-half grade, as the grade decreased from D+ to D.

Average appearance indexes for the two standard yarn numbers (22s and 50s) spun were 88.0, 85.4, 82.0, and 78.0 for no lint cleaning, one cleaner, two cleaners, and three lint cleaners (table 47). The decline in appearance index with two stages of lint cleaning was highly significant statistically, and the further decline with three cleaners was also significant. Total average appearance grade after lint cleaning was reduced one-half grade, from C to D+.

Waste Composition

Waste Weight

A slightly but not significantly greater amount of waste material was removed by the lint cleaners from cotton that had received the lesser amount of seed-cotton cleaning. Waste material extracted per bale by one, two, and three stages of lint cleaning averaged 21, 31, and

TABLE 8.—*Appearance index and grade of carded cotton yarns after experimental saw-cylinder lint cleanings*

[This table is a summary of tables 43, 44, 45, 46, 47, and 48 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used			
	None	1	2	3
Yarn appearance index:				
22s yarn:				
A	93.3	88.3	90.0	86.7
B	90.0	88.3	85.0	78.3
Average [1]	91.6	88.3	87.5	82.5
50s yarn:				
A	85.0	81.7	76.7	76.7
B	83.3	83.3	76.7	70.0
Average [1]	84.2	82.5	76.7	73.4
Average for both yarns:				
A	89.2	85.0	83.3	81.7
B	86.7	85.8	80.8	74.2
Average [1]	88.0	85.4	82.0	78.0
Yarn grade:				
22s yarn:				
A	C	C	C	C
B	C	C	C	D+
Average	C	C	C	D+
50s yarn:				
A	C	D+	D+	D+
B	D+	D+	D+	D
Average	D+	D+	D+	D
Average for both yarns:				
A	C	C	D+	D+
B	C	C	D+	D
Average	C	C	D+	D+

[1] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

37 pounds for seed-cotton cleaning level A and 19, 28, and 33 pounds for cleaning level B (tables 9 and 49).

Differences in waste per bale between the use of one and two lint cleaners were highly significant, while differences between two and three lint cleaners were not significant. These data were fitted to the curvilinear regression equation relating amount of waste extracted to total stages of lint cleaning: Log $Y=1.305+0.521$ log X, where

Y=amount of waste material extracted, and

X=number of lint-cleaning stages.

The correlation coefficient (r) for the equation was found to be 0.996 (fig. 8).

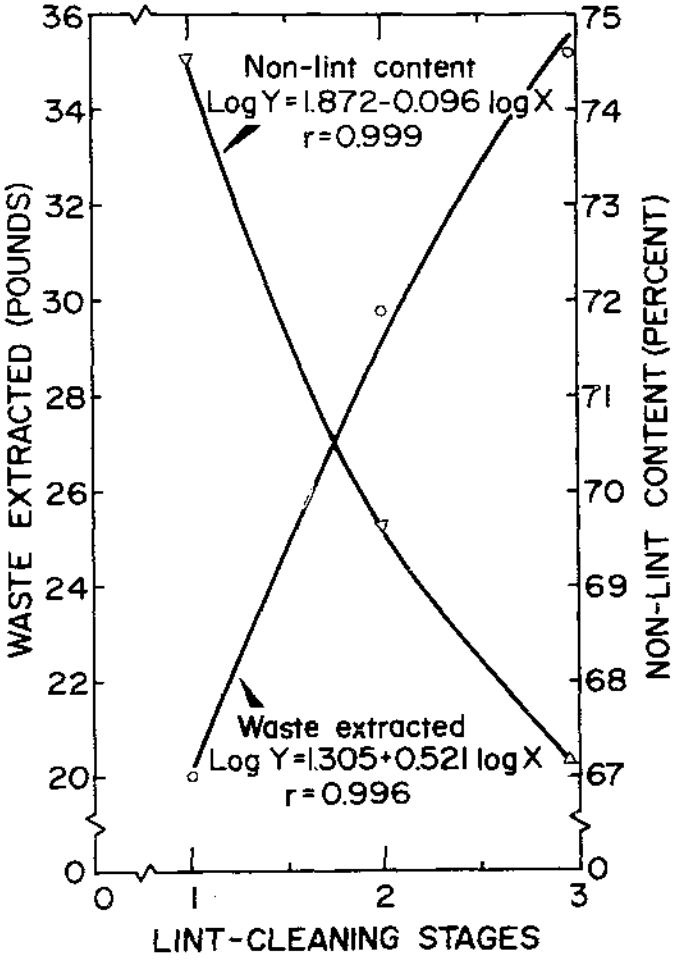

FIGURE 8.—Total waste extracted by saw-cylinder lint cleaners used in the experiments, and the nonlint content of this material.

TABLE 9.—*Nonlint content of waste material and weight extracted per bale during experimental saw-cylinder lint cleanings*

[This table is a summary of tables 49 and 50 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used		
	1	2	3
Nonlint content [1] (percent):			
A	76.10	71.52	68.46
B	72.94	67.73	65.78
Average [2]	74.52	69.62	67.12
Weight extracted per bale (pounds):			
A	21.3	31.3	37.3
B	18.8	28.2	33.0
Average [2]	20.0	29.8	35.2

[1] Shirley Analyzer.

[2] Differences attributed to number of lint-cleaner stages are significant at the 1-percent level.

Nonlint Content

The percentage of nonlint material in the waste was determined with the Shirley Analyzer. It was less for the cotton that had received the higher degree of seed-cotton cleaning (table 50). This was highly significant and indicates that lint cleaners remove a greater percentage of lint from the cleaner cottons.

Nonlint content of the lint-cleaner waste for one, two, and three stages of lint cleaning averaged 76.1, 71.52, and 68.46 percent for seed-cotton cleaning level A and 72.94, 67.73, and 65.78 percent for cleaning level B. Decreases between one and two lint cleaners were highly significant, and three lint cleaners gave further significant decrease.

These data were fitted to the curvilinear regression equation relating nonlint content to total stages of lint cleaning: Log $Y=1.872-0.096$ log X, where

Y=nonlint content, and

X=number of lint-cleaning stages.

The correlation coefficient (r) for the equation was 0.999, which was significant statistically. Again this decrease in nonlint content of the waste with added lint cleaners is attributed to the fact that cleaners

take out a greater percentage of lint material as the nonlint content of the cotton decreases.

Fiber-Length Distribution

Upper quartile length.—The upper quartile length of waste material extracted by the one-lint-cleaner, two-lint-cleaners, and three-lint-cleaners treatments averaged 1.224, 1.206, and 1.202 inches, respectively (tables 10 and 51). Decrease in this length for two lint cleaners was significant, but the further decrease for three cleaners was not significant.

Mean length.—The one-cleaner, two-cleaners, and three-lint-cleaners treatments gave average mean lengths of 0.986, 0.950, and 0.948 inch (table 52). Mean length decrease between one and two lint cleaners was significant, and three lint cleaners gave further significant decrease.

TABLE 10.—*Upper quartile length, mean length, and coefficient of variation in length of lint-cleaner waste material extracted during experimental saw-cylinder lint cleanings*

[This table is a summary of tables 51, 52, and 53 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used		
	1	2	3
Upper quartile length (inches):			
A	1.212	1.194	1.195
B	1.236	1.217	1.210
Average [1]	1.224	1.206	1.202
Mean length (inches):			
A	.969	.934	.939
B	1.002	.967	.956
Average [2]	.986	.950	.948
Coefficient of variation in length (percent):			
A	32.8	35.4	34.7
B	31.7	33.7	34.4
Average [2]	32.2	34.6	34.6

[1] Differences attributed to number of lint-cleaning stages are significant at the 5-percent level.

[2] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

Coefficient of variation in length.—Coefficient of variation data indicated some increase in the variability of the length of the fibers with increase in the amount of lint cleaning. Coefficients for one cleaner, two cleaners, and three lint cleaners averaged 32.2, 34.6, and 34.6 percent, respectively (table 53). Increase in coefficient of variation for fiber length between one and two lint cleaners was highly significant.

Percentage of fibers longer than 1 inch.—Increasing the amount of lint cleaning reduced the percentage of fibers longer than 1 inch from 56.3 to 52.1 percent (fig. 9, and tables 11 and 54). The percentage of long fibers was significantly higher for one lint cleaner than for two or three lint cleaners. Differences between two and three cleaners were not significant.

Percentage of fibers ½ to 1 inch.—Percentage of fibers of ½ to 1 inch did not differ significantly by the number of lint cleaners used (table 55). Percentages averaged 32.7 percent after one cleaner and 34.5 percent after two and three lint cleaners.

Percentage of fibers shorter than ½ inch.—The short-fiber content in lint-cleaner waste averaged 10.4, 12.8, and 12.8 percent after one, two, and three lint cleaners, respectively (table 56). Increase in short-fiber content after two and three lint cleaners was highly significant.

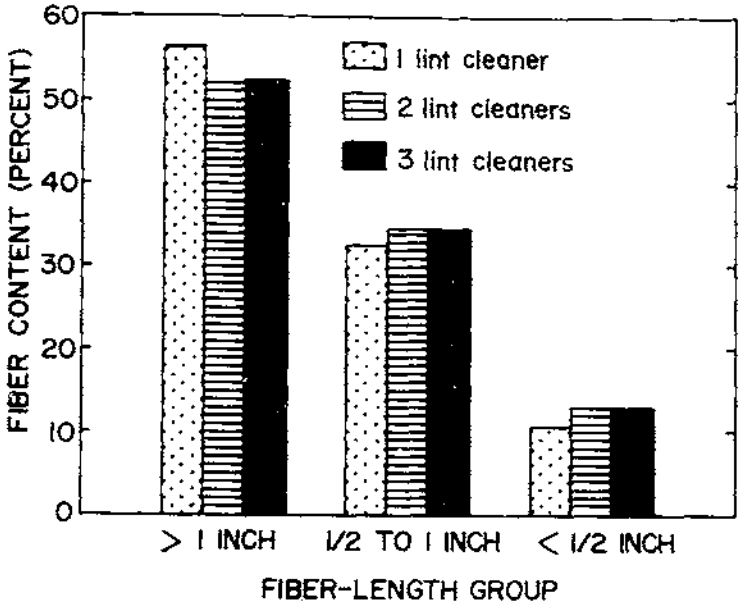

FIGURE 9.—Fiber-length distribution of waste material as affected by amount of lint cleaning.

TABLE 11.—*Percentage of fibers longer than 1 inch, ½ to 1 inch, and shorter than one-half inch in lint-cleaner waste material extracted during experimental saw-cylinder lint cleanings*

[This table is a summary of tables 54, 55, and 56 in the Appendix. Each figure is an average for six replications]

Quality measure and seed-cotton cleaning level	Lint cleaners used		
	1	2	3
Fibers longer than 1 inch:	*Percent*	*Percent*	*Percent*
A	54. 9	50. 7	51. 3
B	57. 7	53. 5	53. 3
Average [1]	56. 3	52. 1	52. 3
Fibers ½ to 1 inch in length:			
A	33. 6	35. 1	35. 4
B	31. 8	33. 9	33. 6
Average	32. 7	34. 5	34. 5
Fibers shorter than one-half inch:			
A	11. 0	13. 7	12. 9
B	9. 9	12. 0	12. 6
Average [2]	10. 4	12. 8	12. 8

[1] Differences attributed to number of lint-cleaning stages are significant at the 5-percent level.

[2] Differences attributed to number of lint-cleaning stages are significant at the 1-percent level.

Analysis of Variance

The study was analyzed statistically as a factorial experiment involving six replications of two seed-cotton cleaning levels and four amounts of lint cleaning. The analysis of variance was calculated with the degrees of freedom distributed as shown in table 57.

These data, with the resulting levels of significance, are shown in tables 58, 60, 62, 64, and 66. Interaction between seed-cotton cleaning and lint cleaning was found to be significant for only lint staple length and yarn average appearance index. Significance differences at the 1-percent and 5-percent levels for individual amounts of lint cleaning were determined by Tukey's w-procedure (*19*) and are shown in tables 59, 61, 63, 65, and 67.

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CONCLUSIONS

Results of this study showed that lint cleaning produces higher grade, shorter fiber length, and lower bale weight. It also affects spinning performance, particularly at low moisture levels. Increasing the amount of lint cleaning at the cotton gin results at the mill in a greater number of neps in the card web, decreased yarn strength, and lower yarn appearance, particularly among the finer yarns. These factors are related to higher spinning costs.

The grower is interested in producing the type of cotton that will yield maximum bale value. This varies somewhat with current prices and mill requirements. Based on prices prevailing during the 1967 to 1970 seasons, when premiums for grade were small, maximum bale value depended on the ginner's ability to preselect the correct amount of lint cleaning. Using too many stages of cleaning could reduce the bale value, because the loss from staple length decrease and weight loss would offset any gain from grade improvement.

Data indicate that as a general rule, for cotton grown and machine-harvested in the Midsouth, the grower can obtain maximum bale value most often by using one lint cleaner on early-season clean cottons and two stages of lint cleaning on late-season more trashy or light-spotted cottons. It is recommended that no lint cleaning be used on cottons graded as high as Middling White. Use of three lint cleaners should be reserved for those cottons that the ginner suspects will be classed with no lint cleaning as Below Grade or Spotted.

Whether it would be a profitable investment for a ginner to install and operate a third lint cleaner is doubtful. It appears that costs of the third cleaner, which are passed on to the grower as higher ginning rates, will in numerous cases cancel benefits even on the trashy cotton. The third cleaner would prove more profitable during periods when higher premiums are allowed for low foreign-matter content and high grades.

Future lint-cleaner research includes drafting recommendations setting the price differential that would be required between grades and staple lengths at each stage of cleaning to produce maximum returns. Application of these recommendations would depend on the ability of the ginner to evaluate the type of cotton he is processing. Developing instruments to aid the ginner in ascertaining such measurements is another phase of this work.

A considerable amount of waste material is removed by lint cleaning. If this material were collected at the gin with minimum investment and sold to the bedding, automotive, and furniture industries, it could provide increased income for the cotton gin owners. If the

waste must be cleaned to make it marketable, the ginner must be careful that the weight loss in cleaning does not cancel out the gains from the premium.

LITERATURE CITED

(1) BENNETT, C. A.
1962. COTTON GINNING SYSTEMS IN THE UNITED STATES AND AUXILIARY DEVELOPMENTS. Sponsored by The Cotton Ginners' Journal and the Cotton Gin and Oil Mill Press, 101 pp.

(2) BROOKS, E. H.
1947. LINT COTTON CLEANER. (U.S. Patent No. 2,418,694.) U.S. Patent Office.

(3) GRIFFIN, A. C., and MCCASKILL, O. L.
1957. TANDEM LINT CLEANING—AIR-SAW CYLINDER COMBINATION. The Cotton Gin and Oil Mill Press, pp. 25, 52–53.

(4) ——— and MOORE, V. P.
1968. A COMPARISON OF CLEANING EFFICIENCIES AND FIBER PROPERTIES OF COTTON GINNED WITH TWO LINT CLEANERS IN SERIES AND IN PARALLEL. The Cotton Gin and Oil Mill Press, August 24, pp. 7, 8, 10.

(5) HOLDER, S. H., JR.
1967. SUPPLY AND PRICE DATA ON COTTON GIN MOTES. U.S. Dept. Agr. Marketing Research Report 809, 24 pp.

(6) ——— and LOONEY, Z. M.
1964. RECLAIMING AND MARKETING COTTON GIN MOTES. U.S. Dept. Agr. ERS–168, 14 pp.

(7) ——— MCCASKILL, O. L., and SHANKLIN, E. H.
1967. EFFECTS OF RECLAIMED GIN-LOSS COTTON ON LINT QUALITY AND SPINNING PERFORMANCE. U.S. Dept. Agr. Marketing Research Report 808, 10 pp.

(8) LOONEY, Z. M., and GHETTI, J. L.
1960. EFFECTS OF TANDEM LINT CLEANING ON BALE VALUES, WEIGHT CHANGES, AND PRICES RECEIVED BY FARMERS. U.S. Dept. Agr. Marketing Research Report 397, 20 pp.

(9) ——— and HARRELL, E. A.
1961. SEED COTTON AND MULTIPLE LINT CLEANINGS AT GINS: EFFECT ON GRADE, PRICE AND BALE VALUE. U.S. Dept. Agr. ERS–43, 15 pp.

(10) ——— and LAPLUE, L. D.
1962. MULTIPLE LINT CLEANING ECONOMICS. The Cotton Gin and Oil Mill Press, March 17, pp. 17–19.

(11) ——— LAPLUE, L. D., WILMOT, C. A., and others.
1963. MULTIPLE LINT CLEANING AT COTTON GINS: EFFECTS ON BALE VALUE, FIBER PROPERTIES, AND SPINNING PERFORMANCE. U.S. Dept. Agr. Marketing Research Report 601, 53 pp.

(12) MANGIALARDI, G. J., JR.
1968. A RESEARCH REPORT ON LINT CLEANING: A STUDY OF SAW SPEED AND COMBING RATIO EFFECTS. The Cotton Gin and Oil Mill Press, November 30, pp. 7–9.

(13) ——— and GRIFFIN, A. C.
1966. LINT CLEANING AT COTTON GINS: EFFECTS OF FIBER MOISTURE AND AMOUNT OF CLEANING ON LINT QUALITY. U.S. Dept. Agr. Tech. Bull. 1359, 24 pp.
(14) MONTGOMERY, R. A., and NISSING, T. J.
1957. TANDEM SAW CYLINDER LINT CLEANING. The Cotton Gin and Oil Mill Press, March 9, pp. 18, 36–39.
(15) Moss, E. E.
1955. COTTON LINT CLEANERS. (U.S. Patent No. 2,704,862.) U.S. Patent Office.
(16) NATIONAL COTTON COUNCIL.
1963. PRESERVING COTTON QUALITY IN GROWING, HARVESTING, GINNING AND MARKETING. 24 pp., Memphis.
(17) ST. CLAIR, J. S., and ROBERTS, A. L.
1958. EFFECTS OF LINT CLEANING OF COTTON: AN ECONOMIC ANALYSIS AT CALIFORNIA GINS. U.S. Dept. Agr. Marketing Research Report 238, 37 pp.
(18) STEDRONSKY, V. L., and SHAW, C. S.
1950. THE FLOW-THROUGH LINT-COTTON CLEANER. U.S. Dept. Agr. Circular 858, 30 pp.
(19) STEEL, R. G. D., and TORRIE, J. H.
1960. PRINCIPLES AND PROCEDURES OF STATISTICS. 481 pp., New York.
(20) UNITED STATES DEPARTMENT OF AGRICULTURE
1969. CHARGES FOR GINNING COTTON, COSTS FOR GINNING COTTON, COSTS OF SELECTED SERVICES INCIDENT TO MARKETING, AND RELATED INFORMATION, SEASON 1968–69. U.S. Dept. Agr., Econ. Res. Serv., Market. Econ. Div., and Consumer and Market. Serv., Cotton Div., 2 pp.
(21) UNITED STATES DEPARTMENT OF AGRICULTURE
1957, 1959, 1969. COTTON GIN EQUIPMENT UNITED STATES. U.S. Dept. Agr., Consumer and Market. Serv., Cotton Div., 20 pp.
(22) VAN DOORN, D. W.
1954. PROCESS AND APPARATUS FOR SEPARATING TRASH FROM LINT COTTON AND THE LIKE. (U.S. Patent No. 2,681,476.) U.S. Patent Office.
(23) WATSON, H., and HOLDER, S. H., Jr.
1966. RECLAIMING GIN-LOSS COTTON. U.S. Dept. Agr. Production Research Report 91, 14 pp.

ADDITIONAL REFERENCES

(24) HOLDER, S. H., Jr.
1967. MARKETING AND UTILIZATION OF COTTON MILL WASTE. U.S. Dept. Agr. ERS–334, 17 pp.
(25) LAFERNEY, P. E., MULLIKEN, R. A., and SHAW, C. S.
1966. SPINNING QUALITY OF COTTON AS AFFECTED BY GIN CLEANING, CARD CRUSHER ROLLS, AND VARYING CARDING RATES, MISSISSIPPI, 1965–66 SEASON. U.S. Dept. Agr. Marketing Research Report 778, 33 pp.
(26) MERRILL, G. R.
1959. COTTON RING SPINNING. 174 pp., Lowell, Mass.

(27) NEWTON, F. E., CALKINS, E. W. S., and GRIFFIN, A. C.
1964. FIBER AND SPINNING PROPERTIES OF COTTON AS AFFECTED BY CERTAIN HARVESTING AND GINNING PRACTICES: YAZOO-MISSISSIPPI DELTA, 1959–60. U.S. Dept. Agr. Marketing Research Report 656, 27 pp.
(28) PENDLETON, A. M., and MOORE, V. P.
1967. GINNING COTTON TO PRESERVE FIBER QUALITY. U.S. Dept. Agr. ESC–560, 19 pp.
(29) STEDRONSKY, V. L.
1964. LINT CLEANING. U.S. Dept. Agr. Handb. 260, pp. 32–45.
(30) UNITED STATES DEPARTMENT OF AGRICULTURE
1963. COTTON TESTING SERVICE. U.S. Dept. Agr. AMS–16, 55 pp.

APPENDIX

TABLE 12.—*Moisture content of wagon samples of seed cotton processed before experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Moisture content of samples processed before cleaning [1]					
	Replication					
	1	2	3	4	5	6
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	11.3	12.8	8.4	10.9	8.1	8.8
One	11.9	9.4	9.9	10.0	8.9	8.6
Two	13.1	12.5	9.6	9.6	8.1	9.0
Three	14.3	7.6	9.7	10.3	8.7	8.3
B:						
None	9.0	11.3	8.9	12.1	7.0	7.9
One	11.0	9.5	12.7	13.5	8.8	8.8
Two	15.0	11.7	9.0	10.8	9.3	9.3
Three	14.6	11.5	9.1	11.7	8.2	8.0
Average	12.5	10.8	9.7	11.1	8.4	8.6

[1] Each figure is an average for five samples subjected to oven moisture-determination tests.

TABLE 13.—*Moisture content of feeder apron samples of seed cotton processed before experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Moisture content of samples processed before cleaning [1]					
	Replication					
	1	2	3	4	5	6
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	9.7	11.3	9.0	7.6	9.0	8.1
One	10.9	8.7	8.2	7.1	9.6	8.8
Two	12.4	8.7	7.7	7.6	8.3	7.6
Three	15.0	10.3	8.7	7.1	8.2	7.6
B:						
None	8.6	8.7	9.2	10.4	7.3	8.8
One	10.2	7.8	11.7	9.7	7.6	8.2
Two	9.4	8.6	7.7	7.8	9.5	8.1
Three	11.1	9.2	8.6	9.5	8.4	7.9
Average	10.9	9.2	8.8	8.4	8.5	8.1

[1] Each figure is an average for five samples subjected to oven moisture-determination tests.

TABLE 14.—*Foreign-matter content of wagon samples of seed cotton processed before experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Foreign matter in samples processed before cleaning [1]					
	Replication					
	1	2	3	4	5	6
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	7.1	8.3	3.2	4.5	5.2	11.3
One	8.1	6.7	3.6	4.3	3.6	10.0
Two	9.8	7.8	3.3	4.1	4.0	9.9
Three	7.9	7.9	2.8	4.0	3.7	11.3
B:						
None	6.6	8.1	3.3	3.7	4.6	11.5
One	7.3	7.1	3.5	3.8	7.4	11.1
Two	9.4	6.0	3.0	4.2	6.7	12.5
Three	7.5	5.7	3.8	5.7	5.1	11.4
Average	8.0	7.2	3.3	4.3	5.0	11.1

[1] Each figure is an average for five samples subjected to fractionation tests.

TABLE 15.—*Foreign-matter content of feeder apron samples of seed cotton processed before experimental lint cleaning*

Seed-cotton cleaning level and number of lint cleaners	Foreign matter in samples processed before cleaning [1]						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	3.5	1.8	1.3	1.2	1.8	2.5	2.0
One	3.8	1.6	1.1	1.0	1.9	2.5	2.0
Two	4.2	2.1	1.1	1.0	2.1	2.6	2.2
Three	5.6	2.0	1.0	1.1	1.6	2.2	2.2
B:							
None	2.1	2.8	1.2	1.3	1.6	2.0	1.8
One	2.3	2.2	1.2	1.2	1.9	2.2	1.8
Two	3.0	2.1	.9	.9	2.4	2.2	1.9
Three	2.4	2.2	.8	1.3	1.6	2.4	1.8

[1] Each figure is an average for five samples subjected to fractionation tests

TABLE 16.—*Moisture content during ginning of cottonseed samples tested before experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Moisture content of samples tested before cleaning [1]					
	Replication					
	1	2	3	4	5	6
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	11.9	11.6	9.9	9.1	10.0	9.0
One	13.3	12.0	8.8	8.9	11.1	9.1
Two	13.0	11.6	9.5	8.7	9.8	8.6
Three	12.4	10.1	9.5	9.4	8.8	8.8
B:						
None	11.6	12.3	9.3	11.6	8.6	8.8
One	10.8	10.2	11.6	11.0	8.9	8.8
Two	13.3	10.5	8.2	9.7	10.4	8.6
Three	11.8	11.7	8.9	10.2	9.7	8.7
Average	12.3	11.2	9.5	9.8	9.7	8.8

[1] Each figure is an average for three samples subjected to oven moisture-determination tests.

TABLE 17.—*Moisture content after ginning and before lint cleaning for sample lint processed before experimental lint cleaning*

Seed-cotton cleaning level and number of lint cleaners	Moisture content of samples processed before cleaning [1] [2]						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	8.5	6.4	6.2	4.7	5.2	5.6	6.1
One	7.7	6.2	5.7	4.9	5.4	5.7	5.9
Two	8.0	5.8	6.2	4.6	5.0	5.5	5.8
Three	8.7	5.7	6.5	4.4	4.9	5.2	5.9
B:							
None	5.6	6.0	5.8	5.0	4.8	5.8	5.5
One	6.4	5.6	6.3	5.2	4.8	5.9	5.7
Two	7.2	5.6	5.5	4.7	5.4	5.9	5.7
Three	6.4	5.7	5.4	5.8	4.5	5.9	5.6
Average	7.3	5.9	6.0	4.9	5.0	5.7	5.8

[1] Each figure is an average for five samples taken between gin stand and lint cleaner and subjected to oven moisture-determination tests. Differences in moisture content between seed-cotton cleaning levels and among number of lint cleaners are not significant.

[2] Ambient conditions during replications 1, 2, 3, 4, 5, and 6 were 82° F. at 59 percent relative humidity; 66° F. at 55 percent relative humidity; 72° F. at 69 percent relative humidity; 71° F. at 41 percent relative humidity; 59° F. at 45 percent relative humidity; and 62° F. at 59 percent relative humidity, respectively.

TABLE 18.—*Classer's grade index for ginned lint samples after experimental saw-cylinder lint cleaning*

Seed-cotton cleaning level and number of lint cleaners	Grade index [1] of samples after cleaning [2]						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	87.0	82.0	90.0	94.0	90.0	79.0	87.0
One	90.0	91.4	93.8	95.8	92.4	85.0	91.4
Two	90.8	94.0	97.0	100.0	94.0	92.4	94.7
Three	90.0	94.6	98.8	100.0	97.6	94.0	95.8
B:							
None	90.8	85.0	93.2	91.4	91.6	80.8	88.8
One	93.2	94.0	94.0	94.6	94.0	87.0	92.8
Two	94.0	94.0	98.8	99.4	94.0	92.2	95.4
Three	94.6	94.0	97.6	98.8	97.6	94.0	96.1

[1] Grade designation and corresponding grade index:

M	=100		
SLM+	= 97		
SLM	= 94		
LM+	= 90		
LM	= 95		
SGO+	= 81	LM[1/3]	=80
SGO	= 76		

[2] Each figure is an average for five samples subjected to cotton-classing tests.

TABLE 19.—*Classer's grade designation for ginned lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Grade designation for samples after cleaning [1]						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	LM	LM[18]	LM+	SLM	LM+	SGO+	LM
One	LM+	LM+	SLM	SLM+	SLM	LM	LM+
Two	LM+	SLM	SLM+	M	SLM	SLM	SLM
Three	LM+	SLM	M	M	SLM+	SLM	SLM+
B:							
None	LM+	LM	SLM	LM+	LM+	SGO+	LM+
One	SLM	SLM	SLM	SLM	SLM	LM	SLM
Two	SLM	SLM	M	M	SLM	SLM	SLM
Three	SLM	SLM	SLM+	M	SLM+	SLM	SLM+

[1] Each figure is an average for five samples subjected to cotton-classing tests, as taken from grade indexes of table 18.

TABLE 20.—*Staple length of lint samples after experimental lint cleaning*

Seed-cotton cleaning level and number of lint cleaners	Staple length of samples after cleaning [1]						
	Replication						Average
	1	2	3	4	5	6	
A:	32nds in.	32nds in.	32nds in.	32nds in.	32nds in.	32nds in.	32nds in.
None	34.4	34.8	34.6	35.0	35.2	35.0	34.83
One	34.0	34.8	35.0	34.4	35.0	34.4	34.60
Two	34.0	34.0	35.0	34.0	34.4	34.8	34.37
Three	34.8	34.4	34.8	34.2	34.0	34.2	34.40
B:							
None	34.8	35.0	35.2	35.0	35.2	35.0	35.03
One	34.6	34.8	35.0	34.8	34.8	34.8	34.80
Two	34.0	34.8	35.0	34.4	35.0	34.2	34.57
Three	34.4	34.4	34.8	34.0	34.2	34.4	34.37

[1] Each figure is an average for five samples subjected to cotton-classing tests.

TABLE 21.—*Weight per bale for ginned lint after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Weight per bale after cleaning [1]						
	Replication						Average
	1	2	3	4	5	6	
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
A:							
None	568	542	522	521	531	540	537
One	526	521	510	507	514	518	516
Two	521	504	503	502	501	505	506
Three	500	500	500	500	500	500	500
B:							
None	546	536	522	524	535	535	533
One	521	515	507	510	516	516	514
Two	513	503	503	506	498	506	505
Three	500	500	500	500	500	500	500

[1] Weight per bale includes the weight of the bagging and ties.

TABLE 22.—*U.S. Department of Agriculture Commodity Credit Corporation's loan rates for warehouse-stored cotton, 1967 and 1970*

Grade	1967 loan rate for staple length—[1 2]			1970 loan rate for staple length—[1 2]		
	34	35	36	34	35	36
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
White:						
M	23.20	24.05	24.65	23.65	24.15	24.60
SLM+	22.05	22.60	23.15	22.55	23.00	23.35
SLM	21.25	21.90	22.45	21.80	22.30	22.75
LM+	19.30	19.80	20.15	19.80	20.10	20.35
LM	18.75	19.25	19.55	19.15	19.45	19.70
SGO+	16.90	17.10	17.20	16.90	17.05	17.10
SGO	16.25	16.40	16.50	16.25	16.35	16.40
Light spotted:						
SM	21.85	22.35	22.75	22.35	22.80	23.15
M	21.05	21.55	21.95	21.50	21.90	22.25
SLM	19.00	19.25	19.50	19.25	19.50	19.75
LM	16.65	16.75	16.80	16.80	16.85	16.90

[1] Loan rates are prices paid per pound on gross bale weight, and staple lengths are in thirty-seconds of one inch.

[2] Bale price per pound for Middling White grade and 1-inch staple length was 20.65 cents in 1967 and 20.50 cents in 1970.

TABLE 23.—*Value per bale of ginned lint at 1967 prices after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Value per bale [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
None	106. 50	90. 79	103. 36	114. 10	105. 14	92. 34	102. 04
One	101. 52	103. 16	111. 69	111. 79	112. 57	97. 13	106. 31
Two	100. 55	107. 10	113. 68	116. 46	106. 46	110. 60	109. 14
Three	99. 00	106. 25	120. 25	116. 00	110. 25	106. 25	109. 67
B:							
None	108. 11	103. 18	114. 32	103. 75	105. 93	91. 49	104. 46
One	114. 10	112. 79	111. 03	111. 69	113. 00	99. 33	110. 32
Two	109. 01	110. 16	120. 97	117. 39	109. 06	107. 53	112. 35
Three	106. 25	106. 25	113. 00	116. 00	110. 25	106. 25	109. 67

[1] Calculated from U.S. Department of Agriculture CCC loan rates shown in table 22.

TABLE 24.—*Value per bale of ginned lint at 1970 prices after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Value per bale [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
None	108. 77	91. 33	104. 92	116. 18	106. 73	92. 07	103. 33
One	104. 15	104. 72	113. 73	114. 33	114. 62	99. 20	108. 46
Two	103. 16	109. 87	115. 69	118. 72	109. 22	112. 62	111. 55
Three	100. 50	109. 00	120. 75	118. 25	112. 75	109. 00	111. 71
B:							
None	109. 75	104. 25	116. 41	105. 32	107. 54	91. 22	105. 75
One	116. 18	114. 84	113. 06	113. 73	115. 07	100. 36	112. 21
Two	111. 83	112. 17	121. 47	119. 67	111. 05	110. 31	114. 42
Three	109. 00	109. 00	115. 00	118. 25	112. 75	109. 00	112. 17

[1] Calculated from U.S. Department of Agriculture CCC loan rates shown in table 22.

TABLE 25.—*Nonlint content in ginned samples after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Nonlint content[1] of samples after cleaning						
	Replication						Average
	1	2	3	4	5	6	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
A:							
None	8.94	8.10	4.64	4.42	5.78	8.75	6.77
One	6.64	3.68	2.84	2.46	4.15	4.97	4.12
Two	3.82	2.64	1.84	1.91	2.62	3.19	2.67
Three	3.12	1.84	1.30	1.77	1.89	2.83	2.12
B:							
None	5.50	6.72	4.20	4.96	5.42	6.95	5.62
One	3.58	2.54	3.06	2.91	3.69	4.61	3.40
Two	3.12	2.72	1.44	2.16	3.22	2.99	2.61
Three	2.32	1.52	1.24	1.81	1.92	2.33	1.86

[1] Each figure is an average for five samples subjected to Shirley Analyzer tests.

TABLE 26.—*Cumulative lint-cleaning efficiency for cotton passed through various amounts of cleaning*

Seed-cotton cleaning level and number of lint cleaners	Cleaning efficiency[1] [2] for cleaning						
	Replication						Average
	1	2	3	4	5	6	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
A:							
One	25.7	54.6	38.8	44.3	28.2	43.2	39.1
Two	57.3	67.4	60.3	56.8	54.7	63.5	60.0
Three	65.1	77.3	72.0	60.0	67.3	67.7	68.2
B:							
One	34.9	62.2	27.1	41.3	31.9	33.7	38.5
Two	43.3	59.5	65.7	56.5	40.6	57.0	53.8
Three	57.8	77.4	70.5	63.5	64.6	66.5	66.7

[1] The cumulative cleaning efficiency of lint cleaners in tandem is the ratio of nonlint material removed from the cotton to the nonlint content of the cotton as it entered the first cleaner, expressed as a percentage.

[2] Data are calculated from table 25. Each figure is an average from five samples.

TABLE 27.—*Unit lint-cleaner efficiency for cotton passed through various amounts of cleaning*

Seed-cotton cleaning level and number of lint cleaners	Cleaning efficiency [1] [2] for cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
One	25.7	54.6	38.8	44.3	28.2	43.2	39.1
Two	42.5	28.3	35.2	22.4	36.9	35.8	33.5
Three	18.3	30.3	29.3	7.3	27.9	11.3	20.7
B:							
One	34.9	62.2	27.1	41.3	31.9	33.7	38.5
Two	12.8	−7.1	52.9	25.8	12.7	35.1	22.0
Three	25.6	44.1	13.9	16.2	40.4	22.1	27.0

[1] The unit cleaning efficiency of a lint cleaner is the ratio of nonlint material removed from the cotton to the nonlint content of the cotton as it entered the lint cleaner, expressed as a percentage.

[2] Data are calculated from table 25. Each figure is an average from five samples.

TABLE 28.—*Fiber-maturity data for ginned lint processed for experimental saw-cylinder lint cleanings*

Lint-cleaning replication number [1]	Causticaire		Micronaire reading
	Maturity index	Fineness	
	Percent	*Micrograms/in.*	
1	81.0	5.2	5.0
2	79.4	5.0	4.8
3	77.9	4.5	4.4
4	76.8	4.4	4.1
5	69.9	3.2	3.1
6	73.9	3.8	3.6
Average	76.3	4.4	4.2

[1] For each replication, two levels of seed-cotton cleaning and four degrees of lint-cleaning treatments were tested. Each figure is an average for eight samples subjected to Causticaire and Micronaire tests.

TABLE 29.—*Span length (2.5-percent) of ginned lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Span length [1] for samples after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
None	1.10	1.13	1.12	1.15	1.12	1.14	1.127
One	1.09	1.10	1.12	1.13	1.13	1.13	1.117
Two	1.09	1.10	1.12	1.11	1.08	1.10	1.100
Three	1.09	1.08	1.10	1.12	1.07	1.12	1.097
B:							
None	1.08	1.10	1.13	1.13	1.09	1.13	1.110
One	1.09	1.10	1.14	1.14	1.08	1.12	1.112
Two	1.09	1.09	1.09	1.14	1.10	1.11	1.103
Three	1.09	1.09	1.13	1.10	1.10	1.11	1.103

[1] Each figure is an average for four specimens subjected to Digital Fibrograph measurements.

TABLE 30.—*Span length (50-percent) of ginned lint samples after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Span length [1] for samples after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
None	0.52	0.51	0.53	0.52	0.49	0.50	0.512
One	.50	.52	.52	.51	.46	.49	.500
Two	.51	.50	.50	.49	.45	.46	.485
Three	.50	.49	.51	.50	.45	.47	.487
B:							
None	.51	.51	.52	.50	.48	.50	.503
One	.51	.50	.52	.51	.45	.48	.495
Two	.50	.49	.49	.49	.46	.46	.482
Three	.50	.49	.51	.47	.46	.48	.485

[1] Each figure is an average for four specimens subjected to Digital Fibrograph measurements.

TABLE 31.—*Uniformity ratio of length for lint samples after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Uniformity ratio [1] for samples [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	47	45	47	45	44	44	45.3
One	46	47	46	45	41	43	44.7
Two	47	45	45	44	42	42	44.2
Three	46	45	46	45	42	42	44.3
B:							
None	47	46	46	44	44	44	45.2
One	47	45	46	45	42	43	44.7
Two	46	45	45	43	42	41	43.7
Three	46	45	45	43	42	43	44.0

[1] Uniformity ratio of length is a ratio of 50-percent span length to 2.5-percent span length, expressed as a percentage.

[2] Each figure is an average for four specimens subjected to Digital Fibrograph measurements.

TABLE 32.—*Upper quartile length of lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Upper quartile length of samples [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
None	1.217	1.243	1.250	1.247	1.240	1.260	1.243
One	1.187	1.220	1.230	1.253	1.250	1.220	1.227
Two	1.187	1.207	1.230	1.230	1.183	1.240	1.213
Three	1.193	1.203	1.227	1.227	1.193	1.237	1.213
B:							
None	1.203	1.203	1.257	1.263	1.217	1.237	1.230
One	1.207	1.193	1.247	1.263	1.210	1.233	1.226
Two	1.190	1.193	1.220	1.230	1.237	1.233	1.217
Three	1.180	1.187	1.243	1.227	1.200	1.223	1.210

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 33.—*Fiber length for lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Mean length of samples[1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
None	1.017	1.027	1.050	1.017	1.020	1.017	1.025
One	.987	.987	1.013	1.023	1.007	.970	.998
Two	.987	.997	1.023	.997	.950	.983	.990
Three	.990	.977	1.010	.990	.950	.977	.982
B:							
None	1.010	.990	1.050	1.037	1.000	.993	1.013
One	.997	.977	1.043	1.013	.957	.980	.994
Two	.977	.957	1.013	.993	.973	.977	.982
Three	.963	.967	1.030	.987	.943	.967	.976

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 34.—*Coefficient of variation of fiber length for lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Coefficient of variation for samples[1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	27.7	29.0	28.0	30.7	29.7	32.3	29.6
One	29.0	31.0	29.7	30.7	32.3	33.7	31.1
Two	28.3	29.7	28.7	31.3	33.0	33.7	30.8
Three	28.0	31.0	29.7	32.7	34.3	34.0	31.6
B:							
None	27.7	29.7	27.7	29.3	30.3	32.0	29.4
One	28.7	30.3	28.0	31.3	34.0	34.0	31.0
Two	29.8	33.0	29.0	32.3	34.7	34.0	32.1
Three	29.7	31.3	28.7	32.0	35.0	33.7	31.7

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 35.—*Fibers longer than 1 inch in lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Fibers longer than 1 inch in samples[1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	63.1	64.1	67.9	61.8	62.9	60.9	63.4
One	57.7	56.4	63.0	63.9	59.6	56.5	59.5
Two	56.6	59.7	64.5	58.6	53.1	56.6	58.2
Three	58.7	56.2	61.1	58.5	51.4	54.9	56.8
B:							
None	61.8	58.2	68.5	66.0	61.0	59.4	62.5
One	58.8	56.1	66.8	60.5	53.5	56.4	58.7
Two	56.4	54.5	62.3	58.2	54.9	56.5	57.1
Three	54.1	54.3	66.1	57.2	51.8	55.6	56.5

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 36.—*Fibers ½ to 1 inch long in lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Fibers ½ to 1 inch in samples[1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	29.2	27.4	24.0	28.3	28.2	28.4	27.6
One	33.2	33.5	27.6	26.0	29.9	31.0	30.2
Two	35.0	30.9	26.9	30.9	34.6	31.4	31.6
Three	33.0	33.7	29.6	29.8	35.3	32.6	32.3
B:							
None	30.2	32.5	23.7	24.6	28.9	29.4	28.2
One	33.0	33.9	25.4	29.5	33.4	31.3	31.1
Two	34.3	33.9	28.7	30.5	32.7	30.8	31.8
Three	36.2	35.4	24.9	31.9	34.7	31.5	32.4

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 37.—*Fibers shorter than one-half inch in lint samples after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Fibers shorter than one-half inch in samples [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	7.1	8.1	7.6	9.2	8.3	10.2	8.4
One	8.7	9.6	8.9	9.6	10.1	12.0	9.8
Two	7.9	8.7	8.1	9.9	11.7	11.5	9.6
Three	7.7	9.5	8.8	11.0	12.7	12.0	10.2
B:							
None	7.4	8.6	7.3	8.8	9.6	10.7	8.7
One	7.8	9.5	7.2	9.4	12.6	11.7	9.7
Two	8.8	11.0	8.5	10.7	11.9	12.2	10.5
Three	9.2	9.8	8.4	10.4	13.1	12.2	10.5

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 38.—*Manufacturing waste from cotton after experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Manufacturing waste [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
None	12.2	11.8	8.0	7.6	9.0	11.8	10.1
One	10.4	7.4	5.0	5.8	8.8	8.2	7.6
Two	6.6	5.8	5.2	5.2	7.2	6.4	6.1
Three	7.4	6.0	5.0	5.6	6.2	5.8	6.0
B:							
None	9.2	10.8	7.4	9.4	9.6	10.0	9.4
One	7.2	6.4	6.2	6.0	7.2	7.8	6.8
Two	6.2	6.2	5.6	5.4	4.8	6.6	5.8
Three	5.8	5.2	5.2	5.6	5.4	6.6	5.6

[1] Each figure represents the percentage of waste extracted by the picking and carding processes in a 5-pound spinning test. Picker and card waste are adjusted to the 5 pounds fed to the first picker.

TABLE 39.—*Neps per 100 square inches of cotton card web after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Nep count [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	10	8	11	11	25	11	12.7
One	14	12	20	20	38	35	23.2
Two	14	16	23	43	42	29	27.8
Three	17	18	24	29	54	38	30.0
B:							
None	7	8	16	20	31	21	17.2
One	9	16	17	21	46	19	21.3
Two	16	17	25	19	74	27	29.7
Three	17	20	30	34	48	33	30.3

[1] Each figure represents the card web produced in a 5-pound spinning test. The nep count is based on 10 specimens totaling 360 square inches and is evaluated independently by two technicians.

TABLE 40.—*Skein strength of 22s carded cotton yarn after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Skein strength [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
None	106	105	113	107	117	106	109.0
One	105	105	111	105	109	99	105.7
Two	101	102	110	100	111	105	104.8
Three	101	101	112	101	112	104	105.2
B:							
None	105	103	115	106	119	106	109.0
One	103	100	113	105	117	105	107.2
Two	99	102	111	102	121	101	106.0
Three	101	98	113	102	115	102	105.2

[1] Each figure is an average for 25 skein-strength determinations on yarn produced in a 5-pound spinning test.

TABLE 41.—*Skein strength of 50s carded cotton yarn after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Skein strength [1] after cleaning [2]						
	Replication						Average
	1	2	3	4	5	6	
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
A:							
None	36	37	43	39	44	38	39. 5
One	34	36	41	39	41	36	37. 8
Two	33	35	39	36	40	37	36. 7
Three	34	33	40	37	40	36	36. 7
B:							
None	35	34	42	39	44	38	38. 7
One	35	34	43	40	44	38	39. 0
Two	33	34	40	37	44	36	37. 3
Three	35	34	39	37	42	36	37. 2

[1] Each figure is an average for 25 skein-strength determinations on yarn produced in a 5-pound spinning test.

[2] Low spinning end breakage was observed for all treatments.

TABLE 42.—*Carded cotton yarn average break factor after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Break factor [1] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	2, 066	2, 080	2, 318	2, 152	2, 387	2, 116	2, 187
One	2. 005	2, 055	2, 246	2, 130	2, 224	1, 989	2, 108
Two	1, 936	1, 997	2, 185	2, 000	2, 221	2, 080	2, 070
Three	1, 961	1, 936	2, 232	2, 036	2, 232	2, 044	2, 074
B:							
None	2, 030	2, 058	2, 315	2, 141	2, 409	2, 116	2, 178
One	2, 008	1, 950	2, 318	2, 155	2, 387	2, 105	2, 154
Two	1, 914	1, 972	2, 221	2, 047	2, 431	2, 011	2, 099
Three	1, 986	1, 928	2. 218	2, 047	2, 315	2, 022	2, 086

[1] Break factor is obtained by multiplying the yarn skein strength by the yarn number and averaging these values for the two standard yarn numbers (22s and 50s) spun.

TABLE 43.—*Appearance index of 22s carded cotton yarn after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Appearance index [1] [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	110	110	100	90	70	80	93.3
One	110	110	90	80	60	80	88.3
Two	110	110	90	80	70	80	90.0
Three	110	100	100	80	60	70	86.7
B:							
None	100	110	100	80	70	80	90.0
One	110	100	90	80	70	80	88.3
Two	110	100	90	80	60	70	85.0
Three	100	90	90	70	60	60	78.3

[1] Each figure represents findings from a 5-pound spinning test.

[2] Appearance grade and corresponding grade index:

B	=110	D+	= 80
C+	=100	D	= 70
C	= 90	BG	= 60

TABLE 44.—*Appearance grade of 22s carded cotton yarn after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Appearance grade [1] [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	B	B	C+	C	D	D+	C
One	B	B	C	D+	BG	D+	C
Two	B	B	C	D+	D	D+	C
Three	B	C+	C+	D+	BG	D	C
B:							
None	C+	B	C+	D+	D	D+	C
One	B	C+	C	D+	D	D+	C
Two	B	C+	C	D+	BG	D	C
Three	C+	C	C	D	BG	BG	D+

[1] Each figure represents findings from a 5-pound spinning test.

[2] Grades are calculated from the appearance indexes of table 43.

TABLE 45.—*Appearance index of 50s carded cotton yarn after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Appearance index [1] [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	100	100	90	80	70	70	85.0
One	100	100	90	70	60	70	81.7
Two	90	90	90	70	60	60	76.7
Three	100	90	80	70	60	60	76.7
B:							
None	100	100	80	80	70	70	83.3
One	100	90	100	80	60	70	83.3
Two	100	90	80	70	60	60	76.7
Three	90	80	70	60	60	60	70.0

[1] Each figure represents findings from a 5-pound spinning test.

[2] Appearance grade and corresponding grade index:

B = 110	D+ = 80
C+ = 100	D = 70
C = 90	BG = 60

TABLE 46.—*Appearance grade of 50s carded cotton yarn after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Appearance grade [1] [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	C+	C+	C	D+	D	D	C
One	C+	C+	C	D	BG	D	D+
Two	C	C	C	D	BG	BG	D+
Three	C+	C	D+	D	BG	BG	D+
B:							
None	C+	C+	D+	D+	D	D	D+
One	C+	C	C+	D+	BG	D	D+
Two	C+	C	D+	D	BG	BG	D+
Three	C	D+	D	BG	BG	BG	D

[1] Each figure represents findings from a 5-pound spinning test.

[2] Grades are calculated from the appearance indexes of table 45.

TABLE 47.—*Carded cotton yarn average appearance index after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Appearance index [1] [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	105	105	95	85	70	75	89.2
One	105	105	90	75	60	75	85.0
Two	100	100	90	75	65	70	83.3
Three	105	95	90	75	60	65	81.7
B:							
None	100	105	90	80	70	75	86.7
One	105	95	95	80	65	75	85.8
Two	105	95	85	75	60	65	80.8
Three	95	85	80	65	60	60	74.2

[1] Each figure is an average for the two standard yarn numbers (22s and 50s) spun.

[2] Appearance grade and corresponding grade index:

B = 100	D+ = 80
C+ = 100	D = 70
C = 90	BG = 60

An index of 100 indicates average yarn appearance.

TABLE 48.—*Carded cotton yarn average appearance grade after experimental lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Appearance grade [1] [2] after cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:							
None	B	B	C−	C	D	D−	C
One	B	B	C	D+	BG	D−	C
Two	C+	C+	C	D+	D	D	D+
Three	B	C+	C	D−	BG	D	D−
B:							
None	C−	B	C	D−	D	D−	C
One	B	C−	C−	D+	D	D+	C
Two	B	C−	C	D−	BG	D	D−
Three	C−	C	D−	D	BG	BG	D

[1] Each figure is an average for the two standard yarn numbers (22*s* and 50s) spun.

[2] Grades are calculated from the appearance indexes of table 47.

TABLE 49.—*Weight per bale for lint-cleaner waste material extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Weight of lint-cleaner waste [1] per bale extracted in cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
One	42	21	12	14	17	22	21.3
Two	47	38	19	19	30	35	31.3
Three	68	42	22	21	31	40	37.3
B:							
One	25	21	15	14	19	19	18.8
Two	33	33	19	18	37	29	28.2
Three	46	36	22	24	35	35	33.0

[1] Weight of waste is based on 478 pounds of ginned lint packaged when using the three-lint-cleaners treatment.

TABLE 50.—*Nonlint content in lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Nonlint content of samples [1] for cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
One	82.90	74.71	73.31	67.96	75.85	81.87	76.10
Two	79.98	74.53	63.60	61.67	74.80	74.52	71.52
Three	76.56	69.05	61.04	59.95	71.02	73.13	68.46
B:							
One	77.47	70.32	72.72	64.01	78.45	74.65	72.94
Two	74.69	70.05	61.86	56.61	73.26	69.90	67.73
Three	69.80	65.97	60.13	57.78	70.37	70.60	65.78

[1] Each figure is an average for five samples subjected to Shirley Analyzer tests.

TABLE 51.—*Upper quartile length of lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Upper quartile length [1] of samples for cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
One	1.157	1.203	1.237	1.243	1.237	1.193	1.212
Two	1.150	1.183	1.225	1.207	1.177	1.220	1.194
Three	1.180	1.180	1.223	1.203	1.193	1.190	1.195
B:							
One	1.170	1.237	1.223	1.267	1.250	1.270	1.236
Two	1.150	1.213	1.200	1.243	1.260	1.237	1.217
Three	1.170	1.215	1.190	1.200	1.240	1.247	1.210

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 52.—*Fiber length for lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Mean length of samples [1] for cleaning						
	Replication						Average
	1	2	3	4	5	6	
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
A:							
One	0.923	0.963	0.990	0.993	1.007	0.940	0.969
Two	.903	.923	.980	.947	.907	.947	.934
Three	.943	.917	.987	.947	.930	.910	.939
B:							
One	.940	1.027	.983	1.027	1.003	1.033	1.002
Two	.910	.973	.930	.990	1.007	.990	.967
Three	.937	.973	.943	.930	.977	.973	.956

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 53.—*Coefficient of variation in fiber length for lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Coefficient of variation [1] for samples from cleaning						
	Replication						Average
	1	2	3	4	5	6	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
A:							
One	32.7	33.3	32.7	32.3	30.7	35.0	32.8
Two	34.7	36.3	33.3	35.0	37.0	36.0	35.4
Three	32.7	35.7	32.3	35.0	35.0	37.7	34.7
B:							
One	33.0	28.7	32.7	31.3	33.7	30.7	31.7
Two	34.7	33.0	36.7	33.3	32.3	32.0	33.7
Three	32.7	33.3	34.0	37.0	34.7	35.0	34.4

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 54.—*Fibers longer than 1 inch in lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Fibers longer than 1 inch [1] in samples from cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
One	47.4	54.6	59.3	58.0	60.5	49.5	54.9
Two	45.8	51.6	58.0	51.7	46.6	50.7	50.7
Three	51.5	48.5	58.6	52.1	50.1	46.8	51.3
B:							
One	52.8	64.2	59.4	63.6	59.4	46.9	57.7
Two	46.7	57.3	51.9	58.0	59.6	47.7	53.5
Three	50.1	55.1	51.9	49.4	56.7	56.4	53.3

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 55.—*Fibers ½ to 1 inch long in lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Fibers ½ to 1 inch in samples [1] from cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
One	40.4	33.5	29.6	31.7	29.6	36.9	33.6
Two	39.9	32.7	29.4	35.	37.0	35.9	35.1
Three	37.1	37.2	30.1	34.2	36.2	37.4	35.4
B:							
One	34.5	26.9	29.6	26.8	29.1	43.9	31.8
Two	39.6	31.4	32.5	29.8	29.5	41.2	33.9
Three	38.5	33.2	34.6	35.1	29.6	30.4	33.6

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 56.—*Fibers shorter than ½ inch in lint-cleaner waste samples extracted during experimental saw-cylinder lint cleanings*

Seed-cotton cleaning level and number of lint cleaners	Fibers shorter than ½ inch in samples [1] from cleaning						
	Replication						Average
	1	2	3	4	5	6	
A:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
One	11.6	11.2	10.6	10.1	9.4	13.0	11.0
Two	13.8	15.3	12.1	12.1	15.9	12.8	13.7
Three	10.9	13.8	10.7	13.3	13.2	15.3	12.9
B:							
One	12.0	8.4	10.5	9.0	10.9	8.8	9.9
Two	13.7	10.6	15.1	11.5	10.3	10.5	12.0
Three	10.8	10.9	13.1	15.0	13.3	12.7	12.6

[1] Each figure is an average for six specimens tested on the Suter-Webb Sorter.

TABLE 57.—*Distribution of degrees of freedom used in calculating analysis of variance for experimental seed-cotton and lint-cleaning treatments*

Source of variation	Degrees of freedom for analysis [1] —	
	No. 1	No. 2
Replication	5	5
Seed-cotton cleaning	1	1
Lint cleaning	3	2
Seed-cotton times lint cleaning	3	2
Error	35	25

[1] Analysis No. 1 was used for bale-value and lint-quality (except cleaning-efficiency) factors; analysis No. 2 was used with cleaning-efficiency and waste-composition data.

TABLE 58.—*Results from analyses of variance for differences among bale-value factors of lint after experimental seed-cotton and lint-cleaning treatments*

Item	F value and significance [1] [2]			
	Replications [3]	Seed-cotton cleaning	Lint cleaning [4]	Interaction [5]
Grade index	17. 58**	2. 79	33. 98**	0. 30
Staple length	3. 76**	3. 05	9. 33**	5. 17**
Bale weight	7. 55**	1. 10	78. 24**	0. 27
Value per bale, 1967 prices	8. 66**	3. 15	5. 96**	0. 41
Value per bale, 1970 prices	8. 04**	2. 78	7. 01**	0. 24

[1] Values required for F to attain significance at 5- and 1-percent levels are: Replications, 2.49 and 3.61; seed-cotton cleaning, 4.13 and 7.44; lint cleaning, 2.88 and 4.41; and interactions, 2.88 and 4.41.

[2] **=significant at 1-percent level. Other figures are not significant.

[3] Each interacting cleaning sequence was replicated six times.

[4] For lint-cleaning treatments, no lint cleaning, one cleaner, two cleaners, and three lint cleaners were each tested with two seed-cotton cleaning levels.

[5] Interaction relates to seed-cotton cleaning level and amount of lint cleaning.

TABLE 59.—*Significant differences for bale-value factors of lint after four experimental amounts of lint cleaning*

Bale-value factor and significance level [1]	Lint cleaners used			
	None	1	2	3
Grade index:				
1 percent	87.9a	92.1b	95.0bc	96.0c
5 percent	87.9a	92.1b	95.0c	96.0c
Staple length (1/32 inch):				
1 percent	34.93a	34.70ab	34.47b	34.38b
5 percent	34.93a	34.70ab	34.47bc	34.38c
Bale weight (pounds):				
1 percent	535a	515b	506c	500c
5 percent	535a	515b	506c	500c
Value per bale, 1967 prices (dollars):				
1 percent	103.25a	108.32ab	110.74b	109.67ab
5 percent	103.25a	108.32ab	110.74b	109.67b
Value per bale, 1970 prices (dollars):				
1 percent	104.54a	110.34ab	112.98b	111.94b
5 percent	104.54a	110.34b	112.98b	111.94b

[1] Numbers in the same row followed by the same letter are not significantly different at the level indicated.

TABLE 60.—*Results from analyses of variance for differences among lint-moisture and nonlint contents, and lint-cleaning efficiencies for experimental seed-cotton and lint-cleaning treatments*

Item	F value and significance [1]			
	Replications [2]	Seed-cotton cleaning	Lint cleaning	Interaction [3]
Lint-moisture content [4 5]	18.72**	3.65	0.02	0.38
Nonlint content [5]	10.36**	6.33**	71.59**	1.23
Cumulative cleaning efficiency [6]	7.85**	1.92	68.91**	0.75
Unit cleaning efficiency [6]	0.40	0.18	3.86*	1.29

[1] **=significant at 1-percent level; *=significant at 5-percent level. Other figures are not significant.

[2] Lint-cleaning treatments were each tested with two seed-cotton cleaning levels. Each interacting cleaning sequence was replicated six times.

[3] Interaction relates to seed-cotton cleaning level and amount of lint cleaning.

[4] Measured between gin stand and first lint-cleaning stage.

[5] Values required for F to attain significance at 5- and 1-percent levels are: Replications, 2.49 and 3.61; seed-cotton cleaning, 4.13 and 7.44; lint cleaning, 2.88 and 4.41; and interactions, 2.88 and 4.41. Lint-cleaning treatments consisted of no lint cleaning, one cleaner, two cleaners, and three lint cleaners.

[6] Values required for F to attain significance at 5- and 1-percent levels are: Replications, 2.60 and 3.85; seed-cotton cleaning, 4.24 and 7.77; lint cleaning, 3.39 and 5.57; and interactions, 3.39 and 5.57. Lint-cleaning treatments consisted of one cleaner, two cleaners, and three lint cleaners.

TABLE 61.—*Significant differences for nonlint content in lint samples and lint-cleaner efficiency for experimental saw-cylinder lint cleanings*

Item tested and significance level [1]	Lint cleaners used			
	None	1	2	3
Nonlint content:				
1 percent	6. 20a	3. 76b	2. 64c	1. 99c
5 percent	6. 20a	3. 76b	2. 64c	1. 99c
Cumulative cleaning efficiency:				
1 percent		38. 8a	56. 9b	67. 4c
5 percent		38. 8a	56. 9b	67. 4c

	Lint-cleaner position		
	No. 1 lint cleaner	No. 2 lint cleaner	No. 3 lint cleaner
Unit cleaning efficiency:			
5 percent	38. 8a	27. 8ab	23. 8b

[1] Numbers in the same row followed by the same letter are not significantly different at the level indicated.

TABLE 62.—*Results from analyses of variance for differences among Digital Fibrograph and Suter-Webb Array lengths of lint samples after experimental seed-cotton and lint-cleaning treatments*

Item	F value and significance [1] [2]			
	Replications [3]	Seed-cotton cleaning	Lint cleaning	Interaction [4]
2.5-percent span length	11. 70**	0. 62	6. 13**	1. 99
50-percent span length	37. 24**	3. 32	19. 85**	0. 36
Uniformity ratio of length	47. 18**	1. 58	8. 80**	0. 30
Upper quartile length	16. 47**	0. 73	8. 49**	0. 85
Mean length	18. 71**	3. 69	21. 77**	0. 20
Coefficient of length variation	56. 34**	2. 25	19. 47**	2. 38
Fibers longer than 1 inch	22. 19**	1. 89	23. 61**	0. 09
Fibers ½ to 1 inch	22. 76**	1. 05	19. 90**	0. 17
Fibers shorter than one-half inch	40. 45**	2. 93	17. 12**	1. 16

[1] Values required for F to attain significance at 5- and 1-percent levels are: Replications, 2.49 and 3.61; seed-cotton cleaning, 4.13 and 7.44; lint cleaning, 2.88 and 4.41; and interactions 2.88 and 4.41.

[2] **=significant at 1-percent level. Other figures are not significant.

[3] For lint-cleaning treatments, no lint cleaning, one cleaner, two cleaners, and three lint cleaners were each tested with two seed-cotton cleaning levels. Each interacting cleaning sequence was replicated six times.

[4] Interaction relates to seed-cotton cleaning level and amount of lint cleaning.

TABLE 63.—*Significant differences for Digital Fibrograph and Suter-Webb Array lengths of lint samples after four experimental amounts of lint cleaning*

Length measurement and significance level [1]	Lint cleaners used			
	None	1	2	3
2.5-percent span length (inches):				
1 percent	1.118a	1.114ab	1.102ab	1.100b
5 percent	1.118a	1.114ab	1.102b	1.100b
50-percent span length (inch):				
1 percent	0.508a	0.498a	0.484b	0.486b
5 percent	0.508a	0.498b	0.484c	0.486c
Uniformity ratio of length:				
1 percent	45.2a	44.7ab	44.0b	44.2b
5 percent	45.2a	44.7ab	44.0b	44.2b
Upper quartile length (inches):				
1 percent	1.236a	1.226ab	1.215b	1.212b
5 percent	1.236a	1.226ab	1.215bc	1.212c
Mean length (inches):				
1 percent	1.019a	0.996b	0.986bc	0.979c
5 percent	1.019a	0.996b	0.986bc	0.979c
Coefficient of length variation:				
1 percent	29.5a	31.0b	31.4b	31.6b
5 percent	29.5a	31.0b	31.4b	31.6b
Fibers longer than 1 inch:				
1 percent	63.0a	59.1b	57.6b	56.6b
5 percent	63.0a	59.1b	57.6bc	56.6c
Fibers ½ to 1 inch:				
1 percent	27.9a	30.6b	31.7b	32.4b
5 percent	27.9a	30.6b	31.7bc	32.4c
Fibers shorter than one-half inch:				
1 percent	8.6a	9.8b	10.0b	10.4b
5 percent	8.6a	9.8b	10.0b	10.4b

[1] Numbers in the same row followed by the same letter are not significantly different at the level indicated.

TABLE 64.—*Results from analyses of variance for differences among spinning properties of lint after experimental seed-cotton and lint-cleaning treatments*

Item	F value and significance [1] [2]			
	Replications [3]	Seed-cotton cleaning	Lint cleaning	Interaction [4]
Manufacturing waste	6.81**	3.77	45.25**	0.21
Nep count	23.96**	0.40	13.22**	0.48
22s yarn skein strength	46.67**	0.96	6.68**	0.33
50s yarn skein strength	87.73**	1.75	14.20**	2.26
Yarn average break factor.	77.61**	2.34	13.62**	0.80
22s yarn appearance index.	114.90**	10.51**	8.70**	1.82
50s yarn appearance index.	81.78**	1.59	14.59**	1.86
Yarn average appearance index.	191.90**	9.22**	21.87**	3.44*

[1] Values required for F to attain significance at 5- and 1-percent levels are: Replications, 2.49 and 3.61; seed-cotton cleaning, 4.13 and 7.44; lint cleaning, 2.88 and 4.41; and interactions, 2.88 and 4.41.

[2] **=significant at 1-percent level; *=significant at 5-percent level. Other figures are not significant.

[3] For lint-cleaning treatments, no lint cleaning, one cleaner, two cleaners, and three lint cleaners were each tested with two seed-cotton cleaning levels. Each interacting cleaning sequence was replicated six times.

[4] Interaction relates to seed-cotton cleaning level and amount of lint cleaning.

TABLE 65.—*Significant differences for spinning properties of lint after four experimental amounts of lint cleaning*

Spinning property and significance level [1]	Lint cleaners used			
	None	1	2	3
Manufacturing waste:				
1 percent	9.8a	7.2b	6.0bc	5.8c
5 percent	9.8a	7.2b	6.0c	5.8c
Neps per 100 square inches of card web (number):				
1 percent	15.0a	22.2ab	28.8b	30.2b
5 percent	15.0a	22.2ab	28.8bc	30.2c
22s yarn skein strength (pounds):				
1 percent	109.0a	106.4ab	105.4b	105.2b
5 percent	109.0a	106.4b	105.4b	105.2b
50s yarn skein strength (pounds):				
1 percent	39.1a	38.4a	37.0b	37.0b
5 percent	39.1a	38.4a	37.0b	37.0b
Yarn average break factor:				
1 percent	2,182a	2,131ab	2,085b	2,080b
5 percent	2,182a	2,131b	2,085bc	2,080c
22s yarn appearance index:				
1 percent	91.6a	88.3ab	87.5ab	82.5b
5 percent	91.6a	88.3a	87.5a	82.5b
50s yarn appearance index:				
1 percent	84.2a	82.5ab	76.7bc	73.4c
5 percent	84.2a	82.5a	76.6b	73.4b
Yarn average appearance index:				
1 percent	88.0a	85.4ab	82.0bc	78.0c
5 percent	88.0a	85.4ab	82.0b	78.0c

[1] Numbers in the same row followed by the same letter are not significantly different at the level indicated.

TABLE 66.—*Results from analyses of variance for differences among weight per bale, nonlint content, and Suter-Webb Array lengths of lintcleaner waste material extracted during experimental seed-cotton and lint-cleaning treatments*

Item	F value and significance [1 2]			
	Replications [3]	Seed-cotton cleaning	Lint cleaning	Interaction [4]
Weight per bale	16.84**	3.13	21.92**	0.08
Nonlint content	41.27**	18.18**	33.30**	0.18
Upper quartile length	8.10**	8.79**	3.51*	0.14
Mean length	2.32	8.25**	6.78**	0.32
Coefficient of length variation	0.29	3.09	6.96**	0.50
Fibers longer than 1 inch	3.80*	3.40	3.92*	0.04
Fibers ½ to 1 inch	5.24**	1.95	1.13	0.03
Fibers shorter than one-half inch	0.08	2.88	6.89**	0.53

[1] Values required for F to attain significance at 5- and 1-percent levels are: Replications, 2.60 and 3.85; seed-cotton cleaning, 4.24 and 7.77; lint cleaning, 3.39 and 5.57; and interactions, 3.39 and 5.57.

[2] **=significant at 1-percent level; *=significant at 5-percent level. Other figures are not significant.

[3] For lint-cleaning treatments, one cleaner, two cleaners, and three lint cleaners were each tested with two seed-cotton cleaning levels. Each interacting cleaning sequence was replicated six times.

[4] Interaction relates to seed-cotton cleaning level and amount of lint cleaning.

TABLE 67.—*Significant differences for weight per bale, nonlint content, and Suter-Webb Array lengths of lint-cleaner waste material extracted during experimental lint cleaning*

Waste property and significance level [1]	Lint cleaners used		
	1	2	3
Weight per bale (pounds):			
1 percent	20.0a	29.8b	35.2b
5 percent	20.0a	29.8b	35.2b
Nonlint content:			
1 percent	74.52a	69.62b	67.12b
5 percent	74.52a	69.62b	67.12c
Upper quartile length (inches):			
5 percent	1.224a	1.206b	1.202b
Mean length (inches):			
1 percent	0.986a	0.950ab	0.948b
5 percent	0.986a	0.950b	0.948b
Coefficient of length variation:			
1 percent	32.2a	34.6b	34.6b
5 percent	32.2a	34.6b	34.6b
Fibers longer than 1 inch:			
5 percent	56.3a	52.1b	52.3b
Fibers shorter than one-half inch:			
1 percent	10.4a	12.8b	12.8b
5 percent	10.4a	12.8b	12.8b

[1] Numbers in the same row followed by the same letter are not significantly different at the level indicated.

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