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EFFECTS OF GIN CLEANING on FIBER PROPERTIES and SPINNING QUALITY, PIMA COTTON, 1965–66 With and Without Crusher Rolls

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EFFECTS OF GIN CLEANING ON FIBER PROPERTIES AND SPINNING QUALITY, PIMA COTTON, 1965–66

With and Without Crusher Rolls

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SUMMARY AND CONCLUSIONS

Pima S–3 cotton from the 1965–66 crop was given the following ginning treatments and then processed with and without card crusher rolls.

Treatment 1, *Low.*	Separators, tower drier, and conveyor-distributor.
Treatment 2, *Moderate.*	Low+one 6-cylinder cleaner and one 7-cylinder cleaner.
Treatment 3, *Multiple Low.*	Five times through the low setup.
Treatment 4, *Elaborate.*	Low+one 6-cylinder cleaner, one bur machine, one stick remover, and one 7-cylinder cleaner.
Treatment 5, *Low+ lint cleaner.*	Low+one Pima lint cleaner.

Treatment 4 removed more foreign matter from seed cotton than the other treatments; treatments 1 and 5 removed significantly less than the other treatments. No significant difference in rate of ginning was found among ginning treatments. Gin turnout was significantly higher for treatment 1 than for treatments 3 and 4. Cottonseed moisture and ginned lint moisture were significantly lower for treatment 3 than for the other treatments. Neps in ginned lint were significantly lower for treatment 1 than for the other treatments.

Fiber properties of ginned lint varied among ginning treatments. Treatment 1 produced a grade of 5.0 while treatment 5, with lint cleaning, produced a grade of 3.0. Differences in fiber length characteristics were found among ginning treatments. Additional cleaning produced fibers that were less uniform in length than treatments with less cleaning. However, most of these differences in length and length distribution were removed during combing, so that few significant length differences among ginning treatments existed in drawing sliver.

Total opening, picking, and carding waste differed in the same pattern as classer's grade—lower grades produced more waste. Differences in comber noils reflected differences in short fiber content; treatment 3 had both more short fibers and more comber noils than the other treatments.

Spinning end breakage was not significantly affected by ginning treatments, but use of card crusher rolls reduced end breakage by about 40 percent. About 30 percent of the broken ends lapped around the rolls, but this phenomenon was not significantly related to ginning treatments or to use of crusher rolls.

Ginning treatment 3 produced slightly lower break factor and slightly more thick places in yarn than the other treatments.

Crusher rolls improved performance and yarn quality of all cottons. End breakage was lower, neps per 1,000 yards of yarn was lower, and yarn appearance was higher when crusher rolls were used than when they were not used.

In this study, the producer benefited from additional gin cleaning with resulting higher grades. However, the use-value of the cottons to the mills, as indicated by lower cost per pound of comber sliver, favors the ginning treatments with little or no cleaning. Also, spinning performance and yarn quality measurements indicated that gin cleaning beyond the minimum was not needed. The added producer benefits from the additional gin cleaning indicate that the lower grades were discounted too much in the pricing of the cottons.

BACKGROUND AND OBJECTIVES

In preceding research with Pima cottons, ginning treatments with humid air added to seed cotton preserved fiber length; however, damp cotton retained foreign matter, which adversely affected spinning performance.[1] Consequently, additional research on ginning was needed to determine the effects of various methods of cleaning cotton.

The crusher roll in the spinning plant was known to be effective in cleaning upland cotton, but no information was available on its effectiveness in cleaning Pima cottons (*Gossypium barbadense*), also known as American-Egyptian and extra-long-staple cottons. This study was designed to provide some information in this area.

SOURCE OF COTTON

Through cooperative efforts of the SuPima Association of America and the Far West Texas Experiment Station at Ysleta, Tex., a new strain of Pima, later released for commercial production as Pima S–3, was obtained from the 1965–66 crop of the C–L Ranch near Dell City, Tex.

PROCEDURE

Harvesting

The cotton was harvested on three successive Mondays. These three lots were used in three replications of the experimental treatments. All harvests were first picking with two two-row spindle-type mechanical harvesters in late November and early December. Good weather prevailed during the harvests; there was no frost until after the last harvest.

Ginning

Each of the three lots consisting of 10 bales were given five different treatments in the gin and these sublots were further divided for treatment, with and without crusher rolls, at the spinning laboratory. All treatments were randomized within each lot.

Table 1 shows the ginning setups in detail. It was necessary to use the handling and cleaning equipment in the saw ginning laboratory to obtain the five cleaning setups desired. All lots of cotton went through the tower drier with 160° F. inlet temperature, then through separators and the distributor to the overflow in the saw gin laboratory. Each lot of seed cotton was then transported to the roller gin laboratory for identical treatments in handling and ginning; one exception involved the lint cleaner.

Treatment 1, designated as Low.—No cleaning or extracting equipment was used, but handling equipment, such as separators, the tower drier, and the conveyor-distributor, was included.

Treatment 2, or Moderate.—One 6-cylinder cleaner and one 7-cylinder cleaner were used.

Treatment 3, or Multiple Low.—The seed cotton was handled five times through the treatment 1 setup.

Treatment 4, Elaborate.—Cotton went through the 6-cylinder cleaner, a bur machine, a stick remover, and the 7-cylinder cleaner.

Treatment 5, Low seed cotton cleaning plus lint cleaner.—The seed cotton was treated just as in treatment 1, but a Pima lint cleaner was used after ginning. The Pima lint cleaner, also known as the long-staple lint cleaner, uses mill-type beaters and air for trash removal.

All lots were ginned on a new high-capacity, rotary-knife roller gin. The principle of this type of gin originated at the Southwestern Cotton Ginning Research Laboratory; modifications of it are manufactured by several gin machinery companies.

During the cleaning and ginning of each lot, samples of seed cotton, cottonseed, and ginned lint were drawn for evaluations of foreign matter content, moisture content, and various qualities.

All bales were shipped to the Pilot Spinning Laboratory at Clemson, S.C., for detailed fiber and spinning analyses.

[1] Chapman, W. E., Mullikin, R. A., and La Ferney, P. E. quality and performance of pima s–1 and pima s–2 cotton under different ginning conditions, el paso area, 1964–65. U.S. Dept. Agr. Mktg. Res. Rpt. 803, 13 pp., illus. 1968.

TABLE 1.—*Gin cleaning treatments, Pima Ginning and Crusher Roll Study, Crop 1965* [1]

Gin cleaning treatment	Equipment in saw gin laboratory								Equipment in roller gin laboratory				
	1st separator	Tower drier 160° F.	6-cylinder cleaner	Bur machine	Stick remover	2d separator	7-cylinder cleaner	Distributor	3d separator	Distributor	Plain feeder	High capacity gin [2]	Pima lint cleaner
1. Low	x	x	------	------	------	x	------	x	x	x	x	x	------
2. Moderate	x	x	x	------	------	x	x	x	x	x	x	x	------
3. Multiple low [3]	x	x	------	------	------	x	------	x	x	x	x	x	------
4. Elaborate	x	x	x	x	x	x	x	x	x	x	x	x	------
5. Low + lint cleaner	x	x	------	------	------	x	------	x	x	x	x	x	x

[1] x indicates equipment used, ___ indicate equipment bypassed.
[2] High-capacity, rotary-knife roller gin.
[3] Seed cotton passed through equipment in saw gin laboratory 5 times.

FIBER TESTING

After bale ties were removed and before processing, samples of cotton were taken at intervals throughout each bale for fiber testing. After mechanical blending, Suter-Webb array, Digital Fibrograph, micronaire, and Pressley strength tests were made on the samples. All fiber tests were made under controlled atmospheric conditions of 70° F. and 65 percent relative humidity.

PROCESSING

Each lot was processed identically from opening through picking with the following organization:

Opening: 2 blender feeders, 1 lattice opener.
Picker: 14-ounce lap, 2 section, 1-process picker.
Carding: 50-grain sliver, 5.5 pounds per hour.
Breaker drawing: 8 ends up, 50-grain sliver fed, 45-grain sliver delivered.
Lap winding: 20 ends up, 45-grain sliver fed, 864-grain lap delivered.
Comber: 864-grain lap fed, 53-grain sliver delivered.
Finished drawing: 8 ends up, 53-grain sliver fed, 55-grain sliver delivered.
Roving: 55-grain sliver fed, 1.75-hank roving delivered, 1.10 twist multiplier.
Spinning: 1.75-hank roving fed, 80s combed yarn delivered, 3.22 twist multiplier, 13,000 spindle speed.

At the carding operation, picker laps were divided. One-half was carded without crusher rolls and one-half with crusher rolls, using 260 pounds of pressure on the rolls.

The comber was set to remove 14 percent comber noils from a special check cotton used for calibration purposes. This check cotton was creeled in the comber before each subsequent lot was processed to insure that settings were still the same and that 14 percent noils were being removed from the check cotton. Each lot was combed with the same settings and timing.

Roving was creeled singly into four 252-spindle spinning frames equipped with Duo-Roth drafting systems. New travelers were used for each spinning doff; frames were run for 30 minutes to break in travelers and to obtain yarn for sizing. Draft gears were changed, if necessary, to obtain the specified yarn size, and end breakage was recorded at 15-minute intervals during the spinning of a full doff of yarn.

The card room and spinning room were kept at a temperature of 80° F. and 50 percent relative humidity throughout the tests.

STATISTICAL ANALYSIS

The test results were examined by analysis of variance. Data from operations before carding were treated as a randomized block experiment having five ginning treatments in six replications. After carding and the introduction of the crusher roll treatments (with and without), the analyses recognized a 5 x 2 split-plot arrangement of treatments in three replications. The Duncan multiple range procedure was used to indicate discrimination among means when pertinent. The crusher roll treatments have no pertinence for those operations prior to the use of the crusher roll.

RESULTS

Harvesting and Ginning

From the early to the late harvest period, the moisture content of the cotton decreased slightly and the foreign matter content increased slightly. The cooperating farmers, who are also farm machinery dealers, supervised the cleaning and adjustments of the two 2-row spindle-type harvesters.

After the seed cotton was transported to the ginning laboratory, it contained an average of 6.19 percent total foreign matter (table 2). The components of foreign matter were hulls, sticks, fine trash, motes, and small amounts of bark, shale, and cottonseed meats. These components varied slightly but not significantly; only the mean of each component for all test lots is shown for wagon samples.

Total foreign matter in seed cotton was reduced by all five gin cleaning treatments, but especially by treatment 4, the Elaborate seed cotton cleaning treatment. Total foreign matter in seed cotton after cleaning was significantly less for treatment 4 than for all other treatments (table 2). Treatment 2, Moderate, and treatment 3, Multiple Low, removed significantly more trash from seed cotton than treatments 1 and 5, both of which represented Low seed cotton cleaning treatments.

The hulls (burs) and sticks in the cleaned seed cotton were significantly lower for treatment 4, Elaborate, than for the other seed cotton cleaning treatments (table 2).

Fine trash in cleaned seed cotton, composed largely of broken leaves, was less for treatments 2, 3, and 4 than for treatments 1 and 5 (both Low).

TABLE 2.—*Means of foreign matter components in nontreated wagon lots of seed cotton and in gin-treated seed cotton, and statistical tests on the latter, Pima S–3 cotton, El Paso area, 1965–66*

Cotton, ginning treatment, and type of analysis or test [1]	Total foreign matter [2 3]	Hulls or burs [3]	Sticks and stems [3]	Fine trash [3]	Motes [3]	Bark	Shale	Cotton-seed meats	Lube oil spots	Grass and grass seeds	Spindle twist
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*No./ 250 g.*	*No./ 250 g.*	*No./ 250 g.*	*No./ 250 g.*	*No./ 250 g.*	*No./ 250 g.*
All wagon lots of seed cotton before treatment	6. 19	0. 97	0. 56	3. 34	1. 31	Trace	1	2	Trace	None	Trace
After treatment:											
1. Low	4. 82 c	. 90 b	. 48 b	2. 51 b	. 93 bc	None	2	2	Trace	None	Trace
2. Moderate	2. 95 b	. 74 b	. 43 b	1. 03a	. 76 b	None	1	1	None	None	Trace
3. Multiple low	2. 41ab	. 73 b	. 39ab	. 91a	. 39a	Trace	2	1	Trace	None	Trace
4. Elaborate	1. 92a	. 21a	. 24a	. 84a	. 62 b	Trace	1	1	Trace	None	Trace
5. Low+L.C	5. 14 c	. 92 b	. 52 b	2. 56 b	1. 13 c	None	2	1	Trace	None	Trace
	Level of significance of differences in treatments [4]										
Analysis of variance	**	**	*	**	**	------	------	--------	------	--------	--------

[1] Refer to ginning details explained in table 1.
[2] Some of the figures do not add exactly to the total because of rounding.
[3] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.
[4] *=Significant at or beyond the 95–percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

Motes or immature seeds in cleaned seed cotton were significantly less for treatment 3, Multiple Low, than for all other treatments. Treatment 3 was included to test the effect of a long exposure or handling time with very little harsh action; the separator screens did remove fine trash and motes quite well. The continued exposures to low drying temperature (160° F.), however, produced undesirable effects in fiber qualities. Presumably, a modification of this treatment with no heat, or with ambient air, would produce better quality fibers.

The rate of ginning, measured in pounds of lint per inch of roll per hour, averaged 14.5 throughout part of the test with no significant differences between gin-cleaning treatments. Before the test was completed, it was necessary to change the roll; remaining lots were ginned at the rate of 21 pounds of lint per inch of roller per hour with no significant difference between gin-cleaning treatments. These figures compare with about 2 to 3 pounds on the older reciprocating-type roller gins. Means shown are for rates used before changing the roll in the gin (table 3).

Lint turnout for all treatments averaged 33.3 percent. The highest turnout, 34.4 percent, came from treatment 1 (table 3), Low cleaning, which left significantly more foreign matter in the ginned lint than the other treatments; this is evidenced by the grade (table 5), picker and card waste (table 6), Shirley analyzer waste (Appendix, table 9), and card waste (Appendix, table 10).

Treatment 1 had one of the highest lint moisture contents, which, along with the greatest trash content, helps to account for the greatest lint turnout (table 3). Both cottonseed moisture and ginned lint moisture were significantly lower with treatment 3, Multiple Low cleaning, where drying exposure times were increased, than with other treatments (table 3).

Neps in ginned lint were significantly lower for treatment 1, Low cleaning, than for all other treatments (table 3).

Reflectance of ginned lint was measured with the Colorimeter before and after the lint was cleaned with the Shirley analyzer (table 3). Before cleaning with the Shirley analyzer, lint from treatment 1, Low cleaning, was significantly lowest in reflectance; after cleaning lint from treatment 1 had the highest reflectance value, significantly greater than treatments 2 and 3.

Foreign matter in ginned lint was significantly lower with treatment 5, Low seed cotton cleaning plus lint cleaner, than for all other treatments (Appendix, table 9). This was also true for seedcoat fragments, as shown in table 4.

Funiculi or tiny black seed stalks, sources of "pepper trash," were reduced more by cleaning treatments 2, 3, 4, and 5 than by treatment 1, Low cleaning (table 4).

Fiber Properties

Fiber quality was measured at three stages of processing: Ginned lint, card sliver, and drawing sliver. Since differences in properties of card sliver among ginning treatments were similar to those in properties of ginned lint, only properties of ginned lint and drawing sliver are discussed in this report. Table 5 shows averages of selected properties of ginned lint and drawing sliver.

Grade

Grade varied considerably among the different cleaning treatments (table 5). Treatment 5, the one with lint cleaning, produced a grade of 3.0 which was significantly higher than any other. The grade of 5.0 produced with treatment 1 was significantly lower than any other. Shirley analyzer nonlint content followed the same pattern as grade (Appendix, table 9).

Fiber Length

Fiber length and length distribution of ginned lint were affected by ginning treatments; however, most of the differences were not significant in finished drawing sliver. Treatment 3 was detrimental to staple length, digital 2.5 percent span length, array mean length, and array short fiber content of ginned lint. Only the difference in array mean length was significant in drawing sliver. The combing process effectively reduced most of these differences in length and length distribution since all cotton was combed at the same settings. Treatment 5, with lint cleaning and the highest grade, produced lint with length and length distribution better than treatment 3 and equal to any other treatment. Treatment 4 had significantly less short fibers than treatments 2 and 3.

Fineness and Strength

Fiber fineness and strength were measured and analyzed but, as expected, showed no significant differences among ginning treatments (Appendix, table 9).

Processing Performance and Yarn Quality

Picker and Card Waste

Waste removed during picking and carding (table 6) followed the same pattern as classer's grade (table 5). The differences were substantial and statistically significant. Treatment 5 resulted in less waste than treatments 4, 3, and 2, which in turn had less waste than treatment 1.

TABLE 3.—*Means of selected ginning, moisture, cottonseed, and fiber qualities, and statistical tests, Pima S–3 cotton, El Paso area, 1965–66*

Ginning treatment and type of analysis or test [1]	Ginning performance		First separator trash weight [2]	Moisture content [2]			Cottonseed		Lint color, reflectance [2]		Neps in ginned lint
	Ginning rate	Lint turnout [2]		Before ginning	Cotton-seed	Ginned lint	Residual linters	Physical damage	Before S.A.[3]	After S.A.[3]	
	Lb. lint/ in./hr.[4]	*Pct.*	*Lb./1,500 lb. S/C* [5]	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Rd*	*Rd*	*No./100 sq. in.*
After treatment:											
1. Low	14. 0	34. 4 b	13. 9a	--------	8. 5 b	5. 4 b	2. 1	14	63. 3a	66. 3 b	10a
2. Moderate	15. 1	33. 1ab	13. 1a	9. 3	8. 8 b	5. 2 b	2. 0	18	64. 5 b	65. 8a	14 bc
3. Multiple low	15. 0	32. 4a	37. 6 b	9. 3	7. 8a	4. 2a	2. 4	19	64. 5 b	65. 6a	16 c
4. Elaborate	15. 4	32. 4a	12. 7a	9. 3	8. 4 b	5. 4 b	2. 5	18	64. 9 b	66. 0ab	13 b
5. Low+L.C	13. 0	34. 0ab	12. 8a	9. 3	8. 1ab	5. 1 b	2. 2	17	64. 1ab	65. 9ab	13 b
	Level of significance of differences in treatments [6]										
Analysis of variance	NS	*	**	NS	*	**	NS	NS	**	*	**

[1] Refer to ginning details explained in table 1.
[2] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.
[3] S.A.=Shirley analyzer.
[4] Pounds of lint per inch of roller per hour.
[5] Pounds of trash per 1,500 pounds of seed cotton.
[6] *=Significant at or beyond the 95-percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

TABLE 4.—*Means of foreign matter components in ginned lint, and statistical tests, Pima S–3 cotton, El Paso area, 1965–66*

Ginning treatment and type of analysis or test [1]	Seedcoat fragments [2]	Funiculi [2]	Hulls or burs	Sticks and stems	Motes [2]	Bark	Shale	Cotton-seed meats	Lube oil spots	Grass and grass seeds	Spindle twist
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*No./10 g.*	*No./10 g.*	*Pct.*
1. Low	1. 12 b	0. 13 b	None	0. 42	0. 22ab	0. 09	0. 10	Trace	Trace	None	None
2. Moderate	1. 25 b	. 09a	None	. 22	. 14ab	. 04	. 14	Trace	Trace	None	None
3. Multiple low	1. 28 b	. 09a	None	. 24	. 15ab	. 02	. 13	Trace	Trace	None	None
4. Elaborate	1. 08 b	. 11ab	None	. 30	. 26 b	. 02	. 11	None	Trace	None	None
5. Low+L.C	. 46a	. 08a	None	. 07	. 10a	0	. 02	None	Trace	None	None
	Level of significance of differences in treatments [3]										
Analysis of variance	*	*	--------	([4])	*	--------	NS	--------	--------	--------	--------

[1] Refer to ginning details explained in table 1.

[2] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.

[3] *=Significant at or beyond the 95-percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

[4] Differences are significant at the 75-percent level.

TABLE 5.—*Means of selected fiber properties by ginning condition, and statistical tests, ginned lint and drawing sliver, Pima S–3 cotton, El Paso area, 1965–66*

Ginning treatment and type of analysis or test [1]	Grade of ginned lint [2]	Staple of ginned lint [2]	Digital fibrograph 2.5-pct. span length		Array mean length [2]		Array fibers <1/2 inch		Array coefficient of variation	
			Ginned lint [2]	Drawing sliver	Ginned lint	Drawing sliver	Ginned lint [2]	Drawing sliver	Ginned lint	Drawing sliver
	Index	*32d inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*
1. Low	5. 0 c	44. 3ab	1. 35ab	1. 38	1. 23 b	1. 25 b	5. 1a	2. 3	28	24
2. Moderate	4. 3 b	45. 3 b	1. 35ab	1. 38	1. 22 b	1. 26 b	5. 6ab	2. 4	29	24
3. Multiple Low	4. 0 b	44. 0 a	1. 34a	1. 38	1. 20a	1. 23a	5. 9 b	2. 6	29	25
4. Elaborate	4. 0 b	44. 3ab	1. 37 b	1. 38	1. 22 b	1. 25 b	4. 9a	2. 4	28	24
5. Low+L.C	3. 0a	45. 3 b	1. 36 b	1. 38	1. 22 b	1. 25 b	5. 4a	2. 2	28	24
	Level of significance of differences in treatments [3]									
Analysis of variance	**	*	*	NS	*	**	*	NS	NS	NS

[1] Refer to ginning details explained in table 1.
[2] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.
[3] *=Significant at or beyond the 95-percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

TABLE 6.—*Means of selected processing and yarn properties by ginning condition, with and without crusher rolls, and statistical tests, Pima S–3 cotton, El Paso area, 1965–66*

Ginning treatment and type of analysis or test [1]	Picker and card waste		Comber noils		Ends down per 1,000 spindle hours		Break factor		Yarn appearance	
	Rolls	No rolls	Rolls	No rolls	Rolls	No rolls	Rolls	No rolls	Rolls	No rolls
	Percent	*Percent*	*Percent*	*Percent*	*Number*	*Number*	*Unit*	*Unit*	*Index*	*Index*
1. Low	8. 01	8. 05	13. 8	13. 5	23	44	2939	2952	114	111
2. Moderate	6. 73	6. 69	13. 7	13. 7	35	58	2955	2934	115	112
3. Multiple low	6. 18	6. 16	14. 0	14. 0	30	48	2897	2874	108	109
4. Elaborate	6. 11	6. 17	13. 5	13. 3	23	37	2904	2973	112	109
5. Low+L.C	5. 34	5. 32	13. 5	13. 5	27	42	2916	2883	113	108
	Means of rolls and no rolls to show effects of ginning treatments [2]									
1. Low	8. 03 c		13. 6ab		34		2946 b		112	
2. Moderate	6. 71 b		13. 7ab		46		2944 b		114	
3. Multiple low	6. 17 b		14. 0 b		39		2886a		108	
4. Elaborate	6. 14 b		13. 4a		30		2938 b		110	
5. Low+L.C	5. 33a		13. 5ab		34		2900ab		110	
	Level of significance of differences in treatments [3]									
Analysis of variance:										
Crusher rolls	NS		NS		**		NS		*	
Ginning	**		*		NS		*		NS	
CRxG	NS		NS		NS		NS		NS	

[1] Refer to ginning details in table 1.

[2] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.

[3] *=Significant at or beyond the 95-percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

Neps Per 100 Square Inches of Card Web

Both ginning treatments and crusher rolls affected neps in card web (Appendix, table 10). The combined effects of repeated drying exposures and extra handling of cotton are seen in the significantly greater number of neps for ginning treatment 3 than for other treatments. However, the effect of crusher rolls on neps is not important; neps which are flattened by the crusher rolls or separated by drafting of the flattened web show up more plainly on the nep boards. This effect on neps was not apparent in yarn quality measurements.

Comber Noils

Comber noils are important not only as a waste factor but also because of the tendency to reduce or remove differences in length and length distribution which exist in ginned lint. The latter influences the relationship between fiber properties of ginned lint and processing performance and yarn quality.

The only significant difference in percent noils was between treatments 3 and 4, which had different short fiber contents in ginned lint. Cotton from treatment 3, which had the highest short fiber content, produced more noils than cotton from any other treatment (table 6).

Spinning End Breakage

Ends down per thousand spindle hours (EDMSH) did not differ significantly among the ginning treatments (table 6). This is because of the small difference in length and length distribution of drawing sliver among ginning treatments, which resulted from the evening effect of combing.

Regardless of the ginning treatment applied, use of crusher rolls significantly reduced EDMSH. The average reduction was almost 40 percent. This effect is consistent with findings of earlier studies of upland varieties.[2]

Lapping of broken ends around the rolls created a problem during spinning. About 30 percent of the broken ends did lap, but no particular treatment contributed to this problem more than the others.

Break Factor

Ginning treatments 3 and 5 produced break factors which were about 55 and 40 units, respectively, less than those of other treatments (table 6). Only the difference between treatment 3 and others was statistically significant. This difference reflects the slight tendency for treatment 3 to produce shorter and less uniform fibers of drawing sliver, since break factor is quite sensitive to fiber length and length distribution.

Other Yarn Quality Measurements

Crusher rolls significantly improved yarn appearance (table 6) and reduced neps and thick places per 1,000 yards of yarn (table 7). For cotton processed through card crusher rolls, yarn appearance index was about 3 units higher, nep count about 40 lower, and thick places were about 30 lower. Use of crusher rolls did not affect yarn irregularity or thin places in yarn. Ginning treatment 3 produced more thick places in yarn than other ginning treatments but did not affect other measurements of yarn quality.

Marketing Consideration

What are the implications of the test results for marketing of Pima S–3 cotton when both producers of lint and manufacturers of cotton products are considered? This section is directed at this question. Bale values and cost per pound of comber sliver were derived to make economic evaluations.

Bale Value

Bale weights were adjusted for foreign matter and moisture losses by using ginning treatment 1 as the base at 500 pounds. This adjustment seems reasonable since there were no significant differences in foreign matter or moisture content in wagon samples. Bale values were then calculated for each ginning treatment by taking the product of adjusted bale weights and spot prices of American-Egyptian cotton, El Paso and Phoenix markets, season 1965–66. Table 7 shows adjusted bale weight, average price, and calculated bale value for each ginning treatment.

Treatment 1 had a significantly lower average bale value than treatments 4 and 5. The values for treatments 2 and 3 were not significantly different from either treatment 1 or treatments 4 and 5. Treatments 4 and 5 provided higher producer returns than treatment 1.

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[2] Mullikin, R. A., and La Ferney, P. E. THE EFFECTS OF CARDING RATES AND CRUSHER ROLLS ON SPINNING PERFORMANCE AND YARN QUALITY. Paper presented at Textile Quality Control Association Fall Meeting, Asheville, N.C., 1966.

Newton, F. E., Burley, S. T., and Moore, V. P. THE EFFECT OF TRASH REMOVAL ON COTTON PROCESSING PERFORMANCE AND PRODUCT QUALITY. Paper presented at 17th Annual Cotton Research Clinic, Pinehurst, N.C., Feb. 1966.

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Cost of Comber Sliver

The cost per pound of comber sliver for each treatment was calculated by first accounting for weight losses from bagging and ties, opening, picking, carding, and combing, then dividing as follows:

$$\frac{\text{Market price}}{\text{Lb. comber sliver/lb. ginned lint}} = \text{price/lb. comber sliver.}$$

Table 8 shows the price per pound of raw cotton, total manufacturing waste removed, and the calculated cost per pound of comber sliver.[3]

Cost per pound of comber sliver varied considerably among the various ginning treatments. The only statistically significant difference occurred between treatment 1 and treatments 2, 3, and 5. Treatment 1 reduced the cost of comber sliver 2 to 3.5 cents per pound, relative to treatments 2, 3, and 5. Treatment 4 had a higher cost per pound of comber sliver than treatment 1 at the 90-percent significance level. Since the cost of comber sliver with treatments 2, 3, 4, and 5 was higher than with treatment 1 and since treatment 3 produced inferior processing performance or yarn quality, treatment 1 does have considerable advantage in manufacturing.

Considering the use-value of cotton in manufacturing, treatment 1 is best so long as the cost of removing and handling the additional waste associated with the treatment does not exceed about 2 cents per pound of comber sliver. But treatment 1 gave the producer a lower return than any other treatment (significantly lower than treatments 4 and 5). The low market prices for the uncleaned cotton thus reflect an overemphasis of trash in these cottons or indicate that manufacturers were interested in the higher grades for reasons not considered in this study. This study points up the fact that, just as with upland cotton, the grading system does not reflect the use-value of the cotton.

[3] Total manufacturing waste includes bagging and ties, opening, picking, and carding waste, and comber noils.

TABLE 7.—*Bale weight, average price per pound, and bale value, American-Egyptian cotton, El Paso area, 1965–66*

Ginning treatment	Adjusted bale weight	Price per pound	Bale value
	Pounds	*Cents*	*Dollars*
1. Low	500. 0	46. 36	231. 80
2. Moderate	488. 8	48. 81	238. 58
3. Multiple low	480. 5	49. 43	237. 51
4. Elaborate	490. 2	49. 17	241. 03
5. Low +L.C	[1] 481. 2	50. 91	[1] 244. 98

[1] An estimated 1 to 2 pounds of lint was lost through the lint cleaner in treatment 5, but this would only reduce bale value to about $244 and leave conclusions unchanged.

TABLE 8.—*Price of raw American-Egyptian cotton, manufacturing waste, and cost per pound of comber sliver, El Paso area, 1965–66*

Ginning treatment	Price per pound of raw cotton	Manufacturing waste	Cost per pound of comber sliver
	Cents	*Percent*	*Cents*
1. Low	46. 36	26. 10	62. 75
2. Moderate	48. 81	24. 81	64. 92
3. Multiple low	49. 43	24. 59	65. 56
4. Elaborate	49. 17	23. 92	64. 62
5. Low+L.C.	50. 91	23. 24	66. 33

APPENDIX

TABLE 9.—*Means of selected fiber properties by ginning condition, and statistical tests, ginned lint and drawing sliver, Pima S–3 cotton, El Paso area, 1965–66*

Ginning treatment and type of analysis or test [1]	Array upper quartile length		Shirley analyzer waste: Ginned lint [2]	Micronaire		Pressley strength "0" gage		Digital fibrograph length uniformity	
	Ginned lint	Drawing sliver		Ginned lint	Drawing sliver	Ginned lint	Drawing sliver	Ginned lint	Drawing sliver
	Inch	*Inch*	*Percent*	*Reading*	*Reading*	*1,000 p.s.i.*	*1,000 p.s.i.*	*Ratio*	*Ratio*
1. Low	1. 46	1. 46	6. 3 c	3. 60	3. 9	95	94	46. 7	48
2. Moderate	1. 46	1. 47	4. 4 b	3. 67	3. 9	97	94	46. 0	48
3. Multiple Low	1. 45	1. 45	3. 8 b	3. 70	3. 8	95	95	46. 7	48
4. Elaborate	1. 46	1. 46	4. 4 b	3. 77	3. 9	96	96	46. 3	48
5. Low+L.C	1. 46	1. 46	3. 0a	3. 67	3. 9	96	94	46. 7	48
	Level of significance of differences in treatments [3]								
Analysis of variance	NS	NS	**	NS	NS	NS	NS	NS	NS

[1] Refer to ginning details explained in table 1.
[2] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.
[3] *=Significant at or beyond the 95-percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

TABLE 10.—*Means of selected processing and yarn properties by ginning condition, with and without crusher rolls, and statistical tests, Pima S–3 cotton, El Paso area, 1965–66*

Ginning treatment and type of analysis or test [1]	Card Waste		Neps/100 sq. in. card web		Yarn irregularity coefficient of variation		Neps/1,000 yards		Thick places/1,000 yards	
	Rolls	No rolls	Rolls	No rolls	Rolls	No rolls	Rolls	No rolls	Rolls	No rolls
	Percent	*Percent*	*Number*	*Number*	*Percent*	*Percent*	*Number*	*Number*	*Number*	*Number*
1. Low	5. 20	5. 25	7	6	17. 3	17. 2	62	89	158	180
2. Moderate	4. 67	4. 63	8	5	17. 0	17. 2	55	109	169	195
3. Multiple low	4. 46	4. 42	9	7	17. 3	17. 5	77	122	199	228
4. Elaborate	4. 40	4. 45	8	6	17. 3	17. 5	67	108	160	197
5. Low+L.C	4. 09	4. 08	8	6	17. 3	17. 5	56	105	158	189
	Means of rolls and no rolls to show effects of ginning treatments [2]									
1. Low	5. 22 c		6a		17. 2		76		169a	
2. Moderate	4. 65 b		6a		17. 1		82		182a	
3. Multiple low	4. 44 b		8 b		17. 4		100		214 b	
4. Elaborate	4. 42 b		7a		17. 4		88		178a	
5. Low+L.C	4. 08a		7a		17. 4		80		174a	
	Level of significance of differences in treatments [3]									
Analysis of variance:										
Crusher rolls	NS		**		NS		**		**	
Ginning	**		**		NS		NS		**	
CRxG	NS		NS		NS		NS		NS	

[1] Refer to ginning details in table 1.

[2] In any column, 2 or more numbers followed by the same letter are not significantly different from each other at the 95-percent level.

[3] *=Significant at or beyond the 95-percent level; **=significant at or beyond the 99-percent level; NS=not statistically significant at the 95-percent level.

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