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EFFECTS OF GIN-SAW SPEED AND SEED-ROLL DENSITY ON QUALITY OF COTTON

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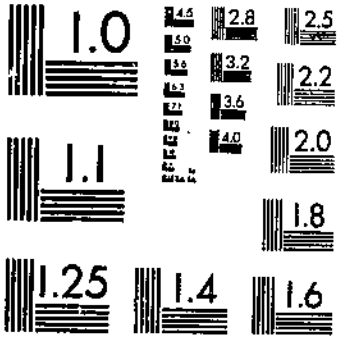

MICROCOPY RESOLUTION TEST CHART
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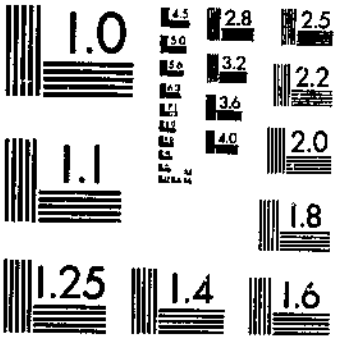

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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EFFECTS OF GIN-SAW SPEED AND SEED-ROLL DENSITY ON QUALITY OF COTTON LINT AND OPERATION OF GIN STANDS [1]

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INTRODUCTION

Much of the alleged damage done to American cotton at commercial gins has been attributed by many individuals associated with the ginning problem to the speed with which the crop is ginned. Observations made by the authors during the past decade, at a large number of gins in operation, indicated the truth of the belief that a substantial portion of the crop is ginned too rapidly.

Cotton growers not informed as to the damage from rapid ginning are concerned primarily with getting their cotton ginned as quickly as possible, and encourage the ginner to rush the cotton through the gin. If a ginner does not do this, such growers are likely to go to some other gin. The cotton-ginning business is highly competitive, and a ginner must follow such practices as will obtain a volume that will justify him staying in it. Until growers in general demand quality instead of quantity ginning, the quality of the American cotton crop will continue to average lower than it should.

During the few minutes required for ginning a bale of cotton, the results of a season's efforts on the part of the grower in planting, grow-

[1] The fiber-quality aspects of this study are a part of the program of work of the Cotton Utility and Standards Research Section of the Bureau of Agricultural Economics, under the leadership of R. W. Webb.

ing, and harvesting the crop may be partially nullified if the best ginning methods and practices are not employed. Therefore a correct understanding of the factors involved in speed of ginning and their effect on cotton quality is worth while.

There is much misunderstanding of the meaning of the term "fast ginning." Many people, including some who are closely connected with the ginning industry, erroneously believe fast ginning to mean high saw speed. Numerous writers for farm papers, professional agricultural workers, and farmers speak of fast ginning and high saw speed as though they were synonymous (*3, p. 3; 5, p. 13; 6, p. 66; 10, p. 57*).[2]

This general misconception is the result of a belief that the number of bales ginned per hour is proportional to saw speed, and of a failure to realize that the rapidity with which the lint is separated from the seed depends in far greater degree upon the rate at which the seed cotton is fed into the gin stand. In order to gin faster, a ginner allows the seed cotton to be fed into the roll box faster. This causes the seed cotton in the roll box to become more compact so that each saw tooth removes a larger portion of fibers than when the roll is less dense. Thus, even with the seed board wide open, fast ginning results from the use of a tight seed roll caused by heavy feeding whereas slow ginning results from the use of a loose seed roll caused by slow feeding.

The speed of the gin saws is not increased, as a rule, for the purpose of increasing the ginning capacity. In fact, the mechanical arrangement of practically every commercial cotton gin is such that the speed of the saws cannot be readily changed. To change the speed of the saws it would be necessary to change the ratio of pulleys and provide for a consequent change in length and perhaps size of belts.

Experiments, each principally limited to one gin and local cottons, conducted by various investigators during recent years, have indicated the importance of seed-roll density as a factor affecting cotton quality during ginning (*4, 7*). These investigators regarded the effects of gin-saw speeds as being less important than those caused by seed-roll density.

Federoff (*4*) reported in 1927 that the prejudice against excessive saw speed is without foundation, because a high saw speed (500 to 700 revolutions per minute) with low-density feeding damages the cotton less than a low saw speed (250 to 300 revolutions per minute) with high-density feeding.

Killough and McNess (*7, p. 32*) reported in 1930:

> Increasing the speed of the saws from 640 to 760 and 840 revolutions per minute, provided the loose breast roll[3] was used, did not seem to have any significant effect on the grade of the cotton, the length of lint, the gin cutting of the lint, or in the condition of the seed. * * * Increasing the density of the breast roll appeared to lower the grade of the cotton and the style of ginning, to increase the amount of gin cutting, to lengthen the time required in ginning, to damage the seed, and in some cases to lower the percentage of lint.

The increased time required with this tight seed roll was caused by the seed board being so nearly closed that the seed could not be discharged readily after the fibers were removed by the saws. Then seed cotton could not be added to the seed roll faster than the ginned seed was discharged, consequently the rate of ginning was decreased.

[2] Italic numbers in parenthesis refer to Literature Cited, p. 35.
[3] Breast roll is synonymous with seed roll.

PURPOSE OF THE STUDY

Because ginning time per bale per fixed number of gin saws has an important effect on the quality of the resultant ginned lint, and because misunderstanding prevails as to what factors influence the rate of ginning, an extensive series of tests has been conducted to determine the effects of varying saw speed and of varying seed-roll density. The purpose of this bulletin is to present the results to show:

(1) The comparative effects that different rates of gin-saw speed have on certain quality elements of ginned lint and on mechanical elements of gin-stand operation.

(2) The comparative effects that different rates of feed of the seed cotton into the gin stand (measured by time of ginning) and consequent different seed-roll densities have on certain quality elements of ginned lint and on mechanical elements of gin-stand operation.

(3) The relative importance of effects of gin-saw speed and seed-roll density on certain quality elements of ginned lint and on mechanical elements of gin-stand operation.

(4) Available information relating to the monetary losses that may result from ginning cotton too rapidly.

MATERIALS AND METHODS

SEED COTTONS

In conducting the experiments described in this bulletin, seed cottons from 11 States were used. These cottons were especially selected to represent pure varieties of American upland cotton of the 1930, 1931, 1932, 1933, and 1934 crops. Each cotton was picked directly under the supervision of, or in accordance with instructions from, a representative of the ginning laboratory, in order to obtain cottons harvested under uniform conditions and have each individual cotton as homogeneous as possible so that tests from any two selected portions would be comparable. Before employment in the ginning tests, every lot was carefully composited by hand to insure uniformity in distribution of moisture and in other characteristics. Laboratory tests of samples from the various lots showed a high degree of comparability with respect to the important physical properties.

The lots of seed cottons used in these experiments are listed in table 1, which also shows for each cotton the locality where grown, date and stage of harvesting, moisture content at time of ginning, certain laboratory determinations with respect to the hand-pulled fibers, and the cotton classer's appraisal of the ginned lint. The lot numbers will identify the seed cottons grouped for preparing some of the summary tables that follow in this bulletin.

TABLE 1.—*Seed cottons used in gin-saw-speed and seed-roll-density tests*

Lot no.	Variety	Locality where grown	Harvesting		Moisture content of seed cotton at ginning (oven tests)	Laboratory determinations [1]					Cotton classer's appraisal	
			Date	Stage		Weight of 100 seed	Weight of lint from 100 seed	Ratio of lint to seed cotton by weight	Upper quartile fiber length [2]	Variability of fiber length [2]	Staple length [3]	Grade [4]
					Percent	*Grams*	*Grams*	*Percent*	*Inches*	*Percent*	*Inches*	
1930 CROP												
2	Coker Cleveland No. 5	McDonough, Ga.	Nov. 22	Third	10.5	11.340	6.897	37.8	1.074	74.0	15/16	M. sp.[5]
6	Mebane	Hutchins, Tex.	Nov. 21	Second	7.5	12.967	6.760	34.3	1.087	67.8	31/32	M.
9	Rowden No. 40	Haskell, Okla.	Nov. 17–18	Third	7.3	13.048	5.876	31.0	1.092	60.6	1	M.
18-A	Missdel No. 1	Stoneville, Miss.	Nov. 6–7	First	8.8	12.373	5.500	30.8	1.259	60.0	1 3/32	S. L. M.
1931 CROP												
44	Dixie Triumph	Clemson College, S. C.	Sept. 21–Oct. 2	Second and third	6.9	11.929	6.464	35.1	0.977	62.3	7/8	M.
47	Mexican Strain 58	Raleigh, N. C.	Sept. 20–30	First, third, and fourth.	8.7	11.804	6.352	35.0	1.202	44.7	1 1/32	M. sp.
51	Missdel No. 3	Stoneville, Miss.	Sept. 29–30	First	7.2	13.500	5.479	28.8	1.329	44.8	1 7/32	G. M., B+
58	D. P. L. 4-8	Jackson, Tenn.	Sept. 30	do	11.3	12.121	6.938	36.4	1.170	61.5	1 1/16	S. M.
63	College No. 1	Athens, Ga.	September	Second	10.0	13.711	6.790	33.1	1.067	52.2	1	S. M.
64	Missdel No. 3	Stoneville, Miss.	Oct. 12–14	do	9.4	12.864	6.019	31.9	1.286	55.1	1 7/32	S. M., B−
68	Sunshine	McKinney, Tex.	Oct. 12–17	do	7.3	14.772	8.142	35.5	1.005	69.0	15/16	M.
69	Trice	Holland, Va.	Sept. 29	First	10.3	13.711	6.493	32.1	1.060	61.1	31/32	S. L. M.
73	Texas Lone Star	Waco, Tex.	Oct. 16	do	7.7	14.206	7.973	35.9	1.033	78.0	15/16	S. M.
1932 CROP												
101	Kasch	Edroy, Tex.	Aug. 3	First	7.9	11.619	7.051	37.8	1.000	77.5	1	G. M.
102	do	do	Aug. 10	do	9.2	10.348	6.396	38.0	1.016	74.9	15/16	S. M.
103	Missdel No. 4	Winterville, Miss.	Aug. 16	do	13.5	10.804	6.257	36.5	1.278	63.2	1 9/32	G. M., B−
104	Delfos 531	Stoneville, Miss.	Aug. 16–17	do	13.7	11.228	5.155	31.5	1.241	90.6	1 5/32	G. M., C+
105	do	do	Aug. 22	do	[6] 16.4	11.942	5.217	30.4	1.307	68.1	1 3/16	S. M., C.
106	do	Greenville, Miss.	Aug. 23	do	12.5	13.555	5.914	30.4	1.362	64.6	1 3/16	S. M., B−
107	Missdel No. 3	Stoneville, Miss.	Aug. 29–30	do	14.6	13.340	5.229	28.2	1.290	50.0	1 5/32	S. M., C+
109	Mebane	Lockhart, Tex.	Aug. 29–30	do	12.4	10.661	7.538	41.4	.987	65.7	31/32	M.

110	Mexican Big boll	Raleigh, N. C.	Oct. 1-3	Second	10.5	12.332	6.310	33.8	1.079	63.4	1 1/16	S. M.
112	Acala	Blytheville, Ark.	Sept. 1	First	15.0	9.983	4.941	33.1	1.031	65.3	1 1/32	M.
113	Delfos 531	Stoneville, Miss.	Sept. 6	Second	16.2	10.438	4.670	30.9	1.259	74.5	1 5/32	S. L. M., C.
114	Missdel No. 4	Winterville, Miss.	Sept. 7	do	13.4	12.541	5.499	30.5	1.138	58.2	1 3/32	S. L. M.
115	Stoneville No. 2	Griffin, Ga.	Sept. 5-6	First	11.7	9.888	5.860	37.2	1.079	64.4	1 1/32	M.
116	Cook 588	Auburn, Ala.	Sept. 2-3	do	14.4	11.492	6.722	36.9	.947	63.5	7/8	S. M.
117	Petty Toole	Tifton, Ga.	Aug. 29-31	Second	10.4	10.265	5.023	32.5	.964	74.6	13/16	S. L. M.
118	Delfos 531	Stoneville, Miss.	Sept. 12-13	do	9.6	11.333	4.882	30.1	1.285	68.2	1 3/16	M., C+
119	D. P. L. 4-8	Baton Rouge, La.	Sept. 5-10	First	12.5	11.343	6.432	36.2	1.115	72.2	1 1/16	S. M.
120	do	Belle Mina, Ala.	Sept. 3-11	do	14.4	10.284	6.089	37.2	1.045	55.3	31/32	S. M.
121	Missdel No. 3	Stoneville, Miss.	Sept. 15-16	Second	13.4	13.589	5.328	28.2	1.321	67.7	1 3/16	M., C+
122	Acala No. 5	Jackson, Tenn.	Sept. 13-16	First	14.6	12.864	5.355	29.4	1.138	68.6	1 1/16	S. M.
123	Delfos 531	Greenville, Miss.	Sept. 16	Second	10.5	13.099	5.337	28.9	1.307	85.5	1 7/32	M., B−
124	Missdel No. 1	Bryan, Tex.	Sept. 19	First	12.6	11.258	5.423	32.5	1.207	94.6	1 1/8	S. L. M., B−
126	Delfos 531	Stoneville, Miss.	Sept. 23-24	Third	11.2	10.961	4.669	29.9	1.237	76.4	1 5/32	M., B.
127	Cook 588	Auburn, Ala.	Sept. 18-24	Second and third	10.0	10.783	5.585	34.1	.928	69.0	13/16	S. M.
129	D. P. L. No. 10	Scott, Miss.	Sept. 20	First	10.7	11.609	5.764	33.2	1.108	69.3	1	M.
131	D. P. L. 4-8	Belle Mina, Ala.	Sept. 25	Second	16.2	10.205	5.787	36.2	1.038	54.9	15/16	M. sp.
132	Delfos 531	Stoneville, Miss.	Oct. 1-3	do	10.2	11.277	7.131	33.7	1.302	76.4	1 1/8	L. M., D.
133	Harper Certified	Britton, Tex.	Oct. 1	First	13.7	12.263	7.058	36.5	.975	56.4	31/32	M.
134	Delfos 531	Stoneville, Miss.	Oct. 6-7	Third	10.3	10.651	4.634	30.3	1.233	85.4	1 1/8	S. L. M., B.
135	do	do	Sept. 28-30	do	10.4	10.576	5.272	33.3	1.230	74.6	1 1/8	S. L. M. B−
136	Coker No. 5	Clemson College, S. C.	Sept. 21-30	Second	11.0	11.164	6.199	35.7	1.162	72.6	1 3/32	M.
137	Acala	Jackson, Tenn.	Oct. 3-5	do	13.3	11.602	5.948	33.9	1.214	65.3	1 3/32	M.
138	do	Burdette, Ark.	Oct. 10	do	12.9	12.430	5.633	31.2	1.071	64.1	1 1/32	M.
139	D. P. L. 4-8	Baton Rouge, La.	do	do	12.7	10.767	6.485	37.6	1.128	68.6	1 1/16	M. sp.
140	Acala	Stillwater, Okla.	Oct. 11-14	do	6.8	11.853	7.120	37.5	1.043	52.0	13/16	M.
141	Delfos 531	Greenville, Miss.	Oct. 18-19	Third	12.3	11.303	5.476	32.6	1.398	54.7	1 5/32	M., C+
142	D. P. L. 4-8	Belle Mina, Ala.	Oct. 20	do	11.6	11.129	6.201	35.8	1.149	60.8	1 1/32	S. M.
144	Delfos 531	Stoneville, Miss.	Oct. 24-25	do	11.4	11.532	5.676	33.0	1.326	74.4	1 1/8	L. M., B
145	Harper Certified	Britton, Tex.	Oct. 24	Second	9.0	12.622	7.449	37.1	.957	52.4	31/32	S. M.
146	Acala	Jackson, Tenn.	Oct. 21	Third	12.0	11.282	6.327	35.9	1.138	67.7	1 1/16	M.
147	Missdel No. 3	Stoneville, Miss.	Week Nov. 7	First	13.3	12.644	5.351	29.7	1.346	61.9	1 5/32	S. L. M., C+
149	Missdel 7376	do	do	do	10.4	13.202	6.431	32.8	1.191	80.4	1 3/32	S. L. M.
150	Stoneville No. 1	Blytheville, Ark.	Nov. 14	Third	9.1	12.765	6.395	33.4	1.158	75.0	1 1/8	S. L. M., B
155	Harper Certified	Britton, Tex.	Nov. 25-30	do	7.9	12.309	7.875	39.0	.985	61.6	15/16	M.
156	Missdel 7376	Stoneville, Miss.	Nov. 7-12	First and all	13.0	11.982	6.406	34.8	1.191	80.4	1 3/32	L. M.
159	Cook 307	Prattville, Ala.	October	First	10.3	12.224	6.895	36.1	.945	65.9	15/16	S. M.

See footnotes at end of table.

TABLE 1.—*Seed cottons used in gin-saw-speed and seed-roll-density tests*—Continued

1933 CROP

Lot no.	Variety	Locality where grown	Harvesting		Moisture content of seed cotton at ginning (oven tests)	Laboratory determinations [1]					Cotton classer's appraisal	
			Date	Stage		Weight of 100 seed	Weight of lint from 100 seed	Ratio of lint to seed cotton by weight	Upper quartile fiber length [2]	Variability of fiber length [2]	Staple length [3]	Grade [4]
					Percent	*Grams*	*Grams*	*Percent*	*Inches*	*Percent*	*Inches*	
201	Kasch	Edroy, Tex	Aug. 10-11	First	18.6	12.893	7.771	37.6	1.026	75.8	1 1/32	S. L. M.
202	Delfos 531	Greenville, Miss	Aug. 15-16	do	17.5	10.827	6.057	35.9	1.232	92.4	1 3/16	S. M., C.
203	Cook 307	Prattville, Ala	Aug. 15	do	16.1	12.357	6.918	35.9	1.043	73.4	31/32	G. M. sp.
204	Delfos 89	Stoneville, Miss	Aug. 22-23	do	14.2	11.718	5.680	32.6	1.298	86.4	1 1/4	S. M., C.
205	Delatype Webber, Strain 9.	Leland, Miss	Aug. 15	do	16.2	13.553	6.280	31.7	1.349	72.7	1 1/4	S. M., C.
206	Kasch	Edroy, Tex	Aug. 24	Second	10.8	12.960	7.144	35.5	1.035	63.0	1	M.
207	Missdel No. 4	Stoneville, Miss	Aug. 28	First	12.4	12.299	6.434	34.3	1.229	80.6	1 3/16	S. M., B.—
208	Rowden No. 40	Montrose, Ark	do	do	18.8	11.972	6.214	34.2	1.054	87.6	1 3/32	S. M.
209	D. P. L. No. 11	Scott, Miss	Aug. 28-29	do	12.4	10.760	7.197	40.1	1.195	74.1	1 1/8	S. M., B.
210	D. P. L. No. 10	do	Aug. 29	do	15.8	12.349	6.851	35.7	1.160	78.0	1 3/32	S. M.
212	Dixie Triumph	Baton Rouge, La	Last week August	do	13.8	11.616	6.106	34.4	1.032	67.3	31/32	M.
214	Delfos 531	Greenville, Miss	Sept. 4-5	Second	12.6	11.129	5.857	34.5	1.234	93.6	1 5/32	M, C.
215	Missdel No. 3	Australia Island, La	Sept. 5	First	11.9	13.971	6.845	32.9	1.297	77.2	1 3/16	S. M., B.
217	Stoneville 2-A	Magenta, Miss	Sept. 7	do	20.2	11.782	6.205	34.5	1.241	81.9	1 3/32	S. L. M.
218	Coker No. 5	Clemson College, S. C	Sept. 2-4	do	18.2	11.615	7.319	38.7	1.125	67.9	1 1/16	M. sp.
219	Missdel No. 3	Stoneville, Miss	Sept. 6	do	14.6	12.857	6.322	33.0	1.343	63.2	1 1/4	M., D+
220	Cook 307	Prattville, Ala	Sept. 7	Second	17.1	11.050	6.250	36.1	1.005	68.9	7/8	S. M.
226	Delfos 9252	Stoneville, Miss	Sept. 19	First	11.8	12.845	6.480	33.5	1.343	68.4	1 7/32	S. M., B.
227	Delfos 719	Magenta, Miss	Sept. 21	do	11.9	12.997	7.262	35.8	1.154	64.8	1 1/8	S. M., B.
228	Cook 307	Prattville, Ala	Sept. 18	Third	7.9	10.203	6.750	39.8	.974	72.7	7/8	S. M.
229	Stoneville No. 4	Stoneville, Miss	Sept. 27	First	13.5	14.469	8.226	36.2	1.185	79.3	1 3/32	S. M.
232	Missdel No. 4	do	Oct. 5-6	Second	9.0	11.162	6.229	35.8	1.220	77.9	1 5/32	S. L. M., B.
233	do	do	Oct. 17	do	11.2	10.613	5.646	34.7	1.225	89.8	1 6/32	S. L. M., B.
236	Rowden No. 40	Montrose, Ark	Oct. 17-18	do	9.3	11.075	5.576	33.5	1.068	76.8	1 1/32	S. L. M.
241	D. P. L. 4-8	Jackson, Tenn	Oct. 24	First, second, and third.	9.2	9.972	6.259	38.6	1.010	74.1	1	M.
242	Missdel No. 4	Stoneville, Miss	Oct. 5-6	Second	10.5	11.482	6.013	34.4	1.282	80.2	1 3/32	S. L. M.
245	Missdel No. 3	Australia Island, La	Nov. 7-8	Late season	12.2	12.976	6.075	31.9	1.329	83.5	1 5/32	S. L. M., B—

1934 CROP

334	Stoneville No. 3	Hollyknowe, Miss	Sept. 21, 24, 25	Second	11.6	10.644	5.239	33.0	1.060	71.7	1 1/16	S. M. sp.
335	do	Stoneville, Miss	Sept. 24–27	Third	10.5	10.325	4.889	32.1	1.015	77.0	1 1/16	S. L. M.
341	Stoneville 2-A	do	Sept. 28	Second	12.7	11.993	5.608	31.9	1.110	74.4	1 5/32	M, B—
344	Wilds No. 5	Australia Island, La	Sept. 15	First	12.5	12.923	5.807	31.0	1.356	53.9	1 9/32	S. M., B.
356	Dixie Triumph	Baton Rouge, La	do	do	11.4	10.083	4.755	32.0	.969	66.1	3/32	S. M. sp.
361	D. P. L. No. 10	Brooksville, Miss	Oct. 8	Second	11.3	10.052	5.972	37.3	.990	68.5	1	S. M.
365	Stoneville 2-A	Stoneville, Miss	Oct. 10–11	Second and third.	9.3	10.799	5.199	32.5	1.064	56.8	1 1/16	L. M.
372	Missdel No. 3	do	Oct. 17	First	12.0	13.146	5.605	29.9	1.266	50.1	1 1/8	S. L. M., B.
381	Rowden No. 40	Montrose, Ark	Oct. 25	Second	9.1	11.771	5.713	32.7	.963	79.4	3/32	S. L. M.
388	Wilson type	Wilson, Ark	Oct. 26	do	11.0	11.142	5.257	32.1	.874	71.0	29/32	L. M.
389	Missdel No. 3	Stoneville, Miss	Oct. 30–31	do	11.5	12.607	5.259	29.4	1.267	76.7	1 1/8	L. M., B.
398	Cook 307	Prattville, Ala	Aug. 25	First	9.4	10.304	6.058	37.0	.916	71.7	29/32	M.

[1] Lint hand-pulled from seed.
[2] Defined on p. 11.
[3] Longest ginned-lint sample classed according to official cotton standards.
[4] Undried seed cotton ginned with loose seed roll at saw speed recommended by gin manufacturer.
[5] The abbreviation "sp." means spotted.
[6] Portions of this seed cotton ginned sometime later tested 12.4 percent moisture content at time of ginning.

GINNING PROCEDURE

The tests described in this bulletin were conducted in the cotton ginning and fiber laboratories of the United States Department of Agriculture at Stoneville, Miss.

At the beginning of the series of tests on each cotton, small samples were taken at random throughout the mass of cotton. These samples were placed immediately in air-tight tin containers and were reserved for moisture-content determinations. Because of the relatively small variability in results obtained, this method of sampling is considered reliable. Another representative sample weighing approximately 3 pounds was reserved for other purposes. The remaining cotton was then divided into portions of such number and weight as required for the tests.

Both brush and air-blast types of 70-saw gins were employed in the experiments. As a rule, more cottons were ginned on the brush type than on the air-blast type in each test. The gin stands were of the double-rib huller type, manufactured in 1930, each having 12-inch diameter saws. One gin had saws of 282 teeth; all others had saws of 264 teeth. The teeth in some of the gin stands were roach-back, and those in others were straight-back. The seed-roll box, ribs, and other features varied somewhat in size and shape with different makes of gins. However, the relative differences in quality and mechanical elements produced by variations in gin-saw speed and seed-roll density were so similar for these gins that the slight differences in construction features mentioned are believed to have no significant effect on the test results and conclusions presented. Studies of these mechanical and constructional factors are under way.

A big-drum cleaner feeder was operated in connection with each gin stand. These gin stands and cleaner feeders were new machines and were maintained in proper adjustment and repair. The seed cotton used in the tests reported herein was not passed through any cleaner, extractor, or drier other than the mechanical separator that removed it from the air current that conveyed it from the wagon.

For laboratory purposes in cotton-ginning research, the speed of the gin saws was regulated during each test by use of a variable-speed unit (fig. 1). With this device it was possible to maintain the desired speed of the saws regardless of the density of the seed roll, by increasing the speed of the transmission enough to overcome the retarding effect of increasing the roll density.

Three gin-saw speeds were used in the tests—low, medium, and high. The medium speed for each gin was that recommended by the manufacturer, 500 revolutions per minute except in the case of the high-speed design of air-blast gin for which 700 revolutions per minute was recommended and used. The low speed was in each case 100 revolutions per minute less, and the high speed 100 revolutions per minute greater, than the medium speed.

Because a satisfactory mechanical roll-density indicator has not yet been developed, uniform density of the seed roll was obtained by the operator observing the height and "feel" of the roll and adjusting the rate of feed of the cotton into the gin stand. This method assured a uniform density across the entire width of the gin rather than at one point only. Loose and tight seed rolls are shown in cross section in figure 2. In a 70-saw gin operating on dry cotton, a loose

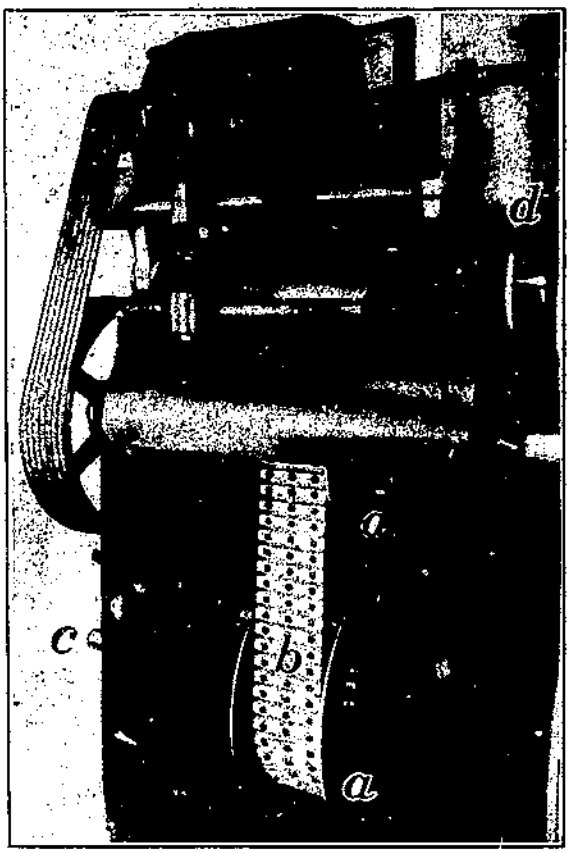

FIGURE 1.—The variable-speed unit used in regulating the speed of the gin saws: *a*, *a*, Cone pulleys reciprocally and simultaneously adjustable to obtain desired effective size ratio; *b*, special V-belt; *c*, shaft driving gin saws; *d*, hand wheel controlling cone-pulley adjustment.

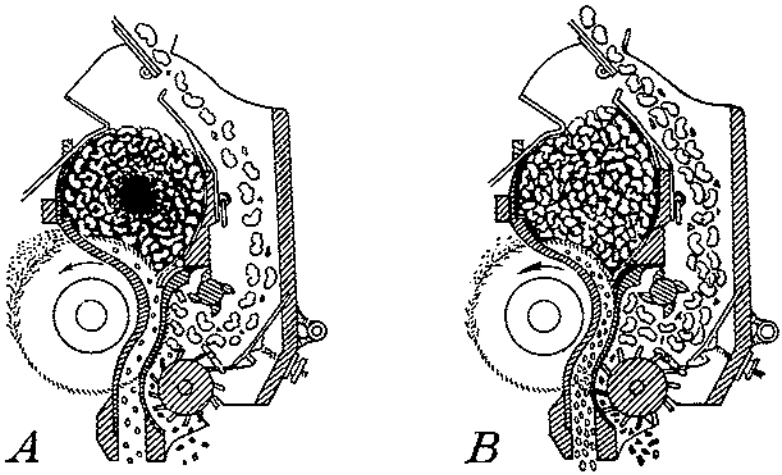

FIGURE 2.—Cross sections of loose (*A*) and tight (*B*) seed rolls. The loose roll has a hollow center, whereas the tight roll is solid.

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seed roll contains a mixture of approximately 40 pounds of seed cotton and cottonseed whereas a tight roll contains 60 pounds or more.

In the saw-speed studies for which results are hereinafter reported, each lot of seed cotton was divided into portions of which one was ginned at low saw speed with loose seed roll, another at medium speed with loose seed roll, another at high speed with loose seed roll, another at low speed with tight seed roll, another at medium speed with tight seed roll, and another at high speed with tight seed roll.

During each test, after the desired conditions had been obtained and maintained for a short time, representative samples of ginned lint weighing approximately 2 pounds were taken at the condenser for fiber analysis and classification. (Laboratory analyses and classification studies made on a series of samples taken from each of several hundred tests confirm the representative nature and reliability of this method of sampling.) Additional samples taken at the condenser at the same time were placed in air-tight tin containers for use in determining the moisture content of the ginned lint. Repeated moisture tests have revealed a high degree of accuracy for this procedure of sampling.

MOISTURE AND QUALITY DETERMINATIONS

The samples reserved during the ginning tests were analyzed in the laboratory with respect to moisture content and certain measurable quality elements and properties, and the ginned-lint samples were classed by Government classers according to the official cotton standards (*14*).

The laboratory tests made on the samples of seed cotton included determinations of moisture content, fiber length, variability of fiber length, lint index, and lint percentage, and those tests on the samples of ginned lint consisted of measurements of moisture content, color, fiber length, and variability of fiber length. Because of limitations in facilities, all of the ginned-lint samples were not arrayed for fiber length and variability of fiber length, but samples were tested in sufficient number to provide data that were considered adequate for the purpose of this investigation.

The moisture determinations were made in drying ovens according to the method for textile materials as recommended by the American Society for Testing Materials (*1*). In all cases the moisture content is expressed as a percentage of the original weight of the sample.

The color measurements were made by means of a disk colorimeter developed in the fiber laboratory of the Bureau of Agricultural Economics in Washington.[4] (*11, 12, 13.*) The color of an adequate area of the sample is matched against the composite color of a standard series of disks used on this instrument. The readings thus obtained are converted into the color attributes recognized by the normal eye,

[4] NICKERSON, D. APPLICATION OF COLOR MEASUREMENTS IN THE GRADING OF AGRICULTURAL PRODUCTS. A PRELIMINARY REPORT. U. S. Dept. Agr. Bur. Agr. Econ. 30 pp. 1932. [Mimeographed.]

and by which any color may be specified. Brilliance, the light-to-dark quality of color, is the chief color measurement used to study the samples of ginned lint because the main color improvement to be made by methods of ginning is that of brightening the lint samples. Chroma refers to the depth of color; that is, to the creaminess, stain, etc., of the cotton.

Length-distribution studies were made in the fiber-array laboratories. The samples from the seed cottons employed in the ginning test were conditioned, and the fibers from four samples of 25 seeds taken at random from each seed cotton were carefully "butterflied" and were removed by hand.[5] The total weights of the lint and of the seed from these samples were determined to obtain the lint index and the lint percentage (*9*). Using the method developed in the fiber laboratory of the Bureau of Agricultural Economics, arrays were made of the lint from 3 of the 25-seed samples and usually 3 arrays were made of selected ginned-lint samples [6] (*15*). The distribution of fiber length in each array was determined by weighing separately, on a microtorsion balance, the groups of fibers representing the different length intervals. Averages of the data from the three arrays were made and the upper quartile length [7] was calculated and used as a basis of determining the effects of the various methods of ginning on fiber length. The fiber-length variability was determined from the middle 80 percent of the cumulative weight percentage of the fibers in the length array. It was calculated by subtracting the length at the 90-percent point from that of the 10-percent point, dividing the result by the length at the 50-percent point, and multiplying by 100 to convert to percentage. This calculation provides an index for comparing the effects of the different methods of ginning on the uniformity of fiber lengths.

The ginned-lint samples obtained from the ginning tests were classed by Government classers according to the official cotton standards (*14*). During the 1932, 1933, and 1934 seasons, one classer was assigned to the ginning laboratory and there made the classifications with much care, making not only an initial classification but also a comparative classification of the samples within each series of samples representing a particular cotton. The samples were given identification numbers, and the classing was done without knowledge of the ginning conditions employed.

In classifying the samples, the grade and its separate factors of color and leaf were recorded for each. Table 2 shows the code indices assigned to grade and to its components, color and leaf. These indices correspond to the numerical designations of the white grades according to the universal cotton standards for grade.

[5] The fiber arrays and the tests for lint index and lint percentage were made in a laboratory having a standard condition of the atmosphere, namely 65 percent relative humidity and 70° F. temperature.

[6] WEBB, R. W. PROBLEMS AND RESEARCH METHODS IN COTTON GINNING. A PRELIMINARY REPORT. U. S. Dept. Agr. Bur. Agr. Econ. 12 pp., illus. 1929. [Mimeographed.]

[7] The upper quartile length is the length of the fibers at the 25-percent point on the length-cumulative weight percentage curve beginning with the longest fibers.

TABLE 2.—*Code indices for cotton classer's grades and for the grade factors color and leaf, based on the universal standards for white grades*

Grade	Code index	Class limits [1]	Grade and grade-factor designation
Middling Fair (M. F.)	1	0.50–0.82	M. F.+
		.83–1.16	M. F.
		1.17–1.49	M. F.−
Strict Good Middling (S. G. M.)	2	1.50–1.82	S. G. M.+
		1.83–2.16	S. G. M.
		2.17–2.49	S. G. M.−
Good Middling (G. M.)	3	2.50–2.82	G. M.+
		2.83–3.16	G. M.
		3.17–3.49	G. M.−
Strict Middling (S. M.)	4	3.50–3.82	S. M.+
		3.83–4.16	S. M.
		4.17–4.49	S. M.−
Middling (M.)	5	4.50–4.82	M.+
		4.83–5.16	M.
		5.17–5.49	M.−
Strict Low Middling (S. L. M.)	6	5.50–5.82	S. L. M.+
		5.83–6.16	S. L. M.
		6.17–6.49	S. L. M.−
Low Middling (L. M.)	7	6.50–6.82	L. M.+
		6.83–7.16	L. M.
		7.17–7.49	L. M.−
Strict Good Ordinary (S. G. O.)	8	7.50–7.82	S. G. O.+
		7.83–8.16	S. G. O.
		8.17–8.49	S. G. O.−
Good Ordinary (G. O.)	9	8.50–8.82	G. O.+
		8.83–9.16	G. O.
		9.17–9.49	G. O.−

[1] *For use in converting code indices into designations of grade and its component factors—color and leaf.*

Preparation of cotton 1⅛ inches or longer in staple was designated according to the tentative standards for preparation of American upland cotton of 1⅛ inches and longer staple, namely A, B, and C, for Strict Middling, Middling, and Strict Low Middling grades[8] (*14*). Each of these preparation designations was further divided into three equal steps, by attaching plus and minus signs to the letter designation to mark the first and third steps, respectively. This made possible the designation of nine degrees of preparation. For cotton shorter than 1⅛ inches the preparation was compared to that of the white grades to which it most nearly corresponded. In both staple-length groups, four additional steps were used to indicate still lower preparation. Table 3 gives all these designations for preparation, with the corresponding numerical code indices, and shows what may be considered as generally comparable steps in the two length groups.

TABLE 3.—*Code indices for cotton classer's designations of preparation*

Designation		Code index	Class limits [1]
Cottons 1⅛ inches and longer	Cottons shorter than 1⅛ inches		
A+	M. F.	1	0.50–1.49
A	S. G. M.	2	1.50–2.49
A−	G. M.	3	2.50–3.49
B+	S. M.	4	3.50–4.49
B	M.	5	4.50–5.49
B−	S. L. M.	6	5.50–6.49
C+	L. M.	7	6.50–7.49
C	S. G. O.	8	7.50–8.49
C−	G. O.	9	8.50–9.49
D+	Ordinary	10	9.50–10.49
D	Inferior	11	10.50–11.49
D−	Dogs	12	11.50–12.49
Gin cut	Gin cut	13	12.50–13.49

[1] For use in converting numerical values into letter designations.

[8] For detailed discussion of these standards, see the following: UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF AGRICULTURAL ECONOMICS, HANDBOOK FOR LICENSED CLASSIFIERS (U. S. COTTON STANDARDS ACT), 30 pp. Revised, 1931. [Mimeographed.]

TABLE 4.—*Cotton classer's fractional designations of staple length, and corresponding decimals*

Staple length		Class limit decimals [1]	Staple length		Class limit decimals [1]
Fraction (inches)	Decimal		Fraction (inches)	Decimal	
	Inches	*Inches*		*Inches*	*Inches*
13/16	0.812	0.8073–0.8177	1 1/16	1.062	1.0573–1.0677
13/16+		.8178–.8281	1 1/16+		1.0678–1.0781
27/32−		.8282–.8385	19/32−		1.0782–1.0885
27/32	.844	.8386–.8489	19/32	1.094	1.0886–1.0989
27/32+		.8490–.8593	19/32+		1.0990–1.1093
7/8−		.8594–.8697	1 1/8−		1.1094–1.1197
7/8	.875	.8698–.8802	1 1/8	1.125	1.1198–1.1302
7/8+		.8803–.8906	1 1/8+		1.1303–1.1406
29/32−		.8907–.9010	1 9/32−		1.1407–1.1510
29/32	.906	.9011–.9114	1 9/32	1.156	1.1511–1.1614
29/32+		.9115–.9218	1 9/32+		1.1615–1.1718
15/16−		.9219–.9322	1 5/16−		1.1719–1.1822
15/16	.938	.9323–.9427	1 5/16	1.188	1.1823–1.1927
15/16+		.9428–.9531	1 5/16+		1.1928–1.2031
31/32−		.9532–.9635	1 11/32−		1.2032–1.2135
31/32	.969	.9636–.9739	1 11/32	1.219	1.2136–1.2239
31/32+		.9740–.9843	1 11/32+		1.2240–1.2343
1−		.9844–.9947	1 3/4−		1.2344–1.2447
1	1.000	.9948–1.0052	1 3/4	1.250	1.2448–1.2552
1+		1.0053–1.0156	1 3/4+		1.2553–1.2656
1 1/32−		1.0157–1.0260	1 13/32−		1.2657–1.2760
1 1/32	1.031	1.0261–1.0364	1 13/32	1.281	1.2761–1.2864
1 1/32+		1.0365–1.0468	1 13/32+		1.2865–1.2968
1 1/16−		1.0469–1.0572			

[1] For use in converting decimal values into fractional designations.

Staple was classed against the official cotton standards for length. Table 4 gives the values used in converting the fractional designations to decimal inches.

The classification data used in this bulletin were obtained by detailed classing, both for the grade factors of color, leaf, and preparation and for staple. It should be kept in mind, however, that classification is not subject to mechanical exactitude, and that the data include variations due to classing method as well as to actual differences between samples. Differences due to classing variations should, by the laws of probability, be scattered no more in one direction than in the other. Therefore, where scatter diagrams show a consistent trend, the average results may be regarded as indicating an effect of differences in ginning. But where scatter diagrams show no trend, the differences may be due entirely to classing, which may sometimes scatter enough to cover up small but consistent changes made by the ginning methods in the cotton itself.

STATISTICAL ANALYSES

To show the effect on certain lint-quality elements of variation in saw speed and in seed-roll density, the data representing ginned-lint samples from 46 cottons ginned with loose and with tight seed rolls at the manufacturers' recommended gin-saw speeds and at 100 revolutions per minute above and 100 revolutions per minute below those speeds were compiled. Thus six samples were secured from each cotton.

The data were grouped by type of gin, (1) brush and (2) air-blast; were divided by staple length, (1) 1⅛ inches and longer and (2) shorter than 1⅛ inches; and finally were subdivided by moisture content of the seed cotton, (1) 12 percent and greater and (2) less than

12 percent. Averages of each quality element and of moisture content were made for the ginned-lint samples representing each of the six ginning conditions. The averages are shown in the appendix (tables 17 and 18).

The average grade of a cotton was ascertained by adding together the code values of color, leaf, and preparation, and dividing this sum by three times the number of samples in the group. This procedure was followed, instead of averaging the grade of the individual samples as designated by the classer, in order to preserve in this final average the minute effects of the various ginning conditions on each of the grade components. This method of calculating an average grade assumes equal steps between the several grades. It is realized that the steps between grades are not equal, but no other method of averaging seemed as practical. To facilitate the averaging of samples classed as spotted, the spotted designation was replaced by reducing the color factor one full-grade step, (subtracting 1.00 from the code index), thus making the resulting grade more nearly equivalent to the white standard. The leaf and preparation designations were used as indicated.

Staple length was designated in intervals of one thirty-second of an inch and converted into decimal values for averaging. The final average staple length of a group of samples was converted from the decimal value to a fractional value and stated to the nearest 1/32 inch, with a plus or minus sign, according to the schedule shown in table 4.

Since portions of the same seed cottons always enter into the averages described, the results are based on paired observations. As a result of this pairing, a varying amount of correlation exists between these series of paired values. Comparatively small differences are therefore relatively more significant than would otherwise be the case. Student's method (*8*) and probability table of *z* values were used to determine the statistical significance of the average differences between the paired groups of samples. This method is especially adapted to paired data in which there is necessarily a high degree of correlation, and data for which relatively few observations are made. The fact that similar and repeated tests show consistent differences for the averages shown, as well as for the differences in individual cottons with some quality elements and certain ginning conditions, is an evidence of significance even though the average differences may be very small. Therefore, scatter diagrams are also presented for the tables of averages, showing individual differences between paired samples for the various quality elements considered. The scatter of these differences between paired items indicates the reliability of the averages presented.

In addition to presenting the quality results as described, results dealing with some of the mechanical aspects as affected by variations in seed-roll density and gin-saw speed are given. Some results relating to the effects on the monetary value produced by variations in seed-roll density were compiled and are presented. Where the tests represented cottons varying in staple length and moisture content, the data were grouped and presented in a manner similar to that pertaining to the quality phases. In some of these analyses, the results of the high-speed air-blast gin were averaged with those secured with the so-called "low-speed" design gins. This procedure was considered satisfactory because the relative differences in quality

and mechanical elements produced by the variations in gin-saw speed and seed-roll density were similar for the two types of gins.

RESULTS OF TESTS AND OBSERVATIONS

QUALITY OF LINT

The results presented in tables 5 to 12 for certain quality elements of ginned lint as influenced by varying the seed-roll density and the gin-saw speed are taken from tables 17 and 18 in the appendix.

It should be pointed out that, since the same cottons were not always used in the corresponding groups for the 2 types of gins, the figures given should not be used to compare one type of gin with the other. Furthermore, because the inherent qualities of the various groups of cottons are not the same, comparisons should not be made between groups of cotton on the basis of the averages shown except with respect to preparation, which is a function of ginning.

GRADE

PREPARATION

Little change in preparation was noted as a result of varying the gin-saw speed 100 revolutions per minute above or below that recommended by the manufacturer (table 5 and figs. 3 and 4). On the average, the low speed gave a better preparation than the medium, particularly with the brush gin, and the high speed gave a very slightly better preparation in some instances. Varying the seed-roll density from loose to tight lowered the preparation an average of about 1.4 steps, which is large in comparison with the differences caused by varying the saw speed.

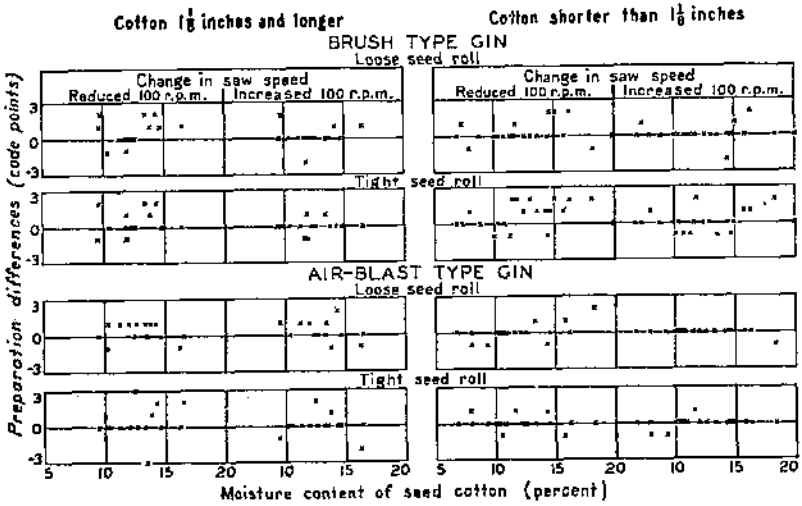

FIGURE 3.—Differences in preparation of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. The differences between paired samples, as appraised by the cotton classer, generally showed beneficial (+) effects more often than detrimental (−) effects from reducing the gin-saw-speed 100 revolutions per minute below the manufacturer's recommendation.

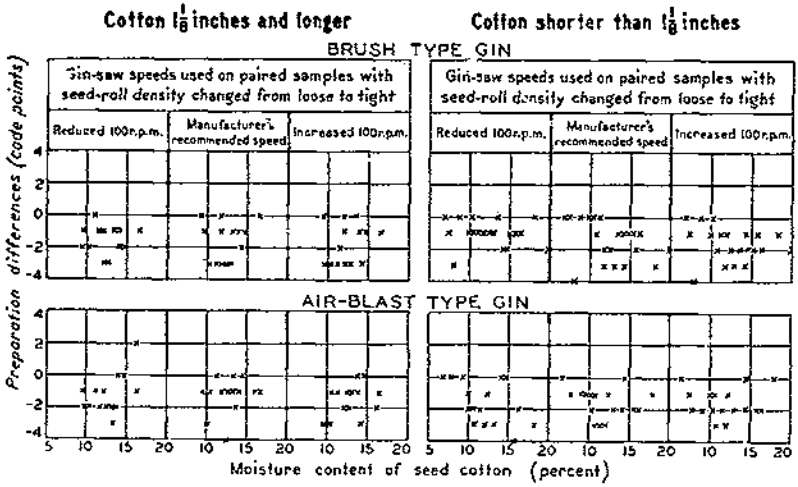

FIGURE 4.—Differences in preparation of cotton lint ginned with loose and with tight seed rolls. In the majority of instances the cotton classer's appraisal of paired samples indicated detrimental (−) effects upon the preparation as a result of ginning with a tight, instead of a loose, seed roll.

TABLE 5.—*Average preparation, as appraised by the classer, of cotton lint ginned at different saw speeds and seed-roll densities*

COTTON 1 1/8 INCHES AND LONGER

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Grade for indicated type of gin [1]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Code index [2]	*Code index* [2]	*Code index* [2]	*Code index* [2]
12.0 and above	Low	5.0	7.4	6.6	7.6
	Medium	6.6	8.1	6.9	8.1
	High	6.3	8.0	6.8	8.0
Below 12.0	Low	5.4	6.6	6.2	7.8
	Medium	5.0	7.1	6.0	7.8
	High	5.6	7.3	6.0	8.0

COTTON SHORTER THAN 1 1/8 INCHES

12.0 and above	Low	5.6	6.7	5.6	7.6
	Medium	6.0	7.8	6.0	7.6
	High	5.9	7.6	6.1	7.6
Below 12.0	Low	4.8	5.7	5.0	6.1
	Medium	4.9	6.0	4.8	6.2
	High	4.7	6.0	4.8	6.3

[1] Comparisons of gin types are not to be made from the data in this table.
[2] See table 3 for designations corresponding to index values shown.

COLOR

The color of the samples as appraised by classing was inappreciably affected by the variations in gin-saw speed but averaged better

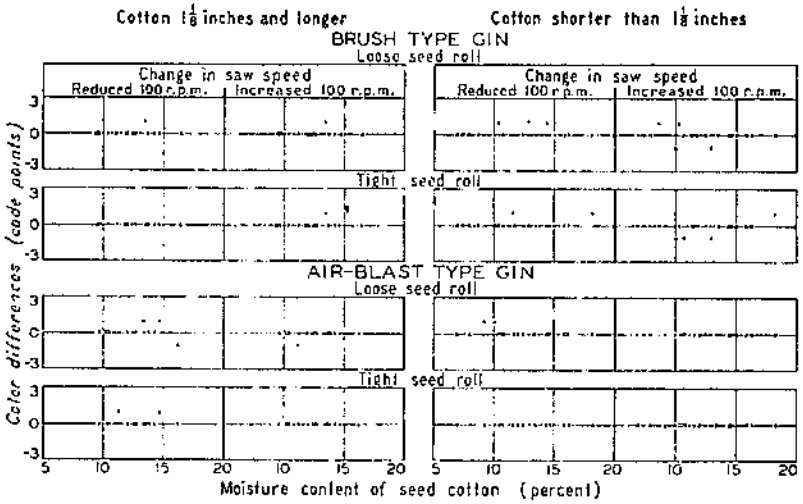

FIGURE 5.—Differences in color of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. Differences between paired samples of cotton ginned at the recommended speed and at speeds 100 revolutions per minute greater or less were shown by the cotton classer's appraisal in only a few instances.

for the loose-seed-roll samples than for the tight-seed-roll samples, as indicated in table 6 and figures 5 and 6. These changes made in

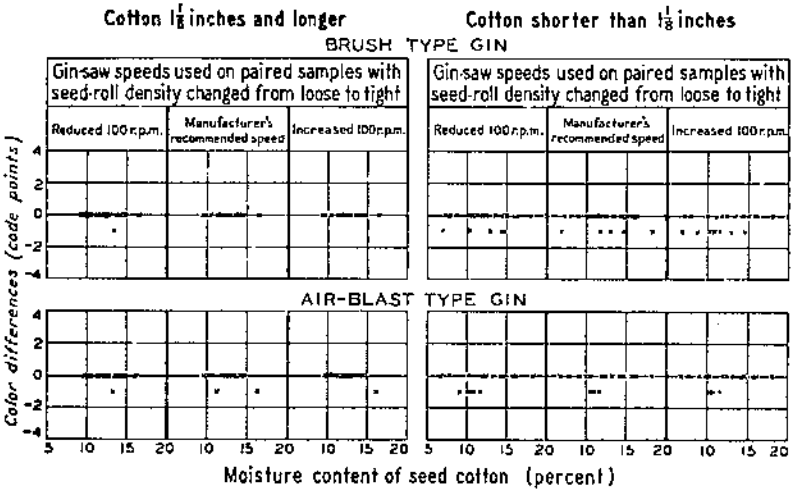

FIGURE 6.—Differences in color of cotton lint ginned with loose and with tight seed roll. Color differences as shown by the cotton classer's appraisal of paired samples with the longer cottons were few and slight but were noticeably favorable to the loose roll (−) with the shorter cotton.

color classification seem to be more pronounced for the shorter than for the longer cottons.

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TABLE 6.—*Average color, as appraised by the classer, of cotton lint ginned at different saw speeds and seed-roll densities*

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Grade for indicated type of gin [1]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Code index [2]	*Code index* [2]	*Code index* [2]	*Code index* [2]
COTTON 1⅛ INCHES AND LONGER					
12.0 and above	Low	4.0	4.1	4.6	4.7
	Medium	4.1	4.1	4.7	4.8
	High	4.0	4.0	4.7	4.8
Below 12.0	Low	4.6	4.6	5.4	5.4
	Medium	4.6	4.6	5.4	5.5
	High	4.6	4.6	5.6	5.6
COTTON SHORTER THAN 1⅛ INCHES					
12.0 and above	Low	4.2	4.4	4.4	4.4
	Medium	4.3	4.5	4.4	4.4
	High	4.4	4.6	4.4	4.4
Below 12.0	Low	4.3	4.5	4.2	4.8
	Medium	4.4	4.6	4.4	4.8
	High	4.3	4.8	4.4	4.8

[1] Comparisons of gin types are not to be made from the data in this table.
[2] See table 2 for designations corresponding to index values shown.

LEAF

Leaf content as indicated by classing appraisals, like color, was in most instances not changed by varying the gin-saw speed but was better for the loose than for the tight seed roll, as shown by table 7 and figures 7 and 8.

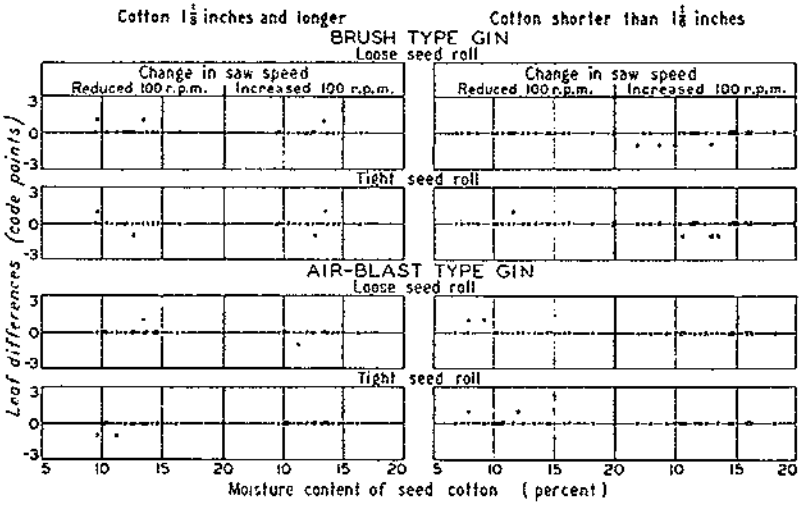


FIGURE 7.—Differences in leaf content of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. Leaf designations as appraised by the cotton classer, of paired samples ginned at the recommended speed and at speeds 100 revolutions per minute greater or less, were the same in most cases.

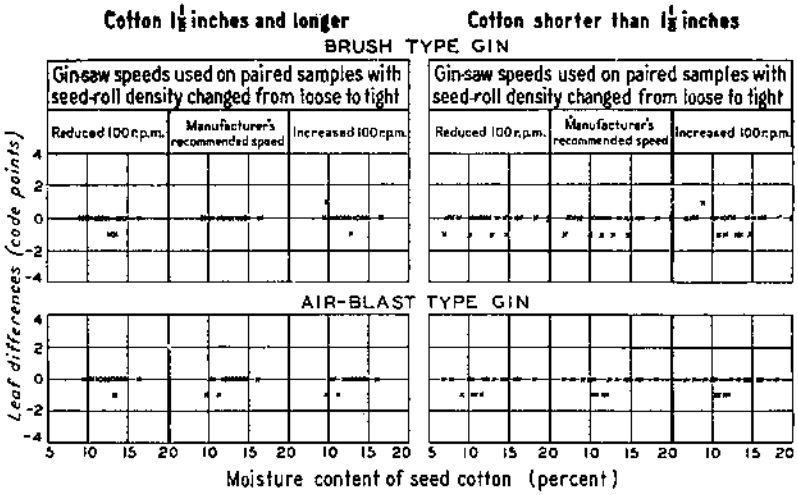


FIGURE 8.—Differences in leaf content of cotton lint ginned with loose and with tight seed roll. The leaf differences shown by the cotton classer's appraisal of paired samples were mostly favorable to loose-roll ginning (−) and were more evident with the shorter than with the longer cottons.

TABLE 7.—*Average leaf content, as appraised by the classer, of cotton lint ginned at different saw speeds and seed-roll densities*

COTTON 1 1/16 INCHES AND LONGER

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Grade for indicated type of gin [1]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Code index [2]	*Code index* [2]	*Code index* [2]	*Code index* [2]
12.0 and above	Low	4.0	4.3	4.4	4.6
	Medium	4.1	4.1	4.6	4.0
	High	4.0	4.1	4.6	4.6
Below 12.0	Low	4.4	4.4	5.4	5.4
	Medium	4.0	4.6	5.4	5.8
	High	4.0	4.4	5.6	5.8

COTTON SHORTER THAN 1 1/16 INCHES

12.0 and above	Low	4.1	4.3	4.1	4.1
	Medium	4.1	4.3	4.1	4.2
	High	4.2	4.4	4.1	4.2
Below 12.0	Low	4.3	4.5	4.2	4.7
	Medium	4.3	4.6	4.3	4.8
	High	4.6	4.7	4.4	4.8

[1] Comparisons of gin types are not to be made from the data in this table.
[2] See table 2 for designations corresponding to index values shown.

TOTAL GRADE EFFECTS

The cotton classer's appraisals of preparation, color, and leaf as shown in tables 5, 6, and 7 were averaged to obtain the net total effect on grade shown in table 8, and the differences for individual cottons as shown in figures 3 to 8 were averaged to obtain the individual grade differences which are shown in figures 9 and 10.

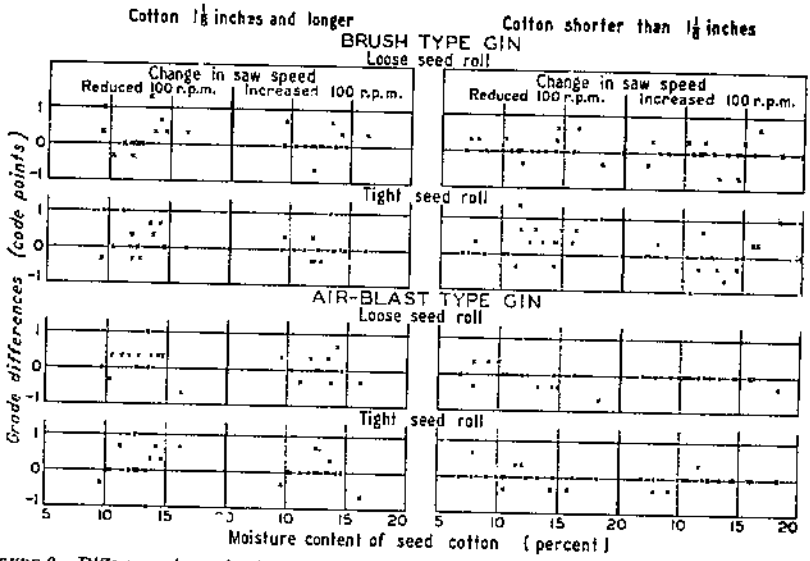


FIGURE 9.—Differences in grade of cotton lint ginned at gin manufacturer's recommended speed and at other speeds. Grade differences between paired samples ginned at the recommended speed and at speeds 100 revolutions per minute greater or less, as determined from the cotton classer's appraisal of preparation, color, and leaf, were favorable (+) to the low speed in more cases than they were unfavorable (−) to the high speed.

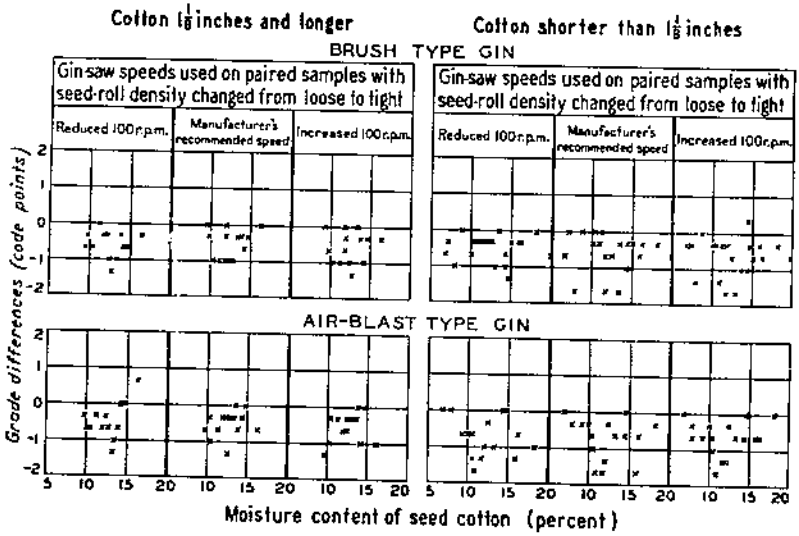


FIGURE 10.—Differences in grade of cotton lint ginned with loose and with tight seed roll. Grade, as determined from the cotton classer's appraisal of preparation, color, and leaf for paired samples, was lower (−) with the tight roll principally because of the influence of preparation.

Since preparation was affected more than color and leaf content by the variations in ginning conditions employed, the differences in average grade are due principally to preparation changes.

TABLE 8.—*Average grade, as appraised by the classer, of lint ginned at different saw speeds and seed-roll densities*

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Grade for indicated type of gin [1]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Code index [2]	*Code index* [2]	*Code index* [2]	*Code index* [2]
COTTON 1⅛ INCHES AND LONGER					
12.0 and above	Low	4.5	5.3	5.2	5.6
	Medium	5.0	5.5	5.4	5.8
	High	4.8	5.4	5.3	5.8
Below 12.0	Low	4.8	5.2	5.7	6.2
	Medium	4.9	5.4	5.8	6.4
	High	4.9	5.4	5.7	6.5
COTTON SHORTER THAN 1⅛ INCHES					
12.0 and above	Low	4.6	5.2	4.7	5.4
	Medium	4.8	5.6	4.8	5.4
	High	4.8	5.6	4.9	5.4
Below 12.0	Low	4.5	4.9	4.5	5.2
	Medium	4.5	5.1	4.6	5.3
	High	4.5	5.2	4.6	5.3

[1] Comparisons of gin types are not to be made from the data in this table.
[2] See table 2 for designations corresponding to index values shown.

The net effects on grade as a result of varying the gin-saw speed 100 revolutions per minute above or below the manufacturer's recommended speed averaged less than one-fifth of a grade for lowering the speed and a negligible amount for increasing the speed, whereas in most instances nearly two-thirds of a grade difference was caused by changing the seed-roll density from loose to tight. The difference in grade between the tight-roll samples and the loose-roll samples was greater for the higher moisture-content cottons than for the lower moisture-content cottons, when the brush type of gin was used, but with the air-blast type of gin this difference was more pronounced on the cottons of lower moisture content. The difference in gins is attributed mainly to the fact that with the wetter cottons the loose seed roll yielded preparation lower for the air-blast gin than for the brush gin, whereas with the tight seed roll the preparation was almost equal for the two types of gins (table 5).

The laboratory determinations of the effects on brilliance of varying saw speed and seed-roll density are shown in table 9 and figures 11 and 12. Since brilliance is highly correlated to grade [9], it was

[9] The correlation is high because brilliance measurements are affected by the three grade factors—by the amount of shadow which varies with the degree of preparation, by the color of the lint, and by the amount of leaf.

affected by the various ginning conditions in somewhat the same manner as was grade as observed by the classer; that is, the loose seed

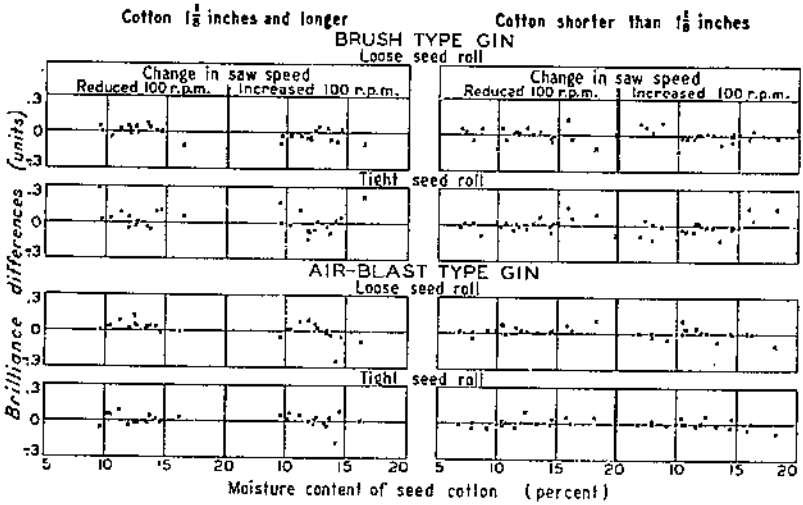


FIGURE 11.—Differences in brilliance of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. Slightly higher brilliance (+) for ginning at low saw speed was indicated generally by laboratory determinations with paired samples ginned at the recommended speed and at 100 revolutions per minute greater or less, for the longer cottons.

roll rather generally gave samples of higher brilliance. Of the gin-saw speeds used, the lowest appeared to produce the most favorable effects on brilliance with the longer staple cottons. These differences

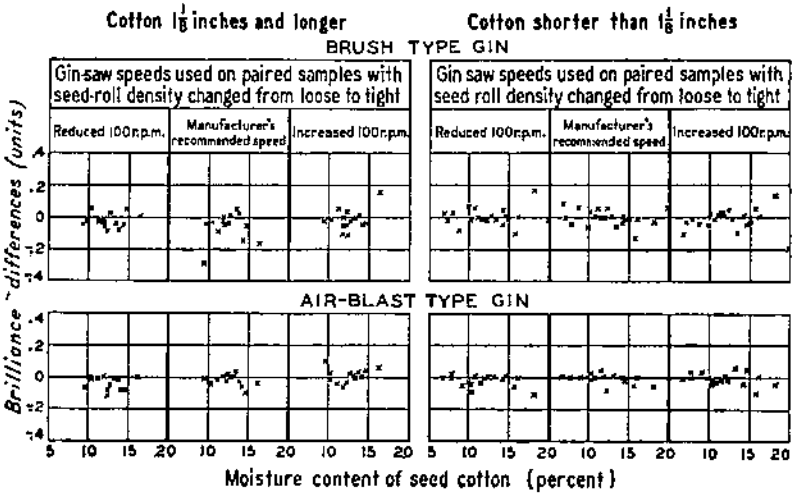


FIGURE 12.—Differences in brilliance of cotton lint ginned with loose and with tight seed rolls. Some tendency favorable to the loose seed roll (−) was shown by the laboratory determinations with paired samples.

were small but in general were found to be significant. With the shorter cottons, the differences in most cases seem not significant.

TABLE 9.—*Average brilliance, as determined by laboratory measurements, of cotton lint ginned at different saw speeds and seed-roll densities*

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Brilliance for indicated type of gin [1]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Units [2]	*Units* [2]	*Units* [2]	*Units* [2]
COTTON 1⅛ INCHES AND LONGER					
12.0 and above	Low	8.71	8.68	8.66	8.61
	Medium	8.71	8.66	8.63	8.61
	High	8.69	8.68	8.59	8.59
Below 12.0	Low	8.59	8.56	8.38	8.36
	Medium	8.58	8.50	8.35	8.33
	High	8.53	8.50	8.37	8.37
COTTON SHORTER THAN 1⅛ INCHES					
12.0 and above	Low	8.54	8.54	8.52	8.49
	Medium	8.54	8.53	8.49	8.47
	High	8.53	8.52	8.47	8.46
Below 12.0	Low	8.55	8.55	8.50	8.47
	Medium	8.55	8.56	8.48	8.48
	High	8.55	8.53	8.49	8.49

[1] Comparisons of gin types are not to be made from the data in this table.
[2] Brilliance readings of cotton samples range approximately from 7 to 9 on a scale which extends in equal steps from 0, which is black, to 10, which is white. Higher brilliance is associated with higher numerical values.

As previously pointed out, the grade element that is chiefly affected by variations in gin-saw speed and seed-roll density is preparation. Photographs illustrating these effects on a long, a medium, and a short cotton are shown in plates 1, 2, and 3, respectively. The greatest difference in grade due to variations in saw speed between the long-staple samples shown in plate 1 is one-third of a grade, and the difference due to variation in roll density is about twice as much. The medium-staple cotton in plate 2 also shows greater differences in grade between samples ginned with different roll densities than between samples ginned with different saw speeds. Even with the short-staple, 1 3/16-inch cotton, in plate 3, the loose-roll samples were better than the tight-roll samples by more than one-half of a grade, though with this cotton there was no evident difference due to saw-speed variation.

STAPLE

The staple length as observed by the classer was not noticeably affected by the speed of the gin saws, but in table 10 and figures 13 and 14 there is some indication that slight shortening of staple length is associated with increase in density of the seed roll. These differences in length may be explained in part by increased breakage of the fiber when the tighter seed roll was used, as a result of the greater resistance to removal of the fibers being offered by the compactness of the seed roll.

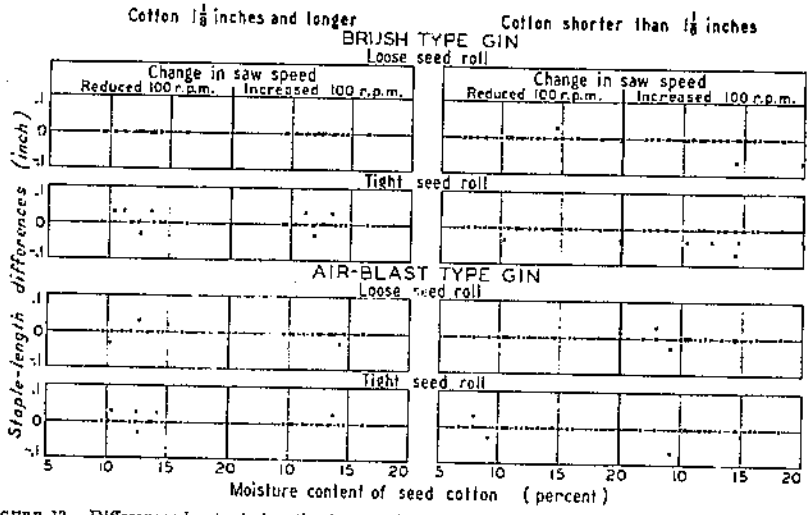


FIGURE 13.—Differences in staple length of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. Staple-length designations by the cotton classer, for paired samples ginned at the recommended speed and at speeds 100 revolutions per minute, greater or less, were not consistently affected by the variations in saw speed.

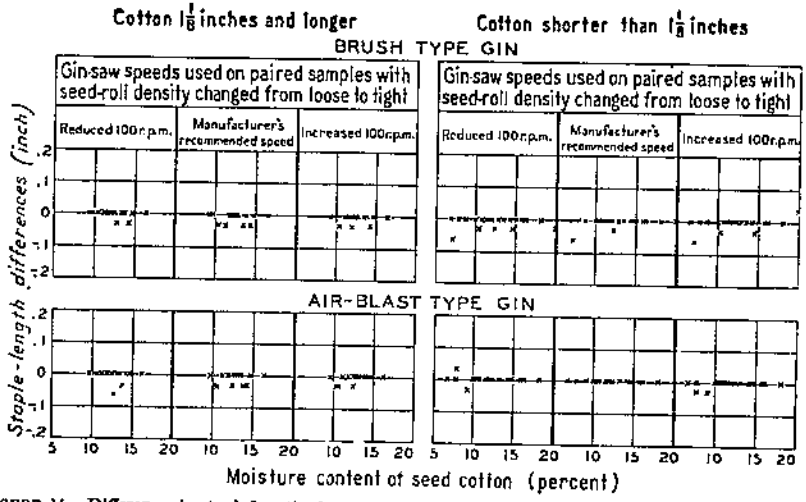
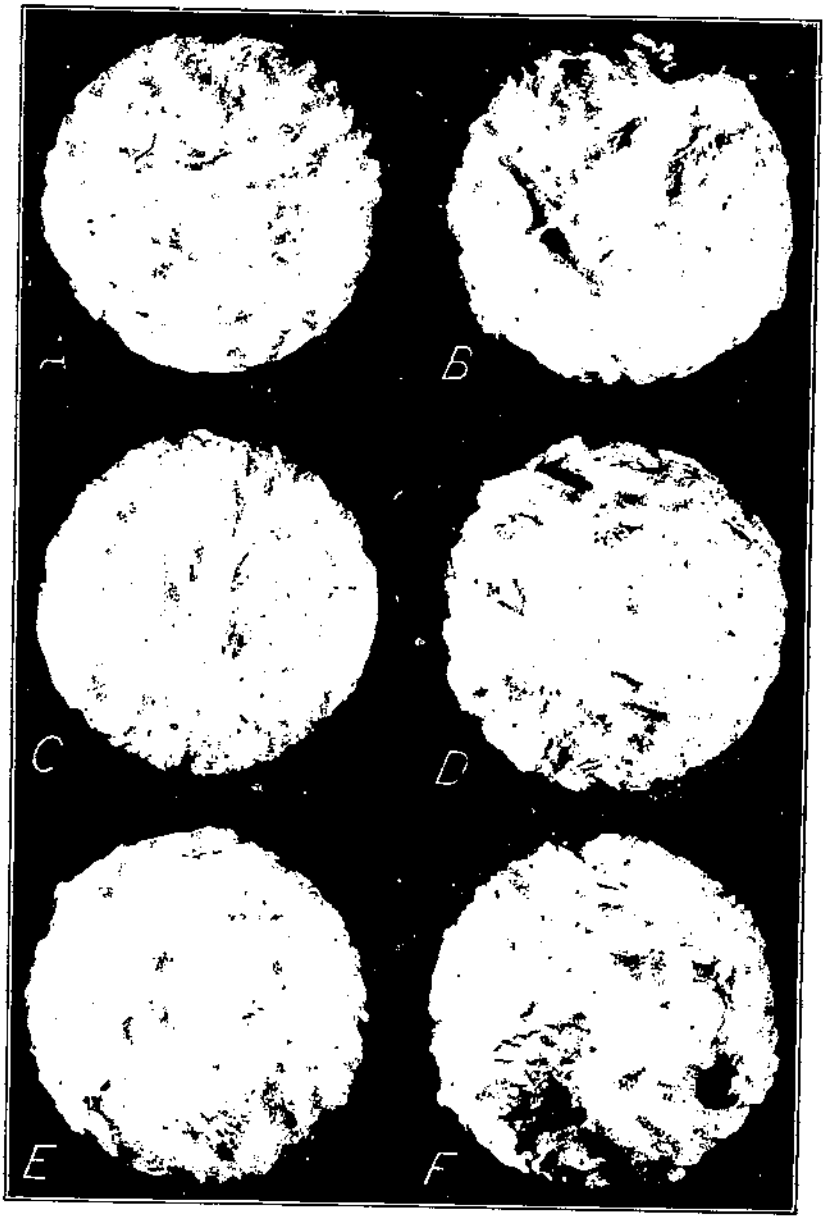
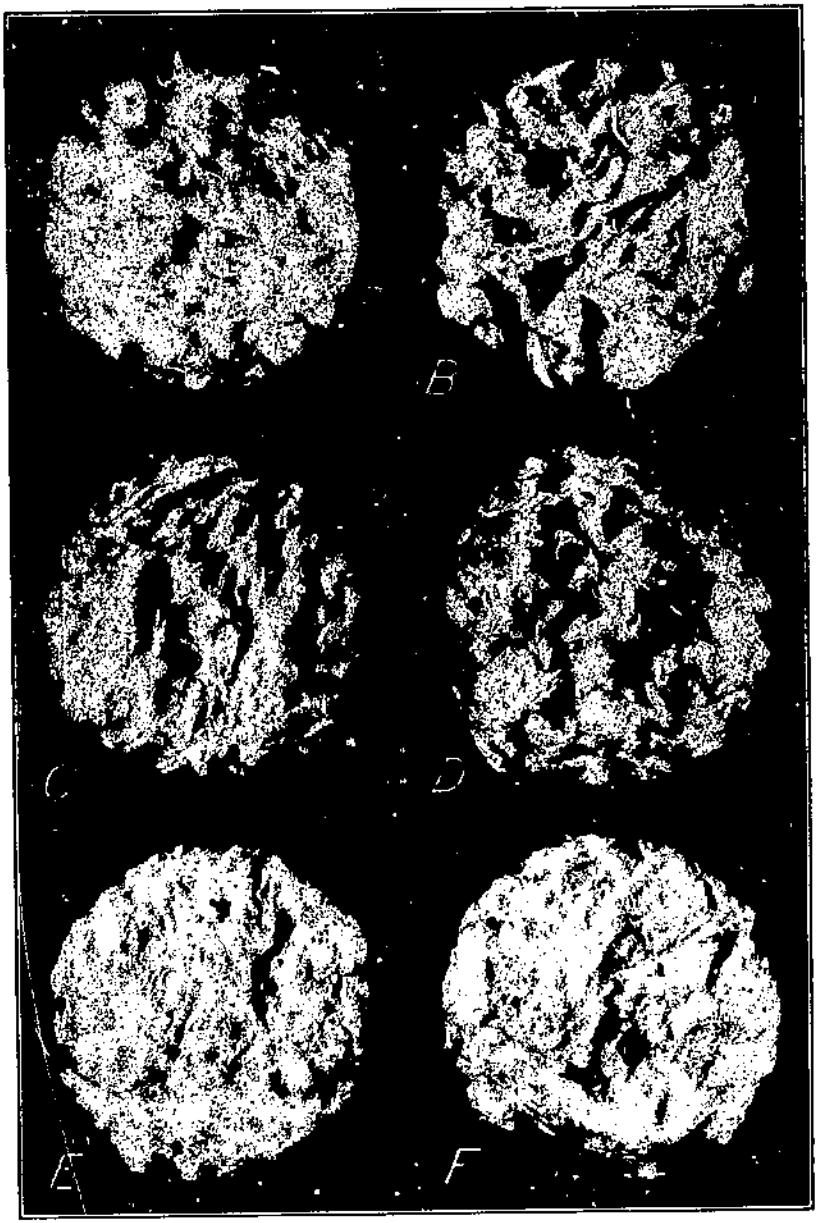


FIGURE 14.—Differences in staple length of cotton lint ginned with loose and with tight seed roll. Staple-length designations by the cotton classer showed some differences between paired samples, which were generally unfavorable (−) to the tight roll.



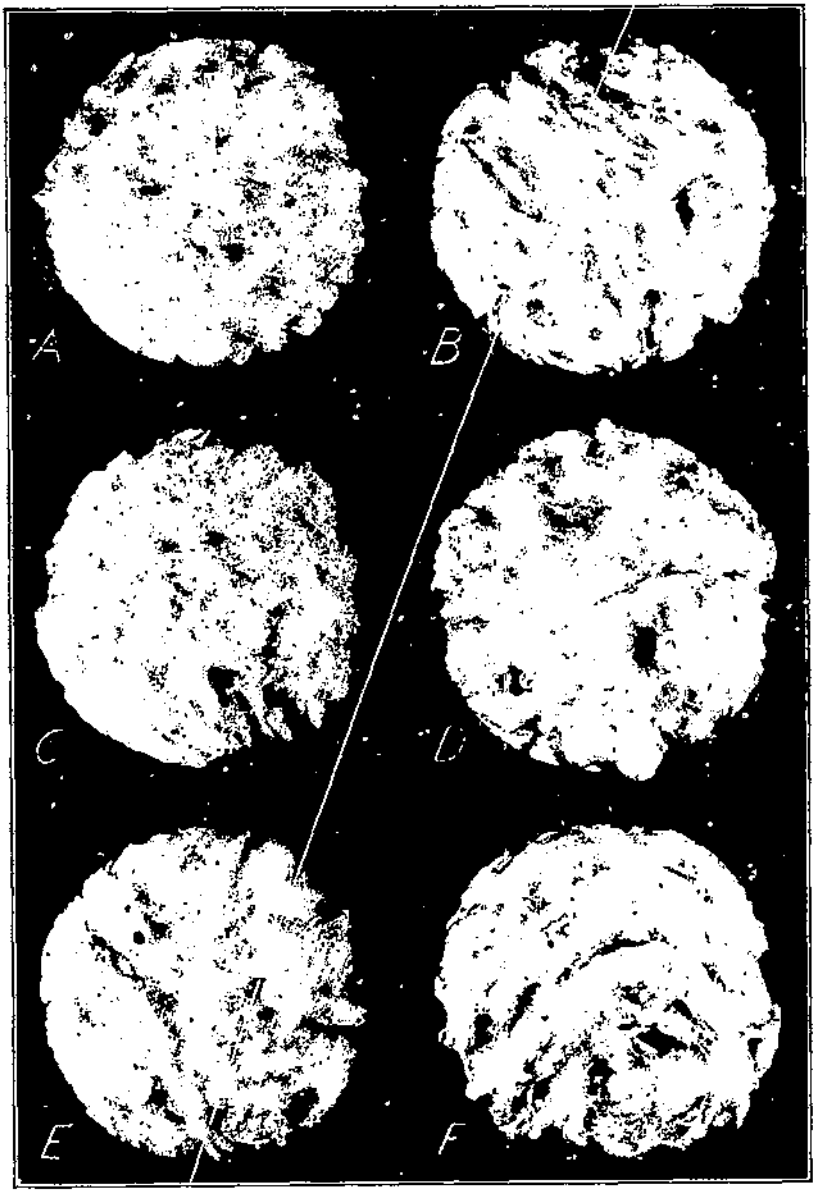
LONG-STAPLE GINNED-LINT SAMPLES REPRESENTING DIFFERENT GIN-SAW SPEEDS AND SEED-ROLL DENSITIES.

A, Low speed with loose roll. *B*, low speed with tight roll; *C*, medium speed with loose roll; *D*, medium speed with tight roll; *E*, high speed with loose roll; *F*, high speed with tight roll.



MEDIUM-STAPLE GINNED-LINT SAMPLES REPRESENTING DIFFERENT GIN-SAW SPEEDS AND SEED-ROLL DENSITIES.

A, Low speed with loose roll; *B*, low speed with tight roll; *C*, medium speed with loose roll; *D*, medium speed with tight roll; *E*, high speed with loose roll; *F*, high speed with tight roll.



SHORT-STAPLE GINNED-LINT SAMPLES REPRESENTING DIFFERENT GIN-SAW SPEEDS AND SEED-ROLL DENSITIES.

A, Low speed with loose roll; *B*, low speed with tight roll; *C*, medium speed with loose roll; *D*, medium speed with tight roll; *E*, high speed with loose roll; *F*, high speed with tight roll.

TABLE 10.—*Average staple length, as appraised by the classer of cotton lint ginned at different saw speeds and seed-roll densities*

COTTON 1⅛ INCHES AND LONGER

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Staple length for indicated type of gin [1]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Inches [2]	*Inches* [2]	*Inches* [2]	*Inches* [2]
12.0 and above	Low	1 5/32+	1 5/32	1 5/32+	1 5/32
	Medium	1 5/32+	1 5/32	1 5/32+	1 5/32
	High	1 5/32+	1 5/32+	1 5/32	1 5/32
Below 12.0	Low	1 5/32+	1 5/32+	1 5/32−	1 5/32−
	Medium	1 5/32+	1 5/32	1 5/32−	1 1/8+
	High	1 5/32+	1 5/32	1 5/32−	1 1/8+

COTTON SHORTER THAN 1⅛ INCHES

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Brush, Loose seed roll	Brush, Tight seed roll	Air-blast, Loose seed roll	Air-blast, Tight seed roll
12.0 and above	Low	1 1/32	1 1/32−	1 1/32	1 1/32
	Medium	1 1/32−	1 1/32−	1 1/32	1 1/32
	High	1+	1+	1 1/32	1 1/32
Below 12.0	Low	1−	1 1/32+	1 9/16+	1 9/16+
	Medium	1−	1−	1 9/16+	1 9/16+
	High	1−	1 1/32+	1 9/16+	1 9/16

[1] Comparisons of gin types are not to be made from the data in this table.
[2] Decimal ranges equivalent to fractional designations are given in table 4.

The upper quartile length by weight of the fibers,[10] as measured in the laboratory, was irregular and did not definitely favor any one of

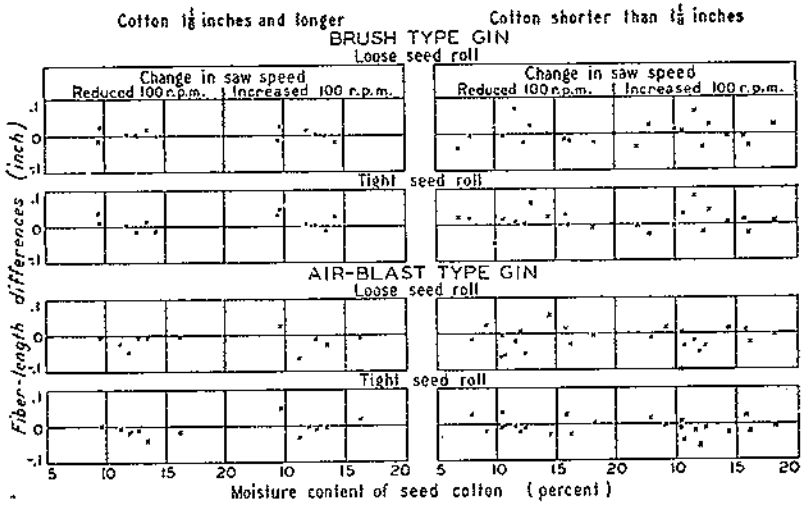


FIGURE 15.—Differences in upper quartile fiber length of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. Fiber-length differences between paired samples, as determined in the laboratory, were not consistently favorable to the gin manufacturer's recommended saw speed or to a speed either 100 revolutions per minute greater or 100 revolutions per minute less than that recommended.

[10] Length at the 25-percent position beginning with the longest fibers in the length-cumulative weight percent curve.

the three saw speeds, as shown by table 11 and figure 15. Similar irregularity is evident in the comparisons made on a basis of roll-density variations, as may be seen in table 11 and figure 16.

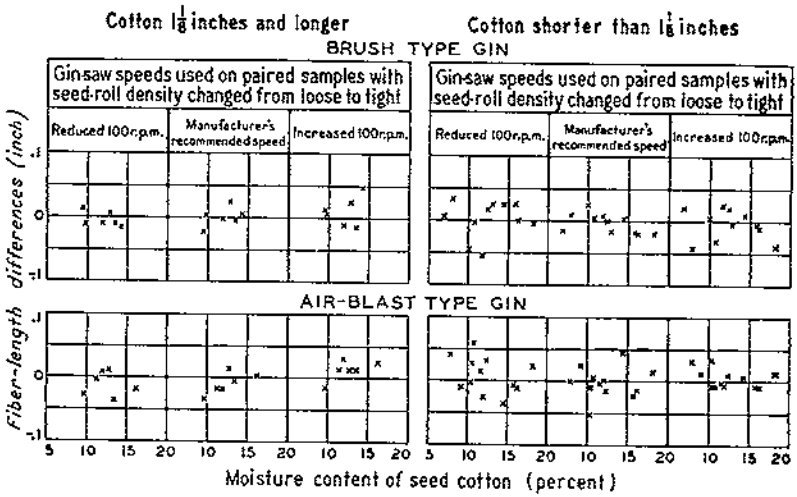


FIGURE 16.—Differences in upper quartile fiber length of cotton lint ginned with loose and with tight seed rolls. Fiber-length differences between paired samples, as determined in the laboratory, were not consistently favorable to either loose-roll or tight-roll ginning.

TABLE 11.—*Average upper quartile length* [1] *of cotton lint ginned at different saw speeds and seed-roll densities*

COTTON 1 1/8 INCHES AND LONGER

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Upper quartile fiber length for indicated type of gin [2]			
		Brush		Air blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Inches [3]	*Inches* [3]	*Inches* [3]	*Inches* [3]
12.0 and above	Low	1.251	1.244	1.215	1.202
	Medium	1.242	1.249	1.219	1.223
	High	1.236	1.255	1.205	1.222
Below 12.0	Low	1.270	1.270	1.267	1.260
	Medium	1.265	1.255	1.289	1.267
	High	1.278	1.281	1.259	1.270

COTTON SHORTER THAN 1 1/8 INCHES

12.0 and above	Low	1.020	1.044	1.048	1.043
	Medium	1.038	1.028	1.053	1.054
	High	1.034	1.030	1.036	1.037
Below 12.0	Low	1.003	.992	.984	1.006
	Medium	.996	1.003	1.008	1.003
	High	1.009	1.006	.982	.993

[1] Length at the 25-percent position beginning with the longest fibers in the length-cumulative weight percent curve.
[2] Comparisons of gin types are not to be made from the data in this table.
[3] See table 4 for fractional equivalents.

The variability of fiber length, as shown in table 12 and figures 17 and 18, was not definitely or consistently affected by either gin-saw

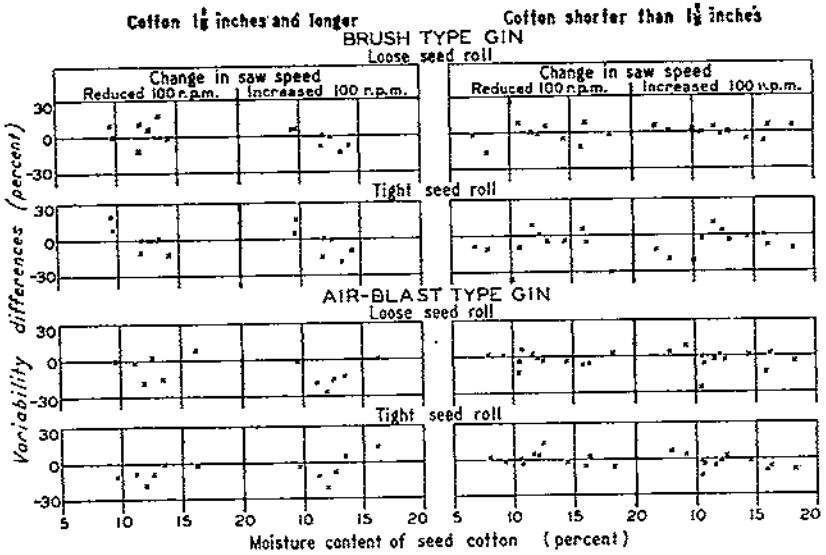


FIGURE 17.—Differences in fiber-length variability of cotton lint ginned at gin manufacturer's recommended saw speed and at other speeds. No definite relationship between fiber-length variability and gin-saw speed was shown by the laboratory measurements on paired samples ginned at the recommended speed and at speeds 100 revolutions per minute greater or less.

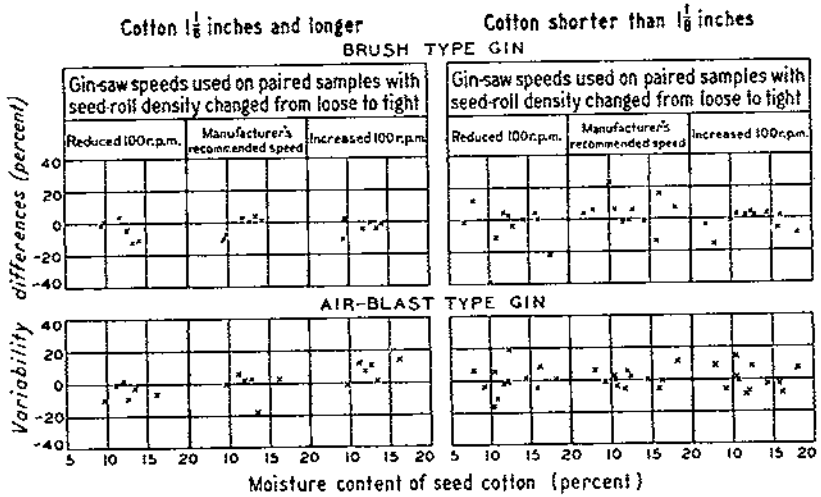


FIGURE 18.—Differences in fiber-length variability of cotton lint ginned with loose and with tight seed rolls. No significant effect of seed-roll density upon fiber-length variability was indicated by the laboratory measurements of paired samples.

speed or seed-roll density. The differences in variability shown for the various methods of ginning are small, and are not consistently favorable to any gin-saw speed or seed-roll density.

TABLE 12.—*Average variability of fiber length*[1] *of cotton lint ginned at different saw speeds and seed-roll densities*

Moisture-content group of seed cottons (percent)	Gin-saw speed (revolutions per minute)	Variability of fiber length for indicated type of gin[2]			
		Brush		Air-blast	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Percent	*Percent*	*Percent*	*Percent*
COTTON 1⅜ INCHES AND LONGER					
12.0 and above	Low	78.3	88.0	87.9	94.3
	Medium	86.1	84.5	86.6	90.9
	High	93.3	95.0	96.4	87.7
Below 12.0	Low	92.7	92.1	96.2	99.4
	Medium	92.4	97.6	89.5	87.0
	High	91.9	96.0	105.8	99.6
COTTON SHORTER THAN 1⅜ INCHES					
12.0 and above	Low	84.7	87.9	85.5	81.2
	Medium	83.7	81.3	82.3	81.8
	High	84.1	84.7	85.1	85.9
Below 12.0	Low	82.8	89.9	87.3	91.4
	Medium	80.3	78.7	86.0	86.4
	High	85.7	88.4	90.2	89.0

[1] Difference between fiber lengths at 90- and 10-percent points on the length-cumulative weight percent curve divided by the length at the 50-percent point.
[2] Comparisons of gin types are not to be made from the data in this table.

GINNING TIME AND LINT TURN-OUT

GINNING TIME

Gin-saw speed and seed-roll density affect not only the quality of the ginned lint but also the ginning time and the lint turn-out. The data on these factors from tests with two brush gins and two air-blast gins and nine cottons were averaged, and are shown in table 13. The weighted average staple length of these cottons was about 1 inch and the moisture content 9.6 percent.

The time required to gin 100 pounds of seed cotton tended, on the average, to increase when the saw speed was reduced 100 revolutions per minute below the manufacturer's recommended speed and to decrease when the saw speed was increased 100 revolutions per minute above the recommended speed. The slightly increased capacity obtained with increased saw speed is due to the greater number of saw teeth coming in contact with the seed roll in a given time, thus removing a somewhat greater number of fibers. The gin capacity is not increased, however, in proportion to the number of saw teeth contacting the seed roll. That is, while increasing the saw speed from 400 to 500 revolutions per minute increased the number of teeth engaging the seed roll per minute by 25 percent, the increase in amount of lint obtained per minute was only about 6 percent.

By timing the rotation of the seed roll in several makes of gin stands it was found that the rotative speed of the seed roll varied not with the saw speed but with the roll density. Tests with a 70-saw brush gin fitted with free-turning circular ends on the roll

box and a special tubular spiked core connected to these ends disclosed, with gin-saw speeds ranging from 300 to 800 revolutions per minute, a constant loose-seed-roll speed of 84 revolutions per minute and a constant tight-seed-roll speed of 116 revolutions per minute.

TABLE 13.—*Average ginning time and average lint turn-out per 100 pounds of seed cotton having an average moisture content of 9.6 percent ginned with 70-saw gin stands operated at different saw speeds and with different seed-roll densities*

Lot nos.[1]	Gin-saw speed	Ginning time		Amount of lint	
		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
		Minutes	*Minutes*	*Pounds*	*Pounds*
18-A, 44, 63, 64, 73, 135, 136, 145, 159	Low	5.1	3.6	31.6	31.7
	Medium	4.9	3.4	32.3	32.2
	High	4.8	3.3	32.4	32.3

[1] Different portions of the first 6 cottons were ginned on a brush and an air-blast gin, and portions of the last 4 cottons were ginned on a brush and an air-blast gin of other make.

The difference in time required to gin 100 pounds of seed cotton was much less between the lowest and the highest saw speed than that between the loose and the tight seed-roll ginning at any saw speed used in the tests. For the loose seed roll, the reduction in ginning time between the low and the high saw speed was only 0.3 minute, or 6 percent. For the medium saw speed, the difference in ginning time between loose and tight seed rolls amounted to 1.5 minutes, or 30 percent, in favor of the tight roll.

On the basis of the data in table 13, the number of bales of 1,500 pounds of seed cotton that would be ginned in 8 hours of continuous operation without interruptions such as are common for changing wagons, tying out bales, and the like, by a plant having four 70-saw stands operating with a loose seed roll, would be 25 for the low, 26 for the medium, and 27 for the high saw speed. Operating with a tight seed roll, or fast rate of feeding, the number of bales ginned at the three saw speeds would be 35½, 37½, and 38, respectively. That is, increasing the saw speed 200 revolutions per minute, from the lowest to the highest speed tested, would result in an increase of not over 3 bales per 8-hour day, while the use of a tight seed roll instead of a loose seed roll would increase the daily capacity about 11 bales for each of the saw speeds.

Because the ginning time was so materially affected by variation of the rate of feeding, with consequent variation in density of the seed roll, data to show such effects were assembled from a wide range of cottons ginned at the manufacturer's recommended saw speed and are arranged in table 14 by staple length and moisture content of the cotton. The table gives also the average lint turn-out for loose and for tight seed roll. Several makes of gins of each type were used in the study.

TABLE 14.—*Average lint turn-out and average ginning time per 100 pounds of seed cotton ginned with loose and tight seed rolls on 70-saw gin stands*

Seed cotton			Seed-roll density	Lint turn-out	Ginning time
Moisture-content group (percent)	Lot nos.	Average moisture content			
	COTTON 1⅛ INCHES AND LONGER GINNED WITH BRUSH GIN				
		Percent		*Pounds*	*Minutes*
12.0 and above	103, 105, 106, 141, 202, 204, 205, 209, 214, 219, 245	14.1	Loose	28.6	4.1
			Tight	28.6	2.8
Below 12.0	51, 118, 123, 135, 144, 150, 226, 227, 233, 242	10.4	Loose	27.9	4.4
			Tight	27.5	3.2
	COTTON SHORTER THAN 1⅛ INCHES GINNED WITH BRUSH GIN				
12.0 and above	112, 114, 119, 120, 131, 133, 139, 156, 201, 203, 210, 217, 218, 220, 229	15.4	Loose	30.4	4.0
			Tight	30.7	2.9
Below 12.0	6, 18-A, 44, 63, 73, 115, 142, 145, 159, 206, 228, 241	9.4	Loose	33.0	5.4
			Tight	33.3	3.7
	COTTON 1⅛ INCHES AND LONGER GINNED WITH AIR-BLAST GIN				
12.0 and above	202, 204, 207, 214	14.2	Loose	29.2	4.0
			Tight	29.0	2.8
Below 12.0	64, 135, 232	9.6	Loose	30.2	4.0
			Tight	30.0	2.9
	COTTON SHORTER THAN 1⅛ INCHES GINNED WITH AIR-BLAST GIN				
12.0 and above	156, 201, 203, 208, 212, 218, 220	16.5	Loose	31.7	3.0
			Tight	31.4	2.8
Below 12.0	2, 9, 18-A, 44, 73, 136, 145, 149, 159, 206, 228, 236	9.1	Loose	33.3	5.1
			Tight	33.4	3.1

The time required to gin a given quantity of cotton with a tight seed roll is considerably less than with a loose seed roll. The explanation for the more rapid ginning with the tight seed roll is that the compactness of the revolving roll causes it to press more firmly against the saws, resulting in each saw tooth engaging a greater number of fibers. According to the data in table 14, equal quantities of seed cotton were ginned with the tight seed roll in about two-thirds of the time required with a loose seed roll. This means that as many bales of cotton could be ginned in 2 days with a tight seed roll as in 3 days with a loose seed roll. Because the ginner has a relatively high fixed operating expense, which does not necessarily vary with the number of bales ginned, he ordinarily will be inclined to gin with a relatively tight seed roll. Competition between gins, especially during the rush of the ginning season when many farmers are anxious to get their cotton ginned as quickly as possible, encourages fast ginning or the use of a tight seed roll.

LINT TURN-OUT

As shown by table 13, lint turn-out tends to increase with an increase in gin-saw speed. As a rule, a decrease in saw speed of 100

revolutions per minute below normal reduced the lint turn-out more than a corresponding increase in speed above normal increased the turn-out. In terms of 1,500 pounds of seed cotton ginned with a loose seed roll, the lint turn-out was decreased 10 pounds by reducing the saw speed by 100 revolutions per minute below normal and increased 2 pounds by raising the saw speed by 100 revolutions per minute above normal.

Some of the increased turn-out at the higher speeds no doubt is due to closer ginning of the seed, which increases the quantity of fuzz or very short fibers that are removed from the seed and placed in the lint (*2*). Insofar as the spinning quality of the lint is concerned, a bale of cotton would probably be less valuable by the addition of this undesirable type of fibers. The friction between saw disk and seeds, when the saws revolve at high speeds, would tend to force some of the seeds that are already sufficiently ginned back into the seed roll past the point of discharge and thereby subject them to further action of the saws, causing closer ginning of the seed.

The lint turn-out as shown by tables 13 and 14 was not definitely or consistently affected by variation in seed-roll density. That is, the quantity of lint obtained does not appear to vary with the rate at which seed cotton is fed to the gin stand. The closeness with which the seed are ginned is dependent to a greater extent on the setting of the seed board than on the compactness of the seed roll. It is possible to close up the seed board and force the seed to remain in the roll box until ginned comparatively close, but with the same seed board adjustment the lint turn-out is not significantly affected by the density of the seed roll.

MONETARY VALUE OF LINT

Although differences in monetary value of cotton as a result of differences in quality may not always be reflected back to the grower, the commercial use of certain methods of ginning that lower the quality of cotton contributes to a reduction of the total value of the American cotton crop, and adversely affects its competitive position in relation to foreign growths of cotton. Therefore, the monetary losses that may result from the damage to cotton quality associated with ginning cotton too fast or with the consequent tight seed roll deserve recognition. For this reason the quality data and lint turn-out results obtained with the cottons and gins listed in table 14 have been compiled, each factor being weighted by the number of samples averaged because the effects involved were similar for the different gins. These results, together with the figures on the estimated money value of the lint from 1,500 pounds of seed cotton calculated for each ginning condition, are shown in table 15 by staple length and moisture content of the seed cotton. In connection with the prices used, it is recognized that the monetary effect of the ginning conditions will differ from year to year, depending on the premiums and discounts for grade and staple. The prices of the fractional grades and staple lengths were calculated by interpolating between the prices of even grades and staples.

TABLE 15.—*Estimated value of lint cotton ginned with loose and with tight seed rolls*

Seed cotton		Seed-roll density	Average moisture content of ginned lint	Grade	Staple length	Price per pound [2]	Bale weight [3]	Value per bale
Lots (number) [1]	Average moisture content							
	Percent		*Percent*	*Code index*	*Thirty-seconds inch*	*Cents*	*Pounds*	*Dollars*
COTTON 1⅛ INCHES AND LONGER								
15	14.1	Loose	9.7	5.30	37.93	8.01	454	39.09
		Tight	9.9	5.84	37.60	7.64	453	34.60
13	10.2	Loose	6.0	5.38	36.77	7.78	448	34.85
		Tight	7.0	5.72	36.62	7.53	444	33.43
COTTON SHORTER THAN 1⅛ INCHES								
22	15.7	Loose	10.1	5.06	32.64	7.50	485	36.38
		Tight	10.5	5.58	32.41	7.20	486	35.43
23	9.2	Loose	7.2	4.85	31.08	7.29	510	37.83
		Tight	7.2	5.33	30.76	7.13	522	37.21

[1] Each group here combines the same moisture-content groups shown in table 14 for both gin types.
[2] Approximate average price for the specified white grades and staple lengths prevailing at Memphis, Tenn., for the season 1932-33.
[3] Calculated for 1,500 pounds of seed cotton, on basis of lint turn-out shown in table 14 plus 22 pounds for bagging and ties.

As pointed out previously, the grade was somewhat lower and the staple slightly shorter for cottons ginned with the tight seed roll, therefore the price per pound was less for the cotton ginned with this type of roll. The weight of the bale was not greatly affected by the variations in seed-roll density. Consequently, with a lower-price lint and no appreciable difference in bale weight, the net monetary value of the lint was lower for the tight-roll ginning. The reduction in the value of the lint from ginning with a tight rather than with a loose seed roll increased with the moisture content and with the staple length of the cotton.

With the longer staple cottons of the higher moisture group, the value of the lint ginned with loose seed rolls was approximately $4.50 (or 13 percent) more than those ginned with tight seed rolls, with Middling ⅞ inch cotton selling at about 7 cents a pound as was the case during the 1932–33 season.

The value of the longer staple cottons of the lower moisture groups was reduced almost $1.50 per bale by ginning with a tight instead of loose seed roll. The amount of reduction for the shorter staple cottons of the high- and low-moisture groups amounted to 95 and 62 cents per bale, respectively. It is recognized that, to prevent the losses shown, the ginning costs are increased, but data on the amount of such costs are not available.

POWER REQUIREMENTS AND ENERGY CONSUMPTION

In the studies here reported, only a limited amount of data on the power phase of ginning were collected because necessary instruments were not obtained until the studies had reached an advanced stage. However, the available data show some rather interesting relationships.

Table 16 shows average figures for the power requirement of a 70-saw brush gin equipped with 12-inch saws, and for the energy consumption of the gin stand in ginning 1,500 pounds of seed cotton, with two different staple-length groups. Varying the gin-saw speed from 100 revolutions per minute below to 100 revolutions per minute above the manufacturer's recommended speed showed a slight tendency to increase the power required by the gin stand, whereas varying the seed-roll density from loose to tight increased the power requirement by about 50 percent. So large a difference in the necessary capacity of the motors or engines required to drive the gins is a material advantage of loose seed-roll over tight seed-roll ginning.

The amount of energy consumed in ginning a bale of cotton was consistently, but only slightly, affected by variations in the ginning conditions employed, decreasing with increase in saw speed and with decrease in roll density. The faster rate of ginning with the tight seed roll and the higher saw speed compensated in large measure for the increased power requirement, in the effect upon energy consumption. On the basis of energy consumption shown in table 16 and assuming a rate of 4 cents per kilowatt-hour for electric current, the largest difference in cost per bale for variations in either saw speed or seed-roll density would be about 6 cents.

TABLE 16.—*Average power requirement of a 70-saw brush gin, and average energy consumed in ginning 1,500 pounds of seed cotton*

Seed cottons		Gin saw speed	Power required		Energy consumed	
Lot nos.	Average moisture content		Loose seed roll	Tight seed roll	Loose seed roll	Tight seed roll
	Percent		*Horsepower*	*Horsepower*	*Kilowatt-hours*	*Kilowatt-hours*
COTTON 15/16 INCHES AND LONGER						
334, 335, 341, 344, 365, 372, 389.	11.4	Low	10.1	15.5	7.8	8.0
		Medium	10.3	16.0	7.1	8.1
		High	11.2	17.6	6.9	7.9
COTTON SHORTER THAN 15/16 INCHES						
350, 361, 381, 388, 398	10.[illegible]	Low	10.7	15.0	8.7	9.4
		Medium	10.4	15.0	7.8	8.4
		High	10.8	15.5	7.5	7.9

[1] For feeder, gin saws, and brush cylinder

SUMMARY AND CONCLUSIONS

Studies have been made to determine the relative influence of gin-saw speed and seed-roll density on the quality of ginned lint and on the ginning capacity, power requirement, and energy consumption during ginning, and to show the losses in monetary value of the lint that may be associated with tight seed-roll ginning. Brush and air-blast gins were used and were operated at or near the manufacturer's recommended speed, and at speeds 100 revolutions per minute above and 100 revolutions per minute below this speed. By feeding the cotton to the gin stands at different rates, it was possible to produce both loose and tight seed rolls at each gin-saw speed. The 98 espe-

cially selected American upland seed cottons employed in these tests were taken from the crop years of 1930, 1931, 1932, 1933, and 1934. They were grown in 11 States, from Virginia to Texas and Oklahoma. In moisture content they ranged from 6.8 to 20.2 percent, in staple length from 1 3/16 inch to 1 5/32 inches, and widely in other characteristics. The results of tests on lint quality are presented for 46 cottons, and of tests relating to lint turn-out, lint value, ginning time, power required, and energy consumed for from 9 to 57 cottons.

The results and conclusions from this series of studies may be summarized as follows:

There were only small effects on the lint quality and the ginning capacity caused by variations of gin-saw speed 100 revolutions per minute above or below the manufacturer's recommended speed. Lowering the speed 100 revolutions per minute improved the quality slightly, but raising the gin-saw speed 100 revolutions per minute did not change the quality appreciably.

Changes in seed-roll density, caused by changes in the rate of feeding seed cotton to the gin stand, are much more important than changes in gin-saw speed in affecting the quality of the ginned lint and the mechanical operation of the gin stand. Loose-roll ginning gives the better quality cotton.

The effects of variations in the method of ginning employed with a wide range of cottons were materially greater on the preparation component of grade than on any other quality element.

No real effect of gin-saw speed on staple length was found. As the seed-roll density was changed, the staple-length differences between loose-and tight-roll samples showed slight tendencies for the loose-roll samples to be classed longer. Laboratory determinations of the upper quartile length and of the variability of fiber length showed little relation of these elements to the gin-saw speed or the seed-roll density.

Grade differences due to variations in gin-saw speed averaged less than one-fifth of a grade improvement for the low speed. The change due to increasing the speed was negligible. Grade differences due to change in seed-roll density amounted to nearly two-thirds of a grade in favor of the loose roll.

Using prices for cotton of like grades and staples prevailing in the Memphis market during the 1932 crop season as a basis of monetary-value computations, the use of a loose seed roll instead of a tight seed roll with a group of cottons averaging 1 3/16 inches in staple length from seed cottons averaging 14.1 percent in moisture content showed net benefits of approximately $4.50 per bale, or 13 percent, and almost $1.50 per bale, or 4 percent, with a group of cottons averaging 1 5/32 inches in staple length from seed cottons having 10.2 percent moisture content.

The amount of reduction in value as a result of using a tight seed roll for short-staple cottons (about 1 inch) from seed cottons of relatively high moisture content and of substantially lower moisture content averaged 95 and 62 cents per bale, respectively.

Ginning capacity and lint turn-out for the group of seed cottons giving 1-inch staple length and having 9.6 percent moisture content were generally slightly less with the low saw speed and often were greater with the high speed. Ginning capacity for an outfit of four 70-saw gins was increased 3 bales per 8-hour day by increasing the

gin-saw speed 200 revolutions per minute, and 11 bales by using a tight seed roll instead of a loose seed roll. Lint turn-out showed no definite or consistent relationship to seed-roll density.

Power requirement, though showing some tendency to increase with gin-saw speed, was not materially affected by changing the gin-saw speed 100 revolutions per minute above or below the manufacturer's recommended speed. The power requirement was increased 50 percent, however, by varying the seed-roll density from loose to tight.

Energy consumption per unit weight of seed cotton ginned was not appreciably affected by variations in gin-saw speed or seed-roll density. The interrelationship of ginning time and power requirements caused the difference in energy consumption to be negligible, although indications were that for these small differences the high gin-saw speed and loose seed roll showed slight advantages.

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APPENDIX

BASIC TABLES SHOWING THE AVERAGE VALUES FOR SAMPLES GINNED AT DIFFERENT SAW SPEEDS AND SEED-ROLL DENSITIES

Tables 17 and 18 give the average figures showing the condition of seed cotton at time of ginning and the results of laboratory determinations and cotton classers' appraisals of the quality of the lint, for all tests discussed in this bulletin. Table 17 relates to the tests made with brush gins, table 18 to those with air-blast gins. The results with each gin type are subdivided according to staple length of the ginned lint and to moisture content of the seed cotton. The number of samples involved in each average is the same as the number of lots of cotton shown in the tables.

TABLE 17.—*Averages of moisture content and certain quality elements of cotton lint ginned with brush gins at different saw speeds and seed-roll densities*

COTTONS 1⅛ INCHES AND LONGER

Seed cotton			Method of ginning		Quality of ginned lint									
						Laboratory determinations				Cotton classer's appraisals				
						Color								
Moisture-content group (percent)	Lot nos.	Average moisture content	Gin-saw speed [1]	Seed-roll density	Moisture content	Brilliance [2]	Chroma [3]	Upper quartile fiber length [4]	Variability of fiber length [5]	Color	Leaf	Preparation	Grade (total)	Staple length
		Percent	*Revolutions per minute*		*Percent*	*Units*	*Units*	*Inches*	*Percent*	*Code index*	*Code index*	*Code index*	*Code index*	*Inches*
12.0 and above	104, 105, 107, 121, 124, 204, 209	13.9	Low	Loose	8.9	8.71	1.78	[6] 1.251	[6] 78.3	4.0	4.0	5.6	4.5	1 5/32+
			Medium	do	9.2	8.71	1.77	[6] 1.242	[6] 86.1	4.1	4.1	6.6	5.0	1 5/32+
			High	do	8.7	8.69	1.75	[6] 1.236	[6] 93.3	4.0	4.0	6.3	4.8	1 5/32+
			Low	Tight	8.8	8.68	1.78	[6] 1.244	[6] 88.0	4.1	4.3	7.4	5.3	1 5/32
			Medium	do	9.3	8.66	1.79	[6] 1.249	[6] 84.5	4.1	4.1	8.1	5.5	1 5/32
			High	do	9.2	8.68	1.77	[6] 1.255	[6] 95.0	4.0	4.1	8.0	5.4	1 5/32+
Below 12.0	64, 118, 126, 134, 215, 226, 227	10.9	Low	Loose	7.3	8.59	1.79	[7] 1.270	[7] 92.7	4.6	4.4	5.4	4.8	1 5/32+
			Medium	do	7.9	8.58	1.76	[7] 1.265	[7] 92.4	4.6	4.6	5.6	4.9	1 5/32+
			High	do	7.5	8.53	1.76	[7] 1.278	[7] 91.9	4.6	4.6	5.6	4.9	1 5/32+
			Low	Tight	7.4	8.56	1.79	[7] 1.270	[7] 92.1	4.6	4.4	6.6	5.2	1 5/32+
			Medium	do	7.6	8.50	1.75	[7] 1.255	[7] 97.6	4.6	4.6	7.1	5.4	1 5/32
			High	do	7.3	8.50	1.77	[7] 1.281	[7] 96.0	4.6	4.4	7.3	5.4	1 5/32

[1] Low, 100 revolutions per minute below medium speed; medium, manufacturer's recommended speed; high, 100 revolutions per minute above medium speed.
[2] Brilliance readings are made on the entire surface of cotton samples, and range from 7 to 9 on a scale that extends in equal steps from 0 which is black to 10 which is white.
[3] The chroma scale extends from 0, a completely neutral color, to 10 or 12, a vermillion red.
[4] Length of the fibers at the 25-percent point on the length-cumulative weight percentage curve beginning with the longest fibers.
[5] Difference between fiber lengths at 90- and 10-percent points on the length-cumulative weight percentage curve divided by the length at 50-percent point.
[6] No laboratory length and variability data available for cottons 104, 105, 107, and 209.
[7] No laboratory length and variability data available for cottons 126, 134, 215, and 227.

TABLE 17.—*Averages of moisture content and certain quality elements of cotton lint ginned with brush gins at different saw speeds and seed-roll densities*—Continued

COTTONS SHORTER THAN 1⅛ INCHES

Seed cotton			Method of ginning		Quality of ginned lint									
						Laboratory determinations				Cotton classer's appraisals				
						Color								
Moisture-content group (percent)	Lot nos.	Average moisture content	Gin-saw speed	Seed-roll density	Moisture content	Brilliance	Chroma	Upper quartile fiber length	Variability of fiber length	Color	Leaf	Preparation	Grade (total)	Staple length
		Percent	*Revolutions per minute*		*Percent*	*Units*	*Units*	*Inches*	*Percent*	*Code index*	*Code index*	*Code index*	*Code index*	*Inches*
12.0 and above	109, 112, 116, 120, 122, 131, 138, 210, 217, 218, 229.	15.2	Low	Loose	10.2	8.54	2.03	[5] 1.029	[5] 84.7	4.2	4.1	5.6	4.6	1 1/32
			Medium	do	10.1	8.54	2.01	[5] 1.038	[5] 83.7	4.3	4.1	6.0	4.3	1 1/32−
			High	do	10.4	8.53	2.03	[5] 1.034	[5] 84.1	4.4	4.2	5.9	4.8	1+
			Low	Tight	10.2	8.54	2.02	[5] 1.044	[5] 87.9	4.4	4.3	6.7	5.2	1 1/32−
			Medium	do	10.3	8.53	2.01	[5] 1.028	[5] 81.3	4.5	4.3	7.8	5.6	1 1/32−
			High	do	10.1	8.52	2.06	[5] 1.030	[5] 84.7	4.6	4.4	7.6	5.6	1+
Below 12.0	44, 47, 58, 63, 68, 69, 101, 115, 129, 142.	9.6	Low	Loose	8.0	8.55	1.86	[9] 1.003	[9] 82.8	4.3	4.3	4.8	4.5	1−
			Medium	do	7.7	8.55	1.86	[9] .996	[9] 86.3	4.4	4.3	4.9	4.5	1−
			High	do	7.8	8.55	1.85	[9] 1.009	[9] 85.7	4.3	4.6	4.7	4.5	1−
			Low	Tight	7.8	8.55	1.86	[9] .992	[9] 89.9	4.5	4.5	5.7	4.9	31/32+
			Medium	do	7.8	8.56	1.85	[9] 1.003	[9] 78.7	4.6	4.6	6.0	5.1	1−
			High	do	7.6	8.53	1.85	[9] 1.006	[9] 88.4	4.8	4.7	6.0	5.2	31/32+

[5] No laboratory length and variability data available for cottons 112, 116, 217, and 229.
[9] No laboratory length and variability data available for cottons 47, 58, 68, 69, and 142.

TABLE 18.—*Averages of moisture content and certain quality elements of lint cotton ginned with air-blast gins at different saw speeds and seed-roll densities*

COTTONS 1⅛ INCHES AND LONGER

Seed cotton			Method of ginning		Quality of ginned lint									
						Laboratory determinations				Cotton classer's appraisals				
						Color								
Moisture-content group (percent)	Lots nos.	Average moisture content	Gin-saw speed [1]	Seed-roll density	Moisture content	Brilliance [2]	Chroma [3]	Upper quartile fiber length [4]	Variability of fiber length [5]	Color	Leaf	Preparation	Grade (total)	Staple length
		Percent	*Revolutions per minute*		*Percent*	*Units*	*Units*	*Inches*	*Percent*	*Code index*	*Code index*	*Code index*	*Code index*	*Inches*
12.0 and above	104, 105, 107, 113, 121, 124, 147, 204, 209.	13.6	Low	Loose	8.7	8.66	1.80	[6] 1.215	[6] 87.9	4.6	4.4	6.6	5.2	15/32+
			Medium	do	8.8	8.63	1.82	[6] 1.219	[6] 86.6	4.7	4.6	6.9	5.4	15/32+
			High	do	9.0	8.59	1.83	[6] 1.205	[6] 96.4	4.7	4.6	6.8	5.3	15/32
			Low	Tight	9.0	8.61	1.82	[6] 1.202	[6] 94.3	4.7	4.6	7.6	5.6	15/32
			Medium	do	8.8	8.61	1.86	[6] 1.223	[6] 90.9	4.8	4.6	8.1	5.8	15/32
			High	do	9.3	8.59	1.83	[6] 1.222	[6] 87.7	4.8	4.6	8.0	5.8	15/32
Below 12.0	118, 126, 132, 134, 215	10.6	Low	Loose	7.0	8.38	1.80	[7] 1.267	[7] 96.2	5.4	5.4	6.2	5.7	15/32−
			Medium	do	7.4	8.35	1.75	[7] 1.289	[7] 89.5	5.4	5.4	6.6	5.8	15/32−
			High	do	7.7	8.37	1.76	[7] 1.259	[7] 105.8	5.6	5.6	6.0	5.7	15/32−
			Low	Tight	7.9	8.36	1.80	[7] 1.260	[7] 99.4	5.4	5.4	7.8	6.2	15/32−
			Medium	do	8.0	8.33	1.76	[7] 1.267	[7] 87.0	5.6	5.8	7.8	6.4	1 1/16+
			High	do	7.8	8.37	1.75	[7] 1.270	[7] 99.6	5.6	5.8	8.0	6.5	1 1/8+

[1] Low, 100 revolutions per minute below medium speed; medium, manufacturer's recommended speed; high, 100 revolutions per minute above medium speed.
[2] Brilliance readings are made on the entire surface of cotton samples and range from 7 to 9 on a scale which extends in equal steps from 0 which is black to 10 which is white.
[3] The chroma scale extends from 0, a completely neutral color, to 10 or 12, a vermilion red.
[4] Length of the fibers at the 25-percent point on the length-cumulative weight percentage curve beginning with the longest fibers.
[5] Difference between fiber lengths at 90 and 10-percent points on the length-cumulative weight percentage curve divided by the length at 50-percent point.
[6] No laboratory length and variability data available for cottons 104, 105, 107, 147, 204, and 209
[7] No laboratory length and variability data available for cottons 132 and 134.

TABLE 18.—*Averages of moisture content and certain quality elements of lint cotton ginned with air-blast gins at different saw speeds and seed-roll densities*—Continued

COTTONS SHORTER THAN 1⅛ INCHES

Seed cotton			Method of ginning		Quality of ginned lint									
						Laboratory determinations				Cotton classer's appraisals				
						Color								
Moisture-content group (percent)	Lot nos.	Average moisture content	Gin-saw speed	Seed-roll density	Moisture content	Brilliance	Chroma	Upper quartile fiber length	Variability of fiber length	Color	Leaf	Preparation	Grade (total)	Staple length
		Percent	*Revolutions per minute*		*Percent*	*Units*	*Units*	*Inches*	*Percent*	*Code index*	*Code index*	*Code index*	*Code index*	*Inches*
12.0 and above	109, 120, 122, 131, 137, 146, 210, 218.	14.6	Low	Loose	9.8	8.52	1.98	[8] 1.048	[8] 85.5	4.4	4.1	5.6	4.7	1 1/32
			Medium	do	10.0	8.49	2.03	[8] 1.053	[8] 82.3	4.4	4.1	6.0	4.8	1 1/32
			High	do	10.0	8.47	2.01	[8] 1.036	[8] 85.1	4.4	4.1	6.1	4.9	1 1/32
			Low	Tight	9.9	8.49	2.04	[8] 1.043	[8] 81.2	4.4	4.1	7.6	5.4	1 1/32
			Medium	do	10.2	8.47	2.06	[8] 1.054	[8] 81.8	4.4	4.2	7.6	5.4	1 1/32
			High	do	10.2	8.46	2.03	[8] 1.037	[8] 85.9	4.4	4.2	7.6	5.4	1 1/32
Below 12.0	101, 102, 110, 117, 127, 129, 140, 142, 155.	9.4	Low	Loose	7.2	8.50	1.98	[9] .984	[9] 87.3	4.2	4.2	5.0	4.5	15/16+
			Medium	do	7.6	8.48	1.99	[9] 1.008	[9] 86.0	4.4	4.4	4.8	4.6	15/16+
			High	do	7.2	8.49	1.98	[9] .982	[9] 90.2	4.4	4.4	4.8	4.6	15/16+
			Low	Tight	7.6	8.47	1.99	[9] 1.006	[9] 91.4	4.8	4.7	6.1	5.2	15/16+
			Medium	do	7.2	8.48	1.99	[9] 1.003	[9] 86.4	4.8	4.8	6.2	5.3	15/16+
			High	do	7.4	8.49	1.99	[9] .993	[9] 89.0	4.8	4.8	6.3	5.3	15/16

[8] No laboratory length and variability data available for cottons 122 and 137.
[9] No laboratory length and variability data available for cottons 127, 140, and 155.

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END