STRIPPER ROLLS FOR COTTON HARVESTERS

Tests of Roll Materials, Speeds, Arrangements, and Designs

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Harvesting cotton with a mechanical stripper has been a common practice in Oklahoma for many years. Early stripping devices were crude sleds with fixed stripping fingers set at an angle to the horizontal. As the stripper moved forward, the space between adjacent fingers permitted the cotton plants to pass through and the bolls were retained. The bolls stripped from the plant were placed in a container directly behind the fingers. The stripping fingers applied an upward force to remove the cotton bolls from the plant. Therefore, stripping was satisfactory where sufficient plant anchorage was provided by the soil. Stripper harvesting works most satisfactorily where the weakest point of the plant system occurs between the boll and the limb which supports it.

Since stripping is a once-over operation, it is necessary to leave the cotton plant standing in the field until such time as the maximum amount of mature cotton may be harvested. This frequently exposes cotton that has matured early in the season to severe weather losses. For this reason, only cotton varieties with storm resistant characteristics are suitable for stripper harvesting.

As the art of harvesting with cotton strippers advanced, efforts were made to find stripping devices which would improve harvester performance. Some of the early improvements were made by Smith,[1] who investigated the possibility of replacing the fixed fingers with a pair of rotating rolls. These rolls had a fixed gap between them through which the cotton plants could pass, but which was small enough to

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[1] Smith, H. P., D. T. Killough, D. L. Jones and M. H. Byrom, *Progress in the Study of the Mechanical Harvesting of Cotton.* Texas Agri. Exp. Sta. Bul. 511. (September, 1935.)

The research reported herein was done under Oklahoma Station Project No. 578.

prevent passage of the cotton bolls. As the plants passed through the roll gap, the bolls were subjected to an upward force which removed them from the plant. The bolls then fell into conveyors located alongside the rolls and were conveyed into a wagon or other container.

Smith's work made important contributions to a better understanding of the requirements for cotton stripping devices. He investigated such things as roll speed, roll angle, and roll materials. Most of his investigations were made on rolls less than three inches in diameter and constructed of unyielding materials. Some variation in gap width was provided by spring-loading the rolls. When sufficient pressure developed between the rolls, the spring would permit an increase in gap size. This feature allowed large amounts of material to pass between the rolls which might otherwise have resulted in a chokage.

Smith's investigation of roll materials included steel rolls, solid rubber rolls, and steel rolls covered with rubber sleeves. Roll speed was found to have an influence on the performance of the stripping mechanism. Peripheral roll speeds well in excess of forward travel speed were found to be most effective. The angle of the roll with respect to the ground surface was also found to be of some importance. A roll angle of approximately 30 degrees, using the materials and speeds investigated, was found to be a most appropriate angle.

In 1949, agricultural engineers at the Oklahoma Station developed a different type of stripping roll.[2] Instead of making rolls from a hard, unyielding material and spring-loading them, a more resilient roll material was used which provided automatic variation in gap width. As with Smith's machine, the gap width depended upon the amount of material passing between the rolls. Gap length, however, was determined by the size of the plant stalk or limb passing between the rolls; therefore the stripping rolls formed a rotating seal around individual plants as they passed between the rolls. Preliminary evaluation of this concept yielded encouraging results.

In 1952 a comprehensive test program was begun to evaluate roll materials, roll speeds, roll arrangements, and the concept of a variable gap width between rolls. It was soon evident that extensive testing would be required to properly evaluate these variables.

The merit of a flexible roll material for removing the cotton bolls

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[2] Schroeder, E. W., and Jay G. Porterfield, *The Development of the Oklahoma Brush-type Cotton Stripper*. Okla. Agri. Exp. Sta. Bul. B-422. (April, 1954.)

from the plant was apparent from the beginning of this test program. It was especially apparent when harvesting cotton from large plants that required considerable compression and consolidation before they would pass through the gap between two stripping rolls. The reduction in the amount of sticks and branches harvested was considerable.

The results described in this bulletin are confined to those obtained from harvesting dryland cotton normally suitable for conventional stripping rolls. Tests are now under way evaluating this concept for irrigated cotton where plants are normally larger, have more branches, and where the harvester must handle a greater quantity of material.

It was decided early in the test work with dryland cotton to include results from ginning the cotton harvested by the various stripping rolls. Therefore ginning tests were conducted in each season that cotton was available in sufficient quantity, and the results of these tests are presented in this bulletin.

Description of Rolls Tested

Many different combination of stripper roll materials, arrangements, speeds, and designs were evaluated in this study. Because of the lack of theoretical knowledge regarding the effects of these four variables on roll stripping performance, not all combinations were evaluated every year. When the study was initiated, certain rolls were fabricated and tested. If their performance indicated no merit, they were eliminated from the study and replaced by another combination of the four variables.

Roll Arrangements and Speeds

Both double and single stripping roll arrangements were evaluated. Under the double roll arrangement, a pair of counter-rotating rolls was mounted in a one-row stripper with one roll on each side of the cotton row. The stripper and all rolls were so designed that all rolls to be comparatively evaluated could be interchangeably installed in the stripper. When installed in the stripper, the rolls were supported at each end by a bearing, and driven from the upper end by beveled gears. In operating position the forward or lower ends of the rolls were approximately 3 inches above the ground, and inclined at an angle of approximately 30° from the horizontal.

Under the single roll arrangement, the inboard roll was removed from the stripper and a stationary steel stripping bar installed in its place. This bar extended the full length of the roll. The gap between the roll and bar was approximately 1/4 inch when no plants were in the stripper.

Roll speeds evaluated in this study were nominally 300, 500, 700, 900, and 1200 revolutions per minute.

Roll Materials and Designs

Four different materials were used in fabricating the stripper rolls: steel, nylon bristles, a vegetable fiber bristle known as tampico-palmetto, and rubber. The rubber was used in two forms, as "fingers" and as strips. In most instances, two roll designs were fabricated with each material.

THE TAMPICO-PALMETTO rolls were fabricated from strips of bristles embedded in a steel retainer. The bristles were approximately 2 1/4 inches long and the strips of bristles were the same length as the roll. All rolls of this material had a steel core approximately 2 inches in

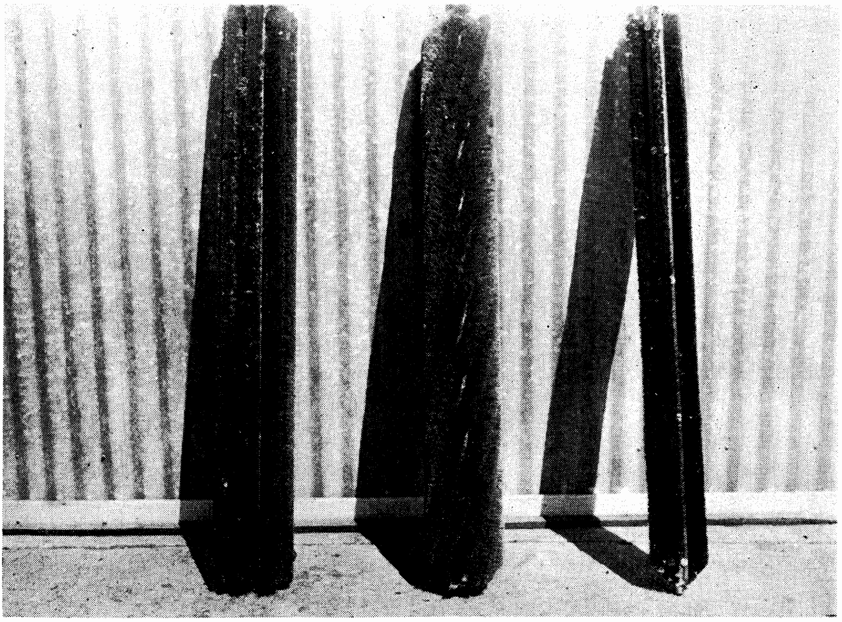


Figure 1. Stripper rolls fabricated from strips of bristle materials. From left to right: 10 strips of tampico-palmetto mounted parallel to the roll axis; 10 strips of tampico-palmetto spirally mounted; 6 strips of nylon mounted parallel to the roll axis.

diameter. The method of fastening, although it varied, was essentially that of drilling and tapping holes in the steel core and fastening ten strips of bristles lengthwise on the core with the bristles extending radially.

The two roll designs were as follows: (1) The strips were attached parallel to the axis of rotation. (2) The strips were wound spirally around the steel core. These will be referred to as straight and spiral tampico-palmetto rolls.

The outside diameter of the roll was approximately 6½ inches. Where two rolls were used for each row, the gap between the rolls was approximately ¼ inch. If the permissible yielding of the 2¼ inch bristles can be estimated at roughly half of the bristle length, then the range of possible gap width would be from ¼ inch to approximately 2½ inches. No measurements were made to determine exactly how wide the gap could be when the material was maximally flexed. It was believed, however, that a gap width of 2½ inches was adequate. A larger gap width might have been possible, but damage to the fibers would probably have resulted from excessive flexing.

Both spiral and straight tampico-palmetto fibers appeared to take a permanent set after less than 100 acres of use. As a result, the rolls had to be moved closer together in order to maintain the minimum gap width of one-quarter inch. This permanent set in the fibers did not seem to result in a measurable difference in the performance of the rolls. However, it might decrease their useful service life.

NYLON ROLLS were constructed by mounting six or ten strips of nylon bristles around a steel core in much the same manner as described for tampico-palmetto rolls. Various bristle lengths and diameters were used. The bristle length was approximately 2 inches, and bristle diameter did not exceed .030 inches. The outside diameter of the roll was approximately 6 inches. Both straight and spiral mountings of the bristle strips were used.

In contrast to the tampico-palmetto bristles, the nylon bristles did not take a permanent set. Some of the larger bristle diameters, however, suffered some fractures, thereby decreasing the number of effective bristles to the point that replacements were required in order to maintain the effectiveness of the roll. The gap between the two rolls was approximately ¼ inch, and it was estimated that the gap during operation would not exceed 2½ inches. This maximum gap width would permit considerable flexing of the bristles without excessive breakage at the base of the mounting strip.

Moisture seemed to have little effect on the nylon strips and bristle wear was not a major problem. When old cotton stalks lodged in the machine and remained in contact with the bristles during operation, heat from friction caused bristle damage.

RUBBER ROLLS of two types were included in this study. One type used strips of rubber ¼ inch thick, approximately 2½ inches wide, and of the same length as the roll. Both straight and spiral mountings were fabricated, in much the same manner as described for the tampico-palmetto rolls. The rubber hardness was approximately 50 durometer. This permitted the rolls to yield under load to provide a gap approximately 2½ inches wide. The normal gap between unloaded rolls was approximately ¼ inch. The rubber strips did not appear to take a permanent set. After considerable use, these strips had been damaged by abrasive wear, and they needed to be replaced periodically. On the spirally mounted rolls, the method of mounting made it difficult to maintain the radial orientation of the strips relative to the steel core.

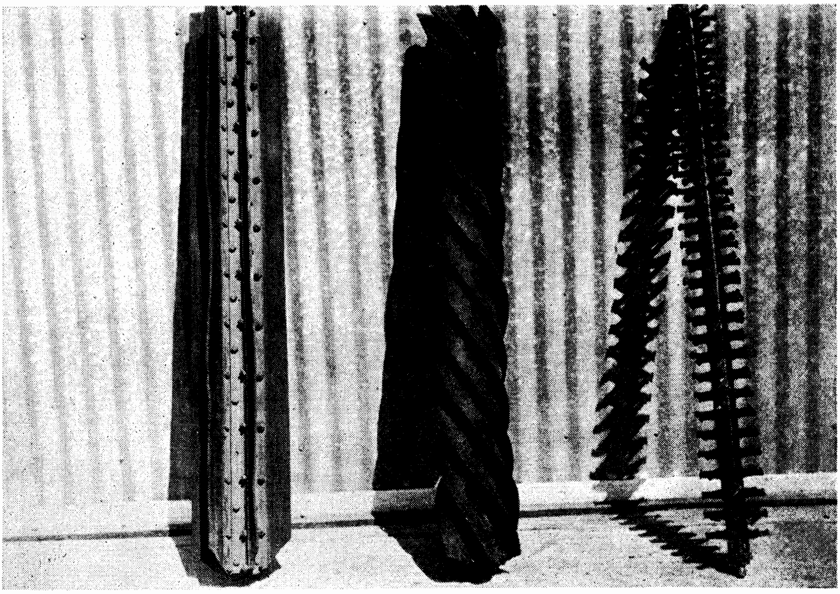


Figure 2. Stripper rolls fabricated from rubber. From left to right: 6 strips of rubber parallel to the roll axis, 6 strips of rubber spirally mounted, 6 rows of rubber fingers.

One side of the strip was in tension and the other side in compression, thus causing the strips to bend toward the roll core.

A second type of rubber roll was fabricated from rubber fingers used on chicken-picking machines. These fingers were approximately 5/8 inch in diameter and the length varied from 2 3/8 to 2 7/8 inches. The fingers were mounted radially in rows parallel to the longitudial axis of the steel core and spaced approximately 1 1/2 inches apart in the row. Rolls were made having three, four, and six rows of fingers per roll. The gap between rolls under maximum plant load was probably greater than for any other material because of the space between adjacent fingers along the roll. The unflexed finger rolls had a gap of approximately 1/4 inch when not rotating. While it was difficult to measure precisely the gap of an unloaded pair of rolls when they were rotating at high speed, some interference between the fingers of adjacent rolls was observed. This was apparently due to elongation of the fingers caused by centrifugal force. The rubber fingers mounted at the lower end of the roll near the ground suffered some deterioration due to abrasive wear.

STEEL ROLLS of two different sizes were used. One size, having a diameter of approximately 4 1/4 inches, was made by forming a tube of

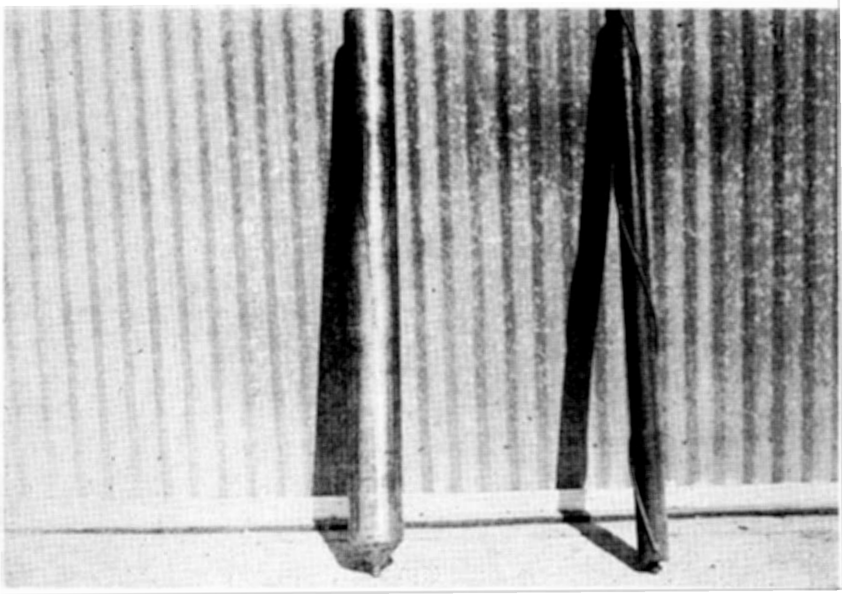


Figure 3. Stripper rolls fabricated from steel. The roll on the left is made of light gauge sheet metal. The roll on the right has a 1/4 inch rod spirally mounted on the roll.

light-gauge sheet metal. The surface of this roll was smooth. Paired use of these rolls provided an unyielding gap width of less than one inch. This gap remained constant regardless of whether or not the rolls were loaded.

The other size of steel roll was approximately 2¼ inches in diameter. A ¼-inch, round steel rod was wound spirally around the surface of this roll to increase the aggressiveness of the roll and to give some variation in gap width as the roll turned. With these rolls, the gap width variation was approximately ½ inch.

Testing Methods Used

Each year from 1952 to 1958 a field of dryland cotton was planted for testing stripper rolls. Although the same variety was not used all seven years, the variety was always a storm resistant one recommended for stripper harvesting. It is believed that the variation in results due to variety were of minor consequence.

The field plan for harvesting was designed to permit statistical analysis of the data. The design was a randomized block with at least four replications for each treatment. The experimental unit size was 1/200th of an acre. Normal cultural practices were used prior to harvest time.

Before the test was harvested, the individual plots were measured and staked, and borders were cut on each end. This was necessary in order to provide an area free of cotton plants where the harvester could be emptied and cleaned before and after harvesting each plot. At the same time, all of the pre-harvest losses in each plot were gathered and sacked for future analysis. Although there was no indication that the rolls would have any influence on pre-harvest loss, it was desired to maintain a record of the magnitude of these losses in most years. Prior to harvesting each plot, a sample of mature bolls was taken from plants adjacent to the plot for subsequent moisture determination.

At the beginning of the test a particular pair of rolls selected at random was placed in the harvester, and the harvester was moved into position at the end of the plot area. The harvester was completely cleaned, and a sack was put over the discharge elevator to catch all the harvested material delivered by the machine. The harvester was then started and operated at normal harvesting speed throughout the plot. At the end of the plot the harvester was stopped and again completely cleaned. All of the material harvested by the machine in this sample area was caught in the sample sack at the discharge elevator. Immediately after the harvester passed over the plot, the losses were gleaned. In most years the losses of cotton on the ground were put into one sack and the losses which remained on the plant were put into another sack, thereby making possible an evaluation of the losses and the relative performance of the rolls in removing the cotton from the plant.

In years when yields were adequate, the cotton between the plots was harvested for ginning evaluation. After each plot was harvested and the machine cleaned, the same pair of rolls was used in harvesting the adjacent inter-plot area. This cotton was kept separate for use in ginning tests.

At the conclusion of the test the following samples from each plot were available for laboratory analysis: A sample of the material harvested by the machine; the machine losses on the plant; the machine losses on the ground; the pre-harvest losses; and a sample for moisture determination.

The laboratory analysis of the loss samples consisted of removing the trash and weighing the remaining seed cotton. The harvest sample was weighed and trash components were determined, using the entire

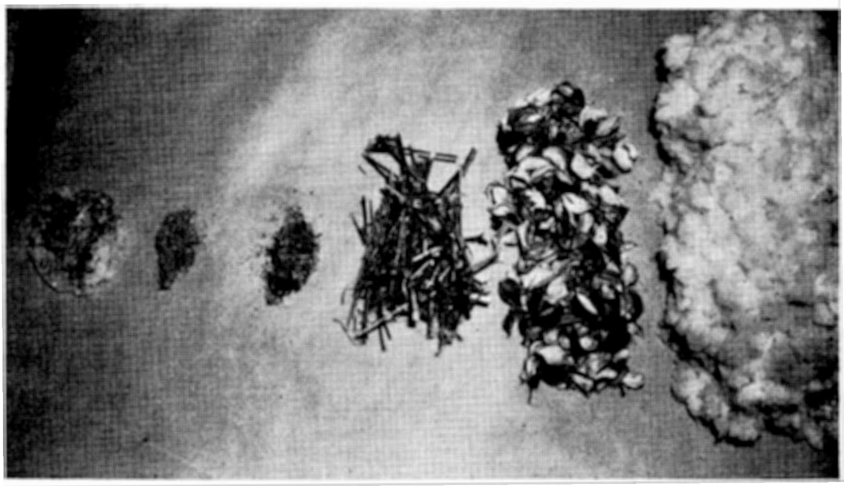


Figure 4. The composition of the harvested material. From left to right: Motes; small leaf trash; large leaf trash; sticks; burrs; and clean seed-cotton.

sample or subsamples. Normally, the components removed by hand were sticks, burrs, and large leaf trash. A portion of the hand-cleaned sample was then put into a fractionator where the small leaf trash and motes were separated from the seed cotton. The weight of each component was determined and subtracted from the original weight of the harvest sample to arrive at the amount of clean seed cotton harvested. The weight of clean seed cotton thus obtained was used as a basis for computing losses and trash content as a percent of either net yield or total yield.

In those years when ginning evaluations were made, cotton harvested by each roll material was ginned separately with a gin machinery arrangement typical for machine-stripped cotton. While the gin arrangement varied somewhat from year to year, it was constant for all rolls within any one year. Samples were taken from the test lots of cotton at various points in the gin, and analysis of trash components were made on these samples. The results of the ginning tests were statistically analyzed in years when sufficient cotton was available to permit adequate sub-sampling.

Test Results and Reporting Methods

During the seven years in which detailed tests were made on cotton stripper rolls, there were changes in the number of replications, the number of rolls tested in any one year, and the physical make-up of the rolls tested. Although statistical analyses were made each year, it was a seemingly impossible task to combine statistically the results from all years because of the variation among years in the details of the test design. Therefore, instead of presenting statistical analysis by years, a summary of the performance of each roll is presented, using a technique which gives the performance of each roll as compared to the average for all rolls.

This technique required several computational steps. The first step was to determine attribute means for a specified test. For example, a specified test might include three rolls of different materials, operating at a given roll speed and arranged in a given manner for a given year. Secondly, using each attribute mean as 100 percent ,the attribute values for each roll were converted to percent. The third step was to add all attribute values (converted to percent) for a roll of given material from all specified tests and find the performance mean of this sum. The usefulness of this performance mean lies in the direct comparison of it to 100 percent. A performance mean of less than 100 percent indicates performance below the average of all roll tests, including the roll under discussion. A performance mean in excess of 100 percent indicates performance above the average of all roll tests, including the roll under discussion. Appendix A reports the mean value for each attribute, and also the range of values measured for that attribute.

Roll performance means for various attributes in relation to roll material and roll speed are presented graphically on pages 14 through 24. In these graphs, the short vertical line in the middle of each bar represents the performance mean. The length of the bar shows the range of a given performance mean as ± one standard deviation of that mean. The continuous vertical line across all bars represents a roll performance mean of 100 percent.

Table I.—Example showing method of computing roll performance means for a given attribute, as shown in Figures A through X.

Test No.	Roll A		Roll B		Roll C		Units Sum	Test Mean
	Units	Pct.	Units	Pct.	Units	Pct.		
1	10	67	15	100	20	133	45	15
2			4	80	6	120	10	5
3			6	120	4	88	10	5
Performance Mean		67		100		111	9.28	

An example which may be helpful in interpreting the graphs is given in Table I. The 67 percent performance mean of Roll A when compared to 100 percent shows this roll to perform below the average. The 100 percent in this case represents a real value of 15, since that is the real value average of all rolls in the one test which included Roll A. Roll B has a performance mean of 100 percent, which indicates its performance was average. The 100 percent in this case, however, represents a real value of approximately 9.3, since that is the average real value of all rolls in the tests which included Roll B. The performance mean of roll C may be interpreted in like manner.

Direct comparison of the performance means of roll A and roll B is therefore more informative than is a comparison of their unit means.

Roll Materials

For purposes of analyzing the influence of roll materials on performance, all roll speeds, arrangements and designs were combined.

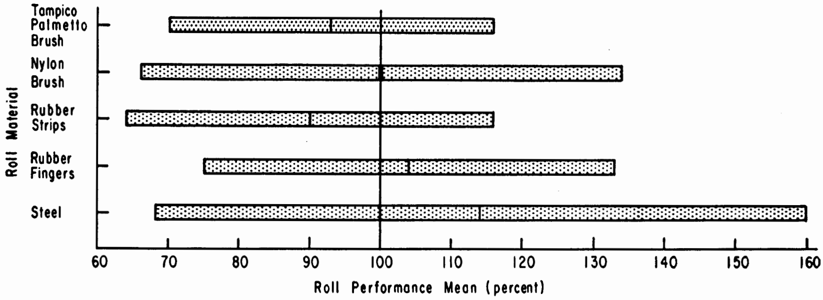


Figure A. Machine loss on the ground.

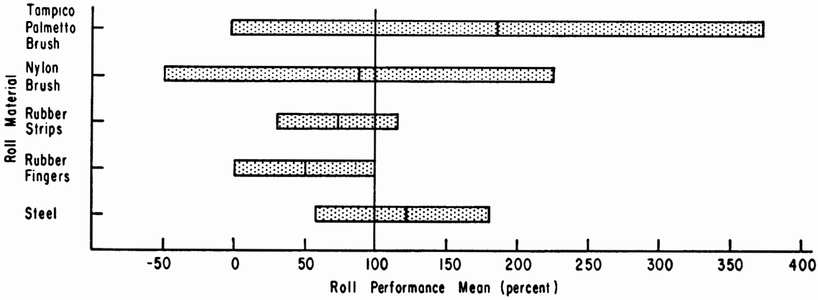


Figure B. Machine loss on the plant.

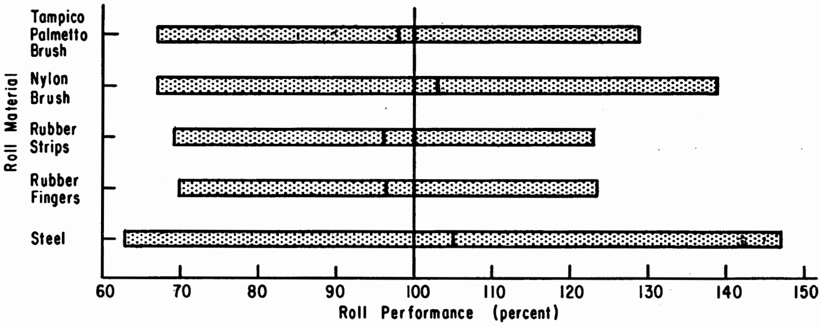


Figure C. Total machine loss.

MACHINE LOSS—Loss of seed cotton during the stripping operation can occur at any point prior to deposit of the harvested material in the wagon. In this study, the total of such losses was termed machine loss. This loss could be either on the plant or on the ground, and could be in the form of whole bolls, boll segments, or seed cotton locks. While the total machine loss cannot necessarily be attributed to the stripping rolls, no procedure was known for assigning the proper proportions of loss to the rolls.

Steel rolls had greater and more variable machine losses on the ground than did the flexible rolls.

Rubber finger and rubber strip rolls had less machine loss on the plant, and this loss was less variable than for any other roll. Inasmuch as these two rolls were the most aggressive of all rolls studied, machine loss on the plant might be considered an index of roll aggressiveness. However, observations indicated that most of the losses remaining on the plant were the result of low-growing bolls which were inaccessible to the stripping rolls. Since loss of low-growing bolls is not a function of roll design, material, or speed, machine loss on the plant is only a partial indicator of roll effectiveness and aggressiveness.

There was less variation among rolls in total machine loss than in either machine losses on the ground or on the plant. Total machine loss is probably the best available indication of a roll's effectiveness in harvesting the cotton presented to it. The rubber finger and rubber strip rolls had less total machine loss, and this loss was less variable than for any of the other rolls. However, the difference in total machine loss among rolls does not appear great enough to be the dominant consideration in the selection of a roll material.

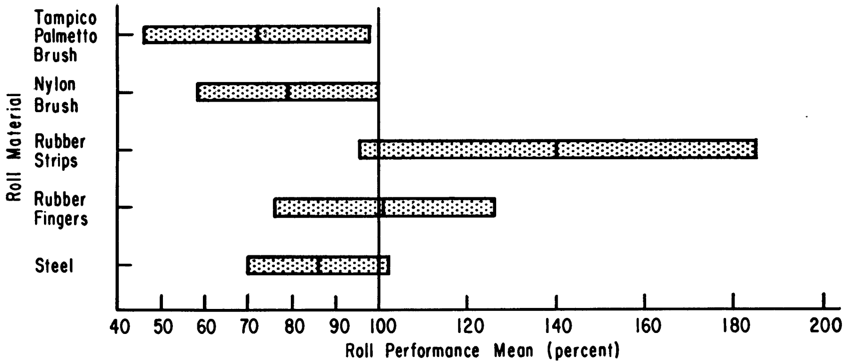


Figure D. Sticks in harvested material.

FOREIGN MATTER HARVESTED—All materials harvested other than lint and seed were termed foreign matter or trash. This trash was sticks, burrs, leaves, motes, and dust.

Sticks, stems, or limbs in the harvested material can be one of the most objectionable contaminants in stripper harvested cotton, since their presence can result in costly grade penalties. The amount of sticks harvested by the various rolls is probably a better index of their

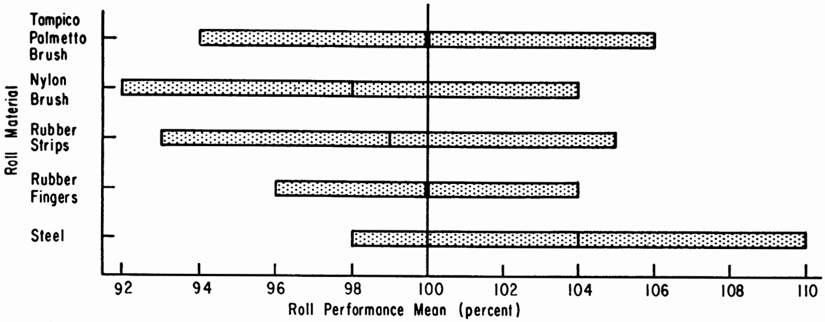


Figure E. Burrs in harvested material.

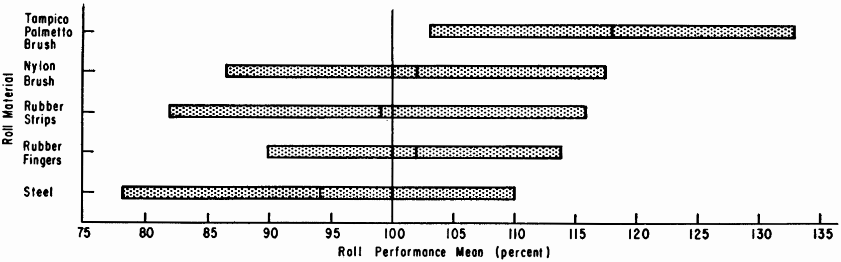


Figure F. Leaf and mote trash in harvested material.

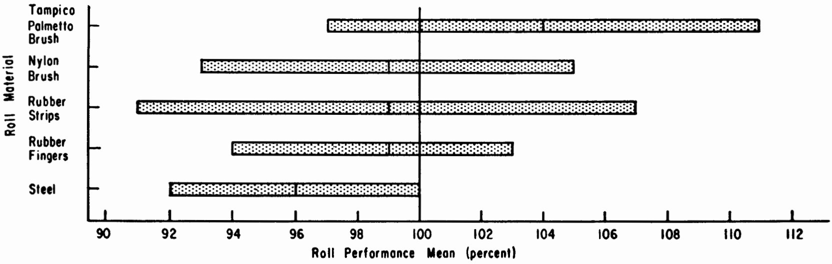


Figure G. Total trash in harvested material.

aggressiveness than any other single measure. The bristle and steel roll materials harvested less sticks than did the aggressive rubber rolls. This is attributed to the relatively smooth surface of the steel rolls and the readily yielding surface of the bristle rolls. During operation, the relatively great weight of and resulting centrifugal force on the rubber fingers and strips resulted in a roll surface which did not readily yield to accommodate plant limbs.

The steel rolls harvested slightly more burrs than did the flexible rolls. This was probably because burrs and burr segments could not readily pass through the narrow, unyielding gap between the steel rolls. Also, the combing or brushing action of the flexible rolls, particularly the nylon rolls, resulted in some extraction of seed cotton locks from the burr, with the burr remaining on the plant.

The steel rolls harvested less leaf and mote trash than did the other rolls. The greatest amount of leaf and mote trash was harvested by the tampico-palmetto roll.

The steel rolls harvested less total trash than did the other rolls, notwithstanding the fact that some other rolls (nylon and tampico-palmetto) harvested fewer sticks and burrs. The reason for this lies in the greater amounts of leaf and mote trash harvested by the flexible rolls.

Considering the type and relative amounts of foreign material harvested by the various roll materials, it appears that steel and bristle roll materials might produce a harvested product less likely to result in "barky" lint designations than that harvested by rubber rolls. The bristle roll materials might, however, result in lint containing slightly more leaf trash than that from the other roll materials. Of the two foregoing types of lint foreign matter, bark is considered by far the more undesirable.

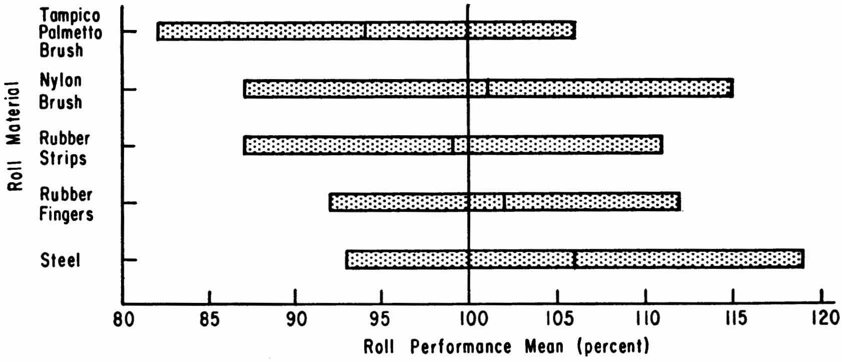


Figure H. Net yield of clean seed cotton.

SEED COTTON HARVESTED—The net yield of clean seed cotton harvested from the test plots was greatest with the steel rolls and least with the tampico-palmetto rolls. The latter is believed to be a reflection of low crop yields during the years in which the tampico-palmetto rolls were used.

GIN CLEANING—After passing through the seed cotton cleaning ma-

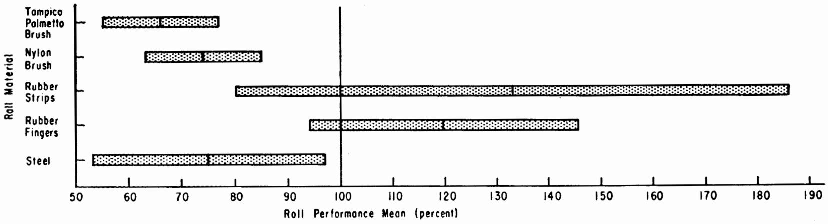


Figure I. Stick content at entrance of gin stand.

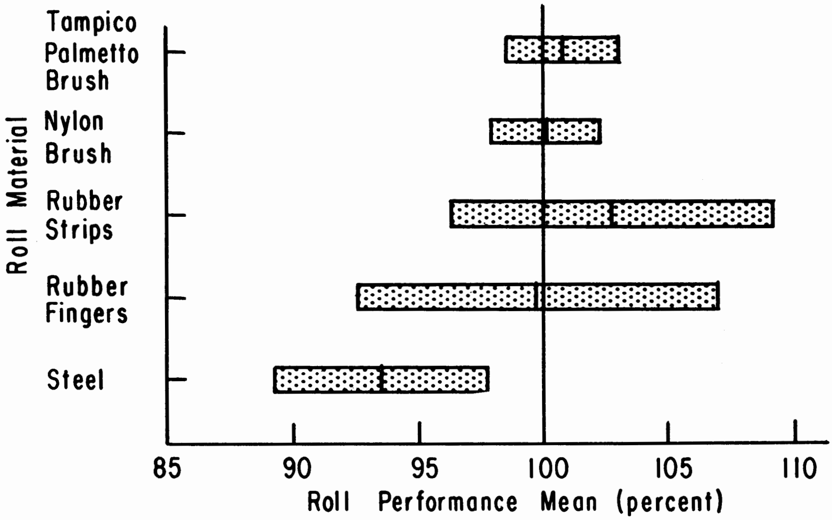


Figure J. Lint waste content.

chinery in the gin, the cottons harvested by the rubber strip and rubber finger rolls contained far more sticks than did any of the cottons harvested by other roll materials. As discussed previously, the relative performance of the roll materials with respect to stick content directly reflects the stick content of the harvested material.

Waste contents were not greatly different among the lints ginned from the cottons harvested by the flexible rolls. The steel rolls, however, resulted in considerably less lint waste content. This is believed due to the lower amount of leaf and mote trash harvested by the steel rolls.

GIN TURNOUT—While gin turnout is a measure of the amount of lint ginned from a given weight of harvested material, turnout includes the weight of foreign material remaining in the lint. The fees charged for ginning a bale of lint are inversely related to gin turnouts.

Gin turnout was highest for the steel rolls. As would be expected, the pattern of gin turnouts essentially reflects the variation among roll materials in total trash content of the harvested material.

LINT GRADE AND STAPLE LENGTH — Grade index is the numerical equivalent of the cotton classer's descriptive designation

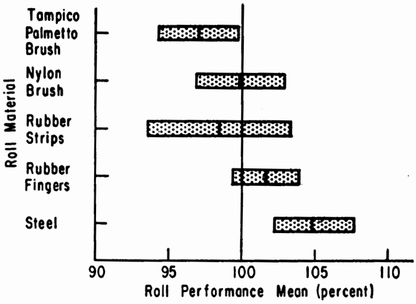


Figure K. Gin turnout.

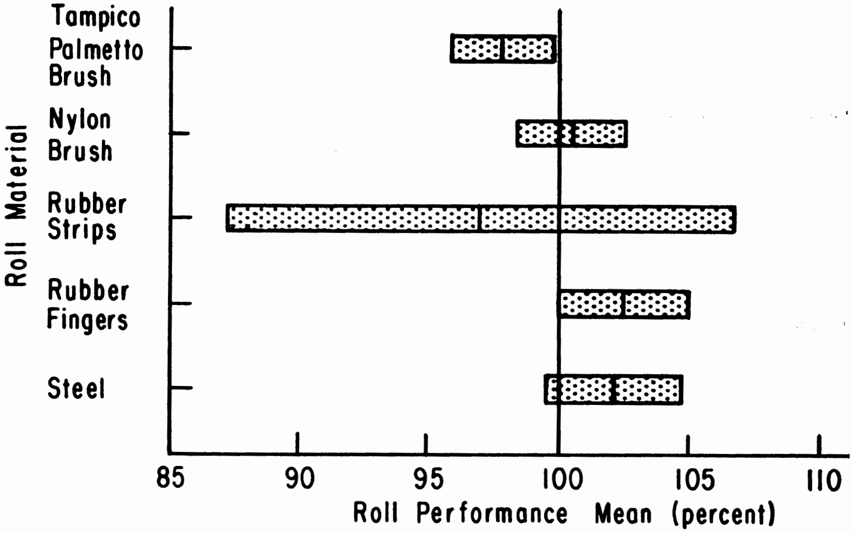
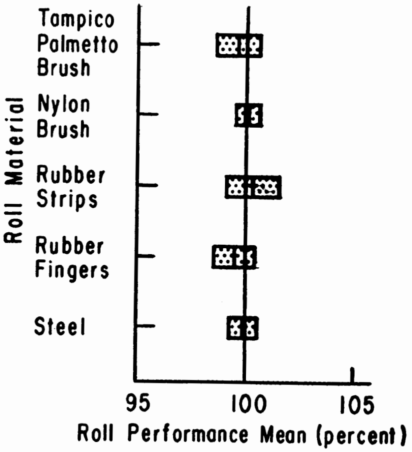


Figure L (Above). Grade index.

Figure M (Right). Staple length.



of lint grade. Steel and rubber finger rolls produced slightly higher grade indices than did other roll materials, particularly the rubber strip rolls. The high grade index associated with the steel rolls is believed due to the lower amount of leaf and mote trash harvested by them. No explanation can be advanced for the high grade index associated with the rubber finger rolls, especially in view of the performance of these rolls with respect to lint waste content and harvested trash components.

As would be expected, roll material had no discernible effect on staple length.

Figure N (Right). Unit lint values.

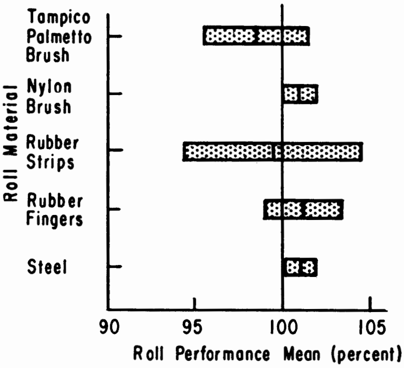
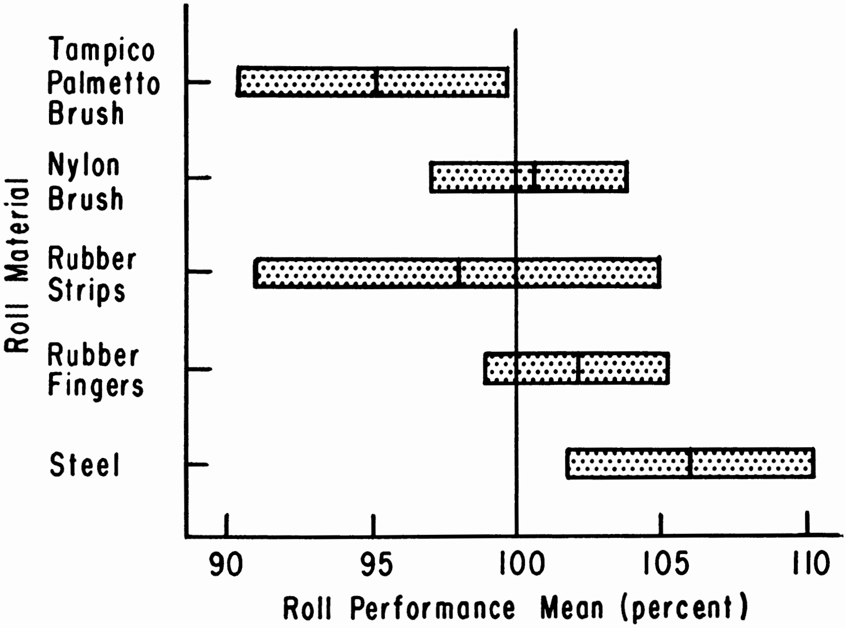


Figure O (Below). Gross returns per bale unit.



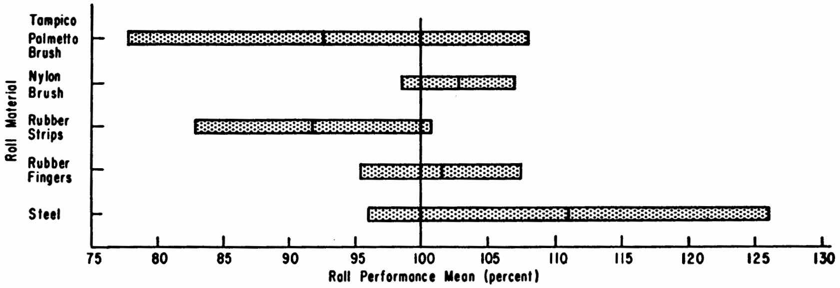


Figure P. Gross returns per acre.

LINT VALUE—Inasmuch as grade index was only slightly affected by roll materials, and staple length was not affected, unit lint value showed little variation among roll materials. But when gin turnout and unit lint value are combined, the steel rolls produced greater returns per unit of harvested weight than did the other roll materials. When this attribute is further combined with the amount of material harvested per unit of area by each roll material, the steel rolls produced substantially greater returns per acre than did the others. The tampico-palmetto and rubber strip rolls produced the lowest acre returns.

Roll Speeds

For purposes of analyzing the influence of roll speed, all roll materials, arrangements, and designs were combined. A careful examination of the data seemed to indicate this was justified because the general trend of performance with changing speed was similar for all roll materials.

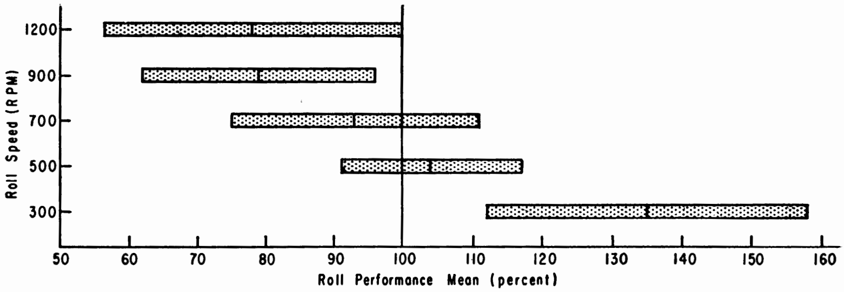


Figure Q. Machine loss on ground.

MACHINE LOSS—Machine loss on the ground decreased substantially with each increase in roll speed up to 900 rpm. Above this, no further decrease occurred.

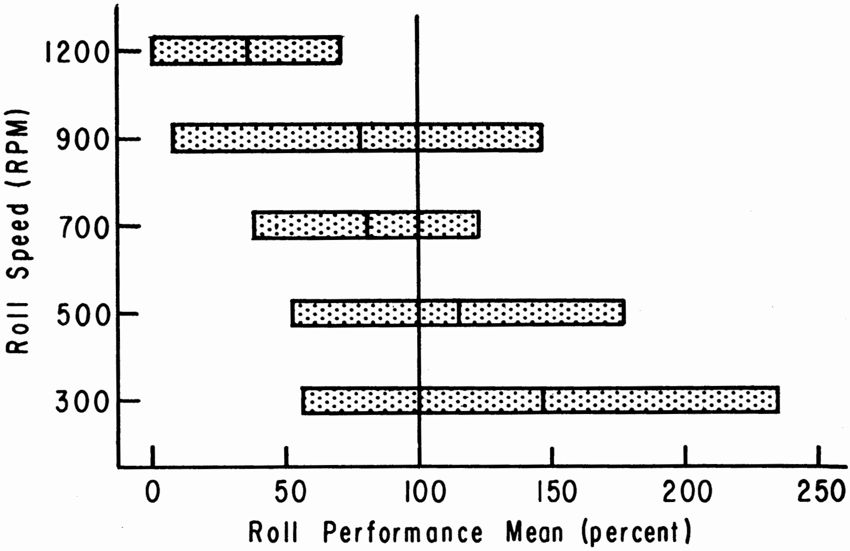


Figure R. Machine loss on plant.

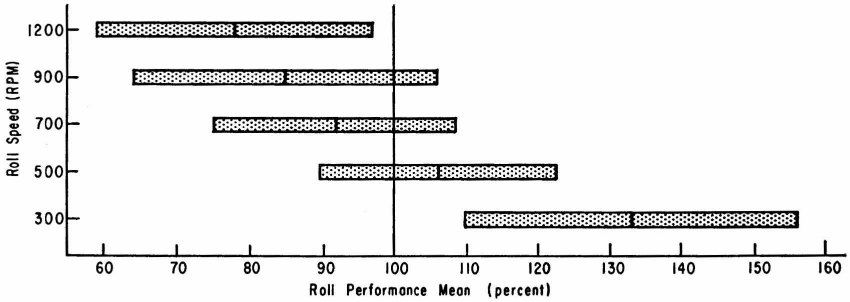


Figure S. Total machine loss.

With one exception, machine loss on the plant decreased substantially with each increase in roll speed. The exception was between 700 and 900 rpm, where only a small decrease occurred.

Total machine loss appears to be more closely related to ground loss than to plant loss. This would be expected since the magnitude of ground losses was usually much greater than that of plant losses. Total machine loss decreased substantially with each increase in roll speed.

FOREIGN MATTER HARVESTED—As roll speeds increased, stick contents of the harvested material increased, and burr contents decreased slightly. Changes in roll speed produced no consistent trend in leaf and

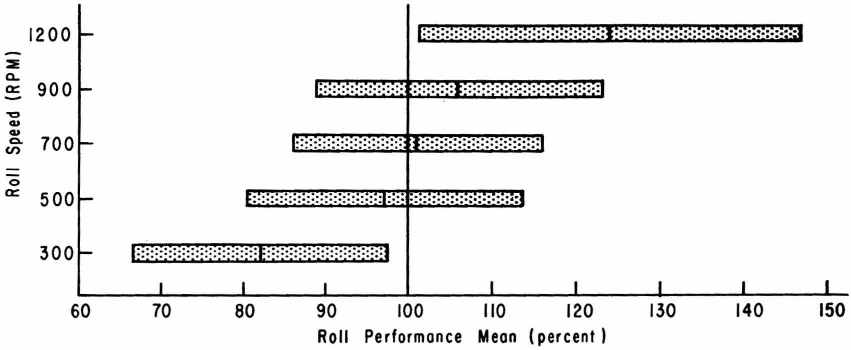


Figure T. Sticks in harvested material.

mote trash in the harvested material. No relationship between roll speed and total trash content of the harvested material was apparent.

Inasmuch as the highly objectionable stick component of foreign matter may be expected to increase with increasing roll speeds, it would appear that low roll speeds are desirable. But high roll speeds were found desirable from the standpoint of reduced machine losses.

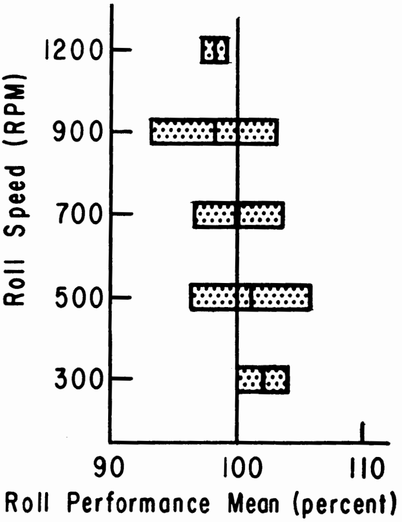
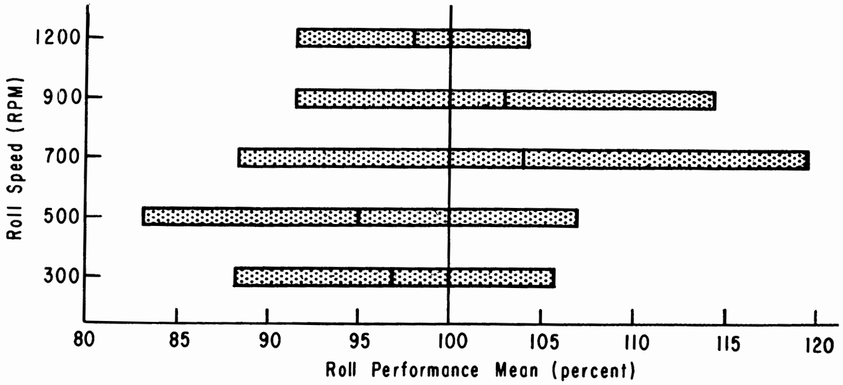
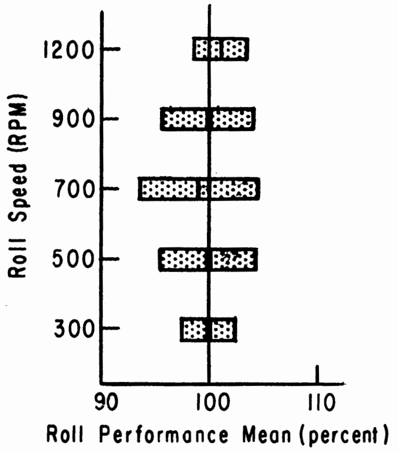


Figure U (Right). Burrs in harvested material.

Figure V. Leaf and mote trash in harvested material.





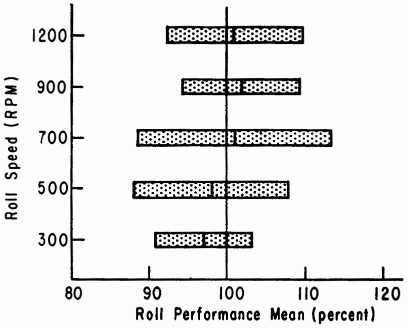


Figure W (Above). Total trash in harvested material.

Figure X. Net yield of clean seed cotton.

Obviously, some compromise between machine loss and foreign matter contamination is necessary. It is believed that the risk of "barky" lint designations and the accompanying price penalties associated therewith command the selection of low to moderate roll speeds, higher machine losses notwithstanding. It is believed that a roll speed of 700 rpm is perhaps the best compromise that can be effected.

SEED COTTON HARVESTED—Increasing roll speeds produced a slight trend toward higher net yields of harvested seed cotton. A roll speed of 700 rpm appears acceptable for this attribute.

Roll Arrangements

One year a test was conducted to compare double and single-roll arrangements for each roll material at speeds of 300, 500, 700, and 900 rpm. Roll speeds and roll materials were combined for analyzing roll arrangements. For all attributes measured, the double roll arrangement was superior to the single roll and stripping bar arrangement. If design problems, such as roll cost and availablity of roll installation space, are not dominant considerations, there is ample justification for the double row arrangement if harvester performance is the principal criterion of design.

Roll Designs

Some tests were designed to provide comparison between straight and spiral mounted strips of roll materials. Roll speeds and roll materials were combined for analyzing roll design. For 13 of 16 attributes measured, straight mounting was superior to spiral mounting, and for two attributes their performance was equal. Based on this information, the spiral mounting was eliminated from the test program.

Also, some tests were designed to provide limited comparisons of the number of rows of material mounted on each roll. Roll speeds were combined for analyzing differences among the number of rows per roll. For rolls constructed of rubber materials, six rows per roll were generally inferior to either three or four rows per roll. For nylon bristle rolls the evidence favors ten rows per roll over six rows per roll.

Summary

Over a seven-year period, a number of different stripper roll materials, roll speeds, roll arrangements, and roll designs were evaluated. Measurements were taken to determine the composition of the material harvested and the amount of machine losses in the field; and in some tests the performance of the cotton in the gin and the characteristics and value of the ginned lint were also determined.

Bristle roll materials harvested fewer sticks, the most objectionable type of foreign material. Steel rolls also performed relatively well in this respect. Steel rolls harvested the greatest amount of cotton per unit of field area, produced the highest gin turnout, cleanest lint, and highest gross returns per acre. The nylon bristle rolls also performed relatively well in these respects. From the foregoing considerations and from results of related studies, it is believed that smooth steel rolls would be superior to most other materials examined for much of the dryland cotton normally stripped. But in years of unusually rank plant growth, the bristle roll would be more likely to reduce the possibility of barky lint designations.

Machine losses decreased and several components of foreign material, notably sticks, increased with increasing roll speeds. It is believed that a roll speed of 700 rpm provides the most nearly satisfactory compromise between machine loss in the field and foreign matter in the harvested material.

Double roll arrangements harvested less foreign material than did a single roll and stripping bar arrangement. It is believed that overall stripping performance will be highest with the double roll arrangements. Straight mounting of roll material strips was found to be superior to spiral mounting of strips. The number of rows of material strips per roll had some influence on roll performance.

It is believed than answers have been found in this study to many of the questions concerning roll speeds, materials, arrangements, and designs for stripping dryland cotton. Further study is under way to provide answers to these same questions regarding the stripping of irrigated cotton.

APPENDIX

Range and Mean Values of Attributes Measured

	Maximum	Average	Minimum
Burrs in harvested sample (percent)	39.74	25.02	18.48
Sticks in harvested sample (percent)	8.25	2.63	.35
Total trash in harvested sample (percent)	59.53	39.85	27.98
Machine loss on ground (percent)	21.91	6.22	.81
Machine loss on plant (percent)	6.85	.96	.00
Total machine loss (percent)	26.04	7.07	.89
Net yield (Lbs. cleaned seed cotton per 1/200 A.)	9.367	4.150	1.716
Total yield (Lbs. clean seed cotton per 1/200 A.)	9.96	4.494	1.81
Stick content at entrance of gin stand (percent)	2.00	1.09	.29
Waste in lint (percent)	16.78	7.08	4.05
Gin turnout (percent)	26.00	21.50	16.65
Gross returns ($/bale)	159.00	128.00	93.00
Gross returns per acre ($)	102.17	66.17	30.00
Unit lint values (¢/lb.)	27.99	24.74	21.67
Staple length (32nds inch)	30.25	29.36	28.20
Grade index (index points)	96.00	82.10	68.00
Large leaf in harvested sample (percent)	27.17	9.92	.88
Small leaf in harvested sample (percent)	3.15	1.60	.89
Total leaf and mote trash in harvested sample (percent)	31.27	11.95	4.06
Motes in harvested sample (percent)	4.11	1.64	.81