MP-403 JANUARY 1960

Comparison of Cotton Harvesting Systems on the High Plains

TEXAS AGRICULTURAL EXPERIMENT STATION

R. D. LEWIS, DIRECTOR, COLLEGE STATION, TEXAS

COMPARISON OF COTTON HARVESTING SYSTEMS ON THE HIGH PLAINS

*L. L. Ray and D. L. Jones**

EVERY YEAR COTTON FARMERS FACE THE PROBLEMS of how to maintain or improve the quality of their product and reduce production costs at the same time. Most farmers in a given region realize that certain standards of fiber quality must be met to compete with man-made fibers or cotton grown in other areas. But production costs also must be considered. Experimentation and practice have shown that one of the best ways to lower production costs in the High Plains is to harvest with the mechanical stripper. It also is well known that stripping generally results in lower fiber quality. The lowering of production costs and of fiber quality by machine stripping are a matter of degree and vary greatly from year to year and from farm to farm. Thus the effects of machine-stripper harvesting are controversial among producers and others of the cotton industry.

Cotton producers need more information on the economic aspects of harvesting and on the relationship of the harvesting system to fiber quality. Previous experiments and farmer experience have shown that with the same harvesting date there is little difference in the quality of hand-snapped cotton as compared with machine-stripped cotton. However in farm survey studies the gross lint income generally has been less where the once-over stripper harvesting system was used than where hand snapping was used for an early harvest. The apparent contradiction may be reconciled by recognizing that the benefits from hand snapping are derived from the fact that when this operation is performed early in the season only the well-matured cotton is harvested. This selective harvest separates the early well-matured fibers from the more immature fibers and decreases the amount of weathering. The cotton remaining after an early hand harvest will be of lower quality, often decidedly so, than cotton harvested by the once-over stripper harvesting system.

The information in this report, properly used, should form a dependable basis to guide the cotton producer in choosing the cotton harvesting practices best suited to his particular farming system.

*Respectively, assistant agronomist, and agronomist, Texas Agricultural Experiment Station, Substation No. 8, Lubbock, Texas.

Experimental Methods

Data were obtained from ten small plot experiments conducted at the Lubbock station during 1952-57. The harvesting systems compared in these experiments were (1) hand snapping at the first harvest and then stripping the remaining crop and (2) stripping the entire crop in one operation. These two harvesting systems commonly are used in the High Plains, the first being used most extensively. The harvesting systems were compared in small replicated plots. All plots received the same cultural treatments and crop management practices. The same harvesting crew and the same type of cotton stripper were used throughout the experiments. Varieties, planting and harvesting dates and the number of replications varied from test to test, Table 1. The individual experiments are referred to by the year in which they were conducted. If more than one experiment was conducted in any year, the different tests are identified by letters following the year designation. Table 2 gives the rainfall data and the first frost dates during the experimental period.

Cotton used in these experiments was produced with methods adapted to harvesting with the mechanical stripper. For instance, all varieties used, with the exception of Empire and D &

DEFINITION OF TERMS

The following terms are defined for clarity in discussion of harvesting practices in this publication. No general definition beyond use in this publication is intended.

HARVESTING METHOD refers to the means employed to perform a single harvesting operation. Hand snapping, machine stripping and machine picking are examples of harvesting methods.

HARVESTING SYSTEM refers to all operations used in harvesting the entire crop. The harvesting system may be a series of operations employing more than one harvesting method, for example, hand snapping followed by machine stripping. In once-over stripper harvesting, the harvesting system consists of only one operation.

TABLE 1. GENERAL INFORMATION ON COMPARING HARVEST SYSTEMS CONDUCTED AT THE LUBBOCK STATION, 1952-57

Year	Variety	Date planted	Date hand snapped	Date[1] stripped	Replications	Percent open, first harvest	Lint yield, pounds per acre
1952	Stormmaster	5/28	10/20	11/11	8	82	568
1953a[2]	Stormmaster	5/4	9/22	11/24	6	35	897
1953b	Stormmaster	5/23	9/9	11/24	5	94	645
1954a	C. A. 119	5/28	10/27	12/3	2	72	415
1954b	Empire	5/28	10/27	12/3	2	88	438
1954c	D & PL—Fox	5/28	10/27	12/3	2	80	409
1955a	C. A. 119	5/13	11/22	11/28	5	82	532
1955b	C. A. 119	6/8	11/22	11/28	5	61	789
1956	C. A. 119	5/24	9/25	11/14	10	86	595
1957	Blightmaster	5/24	10/31	12/16	5	47	466

[1]The once-over stripper harvest and the stripper harvest following hand snapping were performed on the same date.
[2]Where more than one experiment was conducted in the same year, a letter following the year identifies the specific experiment.

PL-Fox in one experiment, were stormproof types. For each experiment a relatively uniform area of cotton was selected and divided into an even number of two-row plots. Half of these plots were hand snapped. After frost the other half of the plots were stripped, as well as the remaining cotton on the plots which were previously hand snapped. From each harvest method 20 to 40 pounds of bur cotton were ginned for gin turnout information and to obtain lint samples for classing, fiber laboratory tests and spinning performance evaluations. Spinning performance data were not obtained from the 1954 or 1957 experiments.

The economic returns were calculated on the basis of lint only. Returns from the seed were not considered since they represent only a small part of the income and since the harvest method effect on the income from seed should be small. Lint values were calculated for each individual experiment, using the grade and staple and the yield from the specific test. The government loan rates for the Lubbock area and for the year in which the specific experiment was conducted were used in figuring the lint value.

Fiber laboratory determinations were made on: (1) upper-half-mean length of fibers as measured on the fibrograph; (2) fineness as determined by the micronaire; and (3) fiber strength using the Pressley instrument, reported in thousands of pounds per square inch.

Spinning data were obtained on: (1) neps per 100 square inch of card web; (2) the percent waste removed in the picking and carding operations; (3) yarn strength, given in thousands of pounds per square inch; and (4) yarn appearance.

Statistical comparisons were made on mean differences between harvest methods and systems. The differences between treatment means were evaluated with the "t" test and reported as "P" values. In calculation of "t" values, means of individual tests, rather than replication data, were used for the paired comparisons.

Summary of Test Conditions By Seasons

1952. A light frost occurred on October 7 and the hand-snapping harvest segregated the cotton which was mature from that which was immature at frost.

1953. Experiment 1953a was on a plot of high-yielding early cotton which was hand snapped in late September. Experiment 1953b was hand snapped the day after the first frost. Heavy rains occurred about 2 weeks before hand snapping. Most of the cotton was open at the time of harvest.

1954. Three varieties were used—two open-bolled types and one stormproof type. Only two replications were used, but the plots were 150 feet long. Field losses, even with the open-bolled varieties, were negligible.

1955. Seedlings in experiment 1955a were damaged severely by wind and sand, resulting in a skippy stand. Experiment 1955b was on replanted cotton and represented the latest planting date in this series of experiments. In both tests the crop was very late and there was not enough cotton open for a prefrost harvest. Utmost care was used in hand snapping these experiments and only the fully open cotton was pulled. This sim-

TABLE 2. ANNUAL RAINFALL, MONTHLY RAINFALL DURING GROWING SEASON AND THE DATE OF THE FIRST KILLING FROST AT THE LUBBOCK STATION DURING THE PERIOD OF HARVEST SYSTEM EXPERIMENTS, 1952-57

Year	Monthly rainfall totals, inches						Annual total	Date of first frost
	May	June	July	August	September	October		
1952	1.73	1.76	3.31	1.17	0.90	0	14.53	October 7
1953	0.85	0.45	1.07	2.21	0.08	4.02	10.69	November 8
1954	5.33	0.39	0.36	1.68	Trace	3.08	13.67	November 2
1955	2.13	1.10	3.97	0.85	2.38	4.46	15.39	October 30
1956	2.00	2.56	1.30	0.53	0.03	1.14	9.50	November 5
1957	6.45	4.74	1.54	0.32	0.59	4.68	24.51	October 26

ply was an attempt to separate the mature from the immature cotton.

1956. The cotton was early maturing in this experiment; 86 percent of the crop was open by September 25.

1957. The stripper harvesting operation in this experiment was December 16, later than the optimum date. Grade and staple of the stripped cotton probably was lowered because of this delay.

Results

Effect of Harvesting Method on Fiber Quality

Fiber quality comparisons were made on the basis of harvesting methods. However, the combined harvesting system, hand snapping followed by stripping, contained two lots of cotton of different quality; these must be considered prorata in the overall evaluation of quality. Table 3 summarizes the fiber properties and spinning performance from these experiments.

Fiber Length. Fiber from the hand-snapped harvest averaged 0.04 inch longer than fiber from the once-over stripper harvest, Table 3. This difference was significant at the 1-percent level. Thus, it might be expected that early hand-snapped cotton will be one thirty-second to two thirty-seconds of an inch longer than when the entire crop is stripped. The fiber from the once-over stripper harvest was 0.02 inch longer than the fiber from the stripper harvest following hand snapping. This difference was significant at the 0.05 level. Greater fiber length was the most distinct advantage found for hand snapping at the first harvest.

TABLE 3. SUMMARY OF FIBER LABORATORY MEASUREMENTS AND SPINNING PERFORMANCE OF FIBER SAMPLES FROM HARVEST EXPERIMENTS CONDUCTED AT THE LUBBOCK STATION, 1952-57

Item	Harvesting system			"P" values[1]	
	Hand snapped	Once-over stripped	Stripped following hand harvesting	(1)	(2)
	Fiber properties				
UHM, length, inches	0.96	0.92	0.90	0.01	0.05
Micronaire	4.1	3.8	3.4	0.001	0.001
Strength, pounds per square inch	78.8	77.8	77.5	Greater than 0.5	0.5
	Spinning performance				
Neps per 100 square inches of card web	16.4	15.3	23.6	Greater than 0.5	0.1
Picker and card waste, percent	13.1	14.2	23.9	0.2	0.01
Yarn strength, 22's 1,000 pounds per square inch	87.0	81.3	80.1		

[1]"P" values were obtained from "t" test; with "P" values greater than 0.05 the mean differences usually are not considered statistically significant. "P" value (1) is for the comparison between the hand-snapped harvest method and the once-over stripper harvest method. "P" value (2) is for the comparison between the once-over stripper harvest method and the stripper harvest after hand harvesting.

A contributing cause to the shorter fiber length when the cotton was stripped may be the extreme dryness of the cotton when it is ginned. Generally, the humidity is low at the time cotton is ready for stripper harvest. Ginning excessively dry cotton causes breakage and reduces staple length.

Fiber Fineness. Fiber fineness was measured by the micronaire which determines or estimates the relative weight per unit of fiber length (fineness). Within a given variety, as was the case of fiber comparisons in these experiments, the micronaire readings are indicative of the maturity or immaturity of the fiber. Since the readings correspond to the weight of fiber per unit length, high readings are obtained from more mature cotton and low readings from immature cotton. Very low readings, below 3.5, imply a relatively high degree of immaturity. For this reason, the cotton trade often penalizes cotton with these low micronaire readings.

The micronaire reading on the hand-snapped cotton averaged 0.3 units higher than the reading on the once-over stripped cotton, Table 3. The micronaire readings on the once-over stripped cotton averaged 0.4 units higher than the reading on the cotton stripped after hand snapping. Table 4 gives the array of micronaire readings of samples from each of the two harvesting systems. The hand snapped followed by stripper harvesting system had five samples with micronaire readings below 3.0 while the once-over stripper harvesting system had no samples in this class. The hand snapped followed by stripping system had the greater range and variability in micronaire readings.

Fiber and Yarn Strength. A distinction should be made between fiber and yarn strength. Fiber strength is one of several factors which influences yarn strength. These experiments showed little difference in fiber strength of cotton from the various harvesting methods, Table 3. However, there was a significant difference between the yarn strength in favor of the hand-snapped cotton as compared with the stripper-harvested cotton. The greater yarn strength may be accounted for largely by the longer fiber of the hand-snapped cotton, since fiber length and yarn strength are known to be correlated positively within a given variety or type.

Neps and Waste. The greatest difference in the number of neps and amount of waste was found between the once-over stripper harvested cotton and the cotton stripped after hand snap-

TABLE 4. MICRONAIRE ARRAYS OF FIBER SAMPLES FROM THE TWO HARVESTING SYSTEMS COMPARED IN EXPERIMENTS AT THE LUBBOCK STATION, 1952-57. (SAMPLES DISTRIBUTED ON THE BASIS OF A 100-BALE CROP.)

Harvesting system	Number of bales of a specific micronaire				
	Under 3.0	3.0-3.4	3.5-3.9	4.0-4.4	4.5-4.9
Hand snapped then stripped	5	10	37	40	8
Entire crop stripped	0	30	20	40	10

ping, Table 3. These properties were about the same for the hand-snapped cotton and once-over stripped cotton. The results obtained for neps and waste favor once-over stripping. Commercial gins contain considerably more cleaning equipment than the laboratory gin used. Thus, the waste content of all samples was higher than would be expected from commercially ginned cotton.

Yarn Appearance. Table 5 gives the arrays of yarn appearance grades for the two harvesting systems. The combined hand snapping and stripper-harvesting system had more yarn appearance grades in the high range than the once-over stripper harvesting system. The combined harvesting system also gave grades lower than any of the sample from the once-over stripper harvesting system. The lowest grades were obtained on samples from the stripper harvest following hand snapping. The combination harvesting system gave the greatest range and variability of yarn grades.

Economic Comparisons

Comparisons of total yield, lint value per acre and pounds of harvested cotton required to make a 500-pound bale are shown in Table 6.

Yield. Yield, calculated from weight of harvested cotton, does not include the cotton which was lost either before or during the harvesting operation. Generally, less loss would be expected where the cotton was hand snapped at the first harvest than where the once-over stripper harvesting system was used. But if the losses had been consistently and substantially greater with the once-over stripper harvesting system than with the other system, the mean difference in yield between the two systems should have been significant. This was not the case; the yield difference was only 2.4 percent which was not statistically significant, Table 6.

Gin Turnout. Hand-snapped cotton generally had the highest gin turnout, and the once-over stripper harvested cotton had a higher gin turnout than the cotton stripped following hand snapping. The overall gin turnout, a weighted average in case of the combination harvesting system, was about the same for the two systems, Table 6.

TABLE 5. ARRAYS FOR YARN APPEARANCE GRADES FROM SPINNING TESTS ON FIBER SAMPLES FROM HARVEST SYSTEM EXPERIMENTS CONDUCTED AT THE LUBBOCK STATION, 1952-57 (SAMPLES DISTRIBUTED ON THE BASIS OF A 100-BALE CROP.)

Harvesting system	Number of bales of a specific yarn grade					
	B+	B	B—	C+	C	C—
Hand snapped then stripped	66	26	5	0	2	1
Entire crop stripped	46	36	14	4	0	0

Lint Value. The harvesting system combining hand snapping and machine stripping returned $13.39 more gross income per acre from lint than the once-over stripper harvesting system, Table 6. However, when the harvesting costs were deducted, the difference was $12.95 per acre in favor of once-over stripper harvest. Both of these differences were statistically significant, with "P" values of 0.01 and 0.05, respectively.

Discussion

Effect of Harvesting Practices on Fiber Quality

Stripper Harvesting and Fiber Quality. Fiber quality of the shorter stapled cottons, of approximately 1 inch or less, are not affected adversely by the actual stripper harvesting operation. Acceptable fiber quality will be obtained by stripper harvesting if most of the cotton on the plant at time of harvest is of good quality.

Since machine stripping is not a selective harvesting method, and because all cotton on the plant is harvested at one time, the operation must be delayed until all bolls on the plant are open or dry. Thus, with stripper harvesting there is a period of waiting during which weathering of

TABLE 6. SUMMARY OF AGRONOMIC DATA FROM EXPERIMENTS COMPARING TWO SYSTEMS OF HARVEST CONDUCTED AT THE LUBBOCK STATION, 1952-57

Item	Harvesting system		"P" values[1]
	Hand snapped then stripped	Once-over stripper harvest	
Pounds of lint harvested per acre	582	568	0.1
Pounds of harvested cotton required to make a 500-pound bale	2009	2014	Greater than 0.5
Gross lint value per acre, dollars	175.54	162.15	0.001
Acre lint value less harvest costs, dollars	142.40	155.35	0.05

[1]"P" values were calculated from the "t" test; with "P" values greater than 0.05 the mean differences generally are not considered to be statistically significant.

varying degrees occurs. Also, fibers of more or less diverse quality are mixed or blended into one lot.

Weathering. With the once-over stripper harvesting system, the severity of weather damage depends on the length of time the open cotton is exposed and the climatic conditions during this period. Frequent harvests, which are possible with hand snapping, reduce the amount of weathering. However, regardless of the harvesting system, practicability precludes harvesting frequently enough to prevent some degree of weathering.

Also, under certain conditions an opposite effect to normal weathering occurs; the cotton improves in certain fiber quality aspects after being left exposed in the field. This improvement in quality is chiefly a bleaching process which takes place after a rainy period. Such a situation is frequent in the High Plains because heavy rains often occur during late September and early October, the period of hand harvesting. For 2 to 3 weeks following a rainy period, cotton usually improves in color and general appearance; therefore, the producer generally will obtain better grades by deferring harvest when such conditions are encountered. If a rainy period delays hand harvest until the latter part of October, there may be a definite advantage to waiting and stripping the entire crop. Such a situation was encountered in the 1953b experiment. A heavy rain preceded the hand-snapping harvest by about 2 weeks. The grade and staple of the once-over stripper harvested cotton exceeded in value the grade and staple from the cotton harvested by hand snapping. Evidently, the color of the cotton continued to improve over the period between the hand and stripper harvests.

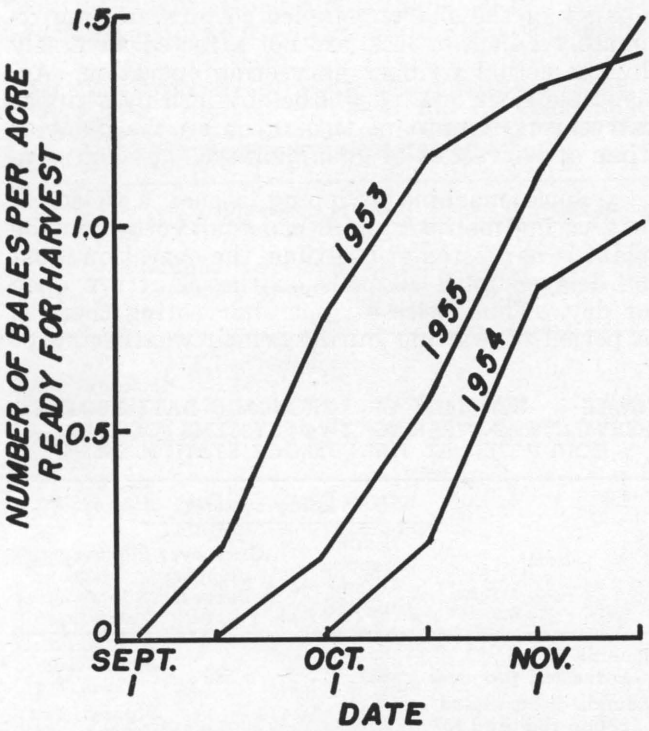

Figure 1. Boll opening patterns for three representative cotton crops, showing the amount of cotton ready for harvest at any specific date. The variability of the maturity pattern as shown in this figure applies not only to different years, but also to different crops within the same year. Actually, the area as a whole had an earlier crop in 1954 than in 1955, which is the reverse of the crops used in this study. This data is from cotton maturation studies conducted at the Lubbock station, 1953-55. (Unpublished)

Blending. The indeterminate fruiting habit of cotton results in bolls opening over a relatively long period of time. As fiber quality is dependent to a degree on conditions prevailing during the maturation period of the boll, quality may vary from boll to boll on the same plant. The differences which occur between the cotton which is fully mature at frost and that which is immature at frost are most striking. For practical purposes, considerations concerning the effect of harvesting through blending may be restricted to the question of mixing the cotton fully developed at frost with that killed before the fiber was mature.

With the once-over stripper harvesting system all the fiber is harvested in one lot regardless of quality. The effects of this blending or mixing of fibers of diverse quality is probably one of the most important factors in the quality of machine-stripped cotton. Most of the cotton should be matured before frost to produce fiber of good quality with the once-over stripper harvesting. If only 40 to 60 percent of the crop is open at frost, a selective hand harvest is necessary to produce high-quality fiber. However, in the three experiments (1952, 1955a, 1955b) where the hand harvesting was done after frost to segregate the mature from immature cotton, the practice was not economically advantageous over stripping the entire crop. In these experiments, with 60 to 80 percent of the cotton open at frost, the cotton was mature and produced an acceptable fiber with once-over stripper harvesting.

The proportional amounts of cotton open at frost varies greatly from year to year and from field to field, Figure 1. The 1953 crop, Figure 1, would be ideal for once-over stripper harvesting, since practically all of the cotton was open at frost. Although total yield of the 1955 crop was greater than the 1953 crop, the 1955 crop had a larger percent of immature cotton at frost, and therefore of lower quality, fiberwise, than the 1953 crop. Actually, the average production figures indicate that the opening pattern for the 1954 crop, Figure 1, best represents the typical crop of the area. There was approximately three-fourths of a bale open at frost and one-fourth to one-half of a bale per acre which opened after frost.

In some years maturity is a serious problem, one-half or less of the cotton being open at frost.

According to ginning records there are few years when 50 percent of the cotton has been ginned by November 1, Figure 2. The percent ginned by this date varies from year to year and from location to location within the area. The greatest percent ginned by November 1 for the area was approximately 60 percent in 1956, while in 1957 only 15 percent of the crop was ginned at this date, Figure 3. The amount of cotton harvested prior to the first frost (mean of November 4) is important in the choice of the harvesting system, because after frost mechanical stripping of the crop generally will return maximum profit. In years when low temperatures prevail, especially during the seedling and boll maturation stages, plant development is retarded. A major effect of temperature on maturity is the increasing number of days required for a boll to mature as the temperature decreases. Boll maturation studies show that the period from flower to open boll lengthens as the season progresses and that the period was longer in years with low fall temperatures than in years with high fall temperature, Figure 4.

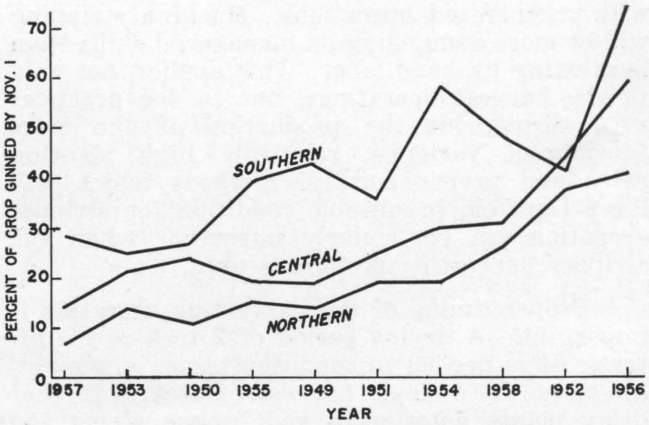

Figure 2. Percent of the High Plains crop ginned by November 1; 1949-58. The years are arranged in order of ascending earliness, that is, the year with the latest crop is at the left of the chart. The area divisions are as follows: SOUTHERN — Dawson, Garza and Lynn counties; CENTRAL — Cochran, Crosby, Gaines, Hockley, Lubbock, Terry and Yoakum counties; NORTHERN — Bailey, Castro, Floyd, Hale, Lamb, Parmer and Swisher counties. Data were compiled from the Reports on Cotton Ginnings, Bureau of Census.

Comparing Harvesting Systems. In the combination harvesting system the principal advantage comes from separating the early, more mature, unweathered cotton from the later immature cotton. The result will be two distinct lots of cotton, as regards quality, one from the hand-snapped harvest and the other from the later stripper harvest. In comparing the combination harvesting system with the once-over stripper harvesting system, the weighted average of the two lots making up the combined harvesting system must be used. Both lots eventually should be sold and utilized. Often quality and price comparisons are made only on the hand-snapped part of the crop. Such a comparison is not valid.

Cotton on the High Plains generally is harvested by hand snapping before frost and by machine stripping after frost. Cotton men often associate the usually poorer fiber quality of the cotton harvested after frost with the mechanical stripper. Actually, much of the high quality, mature cotton had been harvested previously, leaving only the late, immature cotton to be harvested with the stripper. This cotton would be of poor quality regardless of harvesting method.

Application to Farm Practices

Profits. The most profitable cotton harvesting system gives the greatest gross lint return after the harvesting costs are deducted. In these experiments the once-over stripper harvesting system was over $10 per acre more profitable than the system of hand snapping and then stripping.

However, the two factors which determine profit — price and production cost — may vary from year to year. Such changes may shift the advantage toward one system or the other. In recent years there has been a trend toward a wider spread in prices of high and low grades, thereby, shifting the advantage toward hand snapping. For cotton going into the government loan program, however, this advantage may be counteracted by the recent recognition of the light spot grade by the program, and the consequent reduction of the light spot discount. Current market prices and government loan rates should be considered carefully in selecting the cotton harvesting system.

The harvesting costs used in this report were set at the average or "going" rate for the area during the period of the experiments and will not apply to all situations. Also the harvesting costs, especially by hand, may vary from year to year.

Management Practices. Net returns from any farming operation depend to a large extent on managerial efficiency. This is true especially

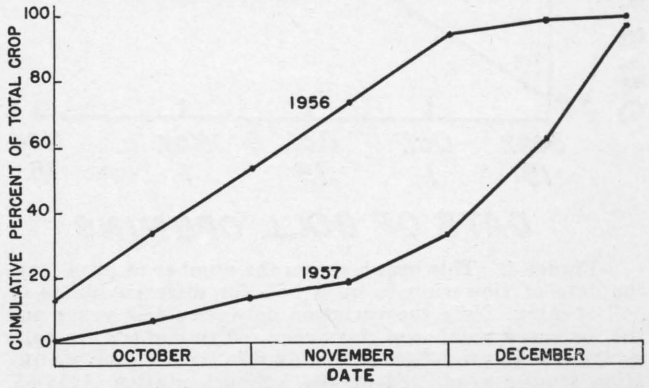

Figure 3. Cumulative ginnings in the High Plains area in an early cotton crop year, 1956, and a late crop year, 1957. Data were compiled from the Report on Cotton Ginnings, Bureau of Census.

with mechanized operations. Machine stripping will be more demanding on managerial skills than harvesting by hand labor. This applies, not only to the harvest operations, but to the practices used throughout the production of the crop. Stormproof varieties, relatively high planting rates and proper cultural methods which will leave the field in suitable condition for stripper operation are particularly important when the stripper harvesting method is used.

Proper timing of the harvesting operation is important. A drying period of 2 to 3 weeks after frost is needed to condition properly the cotton plants for stripper harvest. But with further delay plants deteriorate and broken stems and branches are gathered with the stripped cotton, which with weathering lowers fiber quality.

Frequently excessive quantities of irrigation water are applied late in the growing season and a large crop of late and immature cotton of poor quality is produced. With such management, fiber of acceptable quality seldom would be obtained where the once-over stripper harvesting system is followed.

Harvesting aid chemicals (defoliants or desiccants) may allow earlier stripper harvesting in some instances. However, if they are applied too early, the fiber may be damaged.

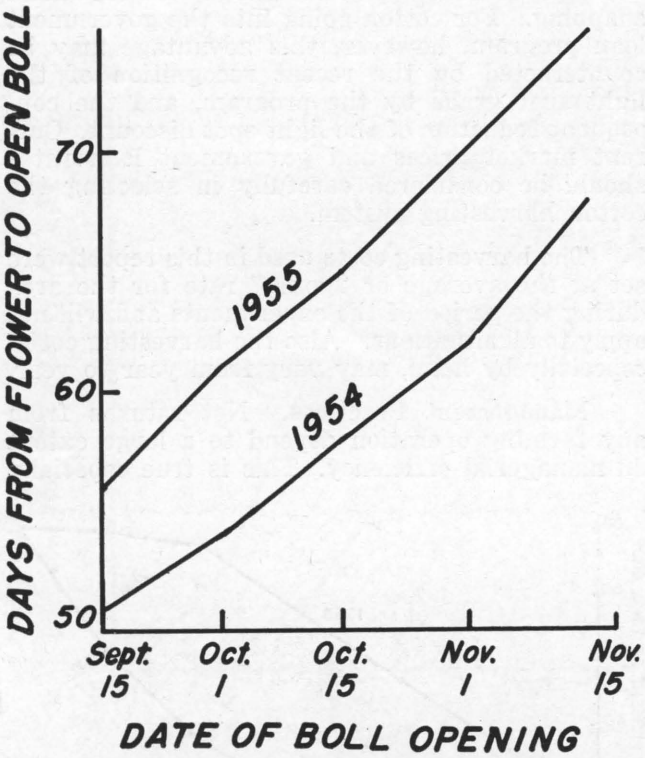

Figure 4. This graph shows the number of days from the date of flowering to open boll for different dates of boll opening. Note the variation between the 2 years and the increased number of days required to mature the bolls as the season progresses. This data is from cotton maturation studies conducted at the Lubbock station, 1954-55. (Unpublished)

In general, the managerial practices used in these experiments were adapted to the stripper harvesting method. The results obtained with the once-over stripper harvesting system would not be expected unless proper practices are used.

Subsidiary Factors. The following factors are difficult to evaluate experimentally and were not included in this study, but they are important in selecting a cotton harvesting system.

Often the farmer, to replenish his capital or for other reasons, desires income early in the harvest season. With the once-over stripper harvesting system, it usually will be late November or December before the cotton can be marketed. A producer may choose to hand harvest to provide income early in the season.

A market price break, a general reduction in cotton prices, usually occurs about the time of the first frost. Stripper-harvested cotton will be marketed after this price break and will be at a disadvantage to earlier hand-snapped cotton. However, it should be noted that this market break does not always occur. Government loan rates, used in calculation of returns in this study, are constant throughout the season.

Certain costs, in addition to the actual harvesting cost, often are connected with the employment of hand labor. Predominant among such costs are housing, insurance, transportation and pay for nonworking days. These expenses often are omitted when harvesting cost is being determined.

Economic comparisons were made from the standpoint of the producer or farm operator. Lease or rent agreements must be considered in evaluating the harvesting system. The harvesting system which gives the maximum economic return to the operator may not be the system which would give the greatest return to the landowner.

Acknowledgments

The following assistance in carrying out the experiments reported in this publication is gratefully acknowledged. All samples were classed by J. M. Ward, Department of Agricultural Economics and Sociology, Texas A&M College System. Fiber laboratory and spinning tests were performed in the textile laboratories of the Texas Cotton Research Committee under the direction of L. E. Hessler. J. D. Bilbro and Don Hill collected the data from the 1957 experiment.