MECHANICAL HARVESTING OF COTTON

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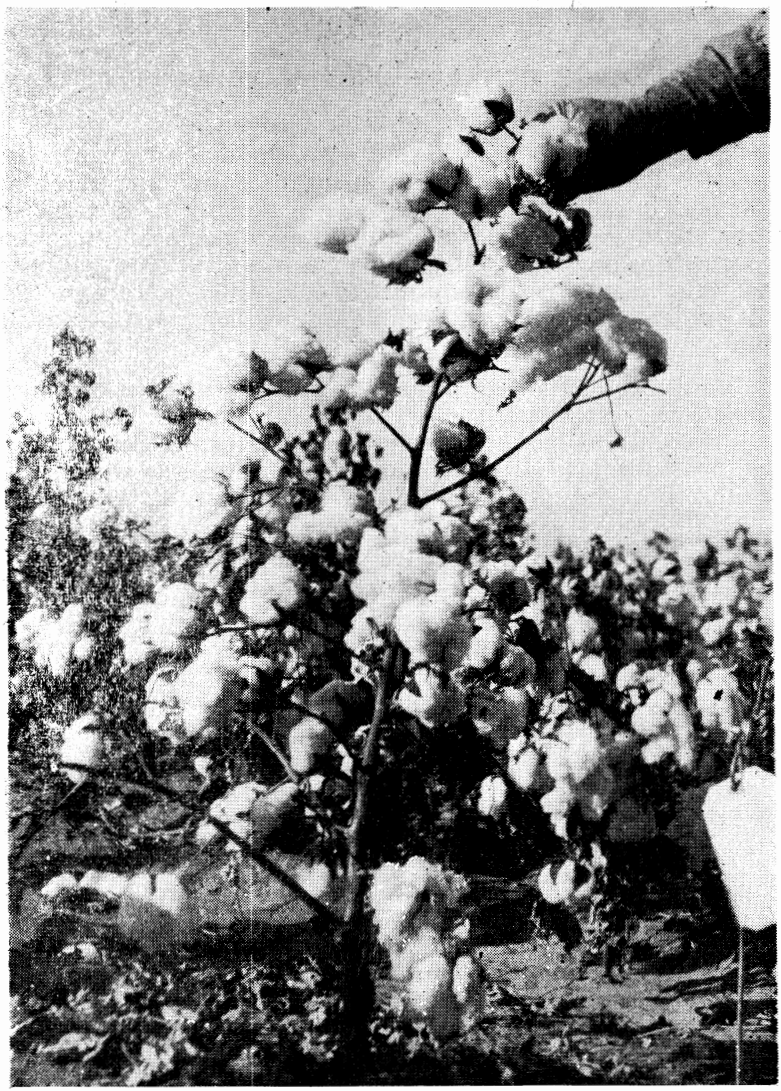
Until a comparatively recent date, the machine harvesting of cotton has been largely a matter of discussion and planning. The period of utilization came very suddenly as a result of labor shortage and each of the war years has seen more and more cotton harvested by mechanical means. It now appears that the amount of mechanically-harvested cotton in 1945 will be determined largely by the number of machines available.

Cotton machine harvesters are still in the developmental stage. However, several successful machines are on the market and available for use. Farmers having extensive cotton acreage to harvest in 1945 would doubtless do well to consider the possibility of utilizing a mechanical harvester.

This bulletin gives the results of some mechanical harvesting of cotton in Oklahoma in 1944. The study is necessarily limited due to the fact that it was not started until the summer of 1945 and also for the reason that machines were not extensively used. It is planned to expand this work the coming year in order that the cotton industry in the state may have more information available. In the meantime, the information from this and other states (particularly Texas) indicate that machine harvesting is practical and that it certainly saves labor and lowers cost.

While the machine sometimes lowers the grade of the cotton harvested, it very often (as in this study) turns out as good or better lint cotton than the ordinary field hands. The lint turnout of machine harvested cotton is usually as high or higher than hand harvested. The Texas Experiment Station has found that cotton harvested with a roller type stripper has "no difference in strength and appearance of yarns and no practical difference in the amount of manufacturing waste," from cotton harvested by the standard method of hand snapping.

* Respectively, Agronomist, Oklahoma Agricultural Experiment Station, Stillwater; Superintent, Cotton Substation, Tipton. Acknowledgement is made of aid given by Mr. Maurice B. Cox, assistant agricultural engineer, Soil Conservation Service, and cooperative agent, Oklahoma Agricultural Experiment Station.



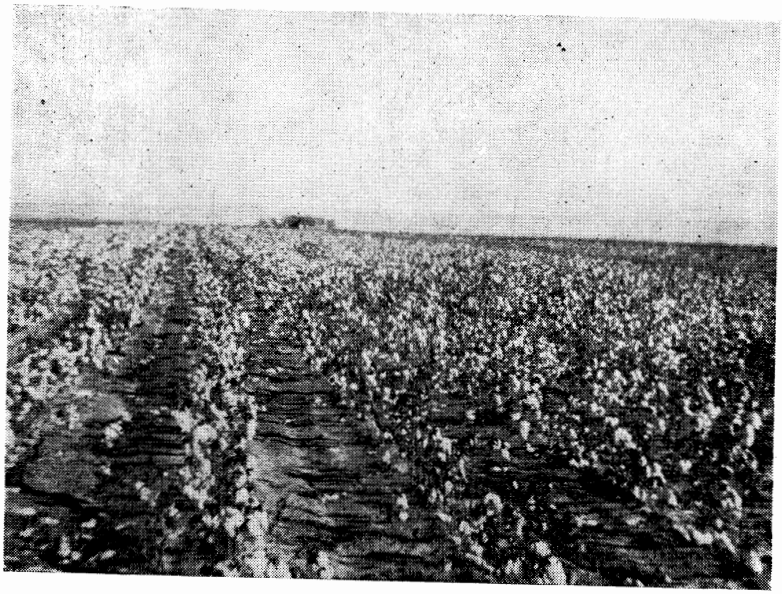
A Good Type of Cotton Plant for Mechanical Harvesting.

During the summer of 1945, a number of farmers and ginners were contacted to secure information on the mechanical harvesting of cotton. From them it was learned that in six comparative lots of hand and mechanically-harvested cotton, the cotton from each of these two kinds of harvesting was picked and ginned (at the same gin) during the same period of time, and was reported to be of the same variety.

From these field data, calculations were made to determine the difference in the value of hand and mechanically-harvested bales after deducting the cost of picking and ginning. Table 1 gives an analysis of the six lots of cotton.

In the analysis of hand and machine harvested cotton listed in Table 1, the "average value of cotton per pound" was determined by averaging the Government loan value of the several bales in each comparative lot, taking into consideration grade and staple which is each case is determined by Government classers. It is difficult to express the grades on an average basis due to the fact that several lots contained not only "white" grades but also "spots" as well as "tinges".

"Cost of harvesting bale" was based on the "pounds of harvested cotton required to give a 500 pound gross weight



A Good Field for Mechanical Harvesting.

bale" times the rate paid for harvesting. The charge used for hand harvesting (pulling) was $1.50 per hundred weight. This was the prevailing rate in Southwestern Oklahoma for the 1944 crop. The charge used for mechanical harvesting was $2.97 per hour for use of machine, tractor and two men. This cost of operation was calculated by assuming:

(1) Use of a two row stripper mounted on a tractor
(2) Speed of operation 1½ miles per hour[1]
(3) Harvesting five crops consisting of 300 acres each, yielding 200 lbs. of lint cotton per acre.
(4) A lint turnout of 23.9% which would necessitate the harvesting of 837 pounds of snapped cotton per acre. (A lint turnout of 23.9% will yield a 500 lb. gross wt. bale from 2000 pounds of snapped cotton which is about normal for Southwestern Oklahoma.)
(5) Life of stripper to be five years, 1239 hours operating time, in which time it will harvest 1,255,500 lbs. of snapped cotton or 627½ bales.
(6) Cost of stripper and proportional use part of tractor $1400.

Calculation of Hourly Cost of Operating Stripper.

Operator's wages (2 men at 62½ cents per hour for 1239 hours)	$1549
Gasoline (1 gal. per hour at 10 cents)	124
Lubricating oil	
Tractor 25 changes at 1½ gal. @ $1 per gal. = 38	
Stripper 1 qt. for 8-hr. day @ $1 per gal. = 39	77
Miscellaneous repairs and upkeep (5% annually on original investment)	350
Depreciation (completely worn out after 5 years use)	1400
Interest on investment (5% annually of ½ of original investment)	175
Total cost 5 crops	$3675

In cotton yielding 837 pounds of snaps (200 lbs. lint at 23.9%) an hour's harvesting at one and one-half miles per hour[1] will gather 1013 lbs. of snapped cotton (242 lbs. lint). At an hourly capacity of 1013 pounds of snapped cotton, it would require 1239 hours to gather 1,255,500 lbs. of snaps

[1] In the operation of a cotton stripper, the speed is generally higher than 1½ miles per hour; however, in these calculations, it was used as an *average* speed. In maintaining a mile and a half speed for 8 hours, the tractor would travel 12 miles and the stripper would harvest 24 miles (9.68 acres).

(considered the life of the stripper). Hourly cost of machine operation $\frac{3675}{1239}$ =$2.97.

In this discussion, it is assumed that the hourly cost of operation of a converted grain combine will be about the same as that of a stripper in the harvesting of cotton. (See discussion page 9).

DISCUSSION OF HARVESTER RESULTS.

Gin Turnout.

As an average of six comparative lots of cotton, the machine-harvested required 145 pounds less bur cotton to make a bale than did the hand-harvested. The machine-harvested cotton had as high or higher lint turnout in five of the six comparative lots.

Grade.

Grades of cotton, harvested by hand and by mechanical means, were, on the average, practically the same. The value of the lint from the machine-harvested was eleven cents per hundred higher than that of hand-harvested. In three of the comparative lots, the hand-harvested cotton had a slightly higher average grade, while in the remaining three lots, the better grades were in favor of the machine-harvested.

Cost of Harvesting.

On the average it costs $24.82 less per bale to harvest by machine than by hand. The cost of hand-harvesting represented 41.3% of the gross value of the cotton in this comparison while the machine-harvested was 7.4%.

Value of Bales.

The gross value of the bales from the two methods of harvesting is approximately the same due to the fact that there is no material difference in the grades. There is, however, a wide spread between the net value (gross value less cost of picking and ginning) of the bales harvested by the two methods. The machine-harvested bales have a 73.5% greater net value than the hand-harvested bales or an additional money value of $26.02.

Comparison of Different Types of Machines.

There are not enough comparative lots of cotton in this study to draw any definite conclusions regarding the relative value of the three types of machines (stripper, stripper with extractor, and converted grain combine). The average net

gain in value of stripper and converted grain combine harvested cotton is about the same, although one of the two combined lots showed a high difference (Column 5, Table 1) and the other a low difference (Column 6, Table 1). The comparisons shown in Column 5 indicate a very short staple variety which is known to clean up well when run through cleaning machinery. The turnout and grade (as indicated by value of cotton) of the hand-harvested cotton in Column 5 indicates a "rougher" than normal job of harvesting and in contrast to the combined cotton, was subjected to no cleaning until it went through the gin machinery.

On the other hand a report from Davidson (not reported in tabulated form) shows a direct contrast to the exceptionally clean job reported in Column 5. This latter cotton was combine harvested in April 1945 from a field in which the entire crop consisted of knotty unopened bolls. The combine-harvested product from this field required 2933 pounds of snapped cotton to produce a 500 lb. gross weight bale. The harvesting and ginning bill on this lot of cotton was $19.61 per bale and all graded "below grade" and sold for $50 a bale. The net value of the cotton from this lot was $30.39 per bale. This was a typical "gleaning" job which could not possibly have been profitable except through harvesting by mechanical means.

Comparing the net gain through stripper harvesting (Columns 1, 2 & 3) and stripper with bur extractor (Column 4), it is seen that the bur extractor did not show as much advantage as might be expected. From Column 4 it will be noted that the quality of hand harvesting was exceptionally good as evidenced by relatively high grade and abnormally large gin turnout. The hand-harvested cotton in this lot required 1719 pounds to make a bale, which is the lowest recorded, and 363 pounds less than the average of the five other lots of hand pulled cotton. If the hand-harvested cotton in this case had the average turnout of the other five lots, the difference in value of the machine-harvested bale over hand-harvested would have been $30.26 instead of $23.46.

REPORT OF THE ANADARKO HARVESTING DEMONSTRATION.

On February 8, 1945, a mechanical harvesting demonstration was held near Anadarko, Oklahoma. The harvesting was done in a field of low growing, very heavy-producing cotton which had never been picked. Much cotton was on the ground and many locks were strung out and wrapped around the stalks.

At the time of the above demonstration, there were a number of pickers in the field who were harvesting the crop by pulling. In the demonstration, there was a John Deere stripper without extractor (see cut) and a modified Texas type machine with extractor (see cut) manufactured by Wayne Cohea of Frederick. In addition to the strippers, there was also an Allis-Chalmers converted grain combine (see cut) and a low drum International picker (see cut). The results of the harvesting of these four machines are given in Table 2 (page 17) together with figures from the hand harvesting.

Many people attending the Anadarko demonstration were inclined to be critical of all the mechanical harvesters for wasting cotton in the field. This criticism was, undoubtedly, partially justified. However, much of this waste had occurred prior to the demonstration and the cotton remaining on the plants at this late date (February 8) was very loose in the burs, which resulted in excessive shattering. The irregularity of width of rows in the field also contributed to further waste with two row machines. (John Deere and Cohea machines).

From Table 2, it is seen that 2017 pounds of hand pulled cotton were required to produce a 500 lb. gross weight bale and that the lint had a $14.63 value based on the actual grade of Low Middling Tinged. The gross value of a bale of this cotton was $73.15 and the picking and ginning cost $37.82 *or 51.7% of the gross value.*

The Allis-Chalmers converted grain combine, used in this demonstration[1] did a very satisfactory job of stripping and perhaps had the greatest capacity of any machine in the field. The harvested cotton from this machine required 1831 pounds to produce a bale of lint cotton having a value of $14.63 (Low Middling Tinged). Based on the cost per hour of operating a stripper as shown on page 6, the charge of harvesting of a bale with this machine was $5.36. The gross value of the bale harvested by the combine was $73.15 and the picking and ginning cost $12.23 *or 16.7% of the gross value.*

The cotton harvested by the John Deere two row stripper[2] had the same turnout as hand-harvested requiring 2017 lbs. to produce a bale. The value of the lint from this machine was the same as that from the hand harvesters and the combine. The cost of harvesting and ginning by the John Deere machine was $13.47 per bale *or 18.4% of the gross value.*

[1] This machine was converted by Herman Loftis of the Loftis Exchange, Allis-Chalmers dealers of Frederick, Okla., and operated by Loftis.
[2] This machine was furnished by Ridling Implement Company, Hobart.

Comparison of Hand (H.H.) a

	1 Hobart Stripper without extractor		2 Hoba Stripp witho extract
	H. H.	M. H.	H. H.
No. of bales harvested	5	5	5
Gin turnout (percent)	21.7	23.5	22.4
Average staple length (inches)	29/32	29/32	7/8
Harvested cotton required to give a 500 lb. gross wt. bale (pounds)	2203	2034	2134
Average value of cotton per pound (cents)[1]	14.84	14.82	15.16
Hours required to harvest a bale by machine		2.00	
Cost of harvesting bale (dollars)[2]	33.05	5.96	32.01
Cost of ginning bale (dollars)	8.26	7.63	8.00
Gross value of bale (dollars)	74.20	74.10	75.80
Value of bale less harvesting and ginning (dollars)	32.89	60.51	35.79
Percent harvesting and ginning cost is of gross bale value	55.7	18.3	52.8
Difference in value of machine harvested bale over hand harvested after charging for picking and ginning (dollars)	27.62		24.51

(1) Based on grade and Government loan values.

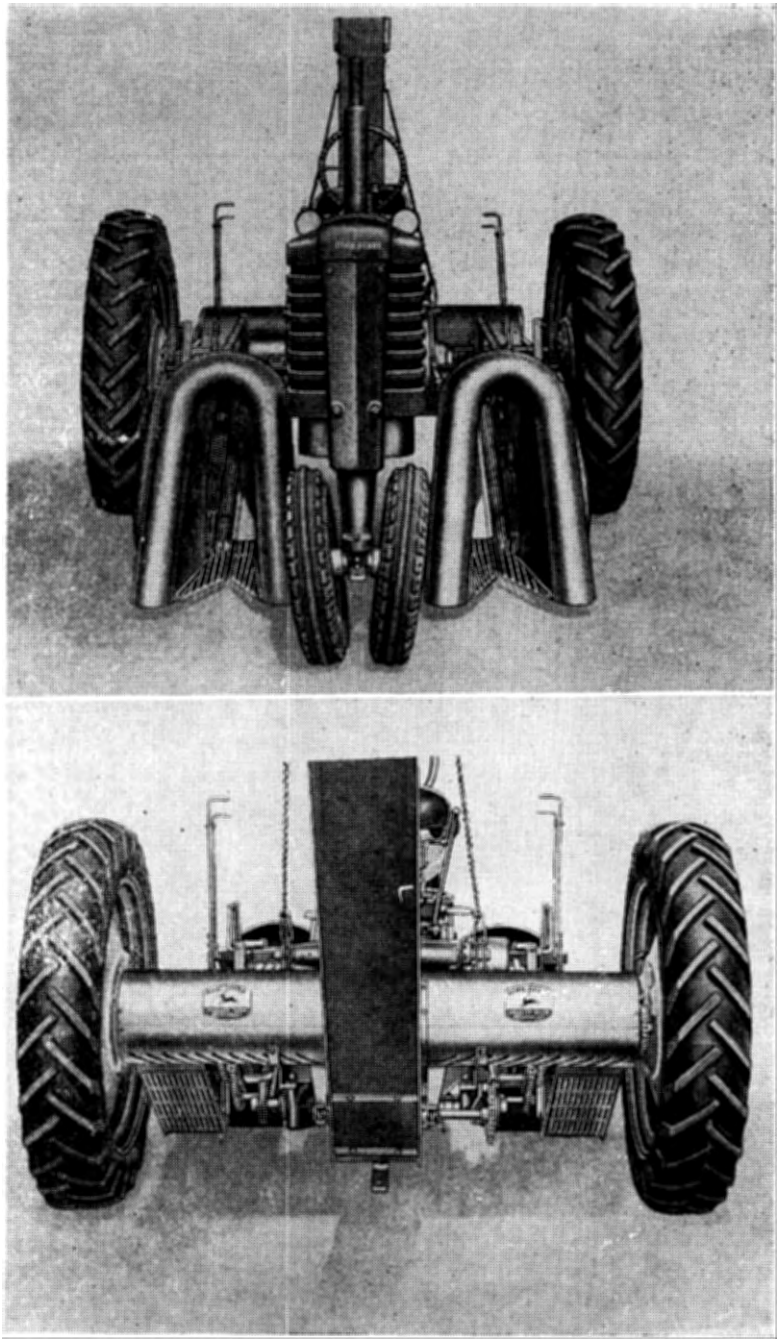
(2) $1.50 per hundred weight for hand pulled and $2.97 per hour for machine.

(3) This cotton was sufficiently clean of burs to be classified as "picked" and was ginned at

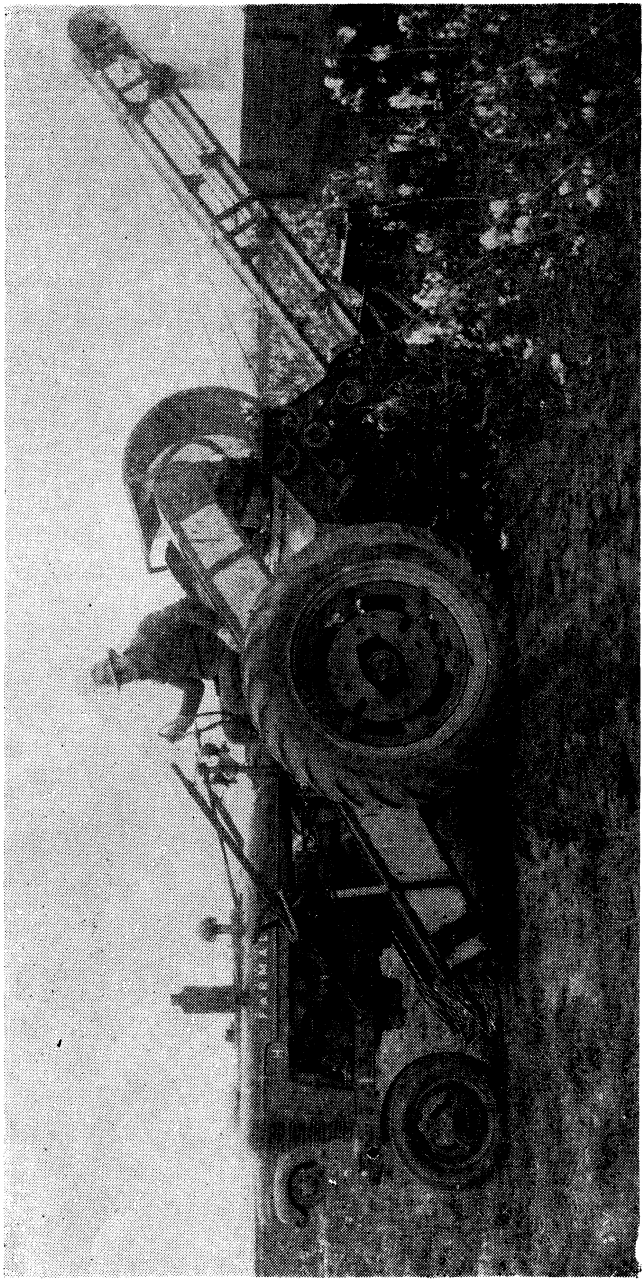
ine Harvested (M.H.) Cotton

3		4		5		6			
Hobart Stripper without extractor		Burns Flat Stripper with bur extractor		Davidson Converted grain combine		Cooperton Converted grain combine		Average	
H. H.	M. H.	H. H.	M. H.	H. H.	M. H.	H. H.	M. H.	H. H.	M. H.
	2	5	14	7	6	8	6	34	38
23.6	23.0	27.8	31.4	22.4	29.5	25.0	25.6	23.8	25.9
29/32	15/16	29/32	29/32	13/16	13/16	7/8	29/32	28.2/32	28.5/32
2025	2078	1719	1522	2134	1620	1912	1867	2021	1876
15.62	16.23	15.73	15.84	12.68	13.18	13.94	13.61	14.66	14.77
	2.05		1.50		1.60		1.84		1.85
30.38	6.09	25.79	4.46	32.01	4.75	28.68	5.47	30.32	5.50
7.59	7.79	6.45	4.87[3]	8.00	6.08	7.17	7.00	7.58	6.90
78.10	81.15	78.65	79.20	63.40	65.90	69.70	68.05	73.31	73.83
40.13	67.27	46.41	69.87	23.39	55.07	33.85	55.58	35.41	61.43
48.6	17.1	41.0	11.8	63.1	16.4	51.4	18.3	52.1	16.8
	27.14		23.46		31.68		21.73		26.02

picked cotton rate.

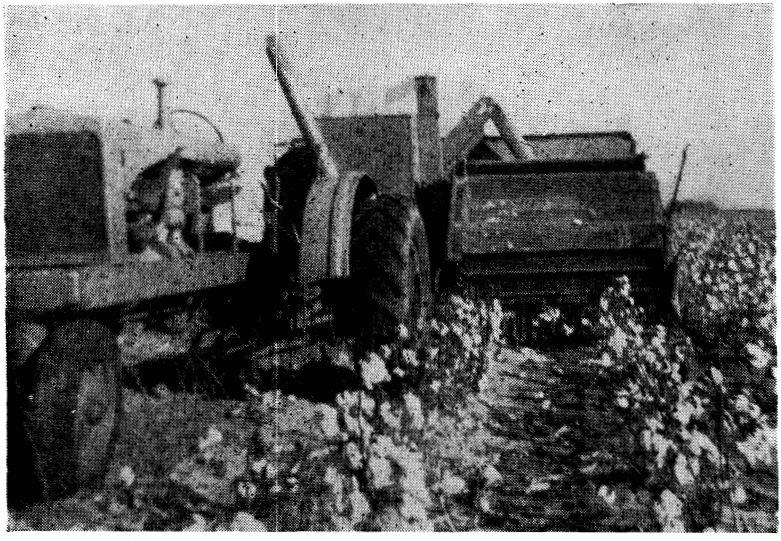


TOP: Front view of John Deere stripper showing single roller. BOTTOM: Rear view of John Deere stripper showing perforations to aid in cleaning.

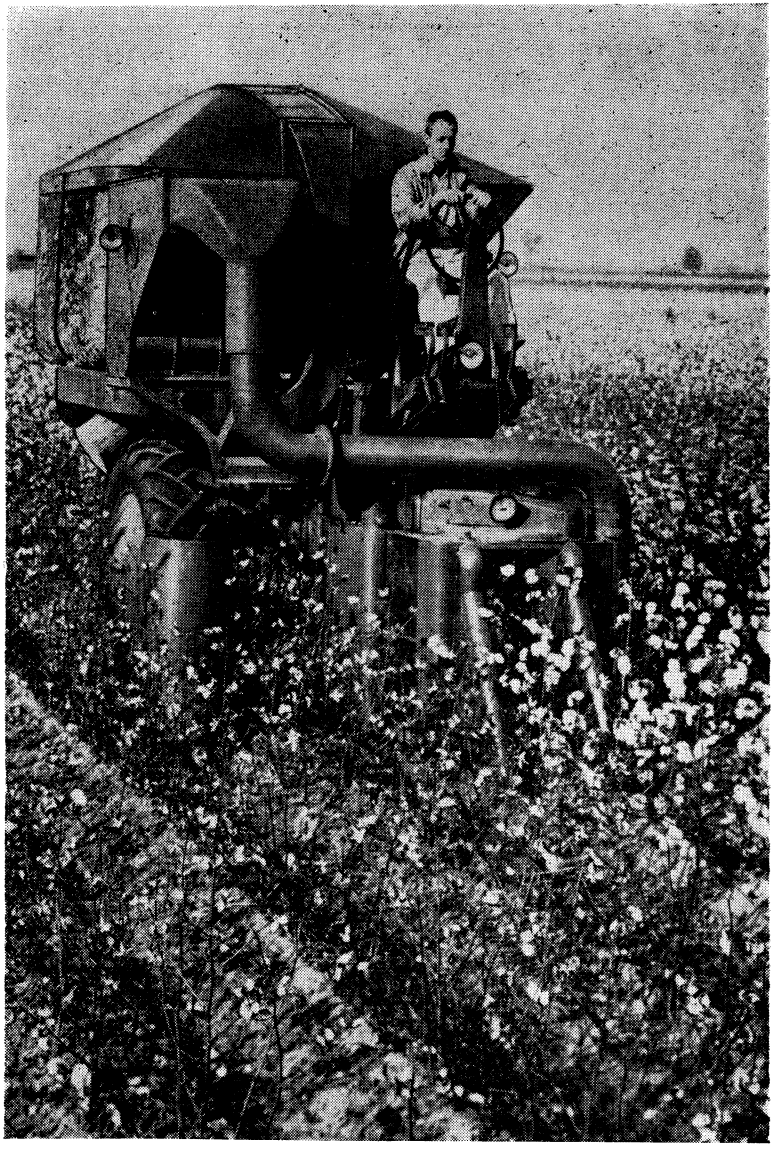


Side View of Cohea Stripper Showing Bur Extractor.

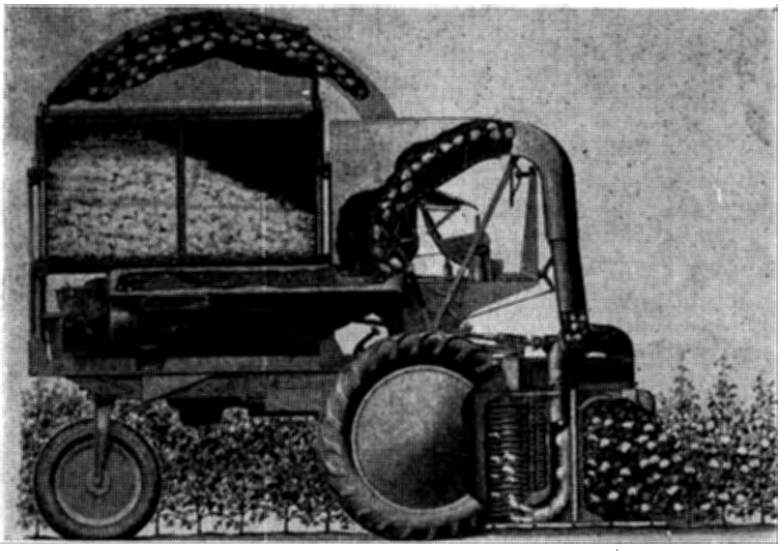
Cohea Machine in Operation.



Converted Grain Combine Harvesting Cotton.



International Cotton Picker in Field.



Cutaway View of International Cotton Picker.

The cotton harvested by the Cohea two row stripper with bur extractor required 1562 lbs. of cotton to produce a bale, which was the same as the International picker. The value of the lint harvested by this machine was $16.63 (grade strict good ordinary). The gross value of the bale was therefore $83.15 and the picking and ginning cost $9.58 *or 11.5% of the gross value.* It should be noted that this machine, just competed, was on its first field trial. Difficulty was experienced on account of irregular rows and in handling the large amount of cotton as it came from the rollers. When this stripper was operated on one row at a low speed, it did an exceptionally clean job of harvesting.

The cotton harvested by the International low drum one row cotton picker required 1562 pounds to produce a bale. The value of this cotton was the same as that of the Cohea stripper. The gross value of the bale was $83.15 and the picking and ginning cost $11.07 *or 13.3% of the gross value.*

It should be noted that the International Cotton Pickers are made in the "low" and "high" drum models. It is generally

considered that the high drum machine is better adapted to conditions as they exist in Oklahoma.

TYPES OF MECHANICAL COTTON HARVESTERS.

The two types of mechanical cotton harvesters may be classified as *pickers* and *strippers*. The stripper type may be further divided into the finger and roller types. The stripper harvester may be equipped with a bur extractor which enables the machine to very often clean the cotton to the extent that it is classified as picked cotton.

Pickers.

The principal commercial picker at this time is the one put out by the International Harvester Company. These machines are in very limited production and for that reason have not been fully tried in Oklahoma. The picker is mounted on a tractor and harvests the cotton by means of parallel revolving drums between which the cotton plants pass. On the drums are mounted rotating spindles having numerous tiny barbs which catch the lint. The cotton is removed from

Table 2

Analysis of Cotton Harvested at Anadarko Demonstration

	HAND-HARVESTED	MACHINE-HARVESTED			
		Allis-Chalmers	John Deere	Cohea	International
Gin turnout	23.7%	26.1%	23.7%	30.6%	30.6%
Average staple length	15/16	15/16	15/16	15/16	15/16
Pounds of harvested cotton required to give a 500 lb. gross wt. bale	2017	1831	2017	1562	1562[4]
Av. value of cotton per lb.	$14.63	$14.63	$14.63	$16.63	$16.63
Cost of harvesting bale	$30.26[1]	$5.36[2]	$5.91[2]	$4.58[2]	$6.07[3]
Cost of ginning bale	$7.56[4]	$6.87[4]	$7.56[4]	$5.00[5]	$5.00[5]
Gross value of bale	$73.15	$73.15	$73.15	$83.15	$83.15
Value of bale less harvesting and ginning	$35.33	$60.92	$59.68	$73.57	$72.08
Difference in value of machine-harvested bale over hand-harvested after charging for picking and ginning		$25.59	$24.35	$38.24	$36.75

[1] Calculated at $1.50 per hundred weight which was the price paid.
[2] Calculated at $2.97 per hour machine operation.
[3] Calculated at $5.83 per 1500 lbs. seed cotton as reported from Hopson plantation at Clarksdale, Miss.
[4] Calculated at 37½ cents per hundred weight. [5] Calculated at 32c per cwt.

the spindles by a rubber doffer and conveyed by air to a storage basket mounted on the machine. These machines have been used very successfully in the Delta region and it is believed they wil come to be more extensively used in Oklahoma.

Strippers.

The strippers range from the simple home made sled (finger type) to the more complicated roller type and many of these machines have been found to be efficient and economical cotton harvesters.

The mechanical *picker* may be used in the field for successive pickings without material damage to unopened bolls. The *strippers* may be used only once and for that reason are never employed except at the end of the season when all cotton is open.

The roller type stripper removes the bolls from the plant by passing it between two outward moving rollers or between a roller and stationary bar. From the rollers, the cotton is conveyed to a bur extractor or a modified cleaner and then into a trailer which is drawn behind the stripper. On those machines which are not equipped with cleaners, the cotton is conveyed direct to the trailer. All conveyor parts of the stripper should be perforated to allow for as much cleaning as possible.

The Converted Grain Combine Cotton Harvester

The operation of the converted grain combine as a cotton harvester has been surprisingly successful. The conversion of this machine consists of substituting V-shaped iron stripper fingers for the cutter bar. (See page 20.) These fingers are usually about 30 inches long, spaced about an inch apart, and placed approximately in the same position as the guards. These stripper fingers are welded to a point on the forward end and installed with the open sides of the V up. A doffer wheel or cylinder is installed at the base of the stripper fingers to throw the cotton back on the conveyor canvas. The substitution of a slatted conveyor for the canvas, as used in grain, has the advantage of allowing more dirt and trash to sift out. It has been found that the cylinder speed should be about one-half that used in threshing grain and that all except four bars should be removed. After passing the cylinder, the cotton can be further cleaned by passing over perforated racks from which point it is conveyed to the trailer. Since there are many grain combines on farms in Oklahoma and since they can so easily be converted into a successful cotton harvester, it

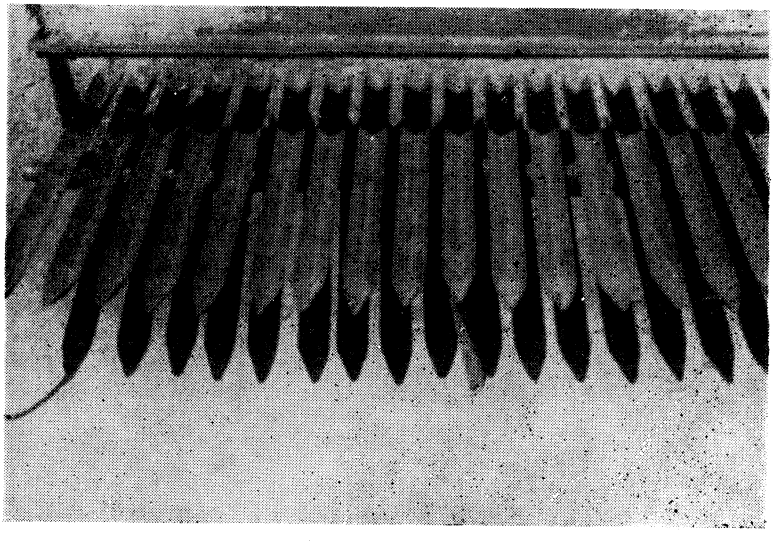
would seem advisable, under present conditions, to use more of these machines for this purpose. It is felt that further improvements can be made in the converting of grain combines to cotton harvesters.

Type of Cotton Plant Best Adapted to Machine Harvesting.

With any type of mechanical cotton stripper, it is necessary for the cotton plant to pass between the stripping units, therefore, it is important that the plant be not too large and that its fruiting habits be comparatively close. Large spready type plants with excessive vegetative growth contribute to more difficulty in operation and waste in harvesting.

DEFOLIATION OF COTTON PLANTS.

The presence of green leaves on the cotton plants makes it difficult, and sometimes impossible, to successfully harvest cotton with machinery. Harvesting with a stripper type machine can only be done after all the bolls are mature at which time the leaves are of no further advantage and are often a deterrent to opening of the cotton. As a rule stripper type harvesting is delayed until the leaves have been removed by frost. Frequently the entire crop of bolls is ready to open before frost, in which case it is a decided advantage



Finger Strippers as Used on Converted Grain Combine.

to remove the leaves. This practice, known as defoliation, speeds the opening of bolls and permits harvesting of the crop at an earlier date, with resulting higher grades.

It has been proved that an application of dusting-type defoliant at the rate of about 30 lbs. per acre will result in defoliation within a few days. Experience indicates that more complete defoliation is accomplished if dust is applied when sufficient moisture is present to stick the dust to the leaves, and aid in the necessary chemical reaction. The cost of defoliation is slightly over a dollar per acre for material and the defoliant may be applied with any equipment which can successfully apply calcium arsenate for the control of insects.