OKLAHOMA
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
STILLWATER, OKLAHOMA

In Cooperation with the United States Department of Agriculture and the Experiment Stations of Texas, Kansas, Nebraska, and Montana.

The Combine Harvester *on* Oklahoma Farms *1926*

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Bulletin No. 162. April, 1927

THE COMBINE HARVESTER

SUMMARY

SIZE OF FARM: The average area cut by the combines included in the study in 1926 was 427 acres for Oklahoma and 567 for the entire group. Of the acreage cut in Oklahoma, 273 acres were grown by the operator and 154 acres were custom work. For the entire group, 304 acres were grown by the operator and 263 acres were custom work (p. 3). The area cut averaged .226 acres per hour for each foot of length of the cutter bar. Acres cut per year varied from 275 to 1077 acres for the different size machines (p. 4).

COST OF OPERATION: The 15-foot combines operated at an average cost of $2.09 per acre; the 7-foot binders, $4.40; the 12-foot headers, $3.44 (p. 5). The 15-foot combines in Oklahoma operated at a cost of $2.56 per acre (p. 5). Costs per bushel for the entire group averaged 14 cents per bushel with the combines, 23 cents per bushel with the header and 29 cents per bushel with the binder.

PURCHASE PRICE: The average purchase price was $1995 ranging from $1043 for the 8-foot machines to $3315 for the 20-foot machines (p. 6).

LABOR: The combine crew ranged from one man with the 8-foot machines to three men with the 20-foot machines. Many farmers harvested 200 to 400 acres with no hired help (p. 7). Three to ten men were typical harvest crews with the binder and header methods.

POWER: The 15 or 16 drawbar horse power tractor used for plowing and other field operations was most commonly used with the combine (p. 8).

FUEL: The 20-foot combines had the lowest fuel consumption per acre, using 1.060 gallons. The 12-foot machines used the largest amount per acre, 1.553 gallons (p. 8).

GRAIN LOSSES: Grain losses in head only were 2.6 per cent for combines, 3.3 per cent for headers and 6.1 per cent for binders (p. 8).

EQUIPMENT: The grain tank was economical when the threshed grain was hauled in trucks. The wagon hitch was equally satisfactory when the grain was hauled in wagons (p. 9).

REPAIRS: An average of $56.00 per season was spent for repairs of the older machines of the 12-foot size (p. 9).

THE COMBINE FOR GRAIN SORGHUM: The combine for grain sorghum was practical under certain conditions. Costs for harvesting sorghums were 4.2 cents per bushel with the combine; 5.2 cents with the header; 17.5 cents with the row binder, and 11.2 cents with the hand-topping method (p. 10). Charges for threshing sorghum ranged from four cents per bushel to 12 cents (p. 11). Weather was an important factor limiting the use of the combine for grain sorghums (p. 12). The combine has been used satisfactorily as a stationary thresher for both the small grains and grain sorghums.

THE COMBINE HARVESTER ON OKLAHOMA FARMS—1926 (1)

The increased use of the combine in lowering costs of harvesting the small grains has reacted to the advantage of farmers prepared to use the machine and to the disadvantage of those producers whose farms are not adaptable to its use. The combine has been used successfully for several years in the harvesting of wheat in the great plains area and in the Pacific Northwest. The use of the combine in Oklahoma has increased most rapidly since 1925, more than 130 machines being sold in each of three counties in 1926.

The foregoing conditions have been accepted as evidence that the use of the combine is past the experimental stage and is at present the most economical method of harvesting wheat when conditions are favorable for its use.

Size of Farm. The most important factor determining the economical use of the combine is the area to be cut. The weighted average acreage harvested by the combine during the season of 1926 in Oklahoma was 427 acres. Of this acreage 273 acres were grown by the operator of the machine and 154 acres were cut for neighbors. The proportions were slightly different for the average of all of the 249 combines included in the survey conducted in Texas, Kansas, Nebraska, Montana, and Oklahoma. Five hundred and sixty-seven acres were cut by the average of all machines, 304 acres of which were owned by the operator of the machine and 263 acres were custom work (see table No. 3). The larger acreage for the average of all machines is partly accounted for by the fact that a portion of the survey was conducted where both winter and spring wheat were grown thus increasing the harvest season and the acreage each machine could handle.

Wheat acreage on the average farm in nine counties in the wheat belt of north central Oklahoma has gradually increased from 30 acres in 1908 to 95 acres planted for the 1927 harvest. Crops not adapted to large machine production have decreased over the same period. Although the average farm in the Panhandle counties is much larger than those in counties farther east, the acerage devoted to wheat is about the same. The average farm in the Panhandle produced 19 acres of wheat in 1908 and 93 acres were planted for the 1927 harvest.

Cost of operation per acre for the combine was reduced by custom work in 69 per cent of the cases studied in Oklahoma and 65 per cent of those in the entire group (see table No. 3). Of the total acreage cut by machines in Oklahoma, 62 per cent was grain belonging to the owner of the machine and 38 per cent was custom work. For the entire group 53 per cent was grain owned by the machine operator and 47 per cent was custom work.

Ten of the fifty-one combines in Oklahoma were on farms with less than 160 acres of wheat or an average of 128 acres. The smallest farm contained

(1) The data used in the present study were collected by the survey method during the harvest season of 1926, by the cooperative effort of the United States Department of Agriculture and the State Experiment Stations of Texas, Kansas, Nebraska, Montana, and Oklahoma. Recognition is made and appreciation extended to all cooperators who made the study possible, also to members of different divisions of the United States Department of Agriculture who supervised most of the tabulations and assisted in planning the study and conducting field work.

65 acres, all of which were planted to wheat. This particular operator cut 591 acres of custom grain with his 16 foot machine.

Fourteen of the 51 farms grew an average of 212 acres of wheat; eleven 274 acres; seven, 359 acres; five, 435 acres, and the largest group, as to acres, containing only three farms, averaged 507 acres, the largest of which contained 520 acres of wheat. Fifteen of the 51 Oklahoma operators did no custom work. Of the operators who did no custom work, three had over 500 acres of wheat of their own, four had from 400 to 500 acres, five, 300 to 400 acres and three, 200 to 300 acres.

Thirty-nine of the fifty-one Oklahoma machines cut wheat only, six wheat and barley belonging to the operator; five cut wheat and oats, and one cut wheat, barley and oats. The barley cut averaged 17 acres per machine ranging from five to thirty acres. The oats cut averaged 18 acres per machine, ranging from nine to forty acres. Three of the 36 machines doing custom work cut other than wheat for custom. One cut wheat and barley, one cut wheat and oats, one cut wheat, barley and oats.

Rates per acre for custom work varied from $2.50 to $4.50. Of the 51 Oklahoma operators, three charged $2.50; nine, $3.00; twenty-one, $3.50; two, $4.00; one, $4.50.

Acreage That Can Be "Combined." Three factors determined the acreage that could be harvested with a combine, : width of cut, rate of travel, and length of the cutting season. Table No. 1 indicates that the rate of travel was somewhat lower for the power take-off combines as compared to the auxiliary engine type. Also, the horse drawn combines were much slower than those drawn by tractors. The average acreage harvested with a combine was .226 acre per hour for each foot of length of the cutter-bar. The size of the machine apparently had no effect on the rate of travel. In heavy yields the rate of cutting was lowered, either by decreasing the speed traveled or lessening the width of swath. The length of the cutting season determined the amount of work that could be done with any given size of machine. In Oklahoma the average length of cutting season was ten days. Table No. 1 shows the average acreage cut annually by all machines of different sizes. The acreage cut varied from 275 for the 8 foot machines to 1077 for the 20 foot machines.

Table No. 1. Acreage Cut Annually by Combines Surveyed in Five States

Type	Width of Cut, Feet	Rate of Travel	Acres Per Day	Acres Per Hour	Acres Per Hour Per Ft. Width	Average Acres Per Season
Power Take-off	8	2.4	16.0	1.55	.193	436.8
	10	2.7	25.6	2.61	.261	457 (1)
Auxiliary Engine	12	2.8	26.7	2.62	.218	423.8 (1)
	15	2.8	35.2	3.40	.227	582.9
	16	2.8	40.3	3.76	.235	690.1
	20	2.4	47.7	4.47	.223	999.7
Horse Drawn	15	1.8	24.0	2.30	.153	
	16	1.5	40.5	2.90	.181	

(1) Most of the eight-foot and 10-foot machines were used in Montana where both spring and winter wheat were grown. The eight-foot and 10-foot machines were all purchased in 1926, whereas the 12-foot machines averaged 4.9 years old. A combination of these two factors accounts for the 10-foot machines cutting more acreage than the 12-foot machines

Cost of Operation. Cost of harvesting small grains with the combine was less than half the cost by the binder method and about half the cost by the header method. Total costs per acre for the entire group for the 15-foot combine, were $2.09; for the 10-foot combine, $1.92; for the 7-foot binder, $4.40; for the 12-foot header, $3.44. Table No. 2 gives a list of the respective cost items for each of the three methods.

Important items of cost include man and horse labor which with the binder were six times and with the header five times those of the combine. The threshing costs necessary with the binder and header were $1.50 per acre for a fifteen bushel yield, the average for the entire group. The average yield for the Oklahoma group was 23 bushels per acre. Threshing charges alone where the binder and header were used were 42 per cent of the total cost of operation for the 15-foot combine. In the foregoing calculations, threshing costs were taken as ten cents per bushel representing an average for the section. Threshing charges common in Oklahoma were eighteen cents per bushel, including all labor necessary to place the grain from the shock to the wagon or truck as threshed grain. Total harvesting costs for the entire group and based on the average yield of 15 bushels per acre were 14 cents per bushel with the combine, 23 cents per bushel with the header and 29 cents per bushel with the binder.

Charges for depreciation and interest are much less for the binder and header, due to the relatively small investment as compared to the combine. The data given in Table No. 2 represent the aggregate for all regions represented in the study. Costs for the 15-foot combine were based upon the average cutting of 583 acres (see table No. 3). The same size machine in Oklahoma cut an average of 350 acres (see table No. 3). The costs per acre for power, labor, oil, repairs, etc. remained about constant. Depreciation and interest charges increased the cost per acre to $2.56 for Oklahoma as compared to $2.09 for the region as a whole.

Table No. 2. Costs Per Acre for Different Harvesting Methods—Entire Group

	Combine, Unit	10-Ft. Cost	Combine, Unit	15-Ft. Cost	Binder, Unit	7-Ft. Cost	Header, Unit	12-Ft. Cost
Man hours (1)	.69	.41	.65	.39	3.6	1.80	2.8	1.40
Horse hours (1)	....	....	....	....	5.9	.59	4.1	.41
Tractor	....	.60	....	.60	....	....	....	....
Fuel, Gal. (3)	1.30	.32	1.40	.35	....	....	....	....
Oil, Gal. (3)	.04	.03	.05	.04	....	....	....	....
Grease, lbs.	.06	.01	.05	.01	....	....	....	....
Twine, lbs. (4)	....	....	....	....	2	.28	....	....
Repairs	....	.10	....	.10	....	.05	....	.05
Threshing 15 bu. (5)	....	....	....	....	....	1.50	....	1.50
Total of Above Variable Costs	....	1.47	....	1.50	....	4.22	....	3.36
Depreciation (6)	....	.33	....	.43	....	.15	....	.05
Insurance (8)	....	.04	....	.06	....	.01	....	.01
Interest (7)	....	.08	....	.10	....	.02	....	.02
Grand Total	....	$1.92	....	$2.09	....	$4.40	....	$3.44

(1) Labor on combine charged at 60 cents per hour, labor on binder and headers at 50 cents per hour.
(2) Horse labor charged at 10 cents per hour.
(3) Fuel charged at 25 cents per gallon, oil at 75 cents per gallon
(4) Twine charged at 14 cents per pound.
(5) Threshing at 10 cents per bushel for a 15-bushel yield.
(6) Based on 8 years life for combine, 10 for binder and 15 for header.
(7) Interest at 6%.
(8) Insurance was calculated by using the commercial rate of $1.75 for each $100 covering fire and tornado for a one year period, calculated on the price of a new machine.

Table No. 3. Custom Work With Combine for Both Oklahoma and Entire Group

Type of Machine	Width of cut feet	Total No. of farms	No doing custom work	AV. A. CUT AN. Own	AV. A. CUT AN. Custom	AV. A. CUT AN. Total	Rate for cutting	Total receipt	Total expenses	RE. PER A. To Combine (1)	RE. PER A. To Com. and labor (2)
Oklahoma											
	12	7	3	238.7	62.9	301.6	2.70	170	35	2.15	2.64
Tractor pulled	15	7	5	241.0	108.6	349.6	3.05	331	60	2.50	2.62
auxiliary engine	16	35	26	285.2	182.1	467.3	3.43	624	112	2.81	3.11
Entire Group											
	12	56	23	222.9	200.9	423.8	3.00	558	129	2.13	2.48
Tractor pulled	15	51	36	294.0	288.9	582.9	3.10	855	208	2.24	2.57
auxiliary engine	16	104	79	366.2	323.9	690.1	3.18	978	195	2.42	2.72
	20	3	3	636.7	363.0	999.7	2.70	1052	254	2.20	2.59
Power take-off	8	25	12	208.8	128.0	336.8	2.90	317	93	1.75	2.23
	10	10	10	292.5	164.5	457.0	3.75	546	117	2.61	3.04

(1) Total return to combine includes the margin for use of combine and tractor with cost of labor, fuel, and lubricants deducted but with no charge made for depreciation and repairs.

(2) Return to combine and labor includes the margin for operating a combine and tractor with charges made for fuel and lubricants, but with no deduction made for labor, depreciation, or repairs.

Purchase Price. Combines are usually sold f. o. b. the factory, and the initial cost varies according to size, equipment, and distance from the factory. The variations in price given in Table No. 4 is partly due to the foregoing factors and partly due to the age of the machines, since the purchase price has varied from year to year. The price ranged from $1043 for the small 8-foot one-man machine to $3315 for the large 20-foot machine. Although records taken in Oklahoma did not include 8-foot and 10-foot machines, some are in use in this state.

The relatively low price for the small machine is largely accounted for by the absence of an auxiliary engine, the power being taken direct from the tractor engine. This feature required a somewhat larger tractor than that required for locomotion only. The weighted average cost of all combines was $1995. The proportion of the purchase price chargeable to the operation of any one year depended upon the life of theh machine. Due to the relative newness of the combine in the region surveyed the years of service were determinable only by the estimates of operators, the average being 8.3 years. Of the fifty combines in Oklahoma included in the survey, sixteen were purchased in 1926, twenty-two in 1925, ten in 1924 and two in 1921. It is of interest to note that fifteen of the sixteen machines purchased in 1926 were of the 16-foot cutter bar size.

Table No. 4. First Cost and Expected Life of Machines for Both Oklahoma and Entire Group

Type of Machine	Width of cut, feet	NO. OF FARMS Okla-homa	NO. OF FARMS Entire Group	INITIAL COST Okla-homa	INITIAL COST Entire Group	EST. YRS. OF LIFE Okla-homa	EST. YRS. OF LIFE Entire Group
Tractor pulled auxiliary engine	12	7	56	$1897	$1810	8	10.7
	15	7	51	1985	2084	6	7.0
	16	35	104	2316	2315	9	7.8
	20	....	3	....	3315	....	11.7
Power take-off	8	....	25	....	1043	....	7.5
	10	....	10	....	1260	....	8.5
Auxiliary engine horse drawn	12	....	3	....	1812	....	13.3
	15	1	3	1800	1903	5	7.0
	16	1	2	2280	2290	5	5.0
Total		51	257	$2202	$1995	8.3	8.3

Labor. The one to three man crew of the combine has replaced the harvest crew of from three to ten men used with the binder or header. This reduction in the size of crew is significant in that it was not always possible to secure sufficient satisfactory labor for the peak load even at high wages. The housewife is also a beneficiary of the new method. The burden of cooking for a large harvest crew passed with the advent of the combine. Observations indicated that many farmers harvested 200 to 400 acres of wheat with no hired labor. Other operators handled their crop with one hired man (see appendix 1).

Twenty-five eight-foot machines in other states were included in the survey. Each machine was operated by one man. Eighteen of the number were operated by hired men and seven either by the farmer or by a member of the family. Of the 10-foot combines eight were operated by two men each and two by one man each. Of the fifty-six combines which were of the 12-foot size, 49 were operated by two men and seven by three men. The third man was used as a helper. Of the 59 combine machine men, 22 were hired. Thirty-one of the tractor drivers were hired. Of the seven helpers, four were hired. Of the 54 15-foot machines, 48 were operated by two men, and six by three men. Of the 54 operators, 16 were hired. Of the 54 tractor drivers, 29 were hired. One hundred and four machines were in the 16-foot group. Of this number, 79 were operated by two men and 25 by three men. Of the 104 operators, 29 were hired. Of the 104 drivers, 62 were hired. Of the 25 helpers, 14 were hired. Only three machines were in the 20-foot class and each was operated by three men. With the exception of one operator all labor for these three machines was hired.

Labor for hauling the grain from the combine was usually hired at a flat rate per bushel, the price depending upon the distance hauled. Usually the hauler supplied the truck, gas, and oil and boarded himself.

Analysis of the labor records of the Oklahoma farms included in the survey indicated that 72 percent of the combine operators were either the farmer or a member of his family, while only 49 percent of the tractor drivers were unpaid. Twenty-six percent of the hauling was done by unpaid labor.

Power Required. The power necessary to operate the combine varied

with the type and size of the machine and the topography of the land. Table No. 5 shows that the tractor of the 15 or 16 drawbar horsepower size was used for all of the 10-foot power take-off combines, for 55 percent of the 12-foot combines, 58 percent of the 15-foot combines, 43 percent of the 16-foot combines and 33 percent of the 20-foot combines. Larger sized tractors were necessary on hilly, sandy, or soft land. Under favorable conditions the 12-horse power tractor was used to pull all types except the 20-foot combines and the 10-foot power-take-off combines.

Table No. 5. Power and Labor Requirements of Combines—Entire Group

Type of Machine	Width of cut feet	No. of Farms	SIZE OF TRACTOR Drawbar Horse Power Under 12	15-16	17-18	20-30	Over 30	SIZE OF CREW 1	2	3	4	5
Power take-off	8	25	25	....	....	....	....	23	2	....	....	....
	10	10	....	10	....	....	....	3	7	....	....	....
Auxiliary engine tractor drawn	12	56	19	31	3	3	....	1	51	4	....	....
	15	51	7	31	9	3	1	....	42	9	....	....
	16	104	18	45	29	12	....	....	79	22	2	1
	20	3	....	1	....	2	....	....	....	2	1	....

(1) Of 3 12-foot machines drawn by horses, one used six horses and two used eight horses. Of 3 15-foot machines drawn by horses, two used eight horses and one used ten horses. Of 2 16-foot machines drawn by horses, two used eight horses

Fuel Used. Table No. 6 shows the amount of fuel per acre used in combining. The power take-off machines show a slightly lower total fuel consumption per acre than the other types excepting the 20-foot machine. This was due to the extra fuel necessary to keep the tractor and the auxiliary engines running. With the 20-foot combines the size of the machine was sufficient to keep both engines running near their capacity and thus operated more efficiently. The 20-foot combines were the most economical in fuel consumption, using 1.060 gallons per acre. The 12-foot machines with the auxiliary engine were the least economical, using 1.553 gallons per acre (see table No. 6). Fuels used in the tractors included gasoline, kerosene and distillate in amounts as shown in Appendix II.

Table No. 6. Fuel and Lubricant (1) Used in Combining—Entire Group

Type of Machine	Width of cut, feet	No. of farms	Average acres cut	Total fuel, Gals. per acre	Total oil, Gals. per acre
Power take-off	8	25	213.2	1.227	.0544
	10	10	292.5	1.301	.0397
Auxiliary engine	12	54	286.8	1.553	.0690
	15	50	356.7	1.430	.0535
	16	103	422.9	1.336	.0612
	20	3	636.7	1.060	.0392

(1) The amount of grease used showed no definite relationship to type of machine and averaged .0472 pound per acre.

Grain Losses. The loss of grain by the different methods of harvesting was determined by counting the number of heads left in the field. The average loss of grain was 2.6 percent for combines, 3.3 percent for headers, and 6.1 percent for binders. These losses did not include those around the stacks or in threshing, which losses should be added to those of the binder and header methods. Of the 190 fields cut with the combine, 41 had losses of

less than one percent; 65, one percent to two percent; 31, two to three percent; 53, over three percent. Losses of over three percent occurred only with an uneven or partly lodged crop, on rough land, with poor machines, as a result of careless operation or on land cut in very windy weather.

The threshing losses measured included only the amount of grain carried over with the straw. The average loss on the combines tested was 1.9 percent while on the stationary separators it was 1.1 percent. Of the 33 combines tested 13 were losing less than one percent and eight from one to two percent. Losses of over two percent wer due to faulty adjustment or overloading. The uniform feeding of the combine partly offset the losses resulting from inexperienced operation. Elevator men generally agreed that the combined grain was of slightly inferior quality to the stacked and threshed grain. For the farmer who stored his grain, storage was an added problem. Grain cut with the combine early in the season had a greater tendency to heat when stored, however the loss from this factor has not been definitely determined.

Equipment. Equipment used on combines in Oklahoma is shown in Table No. 7. Sixty-three percent of the 12-foot, 15-foot, and 16-foot sizes used an extension cut. The newer machines were of the 15-foot and 16-foot size without the extension. Ninety-six percent of the combine used the straw spreader. This apparatus enabled the farmer to list or plow immediately after combining without burning or removing the straw. All combines included in the survey in Oklahoma used either the wagon hitch or the grain tank. The grain tank had a considerable advantage where the grain was hauled by truck. The wagon hitch was as satisfactory as the grain tank where teams and wagons were used to haul the grain. Combines that had neither the wagon hitch nor grain tank had a noticeable side draft.

Table No. 7. Equipment on Combines—Oklahoma

Width of cut, feet	No. of machines	Extension cut	Straw spreader	Wagon hitch	Grain tank
12	7	2 with 3'	6	4	3
15	7	5 with 3'	7	6	1
16	35	24 with 4'	24	18	17

Repairs. The fact that most of the combines in use were only one or two years old acocunted for the low cost for repairs, which cost was probably lower than the average for the entire life of the machine. Appendix III shows that the cost of repairs increased rapidly with the age of the machine and that size had little effect. The machines that were eight years old had an average annual repair bill of $56.00.

THE COMBINE FOR GRAIN SORGHUM IN OKLAHOMA AND KANSAS, 1926 (1)

The use of the combine in harvesting grain sorghum has proved successful under certain conditions. The wheat-combine study previously analyzed indicated that the lowest cost per acre were in sections where both winter and spring wheat were produced which resulted in the lengthening of the harvest season. Due to the Oklahoma wheat belt being restricted to winter varieties, the grain sorghums which were harvested at a different season of the year offered a possibility of increasing the acreage harvested annually with the combine.

The Panhandle counties have the largest acreage of grain sorghum per farm of any region of Oklahoma. Texas county ranks first with 67 acres per farm; Cimarron, 62 acres; Beaver, 48 acres, and Harper, 38 acres per farm.

The most common practice of harvesting the row crop was the hand-topping method. Difficulty was experienced in finding 47 farmers in six counties who had used the combine in harvesting sorghum direct from the field. Due to this factor the proportion of the total number included in the study who used each method, does not indicate the degree of popularity of different practices. An effort was made to take the same number of records for each of the four different methods of harvesting. Two hundred and four records were secured although eleven contained sufficient data of a secondary method to make the record usable in two groups.

Combine Costs. Average costs of cutting and threshing grain sorghum were 4.2 cents per bushel for the combine, 5.2 cents for the header, 17.5 cents for the row binder and 11.2 cents for the hand topping method. Forty-seven combine records indicated that an average of 74 acres was cut by each machine. On the average, two men were required for operation. Forty-two combines were propelled by tractors and five by eight horses each.

Header Costs. The most common practice with headers was to use one man and six horses on the machine, one driver and four horses on one barge or header wagon, and one man loading. The harvesting costs were 3.5 cents per bushel plus a threshing charge of 1.7 cents per bushel if the farmer's combine was used for the threshing operation, making a total of 5.2 cents per bushel. The cost was increased to 10.2 cents per bushel if the threshing was done by a hired machine as indicated in Table No. 8.

(1) The data given on the use of the combine for the harvesting of grain sorghums are the result of a separate survey conducted in November of 1926 in the Oklahoma Panhandle and adjacent Kansas counties by the cooperation of the United States Department of Agriculture and the Experiment Stations of Kansas and Oklahoma.

Table No. 8. Costs of Harvesting Grain Sorghums by Different Methods—Oklahoma and Kansas (2)

	Number of records	Size of Crew (1)		Harvesting cost per bu.	Threshing Cost, Bu.			Total Cost Per Bu.		
		Man	Horse		Own Comb.	Hired Comb.	Hired Thresher	Own Comb.	Hired Comb.	Hired Thresher
Combines	47	2	10	.042	....	....	....	.042	....	....
Headers	37	3	10	.035	.017	.059	.067	.052	.094	.102
Row-Binder	10	2	4	.100	.075	....	.107	.175	....	.207
Hand	121	2	4	.093	.019	.045	.049	.112	.138	.142

(1) Five combines used horses; 42 used tractors
(2) For more detailed data, see Appendix V.

Binder Costs. Only ten records of harvesting with one-row binders were taken. Most farmers using this method had not threshed when the survey was conducted. Due to the light rain fall in the Panhandle section kafir and milo are usually grown as a catch crop when wheat fails and are produced largely for grain and not for forage. The stover is worth more in the field for the purpose of pasturage, holding snow, and preventing blowing of the soil than for feed.

The one-row binder required one man and four horses to operate the machine and one man to shock the bundles. The average cost for cutting and shocking was 10 cents per bushel. Costs for threshing were higher than headed or hand topped grain, due to the presence of more stover. Total costs were 17.5 cents per bushel, or 20.7 cents per bushel if the threshing was done by a hired separator (see table No. 8).

Hand Topping. Fifty-nine percent of the farmers interviewed used the hand-topping method. The average crew included two men and two two-horse teams and two wagons. Costs by this method were 9.3 cents per bushel plus the threshing charges of 1.9 cents if the farmer's combine was used for threshing, making a total cost of 11.2 cents per bushel. The crop when hand-topped had a greater pasture value than when cut by the other methods. Eighty-two percent of the total number of farmers used the fields for pasture after cutting, valuating the feed at 65 cents to $1.50 per acre.

Costs of Threshing. The cost per bushel for threshing grain sorghum varied, depending on how it was stacked, condition of grain and size of the job. A comparison of rates for both the stationary thresher and for the combine when used as a stationary thresher are given in Table No. 9.

Table No. 9. Price Per Bushel Charged for Threshing Grain Sorghum in Oklahoma and Kansas

	STATIONARY THRESHER		COMBINES	
Method of cutting	Number of Machines	Cents per bushel	Number of machines	Cents per bushel
Hand Topping	21	4	12	4
	18	5	7	5
	3	5½	3	10
	5	6	6	12
	13	7	----	----
Header	2	4	2	4
	5	5	4	5
	11	6	2	6
	8	7	3	7
	1	8	1	8
	2	10	----	----

Kinds of Crops. The average size of the 204 farms surveyed was 616 acres, with 414 acres of crop land of which 112 acres were used for grain sorghum and 204 acres for winter wheat. Forty-eight farms situated in the most sandy sections had no wheat. No farms were visited where combines were maintained for the sorghum crop only. On the other hand many farmers owning combines did not use them to cut the row crops but in some cases used combines to thresh kafir and milo from the rick (see Appendix IV).

The average farm included in the survey had 10 horses and mules, four milk cows, 10 other cattle, seven hogs, and 146 chickens. Only three farms had no livestock.

Weather. Farmers interviewed generally agreed that the weather at harvest time largely determined the method of harvesting the grain sorghums. An early frost with the absence of wind ripened and dried the grain and left the stalks standing. Under such conditions, the combine was the best method of harvesting. During the season of 1926, 166 fields, included in the survey, were harvested before frost and 81 after frost. Of the fields in which combines were used, 33 were cut before frost and 24 after. Of the headed fields, 47 were cut before frost and 33 after.

Variety of Sorghums. Fifty percent of the farmers included in the survey grew dwarf yellow milo with an average of 71 acres per farm. Ten percent grew straight neck milo with an average of 60 acres per farm. Twenty-one percent produced black hull kafir.

Twenty-two of the 64 combines operated were used with dwarf yellow milo and 24 with black hull kafir. Thirty-eight of the 98 headers were used with dwarf yellow milo and 24 with black hull kafir. One hundred five of the 148 farmers who used the hand method grew dwarf yellow milo and 13 black hull kafir. Of the 10-row binders, nine were used in black hull kafir and one in dwarf yellow milo.

Sorghum was frequently slightly immature when headed or hand-topped, the heads being allowed to dry in the rick. Combine cutting necessitated the grain being almost dry, otherwise heating resulted. This damage was somewhat overcome by the common practice of piling the threshed grain on the ground in long piles about five feet wide at the base and three feet high. This practice permitted green kernels to dry and lessened the danger of heating.

Appendix I. Paid and Unpaid Labor on Combines—Entire Group

Type of Machine	Width of cut feet	Number of Combs.	NUMBER OF WORKERS USED					
			Combine Operator		Helper		Driver	
			Paid	Unpaid	Paid	Unpaid	Paid	Unpaid
Power Drive	8	25	20	8	....	....	....	....
	10	10	7	3	....	....	2	5
Auxiliary engine pulled by tractor	12	56	22	34	4	3	29	26
	15	51	15	36	3	5	28	24
	16	104	30	76	14	11	62	42
	20	3	3	1	2	1	3	....
Horse drawn	12	3	....	3	....	....	2	1
	15	3	1	2	....	....	2	1
	16	2	1	1	....	....	1	1
Total		257	99	164	23	21	129	100

Appendix II. Fuel and Oil Used in Tractor and Auxiliary Engine—Entire Group

Type of Machine	Width of cut feet	TRACTOR					AUXILIARY ENG.	
		Gallons Gasoline	Gallons Kerosene	Gallons Distillate	Total fuel, Gal. per A.	Total oil, Gal. per A.	Gals. gas per A.	Gals. oil per A.
Power Take-off	8	114.4	126.9	20.4	1.297	.0544	....	....
	10	200.2	138.4	42.0	1.310	.0397	....	....
Auxiliary engine	12	153.2	100.2	16.2	.940	.0446	.613	.0244
	15	148 3	124.3	26.4	.838	.0325	.592	.0212
	16	201.7	96.8	18.0	.748	.0347	.588	.0265
	20	292.3	....	133.3	.668	.0199	.392	.0193

Appendix III. Repairs on Combines—Entire Group (1)

Type of Machine	Width of cut feet	Number of farms	Age of machine, years	Repairs dollars	Labor on machine, days
Power take-off	8	25	1.0	4	.6
	10	10	1.0	1	.3
Horse drawn auxiliary engine	12	3	8.0	56	3.0
	15	3	1.3	5	....
	16	2	1.5	24	2.0
Tractor drawn auxiliary engine	12	56	4.9	40	3.4
	15	51	1.8	16	1.5
	16	103	1.7	18	1.9
	20	3	1.7	8	.2

(1) Average reported by operators for 1926.

Appendix IV. Acreage of Different Crops on Farms of Different Sizes—From Sorghum Survey—Oklahoma and Kansas

Size of farm (crop acres)	No. of farms	CROP ACREAGE									Total acra of farm	No. of farms raising wheat
		Winter wheat	Milo	Kafir	Total grain sorghum	Sorghum and sudan	Broom corn	Corn	Total other crops	Total crop land		
Less than 200	41	17	64	17	82	13	13	13	40	137	260	31
201 to 400	84	158	64	39	103	13	10	12	36	297	471	15
401 to 600	35	312	76	36	114	18	11	21	55	492	653	1
601 to 800	29	471	96	33	132	22	3	25	63	682	1047	....
801 and over	15	739	61	144	205	38	....	61	103	1126	1484	1
All	204	243	70	41	112	17	9	19	49	414	616	48

Appendix V. Cost of Harvesting Grain Sorghum With a Combine—Oklahoma and Kansas

	Width of cut, feet	No. of reports	SIZE CREW		RATE, DAY		OPERATING COST			Average acres	Bu. per acre	Cost per acre	Cost per Bu.
			Man	Horse	Man	Horse	Fuel	Oil	Grease				
Horse Drawn													
	12	2	2	10	3.58	.38	5.50	1.51	.28	20	15	1.03	.07
	15	1	2	10	3.17	.50	37.40	10.40	1.25	210	14	.93	.07
	16	2	2	10	2.53	.36	15.95	3.72	.70	95	28	.65	.02
Tractor Drawn													
	12	5	2	....	3.04	....	17.96	5.80	.32	70	13	.67	.05
	15	15	2	....	3.04	....	24.24	3.99	1.22	77	16	.66	.04
	16	22	2	....	2.78	....	20.73	5.86	.99	69	15	.61	.04

Appendix VI. Cost of Harvesting Grain Sorghum By Hand for Crews of Different Sizes—Oklahoma and Kansas

SIZE OF CREW		No. of	RATE PER DAY		Ave	Bushels	Cost	Cost
Man	Horse	reports	Man	Horse	acres	per acre	per acre	per Bu.
1	2	37	2.44	.18	31	16	1.49	.09
2	2	5	2.18	.30	38	18	1.35	.07
2	4	32	2.76	.36	56	20	2.03	.10
3	6	26	2.38	.26	80	18	1.58	.09
4	8	17	2.73	.30	90	23	1.99	.09
5	10	4	2.64	.28	98	22	2.85	.13

Appendix VII. Cost of Harvesting Grain Sorghum With One-Row Binder—Oklahoma and Kansas

SIZE OF CREW		No. of	RATE PER DAY		Ave.	Bushels	Cost	Cost
Man	Horse	reports	Man	Horse	acres	per acre	per acre	per Bu.
2	4	10	2.73	.38	39	16	1.68	10

Appendix VIII. Cost of Harvesting Sorghum With a Header for Crews of Different Sizes—Oklahoma and Kansas

SIZE OF CREW		No. of	RATE PER DAY		Ave.	Bushels	Cost	Cost
Man	Horse	reports	Man	Horse	acres	per acre	per acre	per Bu.
2	8	7	1.99	.35	62	16	.50	.03
2	10	12	3.24	.37	105	16	.71	.04
3	8	2	3.39	.38	106	13	.52	.04
3	10	13	2.21	.23	92	20	.57	.03
5	10	3	2.34	.43	190	15	.75	.05