COSTS OF MOW CURING HAY
1946

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SUMMARY

The mow curing systems included in this survey cost an average of $465 to build and install in barns. The largest item of cost was fans, averaging $170. Ducts and motors also cost more than $100 per farm. Costs of installing mow curing systems have increased considerably since this survey was taken in 1946.

The average operating cost was about $100 for the season. Depreciation and electricity each made up about one-third of the total operating cost for the season. Farms with large tonnages of hay had the lowest cost per ton for mow curing, since depreciation and electricity costs per ton were low when greater amounts were mow cured.

Mow cured hay remained in the field 1.3 days less than field cured hay. A smaller proportion of mow cured hay was rained on than field cured hay even though it was cut earlier in the season during the period of less favorable weather conditions. The difference between curing time for mow cured and field cured hay was reduced as hay reached advanced stages of maturity.

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INTRODUCTION

The largest harvesting job on most dairy farms is the making of hay. No job is more important on dairy farms from the standpoint of milk production.

Hay is a highly perishable crop in the field. Rain causes hay to lose quality rapidly. About 400 New York farms were surveyed in 1945 to determine the amount of rain damage. From one-fourth to one-half of the hay on these farms was rained on, depending on the method of harvest. 2/ The desire to reduce rain damage and reduce the importance of weather in producing good quality hay has led to new ways of putting up hay. One of the newest methods has been mow curing of hay.

Description of Mow Curing

Mow curing consists of storing hay in the mow after the hay has been partly cured in the field and the moisture content reduced to 40 per cent or less. Curing is completed in the mow by blowing air into the mow and through the hay by means of a system of ducts. A fan and electric motor force air through a central duct on the mow floor. The air moves through openings in the central duct out along the slatted floor and passes up through the hay. The air takes up moisture and

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1/ This study was made in cooperation with the Department of Agricultural Engineering. Records were taken by members of the Departments of Agricultural Engineering and Agricultural Economics, Cornell University. The Farm Electrification Council provided financial support and valuable advice and assistance.

2/ Lamborn E. W. Labor Used And The Cost Of Harvesting Hay, New York State, 1944-1945. Ph.D. Thesis, Cornell University, 1947

reduces the moisture content of the hay. Long, chopped or baled hay may be cured by this method.

Mow curing of hay, when properly done, results in higher quality roughage for cows because there is less rain damage and because hay may be cut when feeding value is highest.

Some of the problems of mow curing are the investment in additional equipment and the cost of operating the system. These are costs which a farmer does not have in other methods of haying. The hard work involved in handling the hay which contains a higher percentage of moisture than field cured hay is another problem.

Purpose and Method of Study

The purposes of this study were to determine:

1. The costs of installation and operation of mow curing systems.
2. Whether differences exist in the length of time that hay was in the field after cutting, amount of rain damage, and the amount of turning and tedding required between mow cured and completely field cured hay.

Information was obtained by the survey method for the 1946 haying season. Farmers estimated the following information on nineteen farms.

1. Number of acres and tons that were field cured and that were mow cured.
2. The number of hours required to do each job, such as mowing, raking, tedding, turning, baling, and hauling and storing.
3. The number of persons in the crew for each job.

4. The kind of power used and number of hours it was used.

5. The haying equipment used for each job and number of hours it was used.

Weekly visits were made during the haying season to eight additional farms. Upon each visit the above facts were obtained for all haying work done since the last visit, plus the following:

1. The date and time of day (A.M. or P.M.) when each job was done for each field or piece cut.

2. Time and weight records. On several loads moisture content, net weight, and time of hauling and storing were determined with scales, stopwatch, and other equipment.

For all hay equipment except tractors, trucks, and horses, detailed information was obtained as to cost of operation. Hay equipment was used for jobs other then hay. The total amount of use for hay equipment was obtained and a proportionate share was charged to hay. Similar data were collected for mow curing equipment.

Farms which had a variety of methods of hauling and storing hay were selected for the survey. They do not represent a sample of all farms in the state on which mow curing was used. The farms are larger than average dairy farms. They are located largely in western New York.

COST OF INSTALLING MOW CURING SYSTEMS

Thirty-eight mow curing systems were installed on the 27 farms studied. Eighteen farms had one mow curing system. Three systems were in use on each of two farms and two systems in use on each of seven farms.

The total cost per mow curing system was $465 and varied from

$297 to $730. The highest cost systems were generally most expensive because of higher than average cost of ducts.

TABLE 1. COST OF MOW CURING SYSTEMS AT TIME OF INSTALLATION

27 Farms in New York, 1946

	Cost per system installed	Per cent of total
Motor	$106	23
Fan	170	36
Belts and pulleys*	5	1
Wiring	59	13
Ducts	125	27
Total cost	465	100

* Belts and pulleys were included with motor, fan or wiring costs, on some farms where these items could not be separated.

Motor size varied considerably on the 27 farms. The five horsepower motor was used on nineteen systems. The largest motor in use was the seven and a half horsepower and was used on six systems. Three horsepower motors were used for eleven systems. One system was powered by a one horse motor and another by a one and a half horse motor.

All systems were installed according to the recommendations of an agricultural engineer. Motors and fans of proper size for the mow capacity were used; thus, motor size was a fairly reliable indication of the size of the system. The cost per system was not greatly different for those systems powered by 5.0 horse motors compared with 7.5 horse motors (table 2). This survey showed no difference in cost of motors because a number of the 7.5 horsepower motors were second hand. Systems powered by 3.0 horse motors cost considerably less than the larger systems. Much of the lower system cost of 3.0 horsepower motors was due to higher costs of motors and ducts for the larger systems.

TABLE 2. MOTOR SIZE AND COST OF MOW CURING SYSTEMS

23 Farms in New York, 1946*

	Horsepower of motor		
	7.5	5.0	3.0
Number of systems	6	17	7
Average per installation			
Motor	$106	$125	$ 79
Fan	204	181	156
Duct	133	157	81
Other	75	66	76
Total cost	518	529	392
Investment per ton stored, 1946	7.60	12.60	9.35

* Those farms with two systems of different sizes and those systems powered with 1.5 horsepower motors were omitted.

Systems with 5.0 horsepower motors had about the same total investment as those powered by 7.5 horse motors, but the investment per ton stored was considerably higher on 5.0 horsepower systems because of the smaller quantity of hay cured.

The average motor cost per system was $106 but motors varied in cost from $35 to $155. The chief reason for variation in cost was the size of motor. All fans except one were new when installed. The average cost of fans was $170 but the variation was from $110 to $283 (table 2).

Ducts varied widely as to method of construction, the proportions of farm materials and farm labor used, values assigned to farm labor and materials and the amount of additional wiring or flooring necessary because of the installation of mow curing systems. For these reasons the cost of ducts showed great variation. On those farms where farm

labor was employed in construction of ducts, the cost was below average. On farms where labor was hired, ducts cost an average of $236 even though the systems were not larger than average. Average cost of ducts on all farms was $125 (table 2).

Wiring costs were influenced by amount of rewiring necessary because of the addition of a heavy motor to the electric system. Not all the costs of rewiring were charged to the mow curing system since wiring was often used for other purposes.

Cost of System and Quantity of Hay Cured on System

There was a marked relationship between the tons of hay stored and the cost per farm of mow drying equipment (table 3). Those farms with small tonnages had lower than average total cost of installing systems but the cost per ton was higher than for those farms with larger systems.

TABLE 3. QUANTITY OF HAY STORED AND INVESTMENT IN MOW CURING EQUIPMENT

27 Farms in New York, 1946

Tons of hay stored, 1946	Average tons	Number of farms	Total investment	Investment per ton stored, 1946
20 to 40	31	10	$472	$15.30
40 to 60	48	8	582	12.10
60 or more	106	9	987	9.30

COST OF OPERATING MOW CURING SYSTEMS

The average operating cost per system was about $102 for the season. The largest items in operating expense were depreciation and electricity, each making up about one-third the total operating cost for the season

(table 4). Repairs were a minor expense partly because of the nature of the equipment and partly because all these systems were in their first or second years of use. Only five farms had repair expense for mow curing systems. Nearly all farms had the same electricity cost per kilowatt hour. This cost for electric power, therefore, indicated very closely the number of kilowatt-hours used.

TABLE 4. ESTIMATED AVERAGE COST OF OPERATING MOW CURING SYSTEMS

27 Farms in New York, 1946

Item of cost	Average cost for the season	Per cent of total
Depreciation	$37.70	37
Repairs	3.10	3
Electricity	31.60	31
Insurance	1.75	2
Housing	6.00	6
Interest	21.65	21
Total	101.80	100

The cost of housing, for all systems, regardless of size, was charged at $6.00. Insurance was charged at $4.00 per $1,000 average inventory value. A charge of 5 per cent on average inventory value was made for interest. Electricity was estimated by farmers usually through a comparison of electric bills. The straight line method of computing depreciation was used based on the following number of years use for each part of the systems: motors, 10 years; wiring, 20 years; belts and pulleys, 10 years; ducts, 20 years.

Operating Costs and Quantity of Hay Cured on System

The cost per ton of operating mow curing systems throughout the

season depends on the number of tons cured on systems and the total cost of the operation. Cost per ton of operating systems may be more significant than total cost of operation. The cost of curing hay on mow curing systems averaged $2.69 per ton but varied from $.83 to $5.80. Tons cured on systems varied from 20 tons to 175 tons. Farms curing relatively few tons had high cost per ton. Those farms curing large quantities of hay had operating costs per ton that were 40 per cent less than for farms curing small quantities of hay (table 5).

TABLE 5. NUMBER OF TONS CURED AND OPERATING COSTS PER TON OF MOW CURING SYSTEMS

27 Farms in New York, 1946

Tons mow cured		Number	Cost
Group	Average	of farms	per ton
20 to 40	31	10	$3.25
40 to 60	48	8	2.80
60 or more	106	9	1.95

Total electricity cost for mow curing was considerably higher for those farms storing 60 or more tons of hay. However, electricity cost per ton was no higher for this amount cured than for those farms storing an average of 48 tons of hay (table 6). For those farms which cured an average of 31 tons of hay electricity costs per ton were highest.

TABLE 6. NUMBER OF TONS CURED AND ELECTRICITY COST PER TON

27 Farms in New York, 1946

Tons mow cured Group	Average	Number of farms	Electricity cost per ton
20 to 40	31	10	$.95
40 to 60	48	8	.65
60 or more	106	9	.65

Total depreciation for mow curing systems did not vary greatly with different amounts of hay stored. For this reason depreciation charges per ton were lower with larger amounts of hay stored on systems (table 7).

TABLE 7. NUMBER OF TONS STORED AND DEPRECIATION COST PER TON

27 Farms in New York, 1946

Tons mow cured Group	Average	Number of farms	Depreciation cost per ton
20 to 40	31	10	$1.20
40 to 60	48	8	.90
60 or more	106	9	.35

To summarize, farms with large systems cured large quantities of hay and had higher total costs of operating mow curing systems throughout the season. However, the cost to mow cure a ton of hay on large systems was less because of lower electricity and depreciation costs per ton of hay.

Operating Cost and Rate of Placing Hay on System

The rate at which hay is placed on the system may affect the number

of hours of operation and therefore the electricity cost per ton. On eight farms the rate of application was obtained. There appears to be a relationship between the amount of hay stored per day and electricity costs. The system on which most hay was stored per day had one of the lowest electricity costs per ton and that farm with the lowest rates of application had one of the highest electricity costs per ton. Information was not obtained for study of the relation of cost per ton and moisture content of hay nor the relation of moisture content and rate of placing hay on the system.

Operating Cost and Size of System

The size of the system as measured by motor size appears to be related to cost per ton (table 8). The cost per ton for systems powered by 7.5 horsepower motors was 45 per cent less than the cost per ton on those systems powered by 3.0 horsepower motors. It must be recognized that there is a limited number of records in the groups. However, the three farms using 7.5 horsepower motors had a small range in cost per ton.

TABLE 8. MOTOR SIZE AND COST OF OPERATION PER TON OF HAY MOW CURED

23 Farms in New York, 1946*

Motor size in horsepower	Number of farms	Cost per ton of operating system
7.5	3	$1.50
5.0	15	2.80
3.0	5	2.75

* Those farms with two systems of different sizes and those systems powered with 1.5 horsepower motors were omitted.

CURING HAY

Curing Time in the Field

One of the important advantages of mow curing was that it reduced the time hay remained in the field for curing. The reduction in curing time may have eliminated some deteriation in hay quality due to rain damage.

Better labor distribution was one result of mow curing. Hay was moved into storage with less curing time which distributed work more evenly over the haymaking season. In field curing hay a greater proportion of the labor in handling hay had to be done during periods of favorable weather. In mow curing hay some of this work was done during less favorable weather.

Detailed records of curing time for mow and field cured hay making operations were taken for each piece cut on seven farms. These records showed the number of days between mowing hay and hauling it to the barn for four periods during the haymaking season (table 9). For the hay cut prior to June 30 field cured hay was in the field for an average of 5.0 days. For mow dried hay the hay was cured an average of 3.2 days. Early in the haying season, then, mow cured hay was left in the field for curing almost two days less than field cured hay. The difference was less, however, as the season advanced and averaged less than one day for haying operations begun July 14 or later. Then the hay when cut had reached a more advanced stage of maturity and contained less moisture.

TABLE. 9. NUMBER OF DAYS BETWEEN CUTTING AND HAULING, FOUR WEEK PERIODS

7 Farms in New York, 1946

Date	Number of days between cutting and hauling		
	Field cured	Mow cured	Difference
Before June 30	5.0	3.2	1.8
June 30 to July 7	3.7	2.6	1.1
July 7 to July 14	3.3	1.8	1.5
July 14 and after	2.0	1.2	.8
Average for the season	3.5	2.2	1.3

Method of Curing and Rain Damage

About 70 per cent of the hay cut prior to July 1 was mow cured and about 30 per cent was field cured. For the first cutting of hay a higher proportion of field cured hay was rained on than mow cured hay, even though the latter was cut earlier in the season during poorer weather. Hay that was rained on was left in the field the same length of time as an average for the season whether mow cured or field cured.

Turning and tedding hay are operations frequently associated with rain damage. There was no difference in quantity of mow cured and field cured hay turned and tedded.

A higher proportion of mow cured hay was handled early in the season during more unfavorable weather conditions and a lower percentage of this hay was rained on indicating that mow curing prevented some rain damage.

Method of Curing and Cost of Field Operations and Man Hours per Acre

One possible objection to mow curing hay would be the additional

time and cost involved in field operations and in hauling and storing mow cured hay. On seven farms detailed information was obtained for each piece cut on labor and costs for cutting, mowing, raking, tedding, and hauling and storing.

Farmers in this survey cut an average of 3.5 acres per piece when field curing hay and 3.1 acres per piece when mow curing hay. Labor used on field operations was almost the same for mow and field curing hay. For mow cured hay 3.2 man hours per acre were used in cutting, raking, tedding, and turning. For field cured hay farmers used 3.1 man hours per acre for those operations. There was no significant difference in man hours per acre for any of the operations.

Costs were slightly higher for the field operations in mow curing than for field cured hay. This was true of cutting, tedding, and raking. Turning costs were lower for mow cured hay.

There was no significant difference in man hours to haul hay from fields and store in mows. For field cured hay 2.3 man hours per ton were used; mow cured hay took 2.4 man hours per ton. Costs in moving hay from field to storage averaged $3.10 for field cured hay and $2.80 for mow cured hay.

DESCRIPTION OF FARMS

Most of the farms surveyed were specialized dairy farms. Dairy cattle were the only important livestock but a few farms had important poultry enterprises. There was an average of 26 cows and 23 head of dairy heifers per farm (table 10).

TABLE 10. AVERAGE NUMBER OF LIVESTOCK PER FARM

27 Farms in New York, 1946

Kind of livestock	Number per farm
Milk cows	26
Dairy heifers	23
Hens	260
Pullets raised	275

Hay was the principal crop grown and amounted to 17 per cent of the total acreage (table 11). Only about eight per cent of the land in farms was in cash crops or crops not contributing directly to the dairy enterprise.

TABLE 11. AVERAGE CROP ACRES PER FARM

27 Farms in New York, 1946

Crop	Acres per farm	Per cent of total
Hay	50	17
Corn for silage	13	4
Corn for grain	4	1
Small grain	39	14
Other crops	10	4
Pasture	102	35
Other land	73	25
Total	291	100

Almost two-thirds of all the hay harvested was mixed hay, consisting of timothy and alfalfa, clover, or ladino clover. On the farms in this survey about one-half the hay was mow cured and about one-half was field cured. About 65 per cent of the alfalfa hay was mow cured. Only about 16 per cent of the timothy in the first cutting was mow cured. Other kinds of hay were about one-half mow cured and one-half field cured (table 12). A smaller proportion of the second cutting was mow cured than the first cutting.

Hay was harvested by a wide variety of methods. Not all possible methods were included, nor do the methods covered in this survey reflect the importance of each method of harvesting hay in New York. On some farms several methods of harvest were used.

TABLE 12. KINDS AND ACRES OF HAY MOW CURED AND FIELD CURED

27 Farms in New York, 1946

Kind of hay	Field cured		Mow cured	
	First cutting	Second cutting	First cutting	Second Cutting
	Average acres per farm			
Alfalfa	1.2	1.6	2.2	.7
Clover	1.7	---	1.7	1.8
Timothy	7.9	---	1.5	---
Mixed	15.1	4.1	16.7	1.3
Total acres	25.9	5.7	22.1	3.8
Total tons	62.7	6.1	58.5	2.6

About one-half the first cutting of field cured hay was handled with loader with various combinations of hauling and storing. About two-thirds of the first cutting of the mow cured hay was handled this way (table 13).

Buckrakes and balers were important methods of harvest. The same methods were used in cutting second cutting hay but more hay loaders were used. All second cutting mow cured hay was handled with a hay loader.

The average labor force on these farms was about equal to three men although family labor was widely used (table 14). The average labor force consisted of the operator full time for a year, one full time hired man and slightly less than the equivalent of one year of unpaid labor. On farms with small tonnages of hay family labor was utilized more than on farms with large tonnages of hay.

TABLE 14. AVERAGE NUMBER OF MONTHS' LABOR FOR THE YEAR FURNISHED BY VARIOUS TYPES OF FARM LABOR

27 Farms in New York, 1946

Tons of hay harvested per farm	Number of farms	Months per farm				
		Operator	Hired man	Day help	Unpaid family labor	Total
Less than 70	9	12.0	6.7	.2	6.4	25.3
70 to 120	8	12.0	9.9	.8	13.1	25.8
120 or more	10	11.6	24.8	1.8	8.0	46.2
All farms	27	11.9	13.6	1.4	9.3	26.2

The labor force used in various haying operations depended upon the labor available, the job to be done and the equipment used. The most common method of cutting hay on these farms was with a tractor mower and one worker, although a small amount of hay was cut with a horse mower pulled by a tractor and using two men. One man operated rakes or tedders. A few acres were turned and bunched by hand.

TABLE 13. AMOUNTS OF HAY HARVESTED

26 Farms in New York, 1946

Method of harvest	Field cured			Mow cured		
	Number of farms	Total acres	Total tons	Number of farms	Total acres	Total tons
First cutting						
Loader and wagon or truck	20	319	766	18	379	1042
Buckrake	5	124	320	7	96	213
Pitched on by hand	1	13	32	1	16	47
Field chopper	--	---	---	2	59	129
Field baler	8	202	433	1	18	59
All farms, first cutting	24*	658	1551	26*	568	1490
Second cutting						
Loader and wagon or truck	4	90	106	5	103	70
Buckrake	1	5	2	-	---	---
Pitched on by hand	1	5	8	-	---	---
Field baler	2	54	48	-	---	---
All farms, second cutting	8*	154	164	5*	103	70
Total harvested	24*	812	1715	26*	671	1560

* More than one method of harvest was used on a number of farms.