North Carolina Agr. Exp. Sta.
Agricultural Engineering
Information Circular No. 17
March, 1965

Tobacco Curing Tests Using LP Gas and No. 2 Fuel Oil

TOBACCO CURING TESTS USING LP GAS AND NO. 2 FUEL OIL

Rupert W. Watkins
Extension Assistant Professor
Department of Agricultural Engineering
N. C. State of the University of North Carolina at Raleigh

and

W. D. Toussaint
Professor
Department of Agricultural Economics
N. C. State of the University of North Carolina at Raleigh

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INTRODUCTION

This study was conducted to compare certain characteristics of tobacco cured by two popular fuels and to establish, under farm conditions, relative curing costs associated with the two fuels.

Experimental tests were conducted during 1963 and 1964 in which similar lots of tobacco were cured with the two fuels: LP gas and No. 2 fuel oil. Data were collected concerning: (1) Market value of cured tobacco,

(2) Weight of cured tobacco, and

(3) Fuel consumption

To assure validity of the test results for farm use, the tests were conducted in cooperation with local tobacco farmers using their tobacco and curing facilities. The farmers were selected according to the following criteria:

(1) An established reputation for growing and curing good tobacco.

(2) Previous experience in curing with the two types of equipment and fuels used in the tests.

(3) Capability of exercising good judgment in harvesting, curing, storing, and marketing tobacco.

(4) Sufficient tobacco acreage and harvesting labor force to load two barns of tobacco on the same day for each cure of the season.

The 1963 trials were conducted by Mr. Thomas F. Allen of Johnston County. The 1964 trials were conducted by Mr. Charles B. King of Wake County.

To assure a fair evaluation of the two fuels, the following factors were given special attention:

(1) Types of curers

(2) Structure and condition of curing barns

(3) Loading procedure

(4) Storage and marketing

PROCEDURE

Types of Curers

The types of curing systems currently most popular were used in the test barns. On each farm a jet type oil curer and a multiple unit type gas curer were used. In each case the curers were equipped with modern thermostats and controls and were installed and serviced by a local dealer.

Structure of Curing Barns

1963 Barns

The barns used in the 1963 tests are shown in Figure 1. Both barns have concrete block foundations and frame construction with one-inch wood sheathing and green roll-roofing on the walls. Both have metal roofs nailed to spaced sheathing boards.

Bottom ventilation for the two barns was identical. In each barn the bottom vents consisted of the core openings of eight foundation blocks (two in each wall) laid on their sides. The total area of these core openings in each barn was approximately 3.5 square feet. Top vents with fixed openings provided about 12 square feet of top ventilation for each barn during the first four cures. After the fourth cure, adjustable top vents were installed. Thus, there was a possibility of a slight difference in top venting for the last two cures.

Although the barns used in the 1963 tests were slightly different in shape, each provided approximately the same (within 2%) curing space. The barn with the bas burners had four rooms which were 16 feet long and had eight full length or "body" tiers. The barn with the oil burner had four rooms which were 18 feet long and had seven body tiers. Vertical spacing of tiers was the same in both barns. To compensate for the 2 per cent additional body space in the gas barn, a few sticks

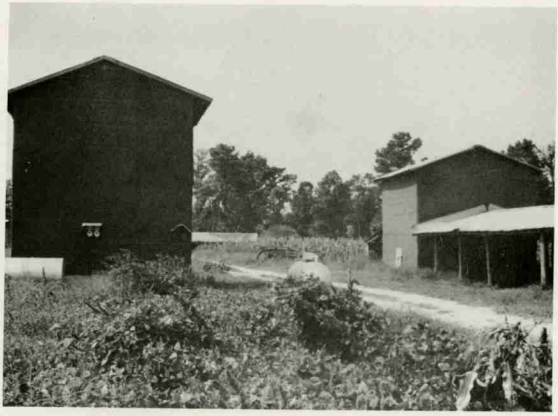

Figure 1. Mr. Allen's barns which were used in 1963 tests.

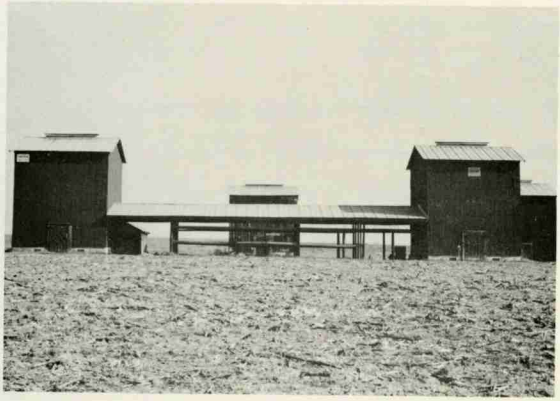

Figure 2. Mr. King's barns which were used in 1964 tests.

of tobacco were hung in the "gable" or short tiers of the oil barn, and stick spacing was kept the same in both barns.

1964 Barns

The barns used in the 1964 tests are shown in Figure 2. For all practical purposes these barns were identical. Both were built at the same time and by the same pattern. Each had a concrete block foundation, frame construction, one-inch wood sheathing and roll roofing walls, and metal roofs nailed to spaced sheathing boards. Each had four rooms, 16 feet 8 inches long, with seven body tiers.

Bottom ventilation in each of these barns consisted of eight adjustable vents (two in each wall), with a total maximum open area of approximately 4 square feet. Each barn had adjustable ridge vents of the same make.

Loading Procedure

1963 Tests

An 8-acre field of one variety, Speight G5, was chosen from Mr. Allen's 26 acres of tobacco to provide a uniform quantity of tobacco for each test barn.

Both barns were filled on the same day in each cure.

In filling the barns, sticks of tobacco were taken at random from the same set of stringing racks or storage pile.

An equal number of sticks of tobacco was placed in each barn.

Sticks were spaced equally in each barn.

Six cures or primings were made during the season.

1964 Tests

Tobacco of similar quality and of one variety, Coker 319, was used to fill the test barns for each cure on Mr. King's farm.

Both barns were filled on the same day in each cure.

Consistent with this farm operation, tobacco was placed directly into the barn as it was strung onto sticks. One "room" of one barn was loaded, then one room of the other, and so on. To equalize any possible variation within the field, the first room of tobacco was placed in the gas barn on alternate weeks and in the oil barn on alternate weeks.

An equal number of sticks of tobacco was placed in each barn.

Sticks were spaced equally in each barn.

Six cures or primings were made during the season.

Curing

Mr. Allen and Mr. King exercised their best judgment relative to curing techniques. Each cured his own tobacco the way he thought best. Both farmers were familiar with the operation of oil and gas curers, and each had an outstanding reputation for knowing how to cure tobacco.

Storage and Marketing

On both farms the tobacco from each cure for each barn was kept separate during storage and market preparation. On each farm the tobacco from both barns was stored in the same pack house.

Tobacco from both barns was prepared for market in the same manner by the same people. In Mr. Allen's method of market preparation, only the dead or non-salable tobacco was picked out. These few leaves were discarded, and all the remainder was tied in one grade. In Mr. King's method, the tobacco was graded slightly closer. Small trash and green grades were picked out and sold as such.

Each farmer followed his usual practice of selling his tobacco when and where he thought best. Tobacco cured by both systems in each priming for an individual farm was placed side by side on the warehouse floor. Baskets of

tobacco were sold during the same sale with no identifying markings to indicate the curing method.

RESULTS AND CONCLUSIONS

Weight of Cured Tobacco

The warehouse weight of the tobacco cured by the two fuels is shown in Table I. These figures represent the total salable tobacco from the respective cures. There is a difference of 10 pounds per cure in favor of oil curing, but this difference is not statistically significant. Of the 12 cures, the weight was greater for gas 6 times and oil 6 times. It is concluded that in these tests the type of fuel used did not affect the weight of tobacco cured.

TABLE I

Market Weight of Tobacco Cured by LP Gas and Fuel Oil

Cure No.	Number of Sticks	Weight	
		LP Gas	Fuel Oil
	1963 Tests		
1	545	766	812
2	465	900	882
3	486	1210	1134
4	417	1082	1190
5	526	1466	1520
6	520	1432	1396
		6856	6934
	1964 Tests		
1	406	764	760
2	450	1038	1032
3	364	976	940
4	480	1382	1392
5	520	1756	1822
6	586	1802	1814
		7718	7760

Market Value of Cured Tobacco

Selling price and government grade were used in these trials to denote the market value of the tobacco cured by the two fuels. Table II shows these prices and grades. This information is summarized in Table III.

TABLE II

Selling Price and Government Grade of Tobacco Cured by LP Gas and Fuel Oil in Farm Tests

Cure No.	Gas			Oil		
	Weight	Gov. Grade	Selling Price	Weight	Gov. Grade	Selling Price
1963						
1	766	P5F	62.3	812	P5F	60.0
2	900	P4F	65.3	882	X4F	68.0*
3	1,210	C4KM	73.4	252	X4KM	72.0
				882	C4KM	72.3
4	1,082	C4KM	73.2	1,190	C4KM	70.7
5	1,466	B4K	64.8	1,520	B4K	68.0
6	1,432	B5K	59.0*	1,396	B5K	59.0*
Average Price			66.2			66.4
1964						
1	640	P4L	56.7	640	P4L	57.7
	68	N2	18.0	70	N2	18.0
	56	N1GL	30.0	50	N1GL	35.0
2	846	X4F	71.7	876	X4F	71.0
	76	N1GR	33.0	58	N1GR	36.0
	116	N2	22.0	98	N1L	30.0
3	890	H4F	74.0	840	H4F	74.0
3 + 4	58	N1L	41.0**	56	N1L	41.0**
	22	N2	22.0**	12	N2	22.0**
	6	No-G	22.0**	32	No-G	22.0**
4	1,382	H4F	74.0	1,392	H4F	74.0
5	1,706	B4F	73.0	1,716	B4F	72.7
	10	B5KM	50.0***	58	B5KM	50.0***
	40	N1XL	63.0**	48	N1XL	63.0**
6	1,682	B4FR	71.9	1,692	B4FR	69.0
	92	N1XL	55.0**	82	N1XL	55.0**
	28	B6GR	41.0**	40	B6GR	41.0**
Average Price			68.8			68.2

*Received by Stabilization at support price.

**Small trash grades of similar tobacco from gas and oil cures were weighed separately and sold together.

***Both of above designations apply.

TABLE III

Summary of Selling Price and Weight of Tobacco Cured by LP Gas and Fuel Oil

Year	Total Weight (lbs.)		Average Price (¢ per pound)	
	Gas	Oil	Gas	Oil
1963	6856	6934	66.2	66.4
1964	7718	7760	68.8	68.2

These data suggest that there was no difference in prices received for tobacco cured with the two types of fuel. Thus, it is concluded that neither selling price nor cured weight are affected by the type of curing fuel used.

Fuel Consumption

Fuel cost is the major part of the operating cost in curing tobacco. Only the number of gallons of fuel used in these tests is presented here. Curing costs are discussed in the following section.

1963 Tests

Fuel consumption in the 1963 tests was determined as follows:

Each test barn had its separate fuel supply tank.

Tanks were filled before the first cure was started.

Delivery receipts and records were kept for each barn throughout the season.

Tanks were filled after the last cure was completed.

Table IV shows the fuel used by the two curing systems during the 1963 season.

TABLE IV

Fuel Used in 1963 Tests

	LP Gas (gallons)	Fuel Oil (gallons)
Total for 6 cures	1675	1174
Average per cure	279.1	195.6

1964 Tests

Fuel consumption in the 1964 tests was determined as follows:

Flow meters (Figure 3), sealed by the Department of Weights and Measures of the North Carolina Department of Agriculture, were placed in the supply line of each test barn.

Meter readings were recorded for each cure.

Table V shows fuel consumption figures for the 1964 tests.

TABLE V

Fuel Used in 1964 Tests

Cure No.	Fuel Used	
	LP Gas (gallons)	Fuel Oil (gallons)
1	199.1	127.9
2	214.8	158.1
3	199.9	135.2
4	237.1	162.8
5	212.1	142.8
6	186.1	132.6
Total	1249.1	879.4
Average per cure	208.2	146.6

As can be seen in Table IV and Table V, each farmer used approximately three gallons of LP for each two gallons of fuel oil. This ratio of roughly three gallons of LP gas for each two gallons of fuel oil was expected since:

(1) The heat of combustion of one gallon of fuel oil is roughly one and one-half times as great as the heat of combustion of one gallon of LP gas, and

(2) Essentially all of the heat of combustion of either fuel was utilized by these "direct fired" systems.

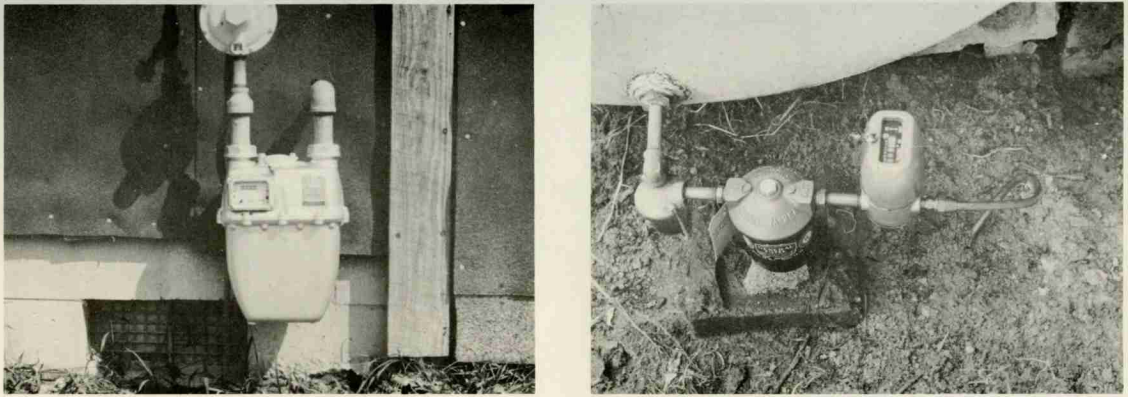

Figure 3. Flow meters for gas (left) and oil (right) were installed in the fuel supply line of each test barn in the 1964 tests.

These results confirmed experiment station research reported by Hassler[1/] and others in 1957. Table VI shows the agreement of these farm tests with experiment station research.

TABLE VI

Fuel Consumption Ratios Found in Farm Tests and Experiment Station Research

Test	Fuel Used (gallons per cure)		Ratio
	LP Gas	Fuel Oil	Gal.LP/Gal.Oil
1963	279	196	1.43
1964	208	147	1.42
1957	145	100	1.45

Curing Time

The average curing time in the 1963 tests was: 150.7 hours for the oil curer and 141.1 hours for the gas curer. In the 1964 tests the average was 143.2 hours for oil and 134.5 hours for gas.

Curing Cost Analysis

Fuel cost is the major cost involved in curing tobacco, but there are overhead costs associated with owning a curer. In addition, the oil curer requires a small amount ($.30 per cure in these tests) of electricity.

Initial costs of the two types of curers vary considerably, but average prices installed are about $150 for the gas curer and $300 for the oil curer. There is an electrical installation fee of about $10 for the oil curer. Thus, overhead costs are computed on initial costs of $150 and $310 for the two types.

A 10-year life is assumed for both curers. Overhead costs are estimated at 17% of initial cost for both types. This is based on 10% for depreciation, 3% for interest, 2% for repairs, and 2% for insurance and taxes. Based on these

[1/] F. J. Hassler, N. W. Weldon, H. B. Puckett, "History of Practices and Research Developments in Bright Leaf Tobacco Curing". Information Circular No. 12, N. C. Agricultural Experiment Station, June 1957.

assumptions, annual overhead costs are $25.50 and $52.70 per barn for gas curers and oil curers, respectively.

The average fuel consumption per barn for 1963 and 1964 was 1462 gallons of gas and 1026 gallons of oil. Assuming the cost of both types of fuel is 15¢ per gallon, fuel costs are $219.30 for gas and $153.90 for oil. Total costs of curing are summarized in Table VII. Curing costs are estimated to be about $36 per barn cheaper for oil than gas under assumed conditions. If 3 acres are cured per barn, curing with oil is $12 per acre cheaper than curing with gas. This saving is relatively small in relation to the total cost of curing. A more important factor in curing than cost may be the ease of obtaining good service should problems arise with the curing unit.

TABLE VII

Estimated Annual Curing Costs for Gas and Oil Curers, Six Cures per Year

Item	Gas	Oil
Overhead cost[1/]	$ 25.50	$ 52.70
Fuel[2/]	219.30	153.90
Electricity	----	1.80
Total annual cost per barn	$244.80	$208.40

1/ Based on 17% of initial costs of $150 and $310 for gas and oil curers, respectively.

2/ Based on fuel consumption of 1462 gallons and 1026 gallons per six cures for gas and oil curers, respectively. A fuel cost of 15¢ per gallon is assumed.

SUMMARY

Farm scale curing tests were conducted in 1963 and 1964 to compare the market value and weight of tobacco cured by LP gas and fuel oil. Information was also gathered on curing cost and curing time with each fuel.

Six cures or primings were made during each season. In each cure similar lots of tobacco were cured in similar barns, one fired by LP gas and one fired

by No. 2 fuel oil. Thus, during each of the two seasons, 12 barn lots of tobacco were cured, 6 with gas and 6 with oil.

Tobacco cured by both fuels in each priming on an individual farm was stored in the same packhouse, prepared for market in the same manner by the same people, and was placed side by side on the warehouse floor.

Based on information obtained in the 24 barn lots of tobacco:

(1) There was no significant difference in the market weight of tobacco cured by the two fuels.

(2) There was no significant difference in the selling price of the tobacco cured by the two fuels.

(3) Approximately three gallons of LP were used for each two gallons of fuel oil.

(4) About nine hours less curing time per cure was required with gas than with oil.

(5) And, assuming initial costs of $310 for the oil curer and $150 for the gas curer, annual overhead of 17% of initial costs (10 year life with 10% for depreciation, 3% for interest, 2% for repairs, and 2% for insurance and taxes), and calculating fuel costs at 15¢ per gallon for gas and for oil, the annual curing cost was approximately $36 more for the gas barn than for the oil barn - six cures per barn.

As any tobacco farmer probably knows, fast and dependable service is a very important factor associated with tobacco curers. A burner that "won't work right" and a service man who "can't come now" can more than offset any advantage associated with either type fuel.

Agricultural Experiment Station

North Carolina State College

Raleigh, N. C.

R. L. Loworn, Director of Research

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