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Cost of Maple Sap Production for Various Size Tubing Operations

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Abstract

Reports sap production costs for small (500 to 1,000 taps), medium (1,000 to 5,000), and large (5,000 to 15,000) maple syrup operations that use plastic tubing with vacuum pumping. The average annual operating cost per tap ranged from $4.64 for a 500-tap sugarbush operation to $1.84 for a sugarbush with 10,000 taps. The weighted average was $2.87 per tap or $11.48 per gallon (assumes four taps required to produce a gallon of syrup). The average annual investment cost for a plastic tubing system ranged from $7.90 for a 500-tap operation to $6.03 for a 10,000-tap system. The average labor time per tap was 4.74 minutes in 1998 compared to 9.60 minutes in 1975. The break-even (zero profit) size for a sugarbush operation was 900, 1,500, and 3,800 taps for a 3.0, 2.5, and 2.0° Brix sap, respectively.

The Author

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Introduction

As with many agricultural businesses, the maple industry has undergone several changes in the last 20 years, not only in the methodology used to produce maple sap but also in the economics of sap production. Sap extraction using plastic tubing with vacuum pumping is preferred by most maple syrup producers. Some producers continue to use the bucket system for sap extraction, but this technique is more labor intensive and requires a larger capital outlay than the tubing system.

Since the 1970's when the Northeastern Research Station's Maple Economic and Marketing Project initiated extensive studies on the costs associated with maple sap and syrup production, few cost updates have been reported (Sendak and Bennink 1985; Huyler and Williams 1994). In the 1970's, a sugarbush with 3,000 to 5,000 taps was considered a large operation. Today**,** there are several maple operations with 12,000 to 15,000 taps. In many cases, these larger operations have bushes in several locations.

Essential to any new business are two forms of capital: 1) investment capital to assemble the physical resources required for production, and 2) operating capital to assure operation during the start-up period. For most new operators who plan to use plastic tubing to extract sap, a key question is: To get started in the maple syrup business, how much will I have to pay for sap production equipment? The answer depends on the size or number of taps that will be installed.

Table 1.—Standard equipment list for tubing-vacuum system

Item	Quantity
Nylon sap spout	1 per tap
5/16-inch sap tubing	15 feet per tap
1/2-inch mainline tubing	2 feet per tap
3/4-inch mainline tubing	1.2 feet per tap
1-inch mainline tubing‘	0.7 feet per tap
5/16-inch connector	0.05 per tap
1/2-inch connector	0.02 per tap
3/4-inch connector	0.012 per tap
1-inch connector	0.007 per tap
5/16-inch end cap	0.04 per tap
5/16-inch tee	1 per tap
4-way wye	0.02 per tap
1- x 3/4-inch reducer	0.002 per tap
3/4 X 1/2-inch reducer	0.004 per tap
Quick clamp	0.082 per tap
Aluminum fence wire	0.7 foot per tap
Quick clamp pliers	1 per operation
Wire ties	1 per operation
Wire tier	1 per operation
Fence wire stretcher	1 per operation
Spout puller	1 per operation
Sap vacuum pump	1 per operation
50-gallon vacuum storage tank	1 per operation
Snowshoes (pair)	1 per operation
Power tree tapper with battery pack	1 per operation
Tapping bit, bit file, and spark plug	1 per operation
Hand tool set	1 per operation

We analyzed the relationship between current physical inputs of production, e.g., equipment and labor used in the sap production phase, and calculated the costs associated with these inputs. Factors such as labor times then were compared to those from a 1975 study of sap production costs (Huyler 1975) to determine any change that may have occurred in the use of plastic tubing systems during the last quarter century. All of these factors were summarized to arrive at: 1) equipment investment and material cost by size of operation, 2) labor productivity and cost by size of sugarbush, and 3) peak labor periods and their distribution.

The objectives of this study were to update the cost of sap production using vacuum pumping for small (500 to 1,000 taps), medium (1,000 to 5,000 taps), and large (5,000 to 15,000 taps) operations, and to compare the distribution of labor time from the 1975 study (tubing system taken down for cleaning and reinstallation the following spring) with that for the tubing-system procedure in wide use today (tubing left in place year round).

Methods

Selection of Sample Sugarbushes

Sample sugarbushes selected for this study were typical tubing/vacuum systems operating in the Northeastern United States. In 1996-97, 12 sugarbush operations were contacted by telephone and a subsequent site visit to obtain the required data. Each of these volunteer operators was experienced in sugarbush management and agreed to provide cost and labor information for the 1996-97 sap season. We specified that the operators have at least 3 years (sap seasons) of experience in the use of plastic tubing for sap collection.

The 12 sugarbushes were divided into three groups: Group 1 consisted of operations (3) with 500 to 1,000 taps; Group 2 operations (6) had 1,000 to 5,000 taps; Group 3 operations (3) ranged from 5,000 to 15,000 taps. There was no requirement that an exact number of taps be established for each sample group.

Equipment and Material Cost

The cost of sap equipment and materials was based on 1998 quoted prices from various sugar maple equipment suppliers and distributors. This cost was based on a standardized equipment list (Table 1) developed from Huyler's 1975 study. New or improved equipment was included in the cost where appropriate. The annual fixed cost for the sap equipment and other fixed costs such as taxes and insurance were included in the total fixed cost. Variable

costs for labor, materials, tap rental, and miscellaneous expenses were combined for each operation to determine the variable annual operating cost per tap.

Labor Input

We recorded the times required to perform the following tasks: preparation, tapping and setup, tubing check and repair, and cleaning and storage. We also determined differences in labor time and distribution for the 1996-97 sap season in which the tubing is left in place year round with those for the 1975 operation in which the tubing network was dismantled and cleaned at the sugarhouse. All labor times were totaled to arrive at a total labor cost.

Preparation.—Preparation included the time required to clean and repair tubing, install tapping equipment, and perform miscellaneous startup tasks. Time began when the initial preparation activity began and ended when the last preparation activity was completed. Times were recorded by the operator to the nearest quarter hour. Any delay time or other activity not directly associated with prepartion time was recorded to determine a delay-free preparation time. Because all tubing systems were left in place year round, we included the time required to reset the tubing network in the sugarbush.

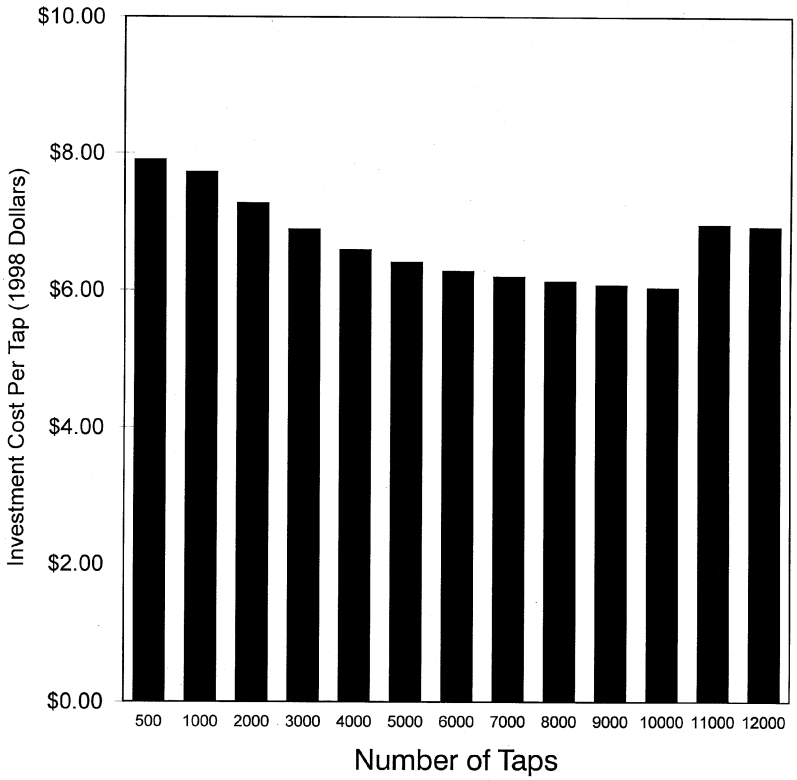

Figure 1.—Investment cost for tubing system in 1998.

Tapping/setup.—Tapping and setup included the time required to tap, insert spouts, reset storage tanks, and perform miscellaneous tasks. Each work activity was recorded to the nearest quarter hour.

Tubing check/repair.—Tubing check and repair included the time required to check the tubing system for leaks, etc., and perform necessary maintenance during the sap season. Time began when the decision was made to check the system and ended when the activity was completed.

Cleaning/storage.—Cleaning and storage included the time required to wash the tubing in the sugarbush and check and store sap production equipment. Time began as soon as preparation for cleaning commenced and ended when sugaring activities ceased and all equipment had been stored.

Cost Analysis

The investment cost was assumed to be a function of output (number of trees tapped), and a curve was fitted to the computed average cost. The average annual operating cost was determined by the ratio of total annual cost to output. Operating cost elements included depreciation on equipment, interest on investment, labor, materials, and land tax. We used a straight-line depreciation schedule and an interest charge of 8.5 percent on the capital equipment.

The labor rate was $6.50 per hour for operator labor, hired labor, and any family labor used in the sugarbush. The materials used in sap production were charged at the actual 1998 cost. We included a flat rate of $0.10 per tap to account for the taxes paid on the sugarbush during that year. This cost was applied on the basis of current average rates in Vermont.

We used a break-even analysis model to determine the zero-profit-size maple sap operation for different sap-sugar contents. Since product value (sap) varies with percent sugar concentration in sap, we included several scales of sugar concentration (degree Brix) in this study.

Results

Investment

The average initial investment for the operations we studied was $6.31 per tap. This cost ranged from $7.90 for small operations (500 taps) to $6.03 per tap for large (10,000 taps) sugarbushes. Figure 1 shows that as size (number of taps) increases, the investment cost per tap decreases up to about 6,000 taps and then decreases at a much slower rate to about 10,000 taps. At 11,000 taps, the cost increases by about $1 per tap. This is the point at which an increase in capital investment is required for additional tapping and other major sap extraction equipment to accommodate the larger number of taps. For example, in sugarbushes of 500

Table 2.—Average operating cost per tap for tubing systems (in 1998 dollars)

Number of taps	Equipment (annual)	Labor	Material	Tax	Total annual cost
500	3.50	0.52	0.52	0.10	4.64
1,000	2.17	.52	.37	.10	3.16
2,000	1.51	.52	.30	.10	2.43
3,000	1.29	.52	.28	.10	2.19
4,000	1.18	.52	.26	.10	2.06
5,000	1.07	.52	.26	.10	1.95
6,000	1.07	.52	.25	.10	1.94
7,000	1.03	.52	.25	.10	1.90
8,000	1.01	.52	.24	.10	1.87
9,000	.99	.52	.24	.10	1.85
10,000	.98	.52	.24	.10	1.84
11,000	1.15	.52	.28	.10	2.05
12,000	1.14	.52	.28	.10	2.04
Weighted average	1.99	.52	.26	.10	2.87
Percent of total cost	69.5	18.1	9.0	3.40	100.0

to 10,000 taps, one or two tapping machines are sufficient to complete the tapping operation in a reasonable time. Larger sugarbushes would need additional equipment to operate efficiently.

Average Annual Production Cost

The average annual sap production cost is simply the total annual cost divided by the output (number of taps). Producers are as concerned with the average per-unit cost of sap as they are with the total production cost. Also, information on average annual cost allows comparison between operations of different sizes. If we use the mean or average annual cost of all operations, which includes average cost elements of labor, equipment, materials, and tax cost, the annual operating cost for plastic tubing systems in 1998 ranged from $4.64 per tap for a 500-tap operation to $1.84 per tap for a 10,000-tap operation. For operations with 11,000 to 12,000 taps, the cost per tap was about $2.05 (Table 2). The weighted average for all operations studied was $2.87 per tap. The two major cost elements, equipment and labor, accounted for nearly 88 percent of the total annual operating cost. If we assume that sap from four taps is required to produce one gallon of syrup, the sap cost would be about $11.50 per gallon for an average size operation.

The downward sloping annual sap production cost curve (Fig. 2) from 500 to about 3,000 taps and the near flattening of the curve from 3,000 to 10,000 taps suggests that economies of scale begin at 3,000 to 4,000 taps, and represent the starting point for the optimum size operation. The flatness of the curve through the 10,000-tap range indicates that there is a wide range of optimum sizes. Diseconomies of scale begin at 11,000 taps (Fig. 2), i.e., the point at which existing equipment reaches maximum efficiency. Thus, the operator of a sugarbush with 11,000 or more taps would be required to invest in additional tappers and other major sap equipment to operaate efficiently. Although we did not study maple operations with more than 12,000 taps, the curve's downward slope suggests that economies of scale would benefit a maple operation beyond this size.

Labor Input

The total time required to operate a sugarbush ranged from 2.92 to 6.93 minutes per tap. The average time per tap for all operations studied was 4.74 minutes (standard deviation of 1.45 minutes). For example, an operator with about 4,000 taps could expect to spend 18,960 minutes or about 316 manhours in the sugarbush each sap season. Table 3 shows the average labor time for each of the four major work activities that occur in the sugarbush. Setup and tapping accounted for 36.4 percent of the total labor time during the 1996-97 sap season versus 56.2 percent in 1975 (Fig. 3).

Table 3.—Comparison of average labor time for each sap production work activity in 1996-97 data and 1975

Activity	Labor time	
	1996-97	1975
	Minutes/tap	
Preparation	0.90	.60
Tapping/setup	1.72	5.40
Checking/repair	.93	1.70
Clean/store	1.19[a]	1.90
Total	4.74	9.60

[a]Clean tubing only.

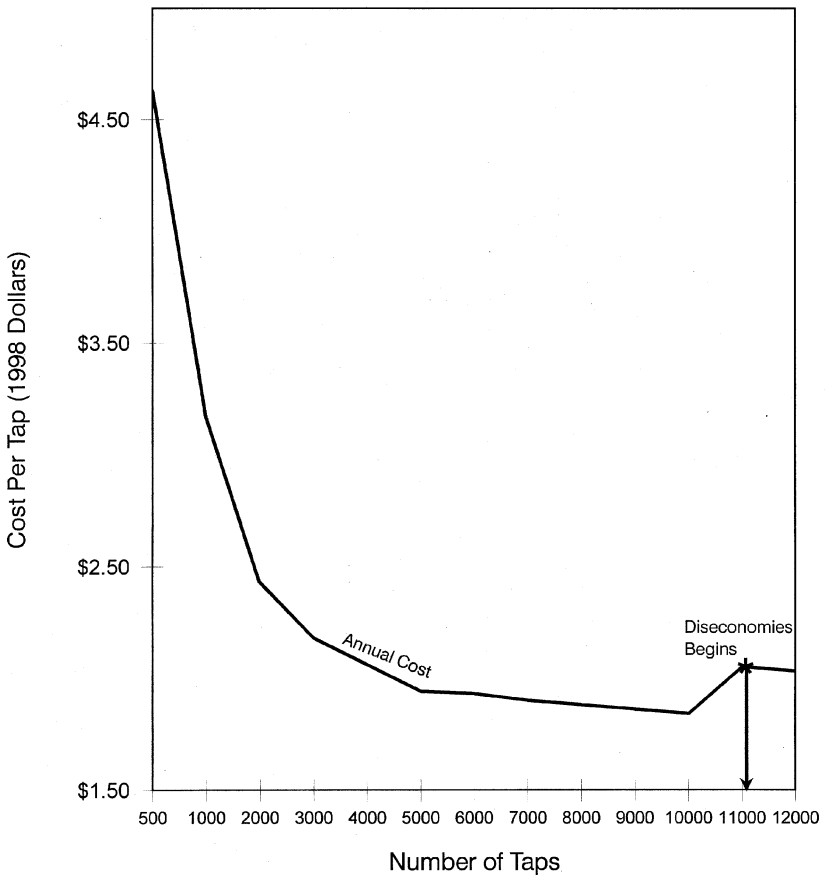

Figure 2.—Average annual sap production cost.

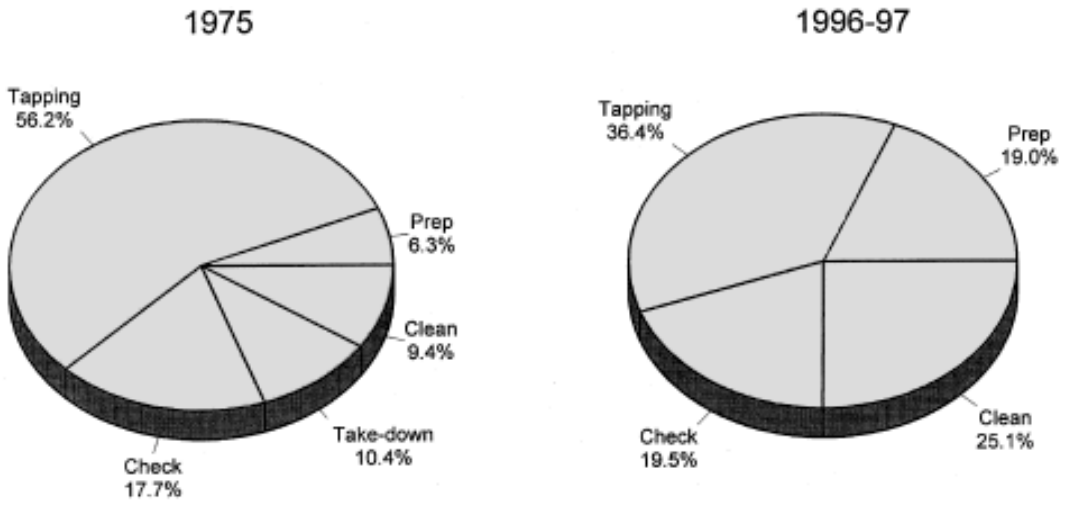

Figure 3.—Percent distribution of labor in 1975 and 1996-97.

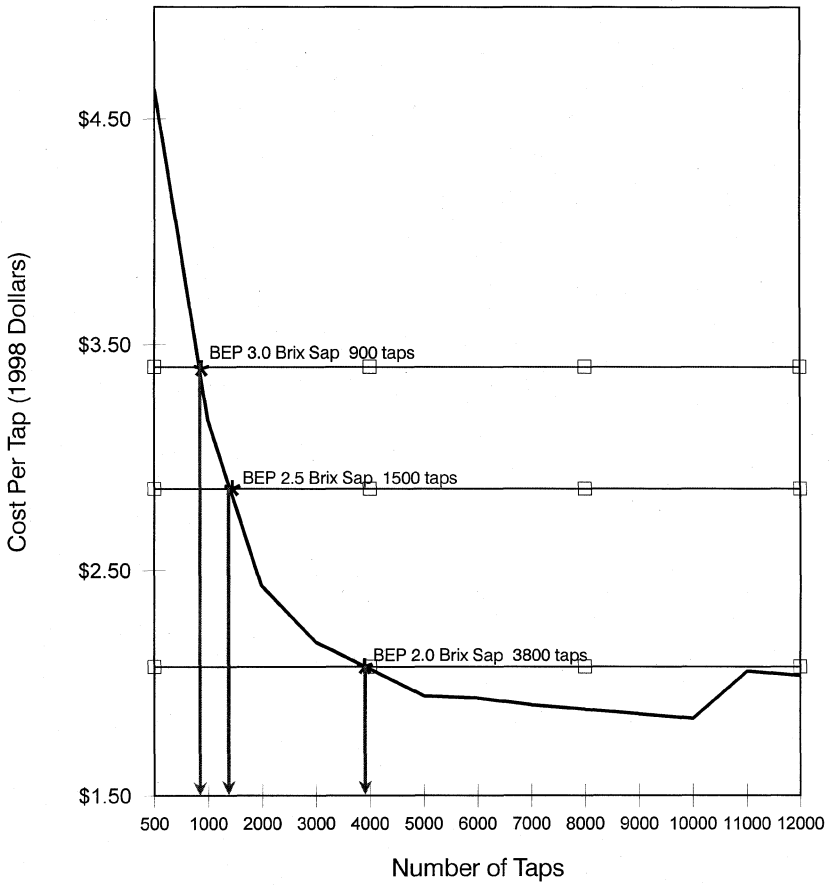

Figure 4.—Break-even points for tubing systems (assuming a yield of 10 gallons of sap per tap).

The total labor time per tap in 1975 was 9.60 minutes per tap, or more than twice the total labor time in 1996-97. Leaving the tubing in place year round required 1.72 minutes per tap to reinstall, whereas taking down the system and reinstalling it the following spring required 5.4 minutes per tap for setup and tapping.

Break-Even Size

The break-even size (zero-profit point) for tubing operations is about 1,500 taps if we assume a sap yield of 10 gallons per tap at 2.5 Brix sap-sugar content (Fig. 4). This figure illustrates the importance of sap-sugar content to sap production: the break-even operation is about 900 taps at 3.0 Brix but nearly 3,800 taps for 2.0 Brix sap.

Conclusion

The key to a successful maple syrup operation is controlling production to maintain an acceptable profit margin. It is important that sugarbush operators keep accurate records so that areas of high cost can be identified and steps taken to reduce them. Costs of production can be used as indicators for setting sap and syrup prices. To produce maple syrup today, an operator would incur an initial investment cost of about $6.31 per tap. The average annual operating cost would be about $2.87 per tap or about $11.50 per gallon of syrup (assuming that four taps are needed to produce one gallon of syrup).

Operators should expect to spend about 4.74 minutes of labor time per tap in the sugarbush. This is about one-half of the time spent in 1975 when the tubing system was taken down and then reinstalled the following spring. Less time is spent in setup and tapping today than in 1975 when the tubing system was taken down, but more time is spent cleaning and checking tubing today than in the past.

As maple syrup producers continue to refine production techniques, for example, installing more main and lateral lines and fewer small sap lines, and using longer drop lines (up to 3 feet) and smaller tap holes (less than 7/16 inch), sap production costs will differ from those reported here.

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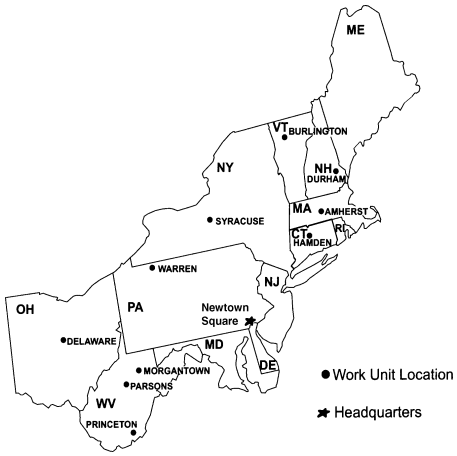
Keywords: sap production, cost, break-even size operation



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