

Maple Syrup Production in Ohio and the Impact of Ohio State University (OSU) Extension Programming

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ABSTRACT

The maple syrup industry in Ohio, which ranks fifth in total production in the United States, is comprised primarily of small family owned operations that are served by The Ohio State University (OSU) Extension system. We evaluated the effectiveness of OSU Extension educational programming designed to improve sugarbush and sugarhouse management through a survey administered at the three 2004 Ohio Maple Days workshops. Most survey respondents indicated that after attending past maple syrup workshops they implemented changes that were relatively simple and inexpensive; however, most indicated they are interested in learning more about technologies that increase production and maple syrup quality.

Keywords: maple syrup, sugarbush, forest management, Extension

Maple syrup production is a sustainable family forestry activity that has a long tradition in North America. Maple syrup was an integral part of many Native American communities, used as the primary sweetener in the Native American diet (Wittstock and Kakkak 1993). Sap was collected in the spring and boiled down to make syrup or sugar using equipment such as clay pots and open fires, which often remained at the site year-round. In many Native American cultures, the rights to these "sugarbushes" were hereditary, passed down from generation to generation. With the arrival of Europeans in the 16th and 17th centuries, maple syrup production in many areas increased providing a cheap and high-quality source of sugar as the tariffs and expense of cane sugar imported from the West Indies made it an unafford-

able luxury (Lawrence et al. 1993, Lockhart 2000).

In many ways, the methods used by early European settlers to produce maple syrup have not changed dramatically over the past 400 years. The major refinements in the process of producing maple syrup have been associated with collection and evaporation technologies (Huyler 1982, Walters 1982, Koelling and Heiligmann 1996), although there has been considerable research on the factors affecting the sap sugar concentration (e.g., Stevenson and Bartoo [1940], Moore et al. [1951], Morrow [1955], Taylor [1956], Kriebel [1961], and Larsson [1967]), tree physiology and sap chemistry (e.g., Marvin 1958, Marvin et al. 1967), the economics of maple product production (e.g., Kearn [1970], Huyler and Garrett [1979], Huyler [1982], Sendak and Ben-

nink [1985], and Huyler and Williams [1992, 1994]), and the genetic improvement of sugar maple for higher sap sugar content (Kriebel 1960, 1989, 1990).

The Maple Syrup Industry In Ohio

During the 19th century, Ohio was one of the largest producers of maple syrup (924,000 gal annually), the third largest producer of maple sugar (614,000 lb annually), and the largest producer of total maple products (equivalent to more than a million gallons annually) in the United States (United States Census Office 1840, 1870, Bryan et al. 1912). Additionally, many maple syrup equipment industries were based in northern Ohio. Ohio generally has ranked about fifth among states in syrup production over the past 10 years, occupying a position ranging from fourth to eighth in any given year (Table 1). In 2003, maple syrup production in the United States totaled 1.24 million gal, down 11% from a 10-year average, with Ohio contributing 75,000 gal, down 15.7% from a 10-year average (USDA–National Agricultural Statistic Service [NASS] 2003).

Ohio's decline in maple production since 1840 is in response to several factors. One of the most important has been the dramatic shift in forest cover. In the mid-1800s, Vermont (representative of much of the

Table 1. Average maple syrup production values from top five producing states from 1992 to 2002.

	Average production (gal)	Average taps (1,000)	Average yield per tap (gal)	Average price (per gal)	Average value of US crop
Vermont	502,000	2117	0.189	\$29.79	\$12,311,200
New York	274,000	1306	0.169	\$27.97	\$ 6,941,100
Maine	197,500	1088	0.213	\$19.68	\$ 1,551,400
Wisconsin	107,800	425	0.175	\$26.55	\$ 2,369,200
Ohio	89,000	398	0.184	\$33.04	\$ 2,528,900

Source: USDA—NASS (2003).

northeastern United States) was only 20% forested because of timber harvesting and land clearing (Vermont Agency of Natural Resources 2005); however, Vermont currently is dominated by forest cover (87%) with sugar maple being the dominant species. Ohio essentially has experienced the opposite trend. In 1840, at the time of the first census of agricultural products, Ohio was 93% forested (Ohio Forestry Association 2003). Ohio's forest cover declined to around 10% by 1900 and has since recovered to approximately 30% today (Ohio Forestry Association 2003).

In addition to the dramatic shift in the maple resource, there have been other important factors responsible for the decline of Ohio's maple production. During the late 1800s the status of maple sugar was transformed from a staple sweetener to a luxury item as cheaper cane sugar was readily available in the American market. Another reason for the decline is the differing roles taken by the various state and government agencies. Although the Ohio Department of Agriculture has not been actively involved in promoting or regulating Ohio's maple syrup industry, the Vermont Department of Agriculture has taken a very active role in promoting and maintaining Vermont's maple industry. This top-down government support in conjunction with very proactive independent producer organizations (e.g., Vermont Sugar Makers Association and Vermont Maple Syrup Promotional Board) has resulted in increased market share across the United States, especially in many upscale markets of the northeastern United States. When contrasted with the Ohio Maple Producers Association, which does very little to promote Ohio maple syrup, or Ohio State University (OSU) Extension, which historically has focused on providing educational support to increase production practices but not marketing strategies, it is not difficult to understand how Ohio's maple production has declined over the past 150 years.

Ninety percent of Ohio's maple syrup operations are family owned and operated, with the business typically passing from one generation to the next (Graham 2005). Although the monetary value from the sales of Ohio maple syrup and other products is small when compared with the row crop or animal husbandry industries, income from maple syrup sales plays a vital role in contributing to the quality of life and economic well-being of many rural Ohio families.

The OSU Extension system has the primary role of providing education and research programming for maple syrup producers across the state. For over 90 years OSU Extension has used a variety of methods to provide producers the latest in research-based information and training that has enabled them to make effective decisions and implement appropriate new technologies and research to increase their productivity and profitability. Integral to this effort has been a series of annual workshops called Ohio Maple Days. These 1-day workshops are held across the state every January and are attended by maple syrup producers from Ohio and surrounding states, including residents of Pennsylvania, New York, West Virginia, Indiana, and Michigan.

In an effort to learn more about where these part-time family operated forest industries obtain information on sugarbush and sugarhouse management and the impact of OSU Extension on these operations, we conducted a survey of the participants attending the three 1-day Ohio Maple Days workshops in 2004. The objectives of this article are (1) to review the advancements in sugarbush and sugarhouse management being implemented in many family owned maple syrup operations in Ohio and (2) to better understand how maple producer educational programs have influenced the production of maple syrup as one of Ohio's primary family owned forest enterprises.

Sugarbush and Sugarhouse Management

The Sugarbush. The heart of any sugaring operation is the sugarbush—the stand of maples (usually sugar maple [*Acer saccharum* Marsh.], as well as black maple [*Acer nigrum* Michx. f.], red maple [*Acer rubrum* L.], and silver maple [*Acer saccharinum* L.]) that are tapped and from which sap is collected. Over 95% of the sugarbushes across Ohio are located in second-growth or third-growth forest stands; however, there are a handful of orchard-type plantations. The average Ohio sugarbush is 27 ac with a range of 0.25–190 ac. Within the traditional sap collection method of buckets, the average size operation has 417 taps with a range of 4–5,000 taps. Within the more modern tubing collection systems, the average size operation has 720 taps with a range of 12–6,500 taps (Graham 2005).

Maple syrup producers must consider the expense in adopting technology and practices that improve profitability and sugarbush health (Figure 1). Sap collection in galvanized metal buckets is the traditional method that is traced back to the use of tin during the Civil War. Before metal containers sap collection in wooden troths from hollowed-out logs and wooden buckets were the standards (Lawrence et al. 1993). More recently developed tubing systems with vacuum have been shown to dramatically increase profitability—they require less capital expense, increase production per tap, and require less labor than a bucket or bag operation (Huyler 1982, Walters 1982, Heilmann et al. 1996). Additionally, the use of tubing contributes to sugarbush health by reducing or eliminating the movement of heavy collecting equipment in the sugarbush during spring, when soils usually are wet and vulnerable to compaction. Ohio maple producers have been slow to implement modern sap tubing collecting systems in that 62% of all taps are found in bucket collection operations and the bucket operations make up



Figure 1. Traditional sugarbush of northeastern Ohio using a bucket collection system. (Photo by Gary Graham.)

78% of all sugaring operations in Ohio (Graham 2005).

Although maple syrup producers in the past often used the sugarbush as pasture or shelter for cattle, sheep, and hogs, livestock is rarely seen in today's sugarbush (Koelling and Heiligmann 1996). Many producers are focused on evaluating sugarbush and tree health, looking for crown dieback, evidence of forest pests, soil compaction, and tree wounds, and then modifying their practices to address the problems. Producers are tapping more conservatively than their predecessors, waiting until the trees are at least 12 in. in diameter before tapping, using fewer taps per tree, and adopting smaller-diameter spouts (five-sixteenths in. instead of seven-sixteenths in.) that produce tap holes that heal more quickly (Heiligmann et al. 1996).

Maple producers also are adopting practices to improve the health and productivity of their sugarbush. Graham (2005) found that 34% of producers in the state follow recommended international tapping guidelines and 62% adjusted tapping levels to tree health. Producers also are using thinning or improvement cuts to encourage the development of healthier trees with larger, deeper crowns, resulting in a greater volume of sweeter sap (Morrow 1955, Larsson 1967, Heiligmann and Staats 1996, Graham 2005). Sap sugar content is tested and used as a criterion for selecting trees for release,

along with more traditional criteria including tree location, crown size, crown class, and tree vigor. In an average year, Ohio sugar maple sap will average about 2% sugar. Individual trees within stands, however, often have sugar contents well in excess of 3% and even 4% or more. Increasing the average sap sugar content from a sugarbush by releasing trees with high sap sugar to develop large, deep crowns translates directly to increased profitability—less sap is required per gallon of syrup produced and less energy is required for evaporation as fewer gallons of water are evaporated to produce a gallon of syrup.

Finally, producers in a position to plant maples, either in plantation, roadside, or as under plantings in a mature stand, are planting seedlings genetically selected for high sap sugar content. These seedlings have been periodically available from several sources for more than 25 years. The sugar content of seedlings grown from one such source, a seed orchard at the Ohio Agricultural Research and Development Center, has ranged from 3.7 to 5.8% for trees from 1 to 14 in. in diameter (Kriebel 1990; Graham 2003, 2005). Establishing the future sugarbush with seedlings with sap sugar contents in that range will dramatically improve potential profitability.

The Sugarhouse. The sugarhouse is the production center of a maple operation, where sap collected in the sugarbush may be filtered and stored for a short time, and then processed into maple syrup and packaged. In simplest terms, the production of maple syrup from sap is the process of evaporating the water in the sap and concentrating the sugar into syrup. Although this evaporation process is simple in concept, the process is critical for producing high-quality maple syrup (Garrett and Dudzik 1989, Heiligmann and Staats 1996). This process also takes considerable knowledge, skill, and equipment to complete.

Historically, water was removed from maple sap and the sugar was concentrated over an open fire in a metal or iron kettle. These techniques used what often are referred to as "batch-type" evaporators, requiring sap to be added continually to the evaporator until the desired amount of maple syrup was obtained. Using these techniques, it was not uncommon to take days to pro-



Figure 2. Typical evaporator used in an Ohio sugarhouse. (Photo by Gary Graham.)

duce 10 gal of dark, strong-flavored maple syrup. Since the early 1900s, most maple syrup producers have used a “flue-type,” continuous-flow evaporator, and this technology has become more efficient over time. In contrast to the “batch-type” evaporator, a typical “continuous-flow” evaporator can produce between 2 and 10 gal/hour depending on size (Huyler 1982, Garrett and Dudzik 1989, Heiligmann and Staats 1996).

Producers also have adopted a variety of ancillary equipment (Figure 2) to improve efficiency and syrup quality during the evaporation process, including in-line ultraviolet light units to minimize microbial contamination; reverse osmosis units for concentrating sap sugar content before boiling, which reduces labor and energy costs and often improves syrup quality; steam hoods (metal covers over the evaporator that trap the steam and exhaust it from the sugarhouse) that preheat the sap and begin the evaporation process; electronic takeoff devices that automatically sense when the syrup has reached the proper finished density and open the draw-off valve; and pressure filters for syrup that use diatomaceous earth as a filtering medium, producing a syrup with an almost “polished” appearance.

Syrup Packaging. Finished syrup may be graded and then immediately must be packaged properly at a temperature above 180° F for storage, sale, or later processing into candy or other confections. Not all maple syrup is graded. Some states, including Vermont and New Hampshire, have state maple grading standards and require that all syrup be graded according to those standards. Most other states do not have such standards and do not require that maple syrup be graded but allow those who wish to grade to use USDA maple grading standards (United States Department of Agriculture 1980). Ohio has state grading standards similar to those of Vermont and New Hampshire, but grading is voluntary (Ohio Administrative Code 2004, Ohio Revised Code 1997). Syrup made in Ohio may be sold by grade using either the Ohio or the USDA maple grades or it can be sold simply as maple syrup. Packaging of syrup in plastic, metal, or glass containers is done in a variety of ways, and there is a wide variety of traditional and modern equipment used. Similarly, for producers who wish to diversify their products and earn additional “value added” income, a variety of equip-

ment is available for making maple candy, cream, spread, and granulated sugar (Heiligmann 1992, 2002).

Associated Costs of Sugaring. One of the greatest challenges to maple producers is the large capital investment required for both sugarbush (e.g., land costs, property taxes, and land management activities) and sugarhouse equipment. There is no doubt that “sugaring” is very labor intensive. However, many small forestland owners find the size of the required capital investment to enter the industry prohibitive. There also are no cost sharing programs available from the federal or state government to improve sugarbush production and management. For example, an individual wishing to develop a small 100-tap bucket operation starting from scratch and using all newly purchased maple equipment can easily invest \$5,000–10,000. Most small family owned producers do not invest anywhere near this much; they reduce their investment by a variety of means, including buying used equipment or using less expensive alternatives such as a flat-pan evaporator rather than a continuous-flow flue-type evaporator.

The challenge to getting into the maple business is not one of profitability, but one of initial investment. Studies from 1985 to 1994 (Sendak and Bennink 1985, Buth 1988, Huyler and Williams 1994) reported the cost of producing a gallon of maple syrup between \$14.41 and \$19.89/gal, depending on the size of the operation and the collection and processing technology used. During this period syrup was selling for between \$23.00 and \$38.00/gal—certainly an acceptable profit. Unfortunately, many potential maple producers do not calculate profitability by depreciating equipment over its usable life (perhaps 20–30 years for an evaporator); they look instead at the initial investment and the expected return, define the point of profit making as the time when they will have paid for all the equipment, and decide based on that criteria that it is “too expensive” to get into maple syrup production. Since USDA–NASS started to report Ohio maple production within the New England report, the average price per gallon of Ohio maple syrup has been \$28.13, with \$29.80/gal in 2002 being the highest and \$15.00/gal in 1996 being the lowest.

Evaluating OSU Extension Maple Programs

Survey Methods. At each of the three Ohio Maple Days workshops in January of

2004, participants were surveyed on the characteristics of their sugarbush, the usefulness of different maple educational programs and publications, the impact that past Ohio Maple Days workshops have had on how they manage their sugarbush and sugarhouse, the major problems associated with implementing newer technologies, and their level of interest in a variety of subjects pertaining to sugarbush and sugarhouse management. The written survey instrument was developed through a review of past workshop topics, discussions with producers, and a pilot focus group of professionals in the maple industry in other states. The survey was administered at the beginning of each workshop and returned during the noon lunch break.

Producers from 40 of Ohio’s 88 counties, as well as from four other states (Indiana, Michigan, Pennsylvania, and New York), attended the 2004 workshops. Total attendance at the three workshops was 289, with 65% of the attendees ($n = 190$) responding to the survey. Of the 190 respondents, 92% represented a single, multiple, or cooperative family operation, and 8% of the respondents represented nonfamily owned maple sugaring enterprises. Most survey respondents indicated they were second-generation producers that had been producing maple syrup for an average of 17 years (range, 1–61 years). Survey respondents were representative of the maple producers across the state because a 2004 survey of the entire state’s maple syrup industry found that Ohio maple producers on average have been producing syrup for 19 years and were typically second-generation producers (Graham 2005).

Sources of Information. Results of the survey indicated that 82% of the respondents relied primarily on the Ohio Maple Days workshops to stay current on issues related to sugarbush and sugarhouse management, and 18% of the respondents relied primarily on workshops and materials provided by the North American Maple Syrup Council, the International Maple Syrup Institute, or other states. Respondents were asked to rate (Likert scale of 1–5) the usefulness of common sources of information on maple syrup production and sugarbush management. Information provided at the Ohio Maple Days workshops was considered the most useful, receiving a 4.1 of 5, followed by other sources, such as the *Ohio Maple News* newsletter (2.1 of 5; Graham 2002), and the *North American Maple Syrup Producers Manual* (2 of 5; Koelling and Hei-

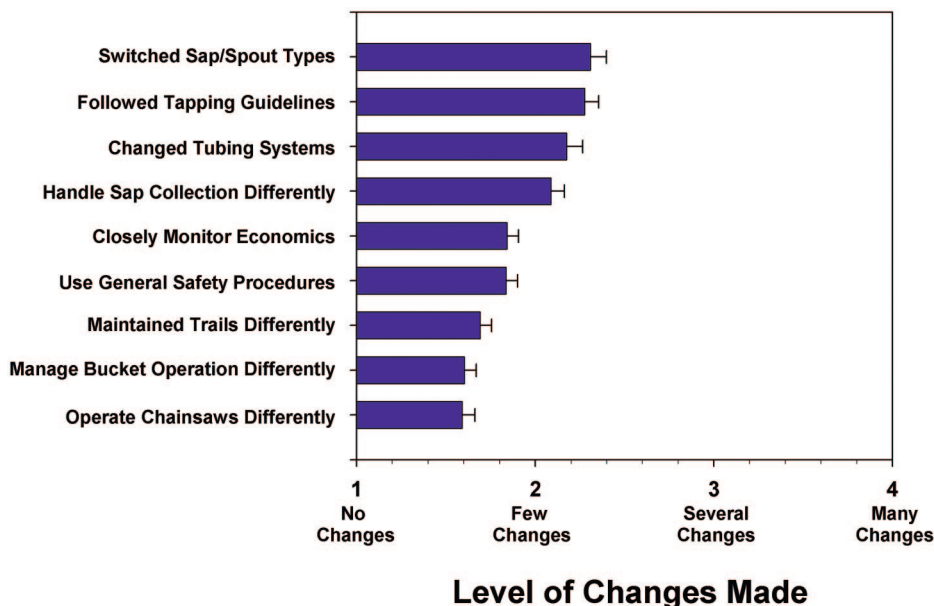


Figure 3. Level of changes made to management of the sugarbush as the result of Ohio Maple Days education programs. Values are mean scores ± 1 standard error.

ligmann 1996), both publications produced by OSU Extension. These results suggest that the primary source of information for family owned maple syrup enterprises in Ohio are the Ohio Maple Days workshops provided by OSU Extension. The fact that the *Ohio Maple News* is produced jointly by the Ohio Maple Producers Association and OSU Extension and the *North American Maple Syrup Producers Manual* is published as an OSU Extension Bulletin further emphasize the important role OSU Extension plays in producer education.

Changes Made in Sugarbush Management. On average, respondents indicated that they had made few changes in the production, economics, safety, or management of their sugarbush in response to information provided at previous Ohio Maple Days workshops. Changes that were implemented were associated with tapping and sap collection, particularly switching spout types, increasing the use of sustainable tapping guidelines, and changing to more efficient tubing systems (Figure 3).

The Ohio Maple Days workshops did influence management activities related to safety and economics; however, the average impact of these educational programs was small. Finally, educational programs designed to inform participants on issues related to stand management, particularly best management practices associated with road and trail management, also had on average some, albeit small, impact on sugarbush management. When asked why few changes

in sugarbush management had been adopted, 27% of the respondents indicated that many were cost prohibitive under current market conditions and 18% indicated that they had little time available to implement the newer technologies demonstrated at the workshops.

Changes Made in Sugarhouse Management. When asked about sugarhouse management, as with sugarbush management, most respondents stated that on aver-

age they had implemented relatively few changes after the Ohio Maple Days programs. Most changes in the management of the sugarhouse were associated with changing or improving maple syrup handling, storage, and filtering procedures, as well as equipment cleaning procedures (Figure 4). Other important changes made were associated with safety protocols, particularly reducing potential lead contamination of maple syrup from lead-based spouts and collecting, handling, and storage equipment, as well as improving maple syrup marketing and sales strategies (Figure 4).

Finally, on average, few respondents implemented new technologies introduced at previous Ohio Maple Days workshops, such as using in-line ultraviolet lights to treat sap, reverse osmosis units to concentrate sap before boiling, or diatomaceous earth sap filters. As with management of the sugarbush, many of the improved technologies associated with increasing the production and quality of maple syrup during processing were considered by many survey respondents as too expensive for their maple syrup operation.

Educational Programming in Sugarbush Management. Respondents were asked to indicate their level of interest in several topics related to the management and production of their sugarbush. On average, production topics that were of highest interest included information on improving tapping systems (including the use of power tappers), tubing

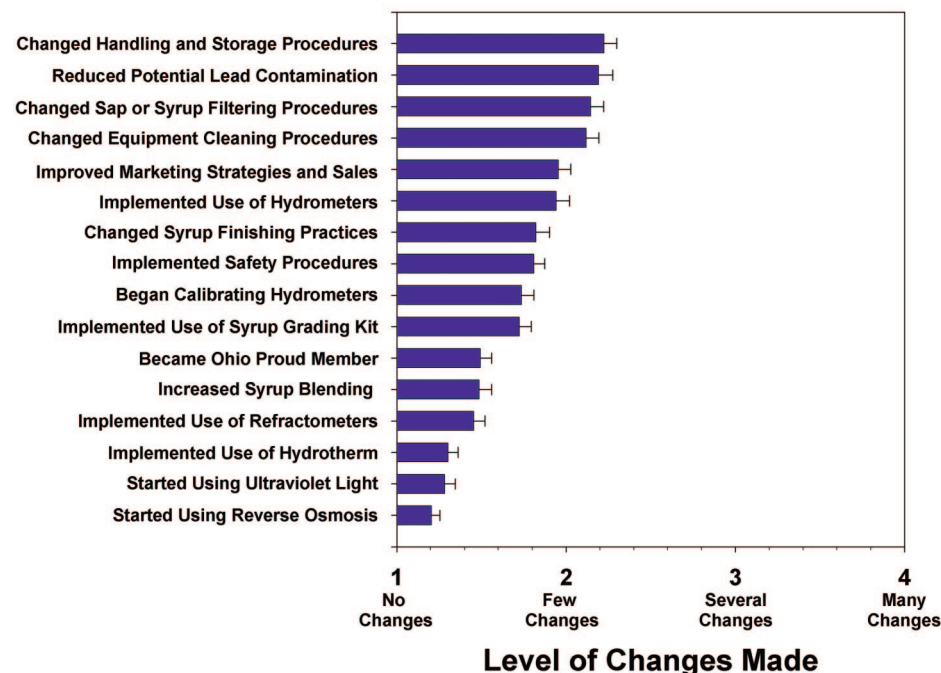


Figure 4. Level of changes made to management of the sugarhouse as the result of Ohio Maple Days education programs. Values are mean scores ± 1 standard error.

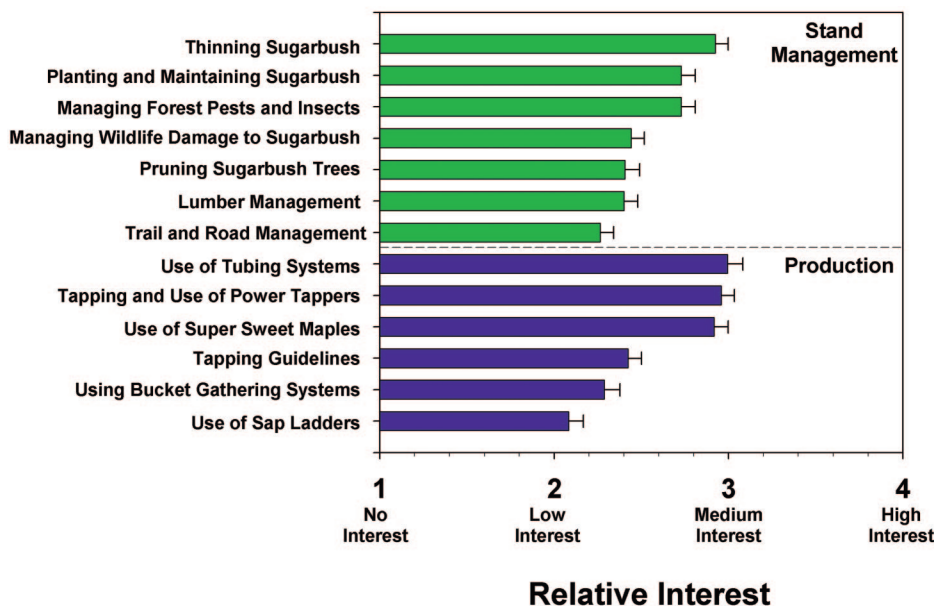


Figure 5. Level of interest in different sugarbush educational programming. Values are mean scores ± 1 standard error.

systems, and the use of genetically improved super sweet maple trees (Figure 5). Additionally, stand management topics of interest to respondents were guidelines for thinning the sugarbush, maintaining the sugarbush (e.g., regeneration, establishment, and maintenance of maple trees), and managing forest pests and insects (Figure 5).

Educational Programming in Sugarhouse Management. Most respondents

stated that information on the use and efficiency of evaporator systems would be of medium to high interest at future Ohio Maple Days workshops (Figure 6). Additionally, information on quality control and quality assurance measures, the control of off flavors, and the use and value of implementing new technologies (e.g., preheater systems and filter press) was of medium interest to the respondents. In terms of mar-

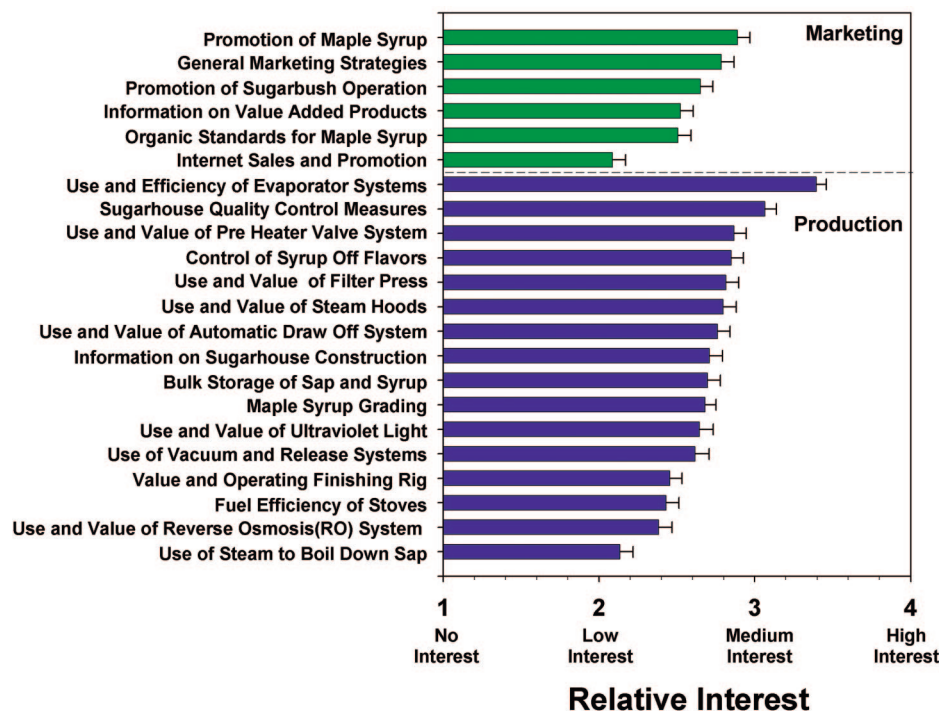


Figure 6. Level of interest in different sugarhouse educational programming. Values are mean scores ± 1 standard error.

keting sugar maple products, general promotion of maple syrup and marketing strategies were of highest interest to respondents from the survey of the Ohio Maple Days workshop participants.

Conclusions

Results from our survey of maple syrup enterprises in Ohio suggest that OSU Extension is the primary source of technical information for these small family owned operations. Most contact with these forest owners is in the form of the Ohio Maple Days workshops, although OSU Extension publications also are a common source of sugarbush and sugarhouse management information. Although past educational programming focused on increasing production and quality, the impact of these programs has been modest, in part because costs associated with implementing newer technologies were high. The majority of changes to both sugarbush and sugarhouse management after past workshops has been associated with techniques or technologies that are relatively inexpensive and easy to implement. Examples include reducing the number of taps per tree, reducing lead contamination from spouts, collection and processing equipment, changing equipment cleaning procedures in the sugarhouse, and maple sap and syrup handling and storage procedures.

These results are not viewed in any way as suggesting that these educational programs for maple producers have failed to achieve their objectives. This survey identified the level of adoption of practices or technologies presented at Ohio Maple Days workshops. As identified previously, the primary objective of OSU Extension's program for maple producers is to provide information and training that will enable them to make effective decisions and implement appropriate new technologies and research to increase their productivity and profitability. Some producers obviously found various practices and technologies presented at Ohio Maple Days programs to be appropriate for their enterprise and others did not. The fact that many did not, but could identify the reason as cost or some other factor, suggests that they received the information needed to make an effective decision. We anticipate that many of the other state Extension programs across the midwestern

and northeastern United States designed to improve sugarbush and sugarbush management likely face the same challenges. Additionally, the results of a more detailed survey of the entire maple syrup industry of Ohio suggest that educational programs need to be designed for specific client groups (e.g., hobby producers, commercial producers, and Amish producers) because each group has different needs and goals that may not be served by a “one-size-fits-all” educational program (Graham 2005).

In addition to providing an array of topics with high producer interest for future workshops, this survey emphasizes the importance of providing information on the cost of implementing recommended practices or technologies and the value received. To some extent, all maple producers have an interest in hearing about new practices and technologies associated with making maple products. However, when it comes to adoption, they will make their decision based on whether or not the practice or technology is appropriate for their specific operation, the cost of adoption, and whether or not adoption will provide them with sufficient value (monetary or otherwise) to justify the cost. As OSU Extension and other educators of forestland owners design future programs, it is critical that information be provided that supports that decisionmaking process.

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