Research: Tubing sanitation

Assessing Strategies for Spout and Drop Sanitation in 5/16" Tubing: Sap Yield, Cost, and Net Profit

Timothy D. Perkins, Abby K. van den Berg,
University of Vermont, Proctor Maple Research Center
Stephen L. Childs Cornell Maple Program, Arnot Forest

Over the past decade, a great deal of research has shown the benefits of improved spout and dropline sanitation on sap yields. Proper use of sanitizing chemicals and replacement of various tubing system components (spouts, droplines) have both been shown to retard taphole drying and result in higher sap production from trees. However there has not been a thorough side-by-side comparison of cleaning versus replacement strategies both alone or in combination, and more importantly, most studies have not examined the costs of each approach and the resulting net profit per tap of these methods.

To remedy that situation, the University of Vermont Proctor Maple Research Center and the Cornell Maple Program Arnot Forest conducted a multi-year study examining several common sanitation strategies and assessing the effects on sap yield, attendant costs, and resulting net profits. The following graphs briefly summarize the results of this work. A larger report is available by email request (Timothy.Perkins@uvm.edu) detailing methods, along with an Excel-based Economics of Replacement Strategies Model for maple producers to estimate results for their own operations.

Treatments examined included (for spouts/drop, respectively):

- Used/Used (no sanitation treatment, Control)
- Bleach/Bleach (used spouts/drops cleaned with Ca-based bleach)
- Isopropyl alcohol/isopropyl alcohol (used spouts/drops cleaned with isopropyl alcohol)
- Peroxide/Peroxide (used spouts/drops cleaned with Premium Peroxide II Sanitizer)
- New/Used (new spout on used tubing)
- CV/Used (new Check-valve spout on used tubing)
- New/New (new spout on new dropline)
- New/Bleach (new spout on used drop cleaned with Ca-based bleach)
- New/IPA (new spout on used drop cleaned with Isopropyl Alcohol)
- New/Peroxide (new spout on used drop cleaned with Premium Peroxide II)
- New/Water (new spout on used drop cleaned with water)

Cleaning in the UVM studies was done by pulling a small amount (nominally 15 ml) of sanitizing solution through the spout and/or dropline under vacuum. This resulted in a very short contact time (< 1 sec), but mimicked what many larger producers do. The one exception to this was for Isopropyl Alcohol (IPA), which was left in the dropline for an extended period of time to simulate the way this sanitizer is utilized in Canada (note that IPA is not

Tubing sanitation continued on page 10

Tubing sanitation: continued from page 9

approved for use in maple tubing systems in the USA). Sanitizing in the Cornell studies was done by immersing the spouts/drops in the treatment solution for a period of time followed by rinsing with water prior to being deployed in the woods for the 2014 season, or by flooding the entire tubing system with the treatment solution for a period of time, then a water rinse, while in place prior to the 2015 season. This resulted in a long-contact time of the system with the sanitizer. Wash/rinse water at Arnot was from a municipal source, so contained a small amount of residual chlorine. Water at Proctor was deionized well water (permeate).

For the control treatments (used spouts/used droplines), spouts were pulled under vacuum (termed "dry cleaning" in the maple industry). When drops were replaced, tees were also changed.

Sap collection was accomplished under vacuum for all studies at both sites.

Results

The lowest sap yields were found in the used spout/drop (control) treatment that employed no sanitation strategy (Figure 1). Chemical sanitization of used spout/drops resulted in an average improvement of 32.6% greater sap yield, with bleach showing slightly better results than peroxide or IPA. Replacement strategies to achieve improved sanitation produced better results. Putting a new spout on a used (uncleaned) drop resulted in a 47.8% improvement in sap yield. Using a new Check-valve spout on a used drop showed a 62.2% increase in sap yield.

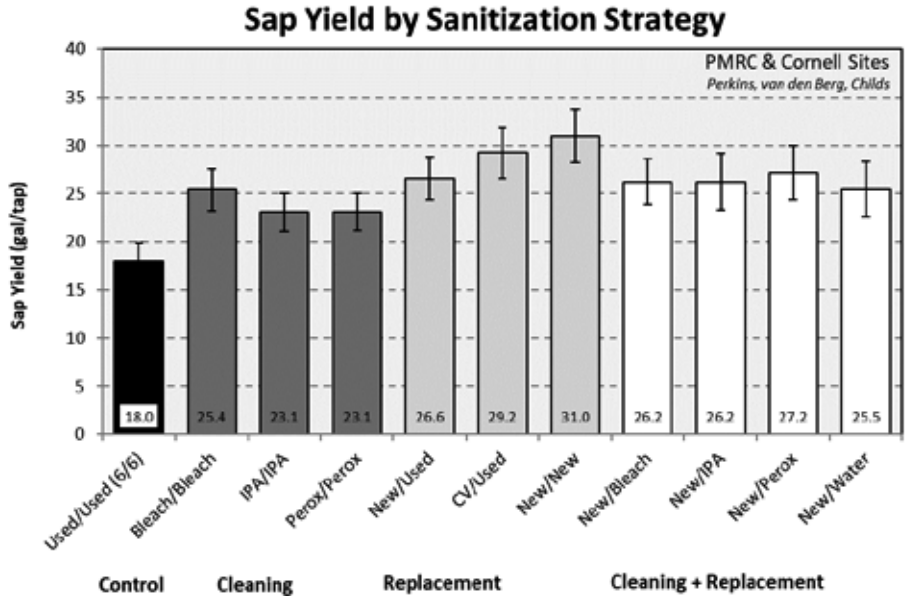

Figure 1. Average sap yield (gal/tap) for all sanitation studies at UVM PMRC (Underhill, VT) and Cornell Maple Program Arnot (Van Etten, NY) sites for 2014 and 2015 sap seasons by sanitation strategy. Controls were used spouts on used droplines. Descriptions for each treatment refer to spout and drop in order. Error bars indicate standard error of the mean.

The maximum increase in sap yield was achieved by using a new spout on a new drop, with a 72.2% increase in sap yield over controls.

Combining chemical sanitation with replacement strategies showed a slight improvement over chemical sanitizers alone, averaging a 46.0% improvement in sap yield, but were not any better than the 47.8% improvement gained from using spout replacement alone on a used, non-sanitized dropline. Interestingly, in the combined treatments, water as a sanitizer appeared to produce as good results as the chemical sanitizers, probably indicating that spout replacement was providing the bulk of the observed results, with the chemical sanitizers providing only a very minor additional effect.

Costs of each strategy ranged greatly, from $0.55/tap for the control treatment (representing labor associated with tapping) to $1.95/tap for a new spout with a new drop (materials, labor to construct and deploy the new drop, tapping). Chemical sanitization costs an average of $1.42/tap, with slight differences among treatment due primarily to the cost of the actual sanitizer used. Both chemical sanitization, whether used alone or in combination with replacement strategies REQUIRES producers to either rinse the system or to allow the first run of sap to flow on the ground. This represents an expense (labor to rinse, or lost revenue of sap) and was included in the calculations. Use of a new spout alone was relatively inexpensive at $0.76/tap (cost of spout plus labor of installing new spout and tapping). Using a Check-valve spout

Tubing sanitation: continued on page 12

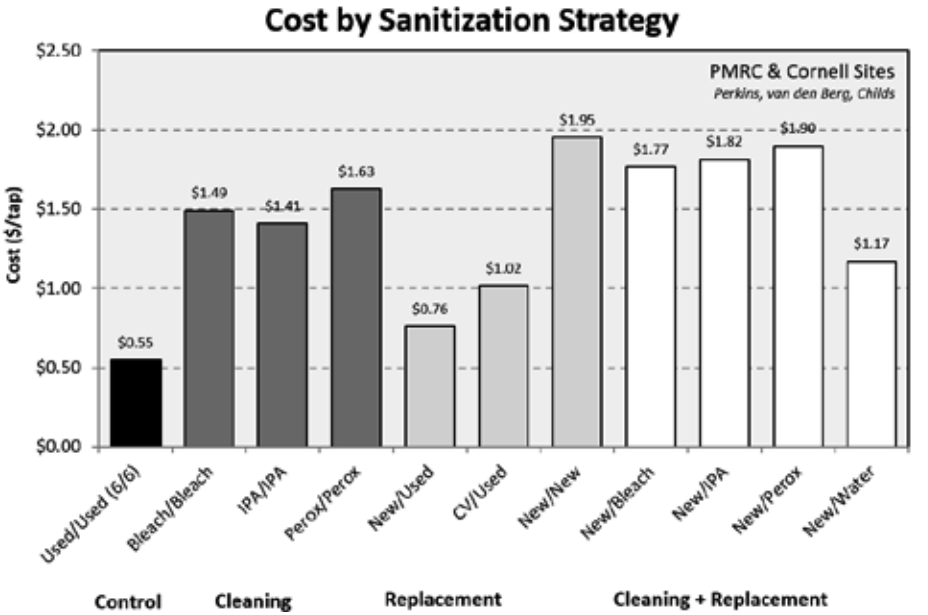

Figure 2. Average cost ($/tap) for all sanitation studies at UVM PMRC (Underhill, VT) and Cornell Maple Program Arnot (Van Etten, NY) sites for 2014 and 2015 sap seasons by sanitation strategy. Costs represent both materials and labor annually for implementing sanitation strategies alone, and do not include other necessary costs of installing or maintaining a vacuum pipeline system.

Tubing sanitation: continued from page 11

was slightly more expensive at $1.02/tap due to the higher cost of this type of spout. An entirely new dropline was $1.95/tap (again, including labor). Combining chemical and replacement strategies was the most expensive approach other than entire spout and dropline replacement, averaging $1.67/tap. Water sanitization was less expensive than the other combined approaches due to lack of rinsing required.

Net profit calculations utilized a sap value of $0.25/gallon. Since changes in sap value vary greatly, and have a large effect on the results, these numbers should only be used as a rough guide. To better understand the net profits in each operation, producers should get a copy of the Excel spreadsheet Economics of Replacement Strategies Model to estimate the best approaches for their own sugaring operations.

In general, ANY sanitation strategy was better than none (Figure 3), however, the highest net profits of the sanitation approaches studied were achieved by utilizing spout/drop replacement strategies. With no sanitation (continuing to employ used spouts and used drops without cleaning or replacement), a net profit of $3.96/tap was realized. Cleaning with chemical sanitizers increased profits by an average of $0.50/tap after costs are factored in, resulting in an average net profit of $4.46/tap. Cleaning drops with chemical sanitizers and adding a new spout increased net profits to an average of $4.90/tap, or $0.94/tap above doing nothing. Interestingly, in the combined chemical/replacement approach, cleaning with water and adding a new spout resulted in the highest net profit in the category, with an average net profit $5.19/tap.

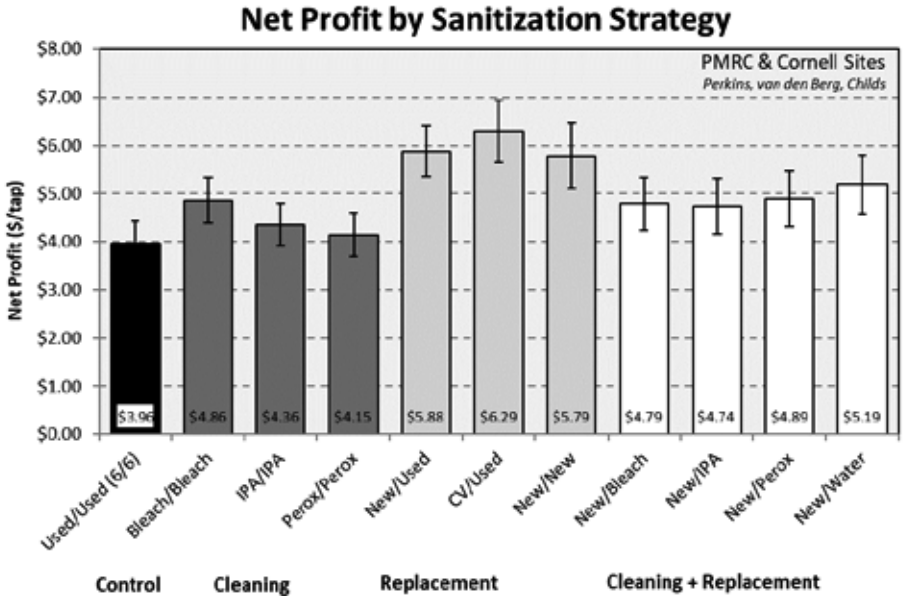

Figure 3. Net profit ($/tap) for all sanitation studies at UVM PMRC (Underhill, VT) and Cornell Maple Program Arnot (Van Etten, NY) sites for 2014 and 2015 sap seasons by sanitation strategy. Values represent value of sap collected minus the cost of implementing sanitation each strategy individually. Error bars indicate standard error of the mean.

Quite clearly however, the highest net profits came from using replacement strategies, with an average net profit of $5.99/tap. Net profit for all three of the replacement strategies tended to be consistently higher than strategies using chemical sanitizers. While complete spout and drop replacement resulted in the highest sap yields, the associated higher cost of that approach tends to reduce net profits slightly. Similarly, while using a new spout on a used dropline results in a modest improvement in sap yield, the low cost of this approach can boost net profits. Using a Check-valve spout on a used drop results in slightly higher sap yields than a new spout alone, and while the increase is less than that found with complete spout and drop replacement, the lower cost of the Check-valve compared to spout-drop replacement typically results in a slight advantage in net profits over both spout replacement or spout-drop replacement.

We note that the long contact time sanitizer treatments provided a higher degree of benefit in terms of sap yield than the short contact time treatments employed, however in some cases the costs are considerably higher as well, so the effects on net profit are variable. Such details require considerably more discussion to parse out, and beyond this brief summary.

Summary

1. Spout and drop sanitation of all types improves sap yields and net profits in 5/16" vacuum tubing systems.

2. Sap yield and net profit is lowest in used tubing systems with no sanitation employed, is better in systems using chemical sanitizers, higher still in combined (sanitizer with spout replacement), and highest with any type of replacement strategies.

3. Within chemical sanitization approaches, long-contact time methods provide better results in terms of sap yield, but the specific approach can alter the costs, and net profits achieved.

4. If using a new spout, use of chemical sanitizers in addition does not increase net profits due to associated higher costs.

5. Within replacement strategies, periodic spout/drop replacement, use of new spouts annually on used tubing, and use of Check-valve spouts on used tubing systems, respectively, tend to provide increasing net profit levels.

6. While replacement of droplines and spouts produces the highest sap yields, the higher cost of implementing this strategy reduces net profits below other approaches (new spouts or use of Check-valve spouts), except where sap yields or sap value are very high.

7. Chemical sanitizer treatments produce some positive benefit, but the net profits tend to be lower and the approach more labor intensive, thus are perhaps more suitable to small-moderate sized maple operations.

Acknowledgements

Funding for this project was provided by a grant from the USDA Northeast Sustainable Agriculture Research and Education Program (LNE13-326) to the University of Vermont and by a grant from the North American Maple Syrup Council. We thank Brian Stowe and Mark Isselhardt for technical assistance and discussions throughout this work.

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number LNE13-326.