Ask Proctor

The UNIVERSITY of VERMONT
Proctor Maple Research Center

Should I Use 3/16" or 5/16" tubing?

One of the first questions maple producers face when deciding to tube (or retube) a sugarbush is whether to use 3/16" or 5/16" tubing. Unfortunately, this decision is often very site-specific, and it can be difficult to thoroughly determine the proper approach without a good site walk-through, and sometimes good measurements must be taken. Besides the lower upfront cost of 3/16" tubing and easier working characteristics, there are some general rules that can be helpful in narrowing down the pros and cons of each approach.

First, if using 3/16" tubing, the site should have good slope in order to achieve some drop in elevation from the taphole to where the sap exits the 3/16" tubing – either into a mainline or into a tank. This change in height is what generates the downward pull (from gravity) of sap in the 3/16" tubing to create the vacuum. This difference in elevation should be on the order of at least 3%, but steeper is better. With a slope less than this, friction of sap with the tubing walls becomes a bigger factor, resulting in poor sap movement and build-up of pressure in the system, which is the opposite of what is desired. For this reason, 3/16" tubing should almost never be installed in flat or low-slope applications without supplemental pumped vacuum.

When used on the proper slope, one foot of drop in tubing, when filled with moving sap, will produce about 0.75-0.80" Hg of vacuum (note that 1 ft water = 0.88" Hg, however tubing is typically filled with a mixture of sap AND gases produced by the tree, and there are frictional forces between sap and tubing, thus the vacuum level is often somewhat lower than the straight mathematical height conversion might indicate). Actual vacuum level achieved will depend upon the height of the taphole in relation to where the sap exits the 3/16" tubing system and number, size, and position of leaks in the system.

A second consideration in determining whether to use 3/16" or 5/16" tubing is whether supplemental pumped vacuum will be used, and what level of vacuum your pump can achieve. Producers with some drop, but not enough to reach maximum levels, or with trees lower down on the slope, may wish to use pumps in order to get higher vacuum levels throughout their system. When used together in a so-called hybrid system, pumped vacuum and 3/16" gravity are additive, meaning that, for example, if you pull 15" Hg in your mainline with a small pump, and get another 10" Hg from using 3/16" tubing, your total vacuum would be 25" Hg (15" + 10" = 25" Hg). Note that the maximum vacuum is based upon your elevation and barometric pressure conditions and cannot be exceeded. When

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using a high-vacuum pump, there is relatively little to be gained using 3/16" tubing (other than the cost savings and easier handling characteristics) because the difference in vacuum is fairly small.

3/16" gravity vacuum and 5/16" systems without pumped vacuum have similar recommendations as to the number of taps on a lateral line. Both can support long (or short) tubing runs around 10-25 taps on a lateral line. In contrast, 5/16" pumped vacuum systems should be short and stick to "strive for five, no more than ten" taps per lateral line for best performance.

Although short distances across flat areas are permitted, and sap can be "pushed" uphill to some degree in both 3/16" or 5/16" systems, this will affect the vacuum level in areas around the flat or uphill area, and should be avoided if possible. A downhill slope after the flat area will produce the best results. Pumped vacuum systems will ameliorate the negative effects to some degree, and are generally required in most instances where sap ladders are needed.

The achievable vacuum level on either 3/16" or 5/16" tubing is strongly affected by leaks in the system. Tubing systems using 3/16" lines are particularly sensitive to leaks. Thus, it is critical that any type of vacuum system be monitored carefully so that leaks are detected and corrected quickly to achieve maximum vacuum and maximum sap yields. Pumped and hybrid systems hold some advantages in that leaks are more easily detected through the observation of small rapidly moving bubbles. Leaks are more subtle and can be considerably more difficult to find in pure gravity vacuum systems until one is more familiar with the

signs of a leak.

Sanitation is another important factor in tubing systems. In the decision whether to use 3/16″ or 5/16″ tubing, one important distinction is that recent research seems to indicate that 3/16″ tubing requires flushing to maintain high long-term yields. Although other strategies such as annual spout replacement, use of CV adapters/spouts, and periodic replacement of drops can greatly reduce the drop off in yield due to sanitation-induced taphole drying in 5/16″ tubing systems, 3/16″ systems seem to be more strongly affected by such losses, possibly due to the higher amount of backflow that can occur in 3/16″ tubing. At this point, the best recommendation is that 3/16″ systems should be flushed each year, at least with clean water, but preferably with an approved sanitizer first followed by subsequent rinsing (or letting the first flush of sap in the following season to run on the ground). If it is impossible to flush the tubing system, then producers should probably use 5/16″ tubing. More research on this subject will be conducted over the next few years to assess whether other sanitation methods can be helpful. At this point, changing spouts annually to maintain high yields, as is currently done by many producers, does not appear to be as effective in 3/16″ tubing systems as it is in 5/16″ systems.

Finally, producers have asked whether using 3/16″ tubing drops into buckets would be helpful. In general, any benefit would be marginal. When using a dropline, the spout would probably be placed a bit higher on the tree than a bucket normally would be hung in order to gain height to generate vacuum. Any vacuum gained by a 3/16″ dropline in this way would therefore be offset by the decreased pressure head in the tree due to the height of placement of the taphole. The bottom line is: you can't cheat physics.

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