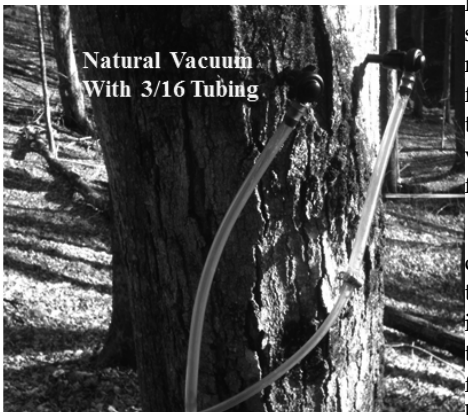
Research: Tubing

Some in maple season and out of season tests on 3/16" maple tubing

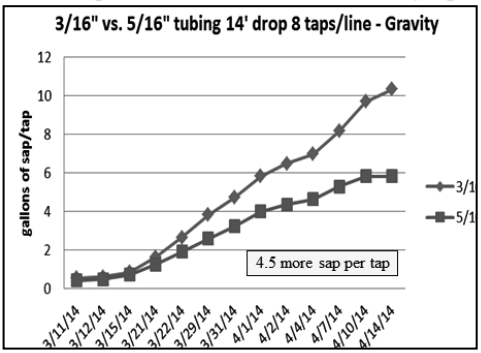
Stephen Childs, NYS Maple Specialist

During the 2014 maple season the Cornell Maple Program maintained three demonstration sites using 3/16" maple tubing. Each site was set up in February and tapped the last week of February. The first sap run occurred on March 10. The demonstrations were meant to compare sap yield from a new 5/16" lateral line with eight taps using 5/16" standard black check valve spouts on a new 5/16" drop lines, with sap yield from a new 3/16" lateral line with eight taps using 5/16" standard black check valve spouts on a new 5/16" drop lines for 8 inches then fitted to 3/16" drop line.



Eight trees were tapped in each demonstration with the two treatments tapped in the same tree, about seven inches apart, in the same basic orientation. The first demonstration had 14 feet of drop from the highest tap on the highest tree to the top of the collection tank. Sap yield was collected following each run starting on March 11. The graph below shows the sap yield difference between the 5/16" lateral line and 3/16" lateral line each with eight taps in gallons of sap per tap. The 3/16" lateral line yielded 10.3 gallons of sap per tap over the season and the 5/16" lateral line yielded 5.8 gallons of sap per tap or an increase of 4.5 gallons of sap per tap.

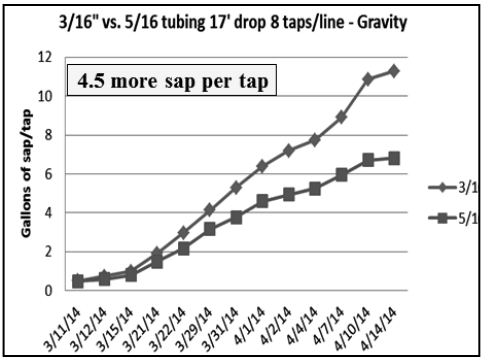
The second demonstration was set up exactly like the first except with 17 feet of drop from the spouts on the highest tree to the top of the collection tank. The graph below illustrates the results of this demonstration and showing a very similar increase of 4.5 gallons of sap per tap.

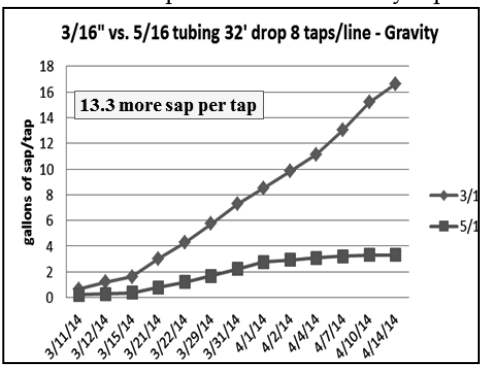


The third demonstration was again the same set up as the first and second except with 32 feet of drop.

In this case the vacuum created by the 3/16" lateral line appears to stolen sap from the spouts hooked to the 5/16" line with the 3/16" line, yielding 16.6 gallons of sap per tap, while the 5/16" lateral line yielded just 3.3 gallons of sap per tap for a difference of 13.3 gallons of sap per tap more in the 3/16".

Results from this kind of demonstration create many new questions such as how many taps are needed on a 3/16" line to result in good vacuum and how many taps can a 3/16" line support. This demonstration demonstrates that eight taps seems sufficient to generate significant vacuum, though vacuum tests were not included in this demonstration – it was simply a yield comparison. Testing the number of taps necessary to generate excellent vacuum will need to be conducted during the maple season, as testing that with a simulated set up would generate many more questions. To try to answer the question of how many taps can a 3/16" line support, a series of experiments were conducted this summer.





For this experiment, a site was located where we had easy access to the top of the elevation and a drop of 35' was measureable. Water was transported to the site in 15 gallons jugs, and 270' of 3/16" maple tubing was laid on the ground to obtain the drop of 35' on about a 13% slope. The line siphoned water from the jugs to establish the volume of water that could be conducted through the 3/16" lines over time. A vacuum gauge was plumbed in at the top of the line to measure vacuum pull on the line. Fittings were added to the line in increments to assess how adding T's would influence the flow level. The flow rate of .2 gallons of sap per hours per tap is used to estimate how many taps the 3/16" tubing could support.

The chart below indicates just how many fittings were in the line, followed by how much water was siphoned through the line per hour, followed by the number of taps the 3/16" line could support if taps were contributing .2 gallons of sap per hour. The next column lists the number of leaks in the line and the vacuum measured at the top. The number of taps that the calculations say can be supported is much larger than I would have anticipated, ranging between 47 where 24 fittings were in the line, to 56 where only a fit-

Flow rates of 3/16 tubing at various number of fittings				
	gallons per hour	taps supported	leaks	vacuum at top
1 fitting	11.2	55.8	0	24"
4 fittings	10.2	51.1	0	24"
8 fittings	9.8	49	0	24"
16 fittings	9.6	48.1	0	24"
24 fittings	9.4	46.8	0	24"
Flow rates of 3/16 tubing at various leak rates				
no fittings	13.8	68.8	0	24.2"
no fittings	12.6	63.1	1	16"
no fittings	10.9	54.5	2	11"
no fittings	10.3	51.6	3	5"

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ting for the vacuum gauge was in the line. I'm not suggesting producers consider going to such high numbers but it is interesting that it appears the line can support them. More testing needs to be done to determine what the vacuum levels are at other points in the line. It is likely that the high vacuum levels only occur at the top and decline as you move down the line but that needs to be tested.

The remaining factor that was tested this summer is the influence of leaks in a 3/16" tubing system. To look at this, leaks were created in the line as it was siphoning water from the jug at the top by drilling a 1/16" hole in the line. The first hole was drilled twenty feet of elevation below the tank, the second hole ten feet below, and the third hole five feet below the elevation of the water tank. The leaks both reduced flow rate and significantly reduced vacuum at the top. As suspected, leaks will significantly reduce the vacuum advantage provided by the 3/16" tubing. A 1/16" hole is very small compared to the average squirel damage typically seen in maple tubing systems.

To sum this project up, 3/16" tubing can provide some yield benefit by creating natural vacuum. That benefit will be directly related to the elevation drop of the lateral line. Additional fittings in the line will only gradually reduce the flow rate but leaks will significantly reduce yield results. Much more testing needs to be done before the dynamics of slope, vacuum and tapping rates on a 3/16" lateral line are fully understood. This study is intended to add a little more to that understanding. A special thanks to Bob Beil, Gordon Putman and the Upper Hudson Maple Producers for their support for this study.