Ask Proctor

Why Does the Sap Stop Running After a Few Days if it Doesn't Freeze Again?

Timothy D. Perkins and Abby K. van den Berg, Proctor Maple Res Ctr, Underhill, VT

Sap flow from tapholes in maple trees is driven by pressure in the tree. The key concept in understanding flow is that sap (or water) will always move from an area of high pressure towards an area of lower pressure, and the rate of flow depends upon the difference in pressure – the higher the pressure difference the faster the flow rate. After the water uptake phase which occurs as the tree freezes, when the tree thaws, sap will flow out of any severed vessels in the wood (such as a taphole). This is initially due simply to head pressure…the standing column of sap above the taphole flows out via gravity. Immediately after thawing the flow rate is relatively rapid, but then begins to slow down within a few hours as sap flows out and the pressure head diminishes. Most of the flow during this time is downward from a zone roughly above the taphole. Due to the anatomy of trees, the resistance to sideways flow of liquid in wood tissue is about ten times that of downward flow. Over time, as the sap in the zone above the taphole is depleted, some sideways movement of sap towards the taphole will also occur, but the flow rate will be slower, but last for up to about a day if refreezing does not occur.

Without a freeze, the flow of sap will continue to slow and eventually stop because there is no longer a difference between the pressure inside and outside of the tree. However, producers often observe an uptick in sap flow during the daytime over a few days. Why does this occur? Where did the extra sap come from? Typically, these short bursts of increased sap flow happen when the temperature warms over the next few days. The warm temperature causes gas bubbles in the wood fibers to expand and squeeze more water from the wood tissues, where it flows into the vessels and out through the taphole. This might occur for a couple of days, and eventually turn into slow weeping flows before ceasing entirely.

To further complicate things, the entire stem of the tree doesn't all freeze or thaw at the same time. Parts of the tree can be thawed and other parts frozen at the same time. This happens especially on different aspects of the tree. The north sides (in the shade) often thaw more slowly than the south sides (in the sun). Early in the spring only a small part of the southern sides of trees may be thawed and flowing sap, while the center and north sides can stay frozen. Later in the season the opposite may be true. Prolonged thawing can also result in weeping flows continuing for days.

We can use different analogies to describe different aspects of sap flow. In this case, it is easiest to think of sap flow in terms of a sponge. Initially the sponge (wood tissue) is saturated with water. When you pick up the sponge from the bucket, water (sap) runs out very quickly, but then slows to a steady drip-drip-drip, then stops. By lightly

squeezing the sponge, you can replicate what happens internally in the tree as the bubbles in the wood expand. More water (sap) will run out for a short time. If you squeeze a bit harder (gas bubbles expanding more), more water will come out. Eventually however, no amount of squeezing will elicit further dripping. The water in the sponge (or the sap in the wood) is exhausted and a refreeze is necessary for the system to recharge.

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