Assessing Damage to Maple Sapwood Caused by Tapping

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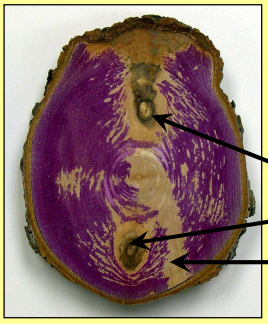
Summary: The area of stained sapwood associated with tapping or other wounds in maple trunks has long been interpreted to represent the area of wood that is compartmentalized, and thus unavailable for sap flow. We tested this interpretation by passing dye through maple stems that had been tapped and observing the area that was blocked. Our results indicate that the blocked portion of the trunk associated with a wound taphole is somewhat larger than the area which is visually compartmentalized (stained).

Methods: In early March, 2005 we tapped a number of small diameter (5-10 cm or 2-4" dbh) sugar maples and connected them to a vacuum tubing system. Tapholes were 0.79 cm (5/16") diameter and approximately 2.5 cm (1") deep, and placed at a height of approximately 1.3 m (4'). Vacuum used for sap collection was 18-20" mercury. We did not monitor sap volume or sugar production from these trees. In July, 2005 we began harvesting these trees for experiments. After the tree was felled, a portion of the trunk approximately 60cm (2') long with the taphole in the middle was brought back to the lab. The cut surface of the trunk was shaved cleanly with a razor blade to open all sap vessels (the sap conducting tubes in the wood), and the stem was placed upside down in a pressure fitting (this position allowed the dye to move in the same direction as sap in a living tree, from the base toward the top). Basic Fuschin dye, filtered to 5 micrometers, (small enough to pass through the vessels of the sapwood) was placed in a pressure chamber so that when we applied pressure (approximately 10 psi) the dye was forced into the maple stem and through any vessels that were open. After a few hours, the pressure was relieved, and the stem was dried in an oven. Finally, the stem was cut into 2 cm sections so that we could observe the area that conducted sap as well as those areas around the taphole where sap could no longer flow..

Left: pushing dye through the stem under pressure. The dye moves from a bottle in the steel pressure chamber to the fitting on top of the stem, and drips out the other end after passing through the stem.
Right: The largest stem we used was about 10 cm (4") in diameter. Because of the irregular surface of the bark an elaborate fitting had to be used to keep the dye from running down the outside of the stem under pressure. In most trials we used longer sections than this.

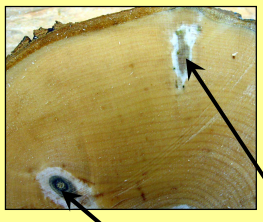
Results:

Left: Two sections from a 55 year old sugar maple through which dye has passed under pressure. Note that the blocked area which was not dyed is slightly larger than the taphole. Also note that almost the entire area of a maple stem is available for conducting sap. This is not true in tree species which develop heartwood (most trees develop heartwood, which acts to support the tree but is no longer used to transport sap). Sugar maple does not develop a true heartwood and unless damaged, the entire trunk normally conducts sap, although the proportion of sap conducting vessels that are still functional decreases with distance from the bark.

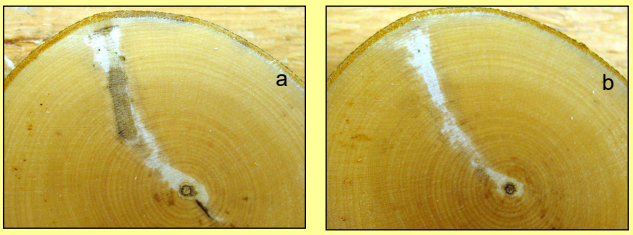


Left: Section 12 cm below the taphole showing sapwood blockage due to the taphole wound. Other blockages are apparent in the sapwood surrounding branch stubs. In addition there are many small obstructions to the dye of unknown cause which run parallel to the growth rings in this stem.

Above: Five Sections, 16 to 24 cm below a taphole, showing un-dyed wood directly below the wound. The blockage extended over 30 cm both above and below the taphole. Note that there is no evidence of dark fungus stain normally associated with tapholes in these sections.



Left and Right: Freshly cut Sections from 20-30 cm (8-12") dbh maples tapped in 2003. **Left**: 10 cm below a taphole; an area of dry white wood surrounds the stain. A similar area of dry wood surrounds an old branch stub. These can be interpreted as areas of blocked sapwood, similar to such areas seen in the dyed stems above.



Above: Sections 10 cm **(a)** and 20 cm **(b)** above a taphole wound. The dark fungus stain can be seen in **a** corresponding to the position of the taphole, while no stain is seen in **b**. The dry white area of the sapwood is probably permanently blocked to the passage of sap.

Conclusions: Passing dye through previously tapped maple stems revealed blocked portions of the sapwood. Some of these blocked areas did not have the characteristic dark stain, presumably caused by wood-staining fungi, and normally associated with old wounds. In all instances where the wood stain was observed, the area of blocked xylem encompassed and was somewhat larger than the area that was stained. Close examination of freshly cut sections of wood with taphole wounds revealed areas of dry sapwood which were similar to the regions of blocked wood in the dye experiments. Presumably, these areas of dry wood were also nonfunctional and blocked to sap flow. Based on the area of xylem blocked to dye flow, or dried in freshly cut sections, we conclude that the blocked area of sapwood is normally 50%-100% larger than the area stained by wood-staining fungi.

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