Maple Digest 2016. 55(1): 41-45.

Research: Trees

Taphole Injury in Red Maple

Timothy Wilmot, University of Vermont Extension

Cette étude a examiné les blessures de entaillage en érable rouge (Acer rubrum) en découpant les troncs d'arbres qui avaient été exploitées et la mesure du volume du bois teinté associé au trou de coulée. Dans la plupart des arbres, le volume de bois teint était similaire au volume de bois teinté associé avec des blessures d'entaillage à l'érable à sucre. Quelques exceptions ont été notées. Érables rouges plus petits que 18 cm de diamètre et d'érables rouges qui avaient été exploitées pendant de nombreuses années ont souvent un grand noyau central de bois décoloré et devraient être exploitées à moins de 5 cm de profondeur. Aussi, entailles ne doivent pas être placés au-dessus des blessures de l'exploitation forestière ou d'autres dommages qui est faible sur le tronc. Fissures dans l'écorce qui forment souvent au-dessus et au-dessous entailles étaient généralement superficielles et ne causent pas de décoloration dans le bois. Notre conclusion est que les lignes directrices de dérivation pour l'érable à sucre sont également appropriés pour l'érable rouge, avec les précautions décrites ici.

Introduction

One of the most common hardwoods of the northeastern forest, Acer rubrum, or red maple, is an important resource for the production of maple syrup. The number of red maples in the northeast large enough to be tapped for sap production is huge. According to the U.S. Forest Service Inventory and Analysis surveys taken in the late 1990's, Vermont has at least 40 million live red maple stems over 9" in diameter, and New York, Maine and Pennsylvania have far greater numbers of trees this size.[1] Many producers take advantage of this species; for example, in a 2010 survey of 200 mostly Vermont maple producers with a total of approximately 780,000 taps, almost one tap in six was in a red maple.[2] Despite the increasing use of this tree for sap production, far less information exists about the effects of tapping on the long term health of this species than exists for sugar maple.

Maple tapping guidelines, which specify the number of taps in relation to bole diameter, and the spacing and depth of tapholes, have been devised primarily using sugar maple wounding as a model. The narrow column of discolored wood that results from a taphole wound represents a portion of the trunk that is compartmentalized and no longer functional in terms of sap flow, and is therefore an area to be avoided until sufficient wood has regrown over the affected area. Producers will know when their drill bit has struck one of these stained compartments by the dark shavings coming from the hole, indicating a hole which will produce little sap. The predictable size of these compartments in sugar maple makes it possible to model their accumulation in a tree that has been tapped for many years. Along with knowledge of the typical growth rate of tapped sugar maples, this modeling has formed the basis of newly revised tapping guidelines for sugar maple currently being developed at the University of Vermont Proctor Maple Research Center (PMRC). With its importance

Red Maple: continued on page 42

Red Maple: continued from page 41

as a present and future resource for maple sap, it is critical that we extend our knowledge about taphole wounds to red maple so that, if necessary, these guidelines can be revised to include the proper and sustainable tapping of this species.

There is evidence in the scientific literature suggesting that taphole wounds in red maple may be larger in red maple compared to sugar maple. Shigo (1965) reported that discoloration and decay in young red maples advance more rapidly than in sugar maple.[3] Red maples are described as especially sensitive to mechanical injury, including increment boring.[4] Many people have observed that red maples with smooth bark, characteristic of some smaller (generally 12″ diameter at breast height (dbh) or less) stems, can develop long vertical cracks through the cambium when nails or spouts are driven into the trunk. All of this evidence points to the likelihood that tapholes in red maple could produce discolored, nonfunctional compartments in the trunk that are larger than those in sugar maple. This would mean that tapping with greater spacing and less intensity than in sugar maple would be required if the health of tapped red maple trees is to be sustained.

Methods and Materials

Several approaches were used in order to gain a better understanding of the volume of discolored (stained) wood associated with wounds in red maple. All trees in this study came from the PMRC (Underhill Center, VT) except for a few large stems collected at another northern Vermont site. In February 2013, 18 codominant red maples 7″-11″ dbh and never previously tapped, were drilled with a 5/16″ bit to a depth of 1.5″ below the bark and fitted with polycarbonate spouts. Most trunks were tapped on both sides, with the tapholes offset vertically by several feet. In February 2014, the process was repeated on eight of these same trees. None of the spouts were connected to tubing and the sap was allowed to drain onto the ground. In July 2014, all trees were felled, the trunks sectioned vertically into two long halves, and brought to the lab where each section was cut into 2″ thick slices above and below the taphole in order to measure the volume of stained wood associated with each taphole.

In July 2014, three additional 12″-15″ dbh red maples that had been tapped for several years for vacuum sap collection were also felled and dissected as described above. During the summer of 2015, several additional 16″-20″ dbh red maples from a neighboring stand that had been used for vacuum sap collection for at least a dozen years were felled and 2″ thick slices were cut to encompass most of the tapped portion of the trunks.

Finally, during the summer of 2015, 70 intact trees, some of which had been tapped for 2-3 years, were cored at breast height to a depth of approximately 3.5″ below the bark in order to measure the depth at which discolored wood was encountered. These cores were taken from trees with a variety of bark textures and stem conditions and many were not randomly located but instead taken to answer specific questions about internal staining.

Results and Discussion

In the following descriptions of the reaction of maples to wounding, “stain” refers to visibly discolored wood which is, at minimum, the area

of non-functional wood created in the tree as a result of the wound. While the extent of the non-functional wood generated by a wound may extend beyond the boundary of the stain, the area where this applies is not easily defined. Therefore, all references in this article to the non-functional portion of the wood related to wounds, decay, or other processes, will be limited to what is visible in a sectioned stem.

The volume of wood excavated by a 5/16″ diameter drill at a depth of 1.5″ below the bark is 0.115 in3. The stained volume of wood associated with 34 tapholes in the first group of 7″-11″ red maples ranged from 1.9 in3 to 6 in3, with an average of 3.2 in3 from 24 tapholes drilled in 2013 and 3.5 in3 from 10 tapholes drilled in 2014; therefore the average volume of the stained wood in these trees was about 30 times the volume of the hole. Previous research on taphole wounds in sugar maples conducted at the PRMC[5,6] showed that the average volume of the stain was between 40 and 50 times the volume of the hole, thus the stain volume seen in these red maples was surprisingly small. Among the 34 tapholes, the stain extended an average of 5.2″ above and below the taphole and on average extended an equal distance above and below the hole. The longest stains extended 12″ in either direction from the taphole.

Two additional tapholes from the 7″-11″ dbh trees had taphole stains that were much larger and were not included in the averages shown above. In one case, a 7″ dbh tree had a stained column of heartwood about 2″ below the bark with which it merged, making a large and ill-defined taphole stain. In the second case, an old wound 24″ below the taphole had created a large column of stained wood in the trunk, which again merged with the taphole wound. In a few of the other trees in this group, there were hidden stain columns from branch stubs or old injuries which did not intersect the taphole stain.

In the three 12″-15″ dbh trees that had been tapped for 3-4 years with sap collected by vacuum, a total of five taphole wounds were analyzed; some other taphole stains were difficult to distinguish from each other and could not be properly measured. The ratio of the stain to the volume of the taphole in five holes analyzed was about 45:1, which was similar to our data from sugar maple wounds. This was larger than the discoloration observed in the smaller trees described above that were not subject to vacuum sap collection; however, given the small sample size it is premature to state that vacuum causes larger taphole stains in red maple. Previous work in sugar maple found no relationship between vacuum level and the volume of the taphole stain.[6]

The 16″-20″ dbh trees tapped for many years each contained a central core of discolored wood, leaving a few inches of white sapwood below the bark. Several shallower tapholes (1.5″ depth or less) had stain volumes that were small and confined to the sapwood. These stain compartments were similar in size to those seen in the 7″-11″ dbh trees described above. Other deeper or older tapholes were associated with larger stains that merged with the central core or with stains from other tapholes. In one tree, a seam low on the trunk which was almost completely closed on the outside had created a long column of stained wood on that side of the tree. A taphole 30″ above this wound had merged with the

Red Maple: continued on page 44

Red Maple: continued from page 43

stain column to create a large area of discoloration.

Among the 7″-11″ dbh trees analyzed for this study, about half of the tapholes were accompanied by a vertical crack in the bark ranging in length from an inch to several feet above and below the hole. Long cracks were almost exclusively confined to tapholes in smooth bark. Sectioning through the cracked portions of the bole showed that for almost the entire length of the crack, it was superficial, penetrating only partway through the tissues commonly referred to as "bark," which are actually outer bark, phloem (the sugar transport system during the growing season), and the vascular cambium (where new wood cells are formed). While this study did not include a detailed analysis of which of these tissues was injured in the formation of the cracks, it was evident that the cracks rarely penetrated all the way to the wood. When a crack extended more than a few inches beyond the taphole, it was not accompanied by a stained area in the wood below the crack, indicating that the wood itself remained undamaged.

In cores taken from intact trees, a clear boundary between functional sapwood and non-functional stained wood was evident when the core intercepted a stained compartment. Cores offset horizontally from small and large trunk wounds often showed no stain to a depth of 3.5″, but cores taken above a wound, or in some cases several feet above a small opening at the base of the tree showed evidence of stain columns that extended for a long distance in a vertical direction. Trees with

very rough or very smooth bark were equally likely to have no evidence of stain at a depth of 3.5." In general, there was very little evidence of stain in any 3.5" core when close examination of the trunk revealed no old wound above or below the core, with the exception of smaller diameter trees. Cores from 13 trees averaging 8.5" dbh had a central stained heartwood core that averaged 3.5" in diameter; thus on average the white functional wood extended only 2.5" below the bark, and in some cases much less than this.

Summary

In most trees the volume of stained wood produced by taphole wounds in red maple appears to be similar to the stained volume produced by taphole wounds in sugar maple.

Some red maple trunks may have pre-existing stain columns from old wounds not related to tapping which extend several vertical feet from the wound. Tapholes that are placed above or below these wounds may intersect the stain column. Close examination of trees suspected of having an old trunk wound should allow the producer to avoid most of these hidden stain columns.

Smaller diameter red maple trees, for example trees less than 9" dbh, may have a heartwood core that could be intersected by the drill bit when deeper holes are drilled. Similarly, trees tapped for many years may have a large internal stain column from the accumulated taphole wounds. Shallower tapholes (e.g. 1.5" or less below the bark) are recommended when tapping these trees.

Cracks in smooth barked red maples, although unsightly, are usually superficial and do not produce stained wood below the crack, other than the stain associated with the actual hole. The cracks do not appear to interfere with normal taphole closure.

Bark texture in red maple does not appear to indicate the depth of the heartwood or internal stain column.

Conclusion: Based on the findings of this study, it is recommended that tapping guidelines developed for sugar maple are appropriate also for red maple, with the precautions outlined above.

Literature Cited

[1] Alderman, D.R., Bumgardner, M.S., and Maumgras, J.E. 2005. An assessment of the red maple resource in the northeastern United States. *Northern Journal of Applied Forestry* 22(3) 181-189.

[2] Wilmot, T. R. 2010. Tapping Survey Results. http://www.uvm.edu/~pmrc/tapping%20survey%202010.pdf

3 Shigo, A.L. 1965. Decay and discoloration in sprout red maple. *Phytopathology* 55(9): 957-962.

[4] Walthers, R. S. and Yawney, H. W. 1990 Acer rubrum L. p. 66 in *Silvics of North America, Vol 2: Hardwoods*. USDA Forest Service Ag. Handbook 654.

[5] Wilmot, T. R., Perkins, T. D., Stowe, B., and van den Berg, A.K. 2007. Comparison of the small spout with the traditional 7/16" spout. *Maple Syrup Digest* 19A (2): 20-26.

[6] Wilmot, T. R., Perkins, T. D. and van den Berg, A. K. 2007. Vacuum sap collection: how high or low should you go. *Maple Syrup Digest* 19A (3) 27-32.

This study was partially funded by a grant from the North American Maple Syrup Council.