

BRANCHES

by Alex L. Shigo

Abstract. Trees have developed effective defense systems for walling off infections that may enter the trunk through dying and dead branches. As the growth rate of a branch decreases, the trunk wood begins to form a swollen collar around the base of the branch. When pruning, cut as close as possible to the collar, but do not remove the collar.

Pruning is not a cure all. When done properly, it can be the best thing you can do for a tree. When done improperly, it is the worst thing you can do to a tree.

To prune properly requires a great amount of skill and understanding about branches. The purpose of this paper is to provide a pictorial review of branches on hardwoods so that better decisions can be made for pruning.

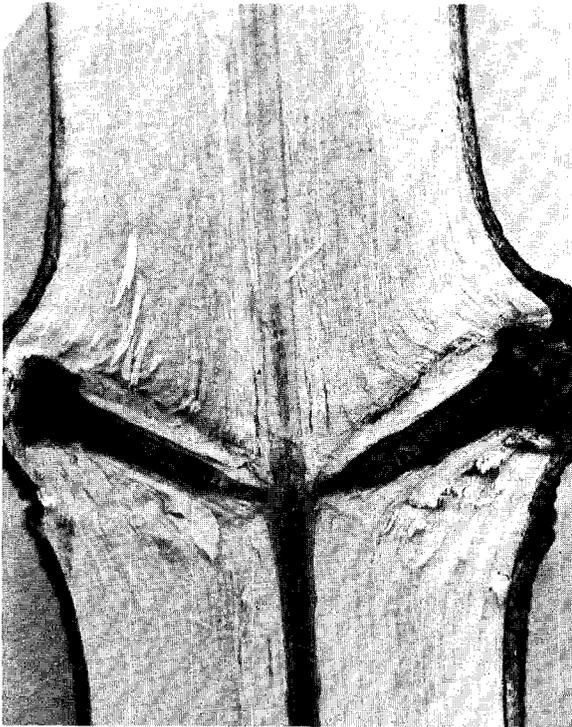


Fig. 1. When small, young branches on small stems die, the internal portion of the branch that connects with the stem pith is walled off. Even if this internal portion is infected, the infection does not spread to the stem wood. This is the situation when the tree's defense system is working perfectly.

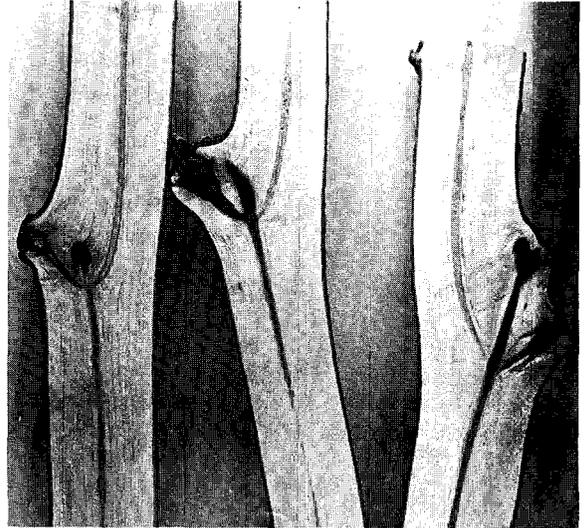


Fig. 2. The same walling off process occurs when small, young leaders die. Again, even if the leaders are infected, the infection does not spread to the stem if the defense system is working properly.



Fig. 3. But, when aggressive microorganisms infect small, young dying branches, they may spread into the stem. Even then the tree responds to limit the infection to the wood present at the time the branch died. Decay can start in very young stems.



Fig. 4. A portion of the stem is injured when a branch falls and microorganisms have the advantage.

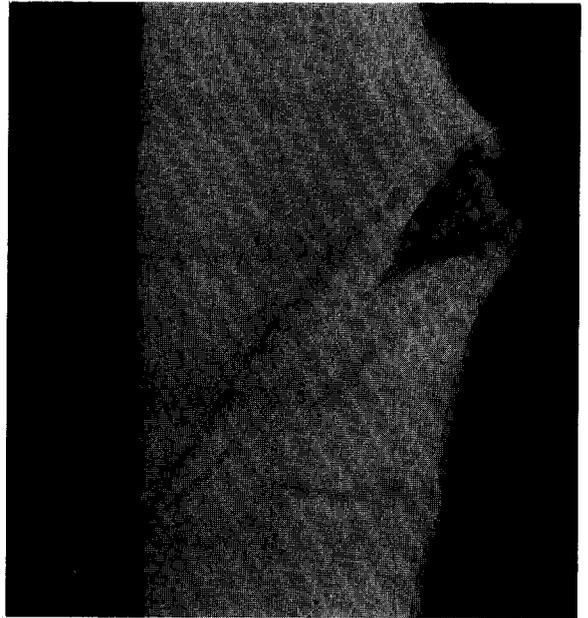


Fig. 6. As trees and branches become larger and older, the same events are repeated. A wide variety of "good" or beneficial microorganisms cause decay in the dying branch back to the tree stem. The decay usually ends at the base of the branch. If the tree's defense system works properly, this decay will be walled off to a very small volume.



Fig. 5. Dissection of the previous section shows the decay that can develop in 2 years despite the vigorous callus. When many such wounds accumulate on a tree, severe internal injury will result. Many problems that become obvious later in the life of the tree began when the tree was young.

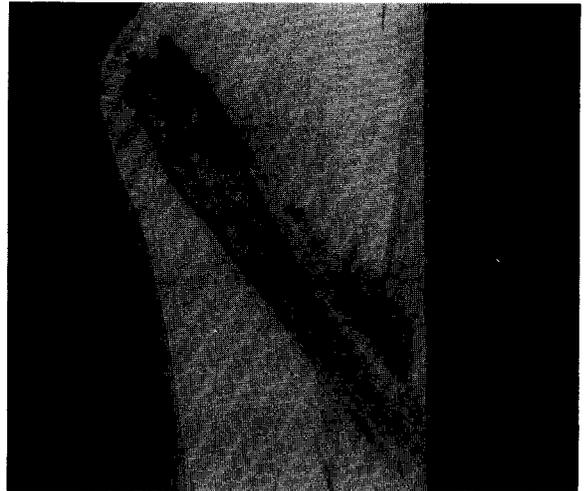


Fig. 7. When aggressive microorganisms infect, or when the tree's defense system does not work perfectly, infection may occur. The infection is usually walled off to the inner tissues of the branch. Note also the insect gallery in the decayed stub. This may have been the reason why the decay was not blocked sooner. The major point here is that the decay was walled off to a very small volume and did not spread into the trunk.



Fig. 8. There are times when the microorganisms “win” and infect the trunk. But, even then, the tree walls off the infection to those tissues present at the time the branch died.

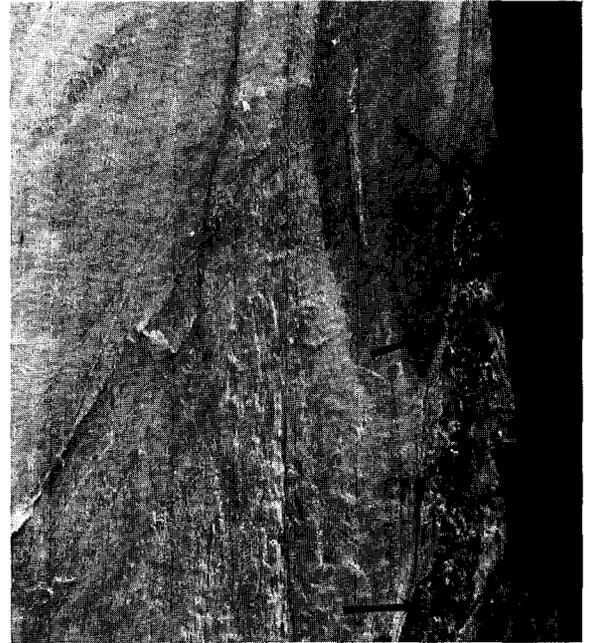


Fig. 10. Decay-causing fungi may also start cankers after they become established in a trunk. The fungi often produce a wedgelike pressure pad that splits the bark from the outer side of the cambium (arrows). Once the fungus starts this action, the seesaw with the tree begins again: the fungus kills a small portion, the tree responds by walling off the killed portion, and this is repeated until the fungi eventually “win.”



Fig. 9. There is still one situation that is worse for the tree, when canker-causing microorganisms enter the trunk by way of the dying branch. A seesaw action then begins. The fungus kills a portion of the trunk, and the tree responds by walling off the infection. Then the fungus repeats its infection the next year and the tree responds again. Target-shaped cankers often form.



Fig. 11. The coalescence of many columns of discolored wood associated with the death of many branches often results in a central column of discolored wood that is often mistakenly called heartwood. This red maple does not have a normal central core of colored heartwood. The central colored column here is discolored wood. The diameter of the column was the diameter of the tree when the branches died. Note also that the decayed wood was walled off to the tips of the branch stubs.



Fig. 12. Heartwood also compartmentalizes discolored and decayed wood associated with dead stubs. The decay associated with this stub in black walnut is surrounded by sound, noninfected heartwood.



Fig. 13. When decay starts in a dead branch stub, the sapwood (arrows), not the heartwood, decays first.



Fig. 14. As a branch begins to wane and die, the trunk wood around the branch grows at the rate of other trunk tissues, but the wood in the dying branch stops growing. As a result, a swollen collar forms at the base of the branch.



Fig. 15. The collar is trunk wood, not branch wood.



Fig. 16. The collar wood is not infected by the decay in the decayed stub.

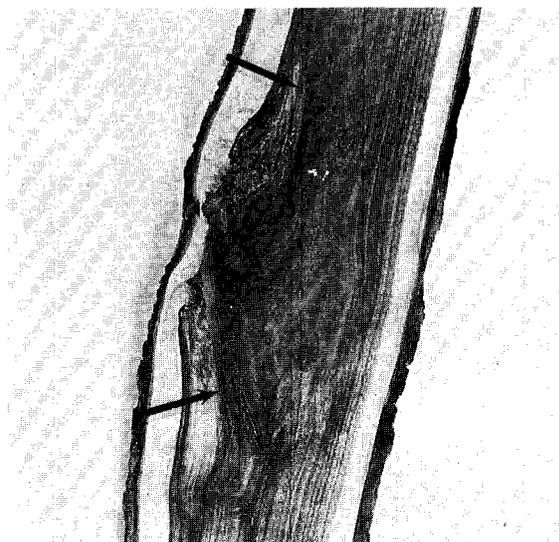


Fig. 18. If the collar is removed, the trunk wood may become infected. The likelihood of this is increased on slow-growing trees. The arrows show the limits of the discolored wood if the branch had been pruned properly.



Fig. 17. When branches are pruned, great care must be taken not to remove the branch collar. Then, even if the branch is infected, the infection will be walled off within the wood present when the branch died (arrows).

In summary, the photographs show that trees effectively wall off dying and dead branches most of the time. As the growth rate of the branch wood decreases and the trunk wood surrounding the branch continues to grow, a swollen collar forms. This collar is trunk wood. On living, dying, or dead branches, the collar should not be removed. The collars on vigorously growing small branches will be very small or flat with the trunk. When such a branch is cut, then essentially a flush cut will be made. For additional details see Shigo et al. 1977, 1978.

Literature Cited

Shigo, A.L., N. Rogers, E.A. McGinnes, and D. Funk. 1978. Black walnut strip mine spoils: Some observations 25 years after pruning. USDA For. Serv. Res. Pap. NE-393. 14 p.

Shigo, A.L., E.A. McGinnes, D.T. Funk, and N. Rogers. 1979. Internal defects associated with pruned and nonpruned branch stubs in black walnut. USDA For. Serv. Res. Pap. NE-440. 27 p.

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