MISSISSIPPI STATE UNIVERSITY EXTENSION

Bacterial Wetwood and Alcoholic Flux

Froth on the tree trunk is alcoholic flux.

Categories of Flux

Flux, an oozing, frothy liquid on the outer surface of a tree has various causes. The problem is seen in many kinds of trees and may occur on the main trunk, branches, flare roots, and roots of old trees or young saplings. Flux is especially common in trees that are environmentally stressed or recently transplanted.

The first external symptom is an eye-catching, often alarming, wet seepage from a small area. If the flux has a foul or sour smell, it is a disease which is variously named bacterial wetwood, slime flux, or bacterial flux. If the flux is milky colored and very frothy/foamy and smells like alcohol, sometimes mixed with a vinegar-like or a sweet odor, it is called alcoholic flux and is not the result of disease.

Bacterial wetwood begins deep inside the tree and is bacterial in origin, while alcoholic flux originates just under the bark, usually near a wound—most commonly, pruning wounds. In both cases, the external flux is colonized by yeasts, bacteria, and fungi, which can modify the colors and odors of the flux. The overall symptoms of the problem vary over geographic areas because of environmental factors. Caution: It is common for the sap of a few tree species such as birches and maples to "bleed" from pruning cuts, especially in the early spring. That bleeding is not explored in this publication.

Bacterial Wetwood (also known as bacterial flux or slime flux)

Wetwood, or slime flux, is a bacterial disease. Bacteria enter the tree through wounds, which may occur as early as emergence from the seed or during the seedling stage. Both sapwood and heartwood grow normally and surround the dormant bacteria. An unknown trigger, perhaps associated with physical injury or environmental stress such as heat and drought, stimulates the bacteria to grow. In the oxygen-poor (anaerobic) heartwood and sapwood, the growing bacteria feed by anaerobic fermentation.

Wetwood bacteria produce enzymes that degrade wood components of the cells making up the heartwood, causing slight weakening of the wood. These bacteria do not cause wood decay. Bacteria that have been associated with wetwood are common in soil and water and include the genera *Enterobacter*, *Klebsiella*, and *Pseudomonas*. While these bacteria are associated with wetwood, they have not been proven to cause the disease.

Anerobic fermentation produces water, alcohol, and the gases carbon dioxide and methane. The rancid or foul odor associated with wetwood apparently comes from decay of fatty acids that the bacteria produced. The infected heartwood becomes unevenly discolored and saturated with

Figure 1. A cross section of a tree that had symptoms of bacterial flux. Note the discolored areas in the region of 12:00 to 2:30 and no symptoms of decay. Photo by the United States Department of Agriculture (USDA) Forest Service - Rocky Mountain Research Station - Forest Pathology, Bugwood.org

water and associated fermentation products (Figure 1). The high internal pressure (up to 60 psi in one study) created by the fermentation process pushes liquid components and some associated bacteria through the weakest area the pressure can follow. It is frequently an old branch stub or pruning wound that may have been grown over for some years and is no longer visible.

The pressure is eventually released as an external "bleeding" or flux (Figure 2). Occasionally, the high pressure caused by the wood infection may push the infection from the heartwood into the outer sapwood. Sapwood infections can be fatal.

The flux point, or emergence point, occurs singly on an otherwise-healthy area (Figure 2). It is usually not too close to the ground (above three feet in height or so), although oaks can have flux points on their flare roots. Rarely, two or three flux points will occur, emerging from obvious wounds or bark cracks. The flux points do not merge to form a large diffuse bleeding canker as seen with some *Phytophthora* (water mold) infections, which are generally within three feet of the soil line.

The liquid ooze, called slime flux, is colorless or light brown and foul-smelling inside the wood, but upon exposure to air and colonization by external organisms, the ooze changes to a brown, slimy, sometimes bubbly secretion (Figure 3) that discolors and stains the tree bark below the flux point (Figure 2). The cambium tissue near the exit point is killed by the alcohol, preventing proper wound callusing. The alcohol in slime flux may attract various insects, such as flies and some beetles.

Slime flux may flow freely at certain times of the growing season and stop flowing at other times. In Mississippi, fluxing on newly transplanted trees may occur for a season or two in the early summer several days after a heavy rain, then disappear. If the ooze continues for months, leaves on upper branches may become stunted and yellowed. In severe cases, the trees upper foliage will wilt and branch die-back may occur. This is not common in landscape trees. The general decline in tree vitality is not known to cause tree death.

In landscape trees, the most significant symptom is generally blemished dark streaks on the bark below the flux point, where liquid has oozed down the tree (Figure 2). When the exudate dries, the area may be discolored white. Where the

Figure 2. A single flux point created by bacterial wetwood. Photo by Joseph O'Brien, USDA Forest Service, Bugwood.org

Figure 3. Slime flux oozing from an oak flare root onto the soil.

wetwood problem has been chronic (prolonged), bark below the flux point can become soaked, and with the help of organisms that colonized the flux, the bark can weaken, and flake easily. Grass and other plants at the base of the tree may be killed where the flux contacts them.

Bacterial flux can be economically important in trees cut for lumber because abnormal color and moisture may devalue the wood. Affected wood may crack along, or across, the growth rings, and wood strength may be further compromised by decay organisms. Symptoms may be only internal or both internal and external. Internal symptoms are commonly discolored wet zones (Figure 1). However, some wetwood may only express symptoms as late as kiln drying, when the excess moisture in that area causes the wood to crack as the surrounding area dries faster. External symptoms are those of urban landscape trees with liquid, oozing or running down the bark.

Past management recommendations for bacterial wetwood included drilling a hole in the tree to relieve the pressure or drilling a hole and installing a plastic or iron drain tube (Figure 4). The idea was to relieve the gas pressure and drain the flux away from the trunk, so the cambium is not killed. However, trees can compartmentalize injuries or diseased wood, walling off the wetwood areas. Because drilling and drain tubes create a deep wound, they may break the compartment the tree has made to encompass the wetwood, causing internal discoloration and any future decay to spread beyond the contained area. Some arborists chisel away the loose bark around the flux point, but there is no evidence that supports the usefulness of this practice. Wound dressing should not be applied.

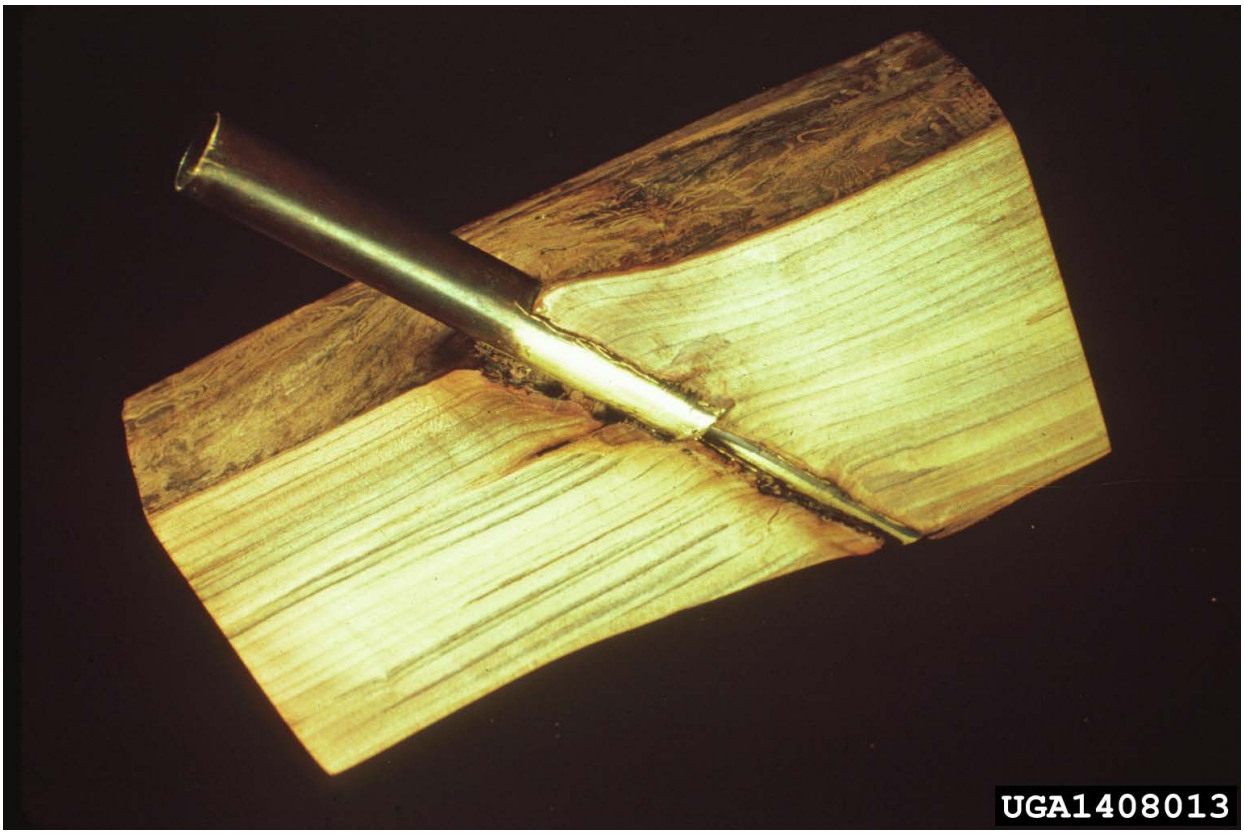

Figure 4. Years ago, holes were drilled into the flux point and a drain tube was inserted. The idea was to keep the fluxing from destroying the bark cambium layer below the flux point. It has since been learned that drain tubes often cause more tree damage because they destroy the barrier the tree has made to wall off the infection (note the wood discoloration at the tip of the drain tube). Also note the other damages the drain tube is causing to the outer wood layers. Drain tubes or drilled holes are no longer used. Photo by USDA Forest Service - Northeastern Area, Bugwood.org

There is no current "cure" for bacterial wetwood other than prevention by good cultural practices to remove or avoid tree stresses. Consider the following tips:

- Remove dead or weak branches. Proper pruning encourages rapid callousing of wounds. The sap flow that results from pruned branches is normal and is not the same as wetwood flux.
- Avoid common landscape stresses from mechanical damage such as damage caused by lawn mowers, string trimmers, and soil compaction or root injury (i.e., zero-turn mowers on wet soil).
- Proper watering during the growing season as well as during the winter months is critical. Maintaining the balance between under- and over-watering is important.
- Proper fertilization at the correct time might also be helpful.

Alcoholic (or foamy) Flux

Alcoholic flux, also called white flux, foamy flux, or frothy flux is not related to bacterial wetwood (Figures 5a and 5b). It occurs in the outer cambial region in shallow cracks (Figure 5a), bark wounds, and especially pruning wounds (Figure 5b).

Alcoholic flux, nearly colorless and resembling frothy white shaving cream, seems to be generated by microorganisms—probably yeasts—producing gas and alcohol. The odor of the alcohol is attractive to insects and persists only a short time in summer (Figure 6). Alcoholic flux is often associated with drought and heat stressed trees. It has also been noted on mimosa trees infected by Fusarium wilt (a fungal disease that damages the xylem or water conducting tissue).

No treatment has been shown to consistently result in tree improvement. Chemical treatments are ineffective. The cultural management practices outlined for bacterial wetwood are appropriate for alcoholic flux as well.

Figures 5a and 5b. Alcoholic flux emerging from a bark crack (a) and around a pruning wound (b).

Figure 6. A fly attracted to the alcoholic flux, but beetles are also common visitors.

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