
*Bacteria and gas bubble through the bark between the buttresses. Finding frenzied congregations of insects on oozing, stinking, discolored areas on the lower trunks of older trees often incites tree owners to call arborists. Insecticide is not the answer, because the insects are only a sign of trouble underneath the bark. Photos courtesy of Guy Meilleur.*

*By Guy Meilleur*

"Roll out those lazy, hazy, crazy days of summer; those days of soda, and pretzels and beer!" as Nat King Cole sang way back when. Summer is also the time for other foamy stuff, the kind that has certain insects singing songs of cheer. However, this is not good news for unfortunate older trees that serve as taverns for moths and hornets and other imbibing creatures.

Finding these frenzied congregations on oozing, stinking, discolored areas on the lower trunks of older trees often incites tree owners to call arborists this time of year. But insecticide is not the answer, because the insects are only a sign of trouble underneath the bark. Oozing slime is a symptom of bacterial infection, and "… warm temperatures are favorable for the development of some bacterial diseases …" as John Lloyd notes in *Plant Health Care for Woody Ornamentals*.

A coating of polysaccharide, which is called a "slime layer" for obvious reasons, surrounds bacterial cells. When the bacteria multiply, they are forced out of the host plant and ooze down the bark. Dividing as fast as once every 20 minutes, they quickly build up their numbers to as high as a billion per milliliter. A cocktail of bacteria – Pseudomonas, Enterobacter, yeasts and other organisms – causes slime flux disease. Whether any of these organisms is particularly pathogenic (or it is simply the physical pressure caused by all of them multiplying) that kills the bark is not clearly understood. Fermentation produces gases, such as methane and carbon dioxide, that increases the pressure that ruptures the bark. Many different microorganisms grow in the flux, producing an indescribably foul or alcoholic odor that is hard to miss.

Different species of trees have different types of slime flux disease. The types found higher up in wounds and crotches of elms and poplars are considered relatively benign. They seldom seem to damage the

bark aggressively. What damage occurs is well above ground level and considered correctable. They are located in Zones 2 and 4 as defined in Dr. Kim Coder's "Hazard Tree Evaluation" form, published in 1990. On older oaks the disease is quite different; it is typically found between buttress roots. This is Zone 1, where damage and disease are considered critical. Previous physical damage or previous insect injury is seldom noted at infection sites on the trees studied. Similar to included bark in a crotch, the bark between buttresses seems to be squeezed. One theory is that the tree opens itself up to infection by wounding itself when bark is included, and the bacteria enter from the soil. This is addressed by Dr. Alex Shigo in *Modern Arboriculture*, in which he states that, "Included bark between roots and root stubs are common underground infection courts."

**To act or not to act**

The old practice of drilling into the infection and installing a drain pipe to direct the slime flux away from the bark can expand the infection court and worsen the disease. The wet, alkaline conditions at these sites is inhospitable to most decay-causing fungi, so one thought is to leave well enough alone. When armillaria fungus is found along with slime flux, more rhizomorphs are found outside the oozing areas. Only a few stunted "shoestrings" are found in the slime. Many insects that are harmless to the living tree – ants, termites, centipedes and sowbugs, for instance – can be found under the dead bark, but there is no reason to go after them. However, carpenterworms, *Prionoxystus sp*., are also active in these infection sites. As Warren Johnson and Howard H. Lyon report in *Insects that Feed on Trees and Shrubs*, "Over a period of time, the activities of the carpenterworm larvae may prove disastrous to the host tree …" The need to expose and treat this pest calls for the removal of dead bark. Bacterial activity and slime flux on older oaks can and does kill cambium, expanding the diseased area every year. So there is also a clear need for noninvasive methods to preserve the tree.

*Slime was seen fluxing here in 1998, but it was untreated. Removal is now required.*

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The first job is to find out which portions of the bark are dead. The initial cues are visual – lesions bleeding with blackened sap at the margins of the diseased area. These lesions appear very similar to those caused by infections of fungi, such as Phytophthora sp. Auditory cues are gained by tapping with a rubber or plastic mallet outside these lesions. A solid sound indicates living bark over solid wood. Tapping inside the lesions will produce a hollow sound, indicating dead bark. A stethoscope can be used to hear the sound better, but is often not necessary to detect dead bark. The next step is probing these areas with a blunt instrument, such as a trowel or screwdriver. Remove all discolored bark down to the wood. In some cases this means removing a lot of bark. If the infection encompasses more than half of the trunk and decay is advancing inward, it is doubtful the tree will remain safe for very long. It is probably best to treat these unfortunate trees with a chain saw at ground level.

*Armillaria root-rot fungus and slime flux infection have taken a toll on this oak.*

Cut around the infected trunk or branch until you come close to healthy cambium. Take care not to cut into healthy bark or wood. Excavation of wounds is still viewed with skepticism in some circles precisely because of the fear that careless digging will result in more damage. When most of the dead bark has been removed, a sharper tool will trim the edges of infected material. In "Helping Plants Survive Armillaria Root Rot" (November 2003 issue of *Tree Care Industry*), author J. Harold Mitchell describes the excavation of tissue infected with the fungus Armillaria. Because bacterial infections seem less virulent and do not cause wood decay like Armillaria does, a more cautious approach to tissue removal seems to be warranted. The goal is to come as close as possible to healthy tissue without cutting into it. A blunt-tipped knife, such as a linoleum knife, can trim the last scraps of diseased bark without scratching the wood. There is no need to trace the wound into an oval, because sap can flow laterally within the cambium. Careful removal of dead bark may reveal the cambial layer, still light in color and adhered to the wood. The more living cambium that is left, the sooner the tree can close its wounds. Rinsing off the last of the debris with a sharp stream of water from the garden hose or better yet a jet of air from a pneumatic tool will finish the excavation work.

### Chemical conundrums

Once the infected tissue is removed, the area can dry out, making the environment more inhospitable for the bacteria. Some publications recommend sanitizing the area with a 10 percent bleach solution. Some bactericides listed for other bacterial tree problems contain 9.5 percent propy-

*While this picture shows Armillaria fungus best, it is clear that the fungus is suppressed by the bacteria.*

lene glycol, so they can also do a good job of sanitizing the area. Both these chemicals are very toxic to bacteria, but unfortunately they are also toxic to plants. Applying either to tree wounds is very risky and not recommended for this disease. If holes from wood-boring insects are found, they should be excavated of loose material and probed with a thin tool, such as a coat hanger or a flexible wire. The goal is to either crush the pest, or at least clear a channel for a secondary attack with air, water or pesticide. No sealant or pruning paint is ever recommended for this condition, even after the surface has dried. As has been said for 20 years, any compound that can seal out problems can seal in problems. Light and air will dry out the area over time; invigoration of the root system can speed compartmentalization.

Fertilization of diseased plants has recently become highly controversial. Some large declining oaks that received a "stress treatment" of high-nitrogen fertilizer injected into the soil looked great a year afterward. Soon after, they succumbed to Phytophthora and other decay organisms that thrive on excess nitrogen. As always with any stressed plant, the soil should be tested. Any nutritional deficiencies, if found, should be corrected cautiously. The elements most lacking in many soils are oxygen and organic matter, so aeration of compacted areas and general mulching are often recommended. Inoculation of soil around the trunk with beneficial microorganisms is sometimes done to prevent infection by basal decay organisms, the "butt rotters." This practice is based on the premise that pathogens will be less able to take hold in the basal area if there is a healthy population of microbes that are symbiotic with the tree. Inoculation is also an intriguing possibility for prevention of bacterial infection. However, some of the same genera of bacteria present in the disease are also present in the inoculant. A better understanding of the disease is needed before these inoculations are made to prevent bacterial disease.

*Carpenter worm larvae growing in concert with bacterial ooze.*

In the course of excavation, any infected sites at ground level will require the removal of earth from the base of the tree. Small roots may be removed in the process, but care should be taken not to nick any woody roots. If fungal pathogens are identified, the surrounding soil can be drenched with a listed fungicide, following label directions. Air and light are the enemies of most fungal and bacterial organisms. Therefore, coarse stone inside a layer of landscape fabric is often used to replace the excavated soil. This prevents mulch and debris from coming into contact with the wound, and makes it easier to inspect the wound on follow-up monitoring visits. Trees are best revisited in early summer, when the slime fluxes again and the need for additional treatment can be determined. According to research cited in "Tree Growth Retardants" in the March 2003 issue of *Tree Care Industry*, growth regulators have demonstrated a fungistatic property due to the inhibition of steroid production. Since steroids are essential constituents of membranes in both fungi and bacteria, application of growth regulators may also be bacteriostatic. They seem to hold great promise for the treatment of bacterial infections.

**Survey says …**

For the last 15 years we have treated this disease in central North Carolina. Most of the trees involved have been located on residential properties under a variety of conditions. To gain a better understanding of this disease, a site with a variety of mature specimens with a consistent microclimate and maintenance regimen had to be surveyed. The quadrangle at the heart of the University of North Carolina-Chapel Hill campus fit those parameters. School lore has it that Colonel Davie sat under a tuliptree on this site in 1792 and started the first public college in North America. A preliminary survey of the mature trees on this historic site was taken to assess the

extent of this disease. The results follow.

- 6 of 23 *Quercus alba*, white oak, were diseased
- 2 of 8 *Quercus phellos*, willow oak
- 0 of 6 *Quercus rubra*, red oak
- 0 of 2 *Quercus stellata*, post oak
- 0 of 1 *Quercus montana*, chestnut oak
- 0 of 4 *Ulmus americana*, American elm
- 0 of 4 *Prunus subhirtella*, Higan cherry
- 0 of 5 *Liriodendron tulipifera*, tuliptree
- 1 0f 1 *Carya tomentosa*, mockernut hickory

The white oaks were by far the worst affected. Willow oaks were affected as frequently – on about a quarter of the trees in this sample. However, their infections were quite small, 2 and 4 inches wide, as was the hickory infection. Carpenterworm larvae were actively feeding under the bark at the two largest white oak infections, 13 and 16 inches wide. Larvae were not found in smaller infections, perhaps due to a sinister symbiosis between these two problems. The adult moth lays its eggs in the same time period that the slime is flowing. They are also known to generally prefer ovipositing in bark crevices, but the larvae can enter infected bark much more easily than healthy bark. They expand the infection as they feed, which attracts more adult moths to lay their eggs there, and around and around the cycle of destruction goes.

The lack of occurrence in the trunks of the elms demonstrates that this disease is very different from what most people call slime flux, or wetwood. "Slime flux" is a poor term, because many conditions involve oozing viscous liquids, such as resin flow from Scleridia canker in Leyland cypress, or from borer galleries in other conifers, oozing gums in Prunus, wetwood from the xylem of elms and poplars, and sap from all manner of wounds.

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Whether you call it slime flux, the white oak woes or the bacterial oozing blues, treating this condition in a prompt and persistent manner can prevent fatal damage to magnificent old trees. Then you can relax in a hammock under their shade, safely enjoy a bubbly beverage, and listen to the birds thank you with their songs of cheer.

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