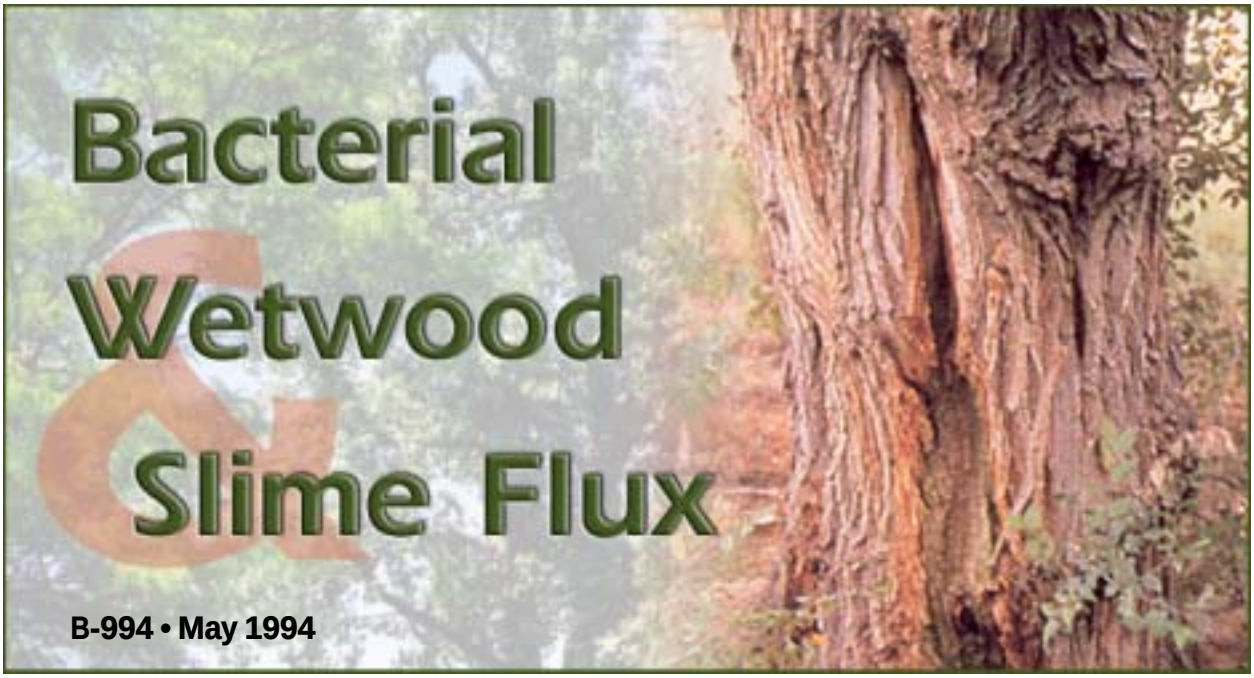

GARY D. FRANC • RESEARCH AND EXTENSION PLANT PATHOLOGIST

Quick Facts

- Wetwood is a common disease in Wyoming that affects the wood and bark of shade and forest trees.
- Wetwood is characterized by water-soaked wood and a liquid that bleeds from wounds, branch stubs, crotches, frost cracks, or other weak points in the wood and bark. On the plant surface, the growth of secondary microorganisms causes the liquid to become slimy in texture, resulting in the condition known as slime flux.
- The causal agents of wetwood are not known, and the disease cycle is not understood. Several bacterial species have been implicated.
- There are no good control measures for wetwood. Proper irrigation and fertility management will reduce wetwood symptoms.

Introduction

Bacterial wetwood is a disease most frequently seen in poplars (aspen and cottonwood), willow, and elm. In some areas, the entire population of Siberian elm may be affected. The disease also affects many other forest and shade trees including species of apple, ash, beech, birch, cherry, fir, linden, maple, mountain ash, mulberry, oak, pines, plum, Russian olive, sycamore, walnut, and western red cedar. Wetwood, sometimes called slime flux, can result in the premature death of branches, sections of the trunk, or the entire tree.

Causal Organism

The causal agents of bacterial wetwood have not been conclusively identified. However, several species of bacteria in the genera Enterobacter, Klebsiella, and Pseudomonas are often associated with wetwood and are assumed to be directly involved. Many bacteria recovered from wetwood have not been characterized. Research using affected elms

Figure 1. Typical external wetwood symptoms. The prolonged oozing of slime has injured cambial tissue and stained the bark.

suggests that an association of bacterial species and possibly yeast act together to produce the complex of symptoms observed.

Symptoms

Wetwood is most easily recognized by the presence of a liquid that oozes or "bleeds" from wounds, crotches, branch stubs, frost cracks, or other weak points in the wood and bark (Figures 1-3). As the liquid flows down the bark, vertical dark or light streaks remain. Although wetwood is usually not a serious threat to landscape trees, the foliage of severely affected trees sometimes wilts, and branches, sections of the trunk, or the entire tree may prematurely die. Symptoms of nutrient deficiency may also appear due to poor water movement within affected trees.

In situations where wetwood liquid flows continuously and becomes colonized by various secondary microorganisms and insects, the condition is known as slime flux. The growth of microorganisms causes the liquid to become slimy and tan to dark colored and contributes to a foul smell. Slime flux causes the mortality of cambial tissue in bark chronically soaked by the liquid (Figures 1 and 2). The slime will also kill turf grass at the base of trees where repeated dripping occurs.

The central core of affected trees is discolored and wetter than the surrounding wood. Affected wood has a decidedly alkaline pH of 7.5 to 8.5. Grasses produced by the activity of microorganisms within the stem cause a build-up of pressure within affected trees. Pressures of approximately 10 pounds per square inch ($0.7\ kg/cm^2$) are common in wetwood with extremes up to 60 pounds per square inch ($4.2\ kg/cm^2$) recorded. The pressure and high moisture content of wetwood causes liquid to ooze from the weakest points within a tree. In a study using elms, the highest pressures occurred from May through August.

Wetwood is important in forest trees harvested for lumber. Abnormal color and moisture in wetwood cause lumber to be devalued. Logs with wetwood often have no defects evident until lumber sawed from it cracks during kiln drying. In addition to problems associated with cracking, wetwood dries only about one-third to one-half as fast as normal wood, requiring twice as much energy. Because cellulose is apparently not degraded in elm wetwood, most wood strength characteristics are not significantly affected. However, shearing strength and the wood condition known as "shake" (a fissure separating annual growth rings in timber) was reported to be associated with wetwood in elm and other hardwood species. Poplar wetwood is reported to be inferior to normal wood in crushing strength.

Disease Cycle

Very little is known about the bacteria and other microorganisms associated with wetwood and their transmission to healthy trees. Wetwood typically develops in wood several years old. Oozing liquid often begins after wounding or pruning occurs. However, it is not known whether bacteria invaded the wounds or if bacteria were already present and the wounds merely provided an avenue for liquid escape.

It has been speculated that insects feeding in slime become contaminated and, when attracted to tree wounds, carry the bacteria that initiate new infections. However, research failed to show that insect vectors were involved in wetwood development. Bacteria recovered from wetwood are also commonly found in soil and on plant surfaces. However, one study showed no correlation between different groups of bacteria recovered from elm wetwood and from soil collected around stem bases.

Figure 2. Close-up of oozing slime from a branch stub and retarded callus formation caused by chronic exposure to slime.

Control

There are no chemical treatments effective for preventing or curing wetwood. The best way to avoid a serious wetwood problem is to prevent damage and stress to the roots and stems of trees. Drought conditions increase the symptoms of wetwood; therefore, adequate water, especially during the summer months, is critical. Recently transplanted trees may show symptoms of wetwood if their root systems are not adequately established. Fertilization of wetwood-affected trees is recommended if nutrient deficiencies are observed.

Inserting drain tubes to relieve internal pressure may help in special circumstances. Properly inserted drain tubes will permit liquid to escape without soaking the bark and will reduce ooze from less desirable places. Therefore, bleeding from stem wounds is minimized along with the associated mortality to the cambial tissue. Drain tubes, however, allow the entry of oxygen into stems, increasing the risk of fungal-caused decay, and may also allow the outward spread of wetwood. For these reasons, drain tubes usually are not recommended.

When installing a drain tube, drill a hole ½-inch (1.3 centimeters) in diameter approximately 7 to 14 inches (18 to 36 centimeters) below the site from which liquid is oozing. The hole should be slanted slightly upward to aid rapid drainage and drilled through the center of the tree to within a few inches of the opposite side. While drilling, note the depth at which wood chips removed from the bore become discolored and water-soaked, indicating the internal portion of the tree that is affected. Insert a semi-rigid plastic pipe into the hole far enough to remain firm but not into the discolored, water-soaked region. Leave sufficient length of pipe to

prevent liquid from dripping onto the bark. If the liquid is oozing from a crack or branch crotch, drill the drain hole perpendicular to the crack or crotch.

Positive pressure within stems interferes with the movement of systemic fungicides or any other material injected into the stems. For this reason, injection holes should be kept as shallow as possible [6/10 to 8/10 of an inch (1 ½ to 2 centimeters)] to avoid penetrating the pressurized central wetwood core.

In trees where oozing liquid has damaged the bark, the dead bark can be cut away to allow for drying and better wound closure. Discolored bark should be removed down to the wood and outward to the margins of the healthy yellow-green cambium. If this area exceeds 30 to 50 percent of the trunk circumference, the trees may not close the wounds. If, however, the bark removal area is small, the margins can be shaped with clean smooth edges and the trees will heal.

Figure 3. Slime flux associated with a probable frost crack injury that has failed to heal.

Appreciation

Appreciation is expressed to the following reviewers: William R. Jacobi, plant pathologist, Colorado State University, and Michael E. Schomaker, forest pathologist, Colorado State Forest Service.

UNIVERSITY
OF WYOMING
Cooperative Extension Service

Issued in furtherance of cooperative extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jim DeBree, director, Cooperative Extension Service, University of Wyoming, Laramie, Wyoming 82071.