Bacterial Blight of Filberts and Its Control

By

P. W. Miller

Oregon State System of Higher Education
Federal Cooperative Extension Service
Oregon State College
Corvallis
and
Bureau of Plant Industry
United States Department of Agriculture
Cooperating

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Figure 1. A branch from an infected filbert tree showing a number of blighted shoots of current growth. At a is shown a young shoot that was killed by bacterial blight shortly after it emerged from the bud. At b is shown a diseased shoot infected near the base of the stem. The shoot has broken at the point of infection. (After Barss.)
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P. W. MILLER, Associate Pathologist,
Division of Fruit and Vegetable Crops and Diseases,
Bureau of Plant Industry,
United States Department of Agriculture

BACTERIAL blight, commonly known as filbert blight, is the most widely distributed and destructive disease of filberts in the Northwest. This malady apparently is native to the Pacific Northwest as Oregon and Washington are the only states in which it has been found so far. The prevalence and destructiveness of bacterial blight varies with the season and the age of the trees, severe damage being caused in seasons especially favorable for its development. The most severe losses occur in young orchards two to four years old, where the disease frequently causes the death of from 10 to 25 per cent of the trees. Although trees more than four years of age seldom die from bacterial blight infection, many buds, shoots, and branches in the tops of older trees are attacked and killed.

NATURE OF THE DISEASE

**Cause.** Filbert blight is caused by a specific bacterium* that lives parasitically within the tissues. This micro-organism is rodlike in shape with a flagellum or whiplike appendage at one end (Figure 2). The bacteria are so small that they can be seen only with the aid of a high-powered microscope.

**Description.** Bacterial blight affects the buds, leaves, nuts, twigs, larger limbs, and trunk of the tree, but does not commonly invade the roots.

**Bud infection.** Leaf and female (pistillate) flower buds infected with blight turn brown or black and die (Figure 3). Death may occur before the buds can open or not until after they are partly open. As far is now known, the staminate (catkin) buds are not subject to infection.

**Leaf infection.** The disease causes small angular to irregular shaped, reddish-brown, dead spots in the leaves (Figure 4). Leaf infection is of only

*Phytoponas sp.*
minor consequence, however, as the disease usually does not cause premature defoliation.

**Nut infection.** On the nuts, the disease produces dark brown to black lesions that are typically confined to the outer portion of the shell (Figure 5). The disease is only of little direct economic importance on the nuts, however, since they are attacked only occasionally, and then the disease causes relatively little damage. An indirect reduction in the crop from blight may and frequently does occur because of the death of many potential pistillate flower buds, nut-bearing twigs, and branches.

**Shoot and twig infections.** On the stems of shoots of the current season's growth, the disease causes reddish-brown lesions (Figure 6). The infections are commonly located about diseased persistent bud bracts that are attached to the stem at various points through its length. The disease spreads from these bracts, which are infected while in the bud stage, to contiguous parts of the stem. The lesions frequently will encircle the entire stem, causing the leaves at the end of the twig to turn yellow or brown and die. The dead leaves often cling to the girdled shoots for some time, giving them the appearance of having been killed by fire. If the lesion is located near the base of the stem, the shoot frequently breaks at the infected point because of a dis-
integration of the cellular structure and hangs downward (Figure 1), or falls to the ground during windstorms.

Twigs of the previous year's growth also are attacked and killed by bacterial blight. Infection of one-year-old twigs typically takes place either through wounds or indirectly by invasion of the bacteria from blighted buds and diseased shoots of current season's growth attached thereto (Figure 7). The disease produces brown areas in the bark of twigs, frequently girdling the stems and causing them to die. Outwardly twig infections vary in color. The diseased areas occasionally have a distinct reddish-brown cast, but more often the outer bark is only slightly darker than the healthy parts surrounding the cankers. Twigs girdled by blight lesions are commonly constricted in the region of the canker and may, and often do, break at that point and hang downward. Twig blight is of considerable economic importance as many nut-bearing twigs are killed, thereby indirectly reducing the crop.

**Limb and trunk infections.** The formation of cankers on the larger branches and trunk of the tree is one of the most serious aspects of this disease as the cankers frequently girdle and kill young trees. The disease causes reddish-brown to chocolate-colored dead areas in the bark (Figure 8). The wood (xylem) is not typically invaded. Branch and trunk cankers sometimes are rather difficult to detect as the outer covering or cuticle does not change markedly in appearance. If the surface is cut away, however, the canker is detected readily, the diseased tissues being reddish brown to chocolate colored with tiny flecks of white scattered throughout. At first, the lesions are almost oval in shape with the maximum dimension parallel to the long axis of the branch. Later they may become irregular. The size of the cankers varies from one-half to six inches in their maximum dimension. The elevation of the canker at first is unchanged, but as the surrounding healthy tissues grow, the lesions appear somewhat sunken with ill-defined margins. Tension resulting from the growth of surrounding healthy parts may cause longitudinal cracks in the center or at the margins of the diseased areas (Figure 9). The lesions may, and frequently do, girdle the branches or trunks of young trees, causing the leaves on the more distant parts to die and drop prematurely.

Drops of sticky, slimy matter, containing myriads of bacteria, often ooze out of cankers during periods of high humidity (Figure 9). As this ooze is water-soluble, rains spread the bacteria in it to susceptible parts below, where, if conditions are favorable, new infections may occur.

Most of the cankers formed in any one year cease active development and
the bacteria in the tissues die as soon as dry weather prevails. In some cankers, however, the germs remain alive throughout the summer and act as sources of primary infection during the fall and spring.

While bacterial blight does not, as a general rule, attack and kill branches that are more than 5 years old, cases are on record of older leader branches being girdled and killed by the disease.

Blight cankers and dead areas on the trunk due to sunscald frequently are confused with each other. The only sure way to differentiate between blight cankers and sunscald is a microscopical examination. Sunscald usually occurs on the trunks at or near the ground line on the south or southwest side of the tree and the affected tissues are generally uniformly dark brown in color; blight cankers, on the other hand, are found fortuitously situated on all sides of the trunk with tiny flecks of white scattered throughout the dark-brown, infected tissues.

**LIFE HISTORY OF THE DISEASE**

**Overwintering.** The blight organism is carried over from one season to the next in infected buds, in branch and trunk cankers and in blighted twigs. Infected buds and branch and trunk cankers are apparently the most important sources of infection. The causal organism does not appear to overwinter in the soil, as all attempts made to isolate it from soils collected from under badly infected filbert trees have been uniformly negative.

**Spread.** Rain is the most important natural agency concerned in the spread of filbert blight. Man also may, and frequently does, spread the disease with tools. Shears or knives used in pruning and suckering may be readily contaminated with the bacteria by cutting through a blight canker. Unless some effective disinfectant is used, the germs may be deposited subsequently on the cut surface of pruning wounds. Insects apparently are not concerned in the spread of filbert blight.

**Mode of entry.** Under natural conditions, the blight bacteria gain access to the tissues through breathing pores (stomata) in the leaves, buds, nuts, and green stems. They may also enter through mechanical injuries (pruning wounds, etc.).

**Time of infection.** Results of recent studies appear to indicate that the buds are susceptible to infection at practically any time during the year. Most of the bud infection, however, apparently occurs during the fall and early winter. Minor bud-infection periods occur during the spring and early summer. No bud infection takes place during dry weather in the summer.

Leaf, nut, shoot, and branch infections take place during the spring and, to a lesser extent, in early summer.

**Seasonal development of the disease.** Most of the infections on the current growth become evident during late spring, although the disease generally does not become conspicuous until early summer. By midsummer disease development is largely over.
CONTROL MEASURES

Surgery. The disease could theoretically be eradicated if it were possible to remove all sources of infection by surgery. Such removal is humanly impossible, though, because the most careful examination fails to locate all sources of infection. Nevertheless, studies carried on over a 6-year period indicate that the removal of all detectable sources of infection in midsummer is an aid in the control of this disease. The extent to which it is helpful apparently depends on the thoroughness with which the diseased parts of the tree are cut out and all wounds are disinfected. Special effort should be made to cut all diseased tissues away. Unless one follows this procedure, some of the bacteria will remain in the tissues bordering the lesions, where they will reinfect the tissues. Blighted twigs should be cut off several inches back from the discolored margins and the wounds disinfected. When cankers occur on the larger limbs or trunk, all of the discolored tissues should be removed and the cut extended well back into the adjacent healthy bark. In cutting out blight-infected wood, the tools used should be disinfected after each cut. If this is not done, there is serious danger of spreading the disease from one wound to another.

Infected areas must be cut out before the first of the fall rains if this plan is to be effective, because cutting away diseased areas after new infection has occurred is obviously of no value. If the removal of infection sources is delayed until fall or early winter, the resulting wounds do not heal properly and are likely to become reinfected during rainy periods unless every cut is protected by a wound dressing containing a germicide. The best time to remove blight infections is in midsummer after disease development is over.

Sanitation. Studies conducted over a period of nine years indicate that tree losses from blight traceable to infection from wounds made with contaminated tools can be largely prevented by sterilizing the pruning and suckering tools with a good disinfectant. A very efficient sterilizing solution for both wounds and tools is Reimer's disinfectant. The formula is:

\[
\begin{align*}
\text{Bichloride of mercury} & \quad 1 \text{ part by weight} \\
\text{Cyanide of mercury} & \quad 1 \text{ part by weight} \\
\text{Water} & \quad 500 \text{ parts by weight}
\end{align*}
\]

If it is desired to make up one gallon of this disinfectant, dissolve 16 one-half-gram tablets of bichloride of mercury and 16 one-half-gram tablets of
cyanide of mercury in 1 gallon of water. Standard-size tablets of these chemicals may be obtained at most drug stores.

This solution should be kept in a glass container as it is corrosive and loses its germicidal properties after coming in contact with metal. The disinfectant will keep indefinitely in a sealed glass container. It is a deadly poison if taken internally and should be labeled and properly safeguarded.

The use of this sterilizing solution on pruning tools is particularly advisable when suckering and pruning young trees one to four years of age, as infections on the trunks during this period frequently result in the loss of the tree.

Pruning wounds one-half inch or more in diameter and those left after cutting out diseased areas should be covered with a wound dressing to prevent subsequent infection from bacterial blight and wood-rotting fungi. One of the most efficient and inexpensive wound dressings known is bordeaux oil paint. It is made by stirring raw linseed oil into one of the commercially prepared bordeaux-mixture powders until a thick, smooth preparation the consistency of house paint is formed. This paint, however, should not be applied to freshly made wounds as the linseed oil may penetrate and kill the tissues bordering the wounds. The cuts should be allowed to dry out for several weeks before applying this wound dressing.

**Spraying.** Experiments are now in progress to determine whether or not timely spraying with bordeaux mixture will aid in the control of this disease. While several more years of study under a wide variety of seasonal and local conditions will be required before definite recommendations can be made, the results of studies conducted over a period of five years indicate that in an average western Oregon season the incidence and severity of bud and twig blight in filbert orchards can be materially reduced by the application of bordeaux mixture (4-2-50) in late summer before the first of the fall rains occur. If, however, the critical period for infection is abnormally rainy, as many as three applications of bordeaux mixture made in (1) the late summer before the occurrence of the first of the fall rains, (2) in late fall when the leaves are about half off the trees, and (3) in early spring when the leaf buds are opening and the green tips of the leaves are showing may be necessary to hold the disease in check.

**VARIETIES IN RELATION TO THE DISEASE**

Filbert varieties differ greatly in the degree to which they are subject to bacterial blight. Of the more important commercial varieties, the White Ave-line, Barcelona, Brixnut, and DuChilly are the most severely attacked. The Daviana and Bolwyller seem to possess considerable resistance to blight as they never suffer severely from this disease. Both of these varieties, however, are light bearers.