

Filbert Tree Decline and Loss Causes and Control

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FOREWORD

The owners of many of the older filbert orchards in Oregon are faced with a problem of maintaining productivity. They are hampered by the fact that their trees are frequently too close together, and in patterns that do not lend themselves to efficient thinning.

Many diseases attack these old filbert orchards. Crowded trees, together with improper soil and other conditions, make an environment favorable for the decline and loss of trees.

The research work on which this circular is based was conducted cooperatively by the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station.

This circular tells of the conditions that cause filbert trees to decline and die. It explains what the orchardist may do to check or prevent such loss.

A handwritten signature in cursive script, reading "Wm. A. Schoenfeld". The signature is fluid and elegant, with a long, sweeping underline that extends to the right.

Director

Filbert Tree Decline and Loss

Causes and Control

by

P. W. MILLER and C. E. SCHUSTER*

A CONSIDERABLE number of older filbert orchards in the Pacific Northwest are beginning to decline. This decline shows itself in several ways, ranging from the simple retarding of growth and decreased yield to the death of the trees.

A number of different causes have been found for the decline and death of filbert trees. Some of the damage is caused by specific organisms that live parasitically on the trees. Other damage results from unfavorable weather, soil, or other conditions. This circular describes the most important of these diseases or conditions and gives recommendations for controlling or remedying them.

DISEASES DUE TO SPECIFIC ORGANISMS

BACTERIAL BLIGHT

Cause and nature of the disease

Bacterial blight is caused by the bacterial organism *Xanthomonas corylina* (Miller et al.) Dowson (Figure 1).

This disease occurs to a varying extent in nearly all filbert orchards in the Pacific Northwest. It attacks the buds, leaves, branches, trunk, and occasionally the nuts (Figures 2 to 5).

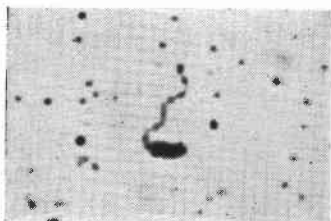


Figure 1. Photomicrograph showing the filbert blight bacterium. $\times 2300$. Photograph by F. P. McWhorter.

The formation of cankers on the tree trunk is the most serious phase of this disease. The cankers frequently girdle and kill trees up to 4 years of age (Figure 6, A). Young filbert trees are made more susceptible to bacterial blight infection by poor environment. Among the conditions which weaken the vitality of the trees are sunscald, poor soil drainage, drought, and cold injury.

The tissues of weakened trees offer little or no resistance to blight infection and the later enlargement of the diseased areas.

After a filbert tree is four years old, it is seldom infected by bacterial blight. However, the presence of blight cankers on the

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trunks of older trees, dating back to early infection, often contributes to the decline and eventual death of many trees by interfering with the upward flow of sap. While the trunks of older trees are resistant to blight infection, the buds, nut-bearing twigs, and branches in the tops are attacked and killed (Figure 7). Here again, sunscald, drought, cold injury, and other adverse conditions make the twigs more susceptible to blight infection.

Control

If bacterial blight is prevalent in the orchard or if conditions that favor its development occur, the following measures are recommended for its control: (a) disinfection of tools used in pruning and suckering, and (b) spraying with bactericides.



Figure 2. A filbert bud infected with bacterial blight (at a).

Disinfecting tools

Blight caused by the use of contaminated tools can be prevented by sterilizing the pruning and suckering tools with an effective bactericide such as bichloride of mercury, 1 part in 1,000 parts of water. The solution should be kept in a glass container, as it is corrosive and loses its germ killing properties shortly after coming into contact with metal. *Bichloride of mercury solution is deadly poison to man or animals if taken internally. It should be labeled "poison" and kept in a safe place away from children.*

The use of a sterilizing solution on the pruning tools is particularly advisable when suckering and pruning young trees, 1 to 4 years of age. Lesions on the trunks during this period frequently result in the eventual loss of the trees. After a tree is 4 years of age, the use of a disinfectant on the tools is not so important, as the tissues of the trunk become increasingly resistant with age. While it is not practicable to sterilize the tools each time between cuts they should at least be sterilized between trees.

Spraying

The occurrence of bud and twig blight due to bacterial blight can be materially reduced in both young and old orchards by timely spraying with bordeaux mixture, 6-3-100 formula.* The addition of an efficient wetting and sticking agent, such as Grasselli spreader-

* 6 pounds of copper sulphate, 3 pounds of unslaked or 4 pounds of hydrated lime, 100 gallons of water.

sticker or B-1956 spreader (glycerol phthalic resin), to bordeaux mixture will increase its effectiveness. In a normal season, one application of bordeaux mixture in the late summer (August) before the first fall rain occurs is generally sufficient to give commercial control of the disease. In seasons when fall and winter rains are "heavy," however, additional applications made in the late fall when the leaves are about three-fourths off the trees, and in the early spring when the leaf buds are breaking open, may be necessary to hold the disease in check.

It is possible to combine in one mixture the material for the control of the bacterial blight with that for the control of the filbert worm, saving both time and labor. This combination mixture consists of bordeaux mixture 6-3-100 plus 3 pounds of lead arsenate in 100 gallons, plus a suitable amount of an efficient and compatible spreader-sticker. In preparing this mixture, the 6-3-100 bordeaux mixture should be made up first; then 3 pounds of lead arsenate per 100 gallons and a suitable amount of spreader should be added in the order named. This mixture should be applied after the moths begin to lay eggs but before any hatch. For the correct time to spray, consult your county agricultural agent.

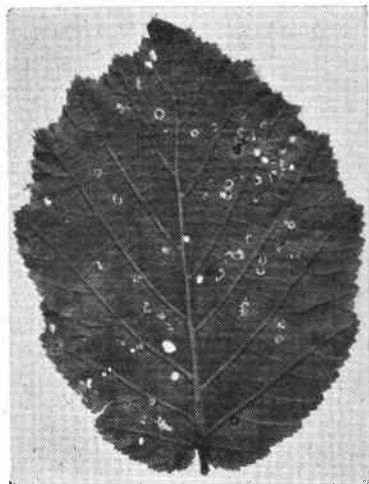


Figure 3. Bacterial blight lesions on a filbert leaf.

MUSHROOM ROOT ROT

Cause and nature of the disease

The mushroom root rot is caused by the fungus *Armillaria mellea* Fr. This is commonly called the "oak root rot fungus" because the oak tree is one of its favorite native hosts.

This disease, while not common on filberts, may under some conditions attack the roots, the root crown, and the basal part of the trunk of the tree. The first indication of its presence is usually a premature dropping of the leaves and dying of the small twigs. Only one sector or portion of a tree may be affected at first. It will be on the same side as the portion of the root system first attacked by the fungus. A number of years may elapse after the first signs of the disease before the tree finally dies (Figure 8).

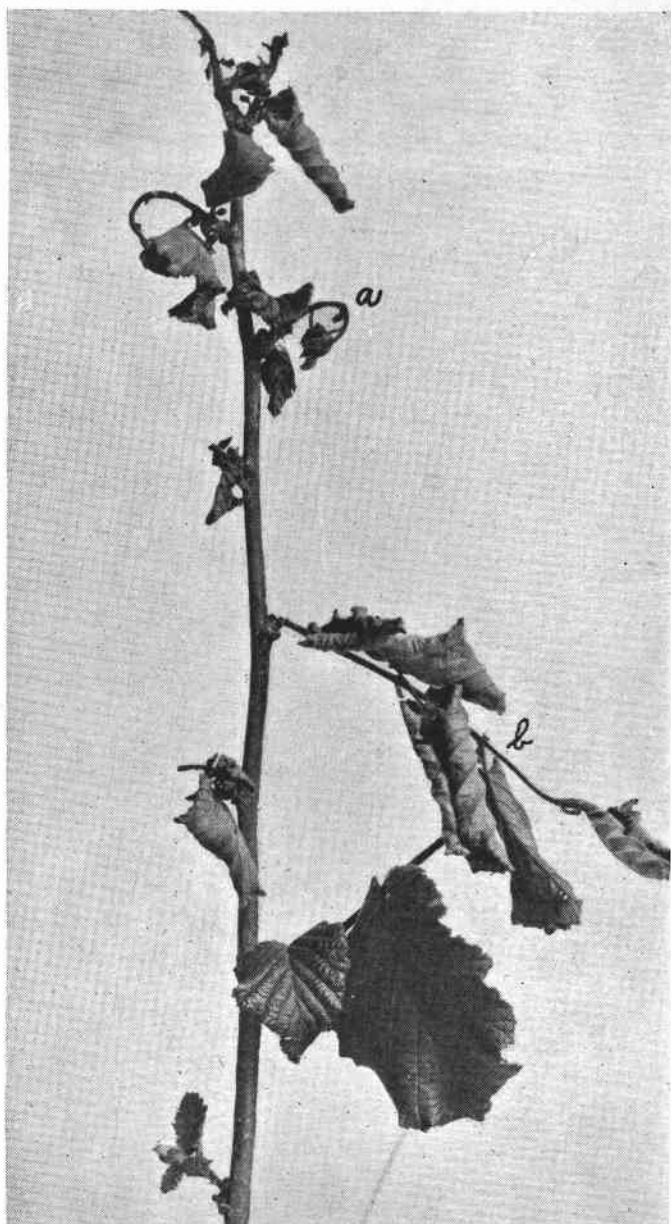


Figure 4. A branch of a filbert tree containing a number of "blighted" shoots of current growth: *a*, a young shoot killed by bacterial blight shortly after it emerged from the bud; *b*, an older shoot that broke at a lesion. *Photograph by H. P. Barss.*

On cutting into the bark of the roots and root crown, the tissues will be found impregnated with a white or creamy colored substance—the mycelium of the causal fungus. Frequently a concentration of this fungus mycelium is found in the cambial region (the part between the bark and the wood) in the form of fan-shaped sheets of fungus growth. The presence of the characteristic white mycelium in the tissues is an indication of this disease.

Dark brown or black, branching, cordlike strands about the thickness of the lead in a pencil or somewhat larger (known technically as rhizomorphs) are also often found clinging tightly to the

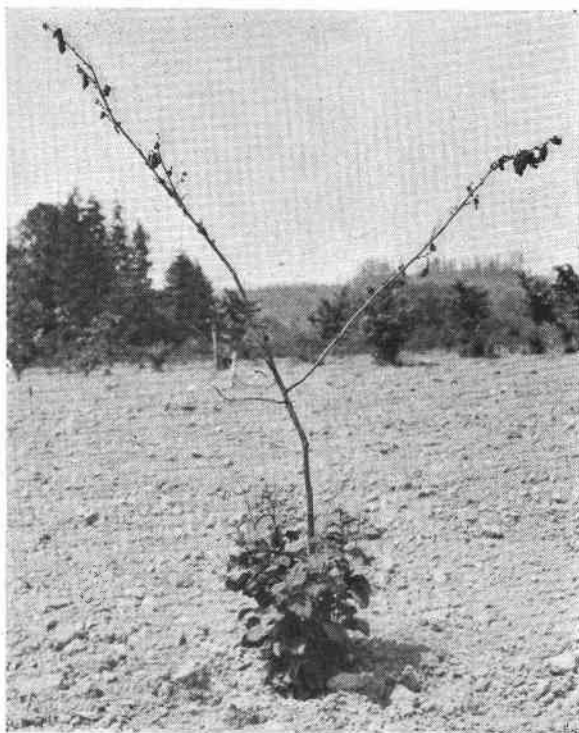


Figure 5. A young filbert tree killed by bacterial blight. The trunk of this tree was encircled by a blight canker.

outside of the bark of infected roots. These rhizomorphs may grow for several yards through loose soil. They are the chief means by which the fungus extends from one spot or one tree to another. If conditions are not favorable for their development, rhizomorphs may not form and therefore are not always present.

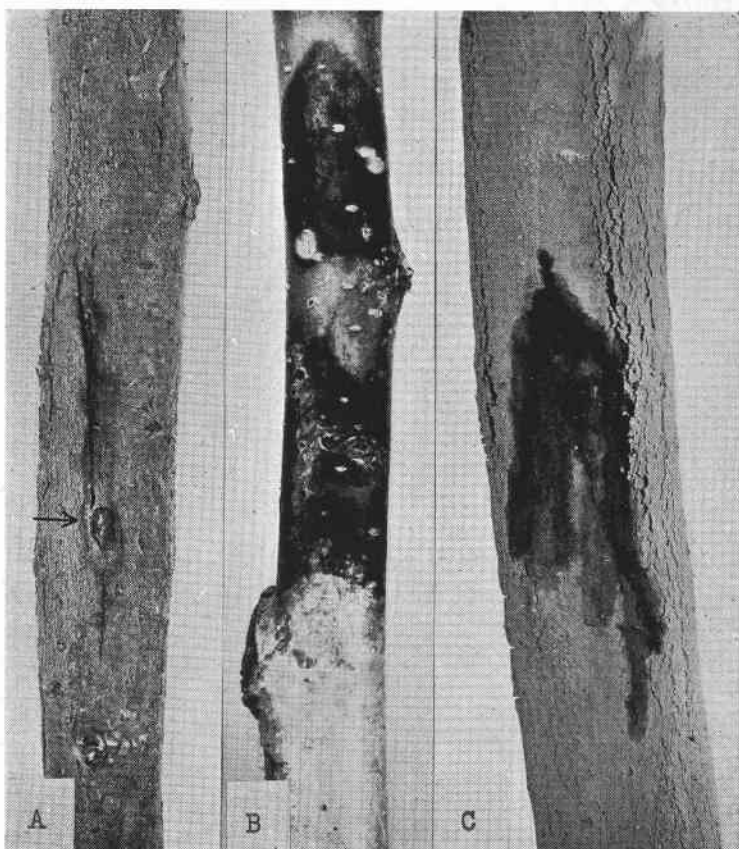


Figure 6. *A*: Bacterial blight canker on the trunk of a young filbert tree; the arrow points to a drop of bacterial exudate that is one of the sources of infection. *B*: A canker due to sunscald. *C*: Winter injury on the trunk of a young tree. Note "sap" coming from the injured area.

Control

Mushroom root rot is a very difficult disease to control since it is not generally detected until after a considerable amount of the crown or root system is involved. After it becomes well established there is little, if anything, that one can do to stop the further progress of the disease on the affected trees. If the disease is discovered in its early stages, it is sometimes possible to prolong the life of an infected tree. This is done by removing the soil from the crown and main roots, cutting out the diseased areas, and disinfecting the wounds with bordeaux mixture or some other efficient fungicide. The crown and main roots should then be left exposed to the air and sunshine

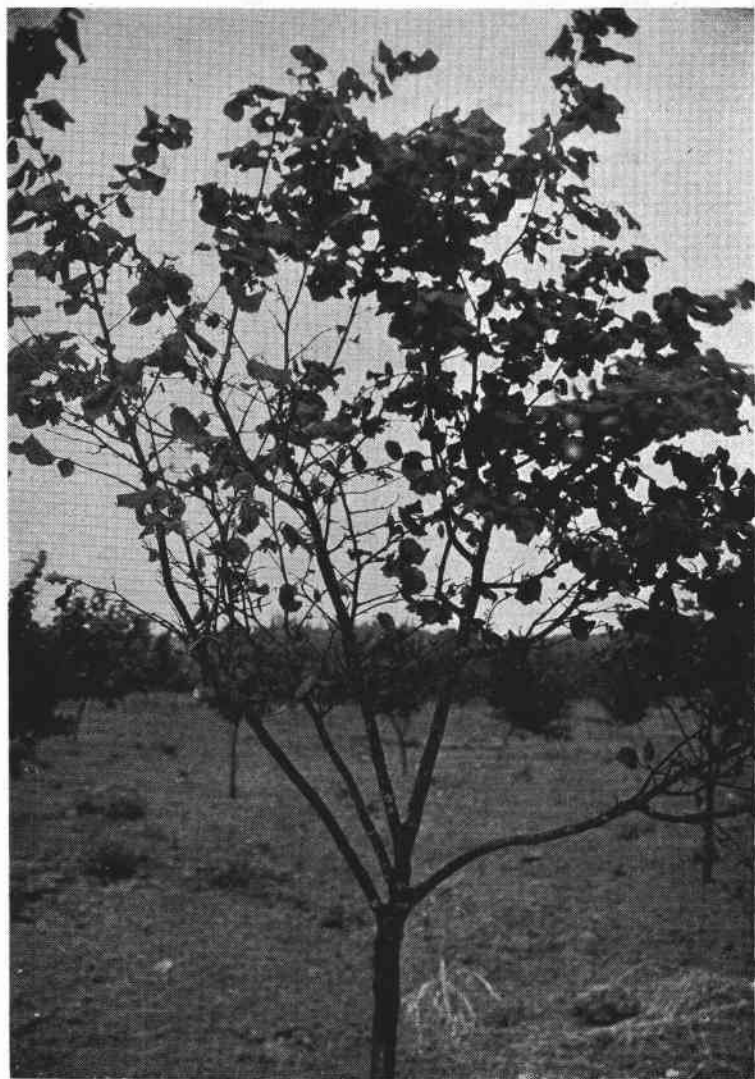


Figure 7. Bud and twig blight in a filbert tree. The killing of the buds and twigs has reduced the bearing area appreciably.

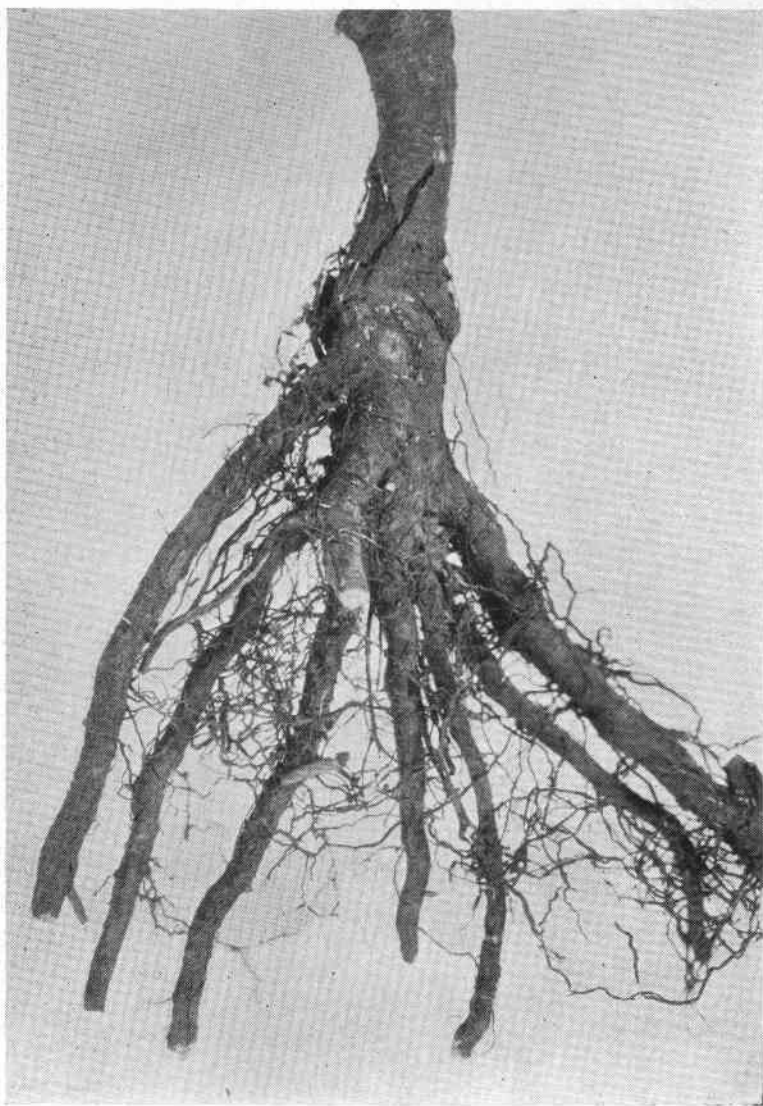


Figure 8. Roots of a young filbert tree killed by mushroom root rot.

during the summer and early fall to stop further progress of the disease. To prevent possible cold injury, the uncovered parts should be covered with soil in the late fall before there is any possibility of freezing weather.

WOOD ROTS

Among the chief parasitic causes for the decline and death of filberts are wood rots caused by a variety of wood-rotting fungi. The presence of wood-rotting fungi in the tissues of the branches causes them to become weak. If in the trunk, they may weaken the tree, thereby causing early decline and eventually its death.

Most of the organisms causing wood rots are wound-parasites which get into the tissues through injuries made in pruning and from such other causes as careless cultivation, winter injury, sunscald, wind-storm, or ice-storm. Stubs of branches left in pruning are among the most common avenues of entry. Pruning cuts should, therefore, be made close to the main branch or body of the tree to hasten healing. In removing limbs, care should also be taken not to tear the bark. This danger will be avoided if the branch is cut nearly half through from the under side first and then finished from above.

All wounds over one inch in diameter should be painted with bordeaux paste,* particularly if made in the fall or winter. Later, after the wound has dried out and started to heal, a permanent wound dressing containing a fungicide should be applied to the surface to prevent the entrance of blight bacteria and wood-rotting fungi. Bordeaux-linseed oil paint made by adding $1\frac{1}{2}$ pints of raw linseed oil to 1 pound of a commercial bordeaux powder is an excellent wound dressing. It is both semipermanent and inexpensive.

DISORDERS DUE TO MALNUTRITION OR ADVERSE ENVIRONMENTAL FACTORS

The most important nonparasitic causes of injury and death of filbert trees in the Pacific Northwest are: (1) sunscald, (2) poor soil drainage, (3) cold injury, (4) insufficient soil fertility, (5) lack of moisture, and (6) combinations of two or more of these.

SUNSCALD

The bark of the trunk of a young filbert tree is very susceptible to injury from the hot rays of the sun whenever the temperature rises above 95° F. Sunscald generally occurs on the south or southwest side of the trunk (Figure 6, B). The first three years after planting are the most critical period for serious damage from sunscald. This is particularly true if the trees are planted shallower in the orchard than they were in the nursery. Unless the trunk is covered to its original depth there is an exposed area at the base of the main stem that is thinner and more tender than the remainder of the

* Made by mixing equal parts of a commercial bordeaux powder and water.

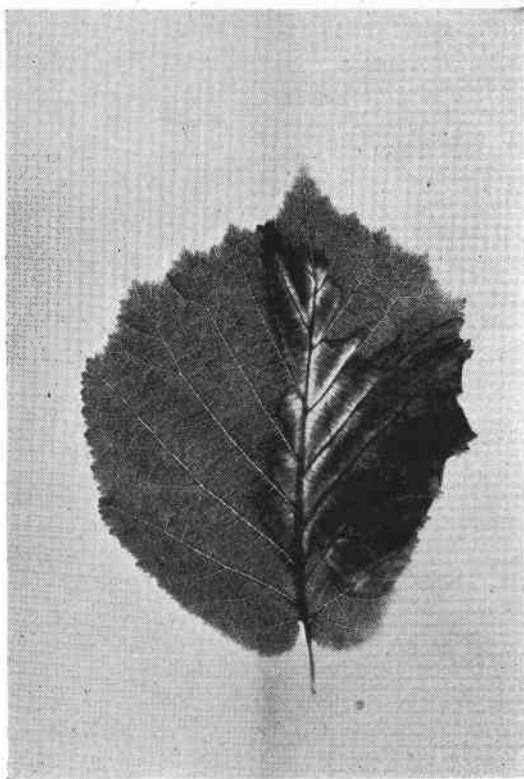


Figure 9. Leaf scorch of filbert caused by sunscald.

stem. Also, trees suffering from drought or those in low, poorly drained soil are more susceptible to injury than vigorous ones. Under some conditions, the top sides of branches, particularly on the south or southwest side of the tree, are injured by the hot rays of the sun. Trees with sparse foliage and those suffering from drought are more susceptible to injury than trees with dense foliage and an abundant supply of moisture. Some varieties, such as the Brixnut and the DuChilly, are more susceptible to sunscald than others.

The leaves of the filbert are also subject to injury by the hot rays of the sun. A scorching or burning of the tissues that in severe cases may involve up to three-fourths of the leaf area may be produced (Figure 9). Badly injured leaves generally drop prematurely. The decrease in the useful leaf area leads to decline in vigor of the tree. Orchards located on a deep, fertile soil with a high reserve of

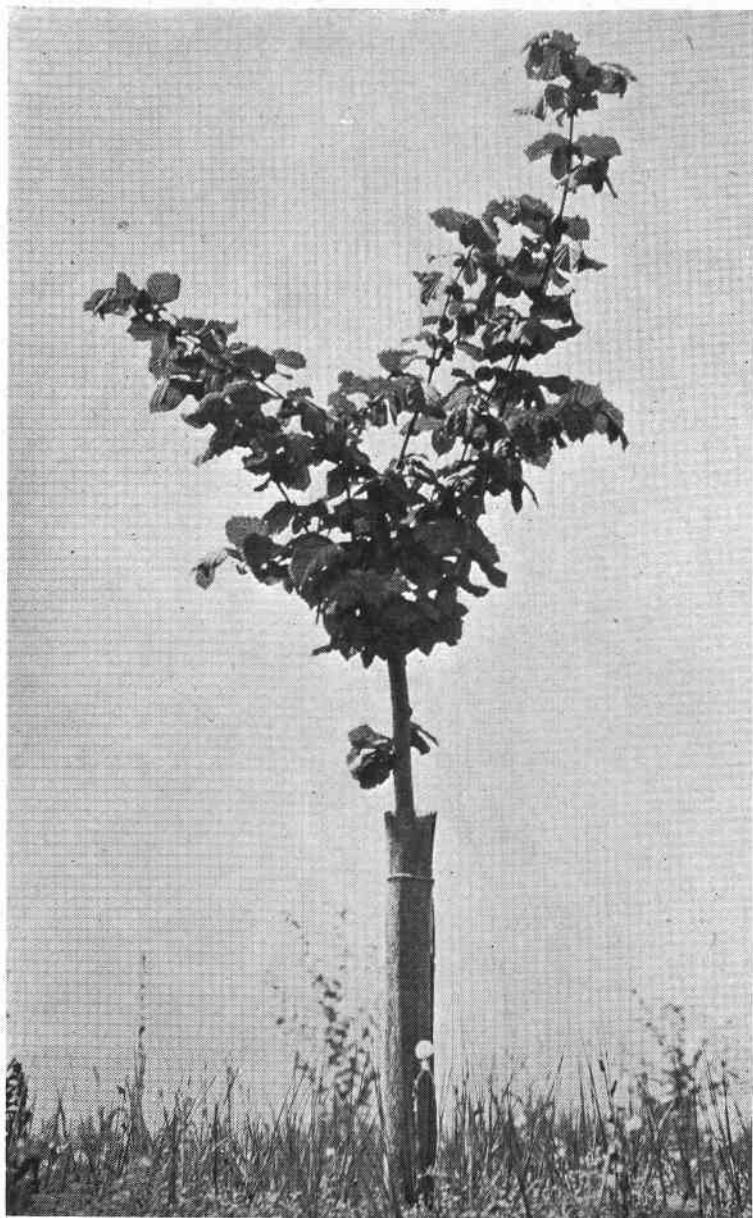


Figure 10. A yucca board protector about the trunk of a filbert tree. Such a covering will prevent sunscald. (*Photograph by O. T. McWhorter.*)

soil moisture are less subject to leaf scald than those on shallow soils with a low reserve of moisture.

A cover placed about the trunk of the tree as soon as it is planted will prevent the trunk from being damaged by sunscald (Figure 10). Among the materials that make good trunk protectors are newspaper mats, extra heavy wrapping paper, and yucca boards. As an alternative, the trunks may be painted with a good adhesive exterior whitewash.* While the latter is not as effective as a trunk protector, it will aid in reducing the damage.

POOR SOIL DRAINAGE

Filberts will not thrive in a waterlogged soil or one having a high water table through most of the winter months. The roots of a filbert tree normally make quite an extensive growth during the winter months in western Oregon, but if the soil is water-soaked this growth may be reduced or stopped entirely. This is due to the filling of the normal air spaces between the soil particles with water, thereby



Figure 11. A filbert tree showing injury resulting from wet, poorly drained soil.

* A very satisfactory whitewash formula is as follows:

Quicklime (do not substitute other forms)	4 pounds
Skim milk	2½ quarts
Water	2½ quarts

Water-slake the quicklime; combine the skim milk and water and then add them to the slaked lime while it is still warm; apply to trees with a brush.

reducing the available oxygen supply. Without oxygen the roots cannot grow and function; without root growth, tree growth is not possible.

In a waterlogged soil the root systems are not extensive enough to provide for the needs of the trees. As a result the trees decline and many eventually die (Figure 11). The vigor of those that do manage to survive is often reduced, leaving them more susceptible to damage from winter injury, shot-hole borers, or other adverse agents.

COLD INJURY

Although filberts are naturally hardier than some fruit trees, they are injured by very low or unseasonable temperatures. The old as well as the young growth is subject to injury (Figure 12). The greatest damage from cold takes place in seasons when freezing temperatures occur before the tissues become fully dormant. Damage to the trunk is generally more severe if snow is on the ground. This is because the sun's rays striking the snow are reflected to the trunk, thawing out the tissues on the south or southwest side of the tree. During the night freezing occurs again, and this alternate thawing and freezing kills the tissues, usually in strips on the south or southwest side of the trunk. Besides interfering with the flow of sap, the cold-injured areas may also serve as places of entrance for blight bacteria and wood-rotting fungi.

Some varieties appear more susceptible to cold injury than others. In Oregon, the Brixnut and the DuChilly varieties have been injured more in past years than the Barcelona and the Daviana.

While there is little, if anything, that can be done to prevent winter injury if the temperatures drop too low, partial protection to the trunk from the injurious effects of alternate freezing and thawing can be obtained by covering with a trunk protector of one sort or another. Painting the trunk with an adhesive exterior whitewash may also help. The whitewash reflects the heat rays of the sun, thereby reducing the extremes in temperature which cause much of the damage.

INSUFFICIENT SOIL FERTILITY

An insufficient amount of the various nutrient elements needed for growth and fruiting is one of the more important factors associated with the decline of filberts.

A fertile soil is absolutely essential to the continued growth and fruiting of the filbert. Not only must all of the elements needed for growth and fruiting be present in the soil in available forms and adequate amounts, but they must also be present in balanced proportions.

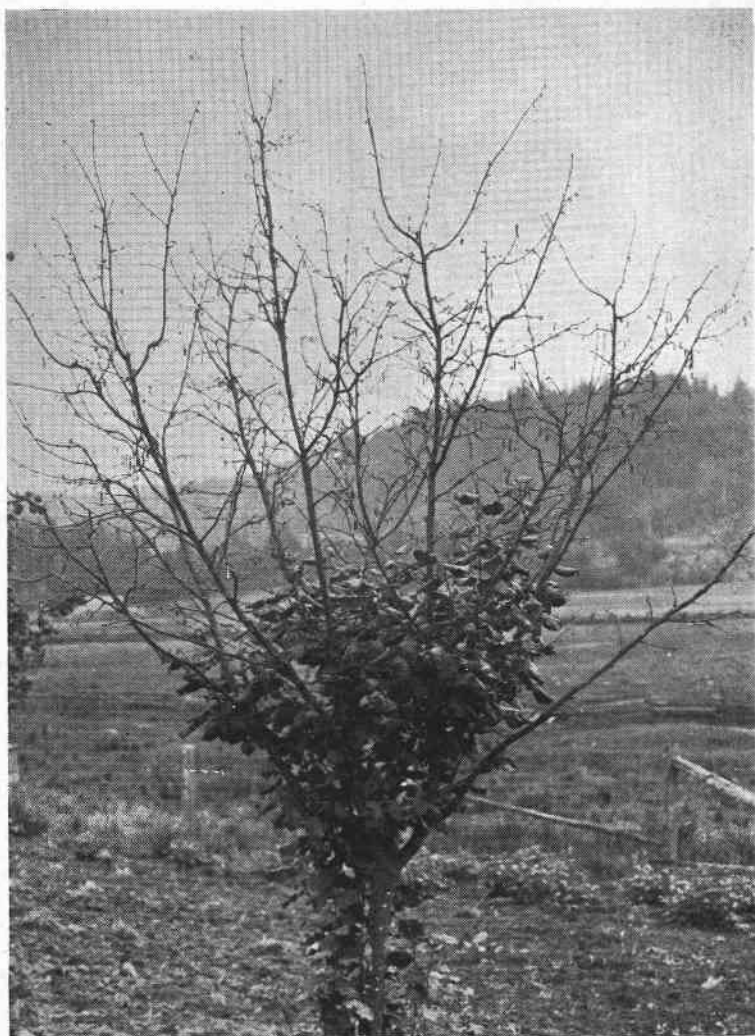


Figure 12. A "cold-injured" DuChilly filbert tree.

The deeper the soil, the greater is the reserve of plant food elements available for the trees. There should be at least 8 "effective" feet of soil for filberts that are being grown without irrigation. Less than this effective depth of soil cannot maintain a mature filbert

orchard in regular, heavy production. The effective depth of a soil is the depth to which the roots can grow in it. If the roots can grow to a depth of only 3 feet, the effective depth is shallow regardless of what is below. Root penetration is stopped not only by rock or gravel, but also by an impervious hardpan, a high water table, or poor aeration.

The problem of nutrient supply is very often aggravated by the fact that the filbert orchard was planted on land that had been cropped for decades with very little, if any, organic matter or chemical fertilizers applied to the soil to replace that destroyed or removed by the crops. The available mineral nutrient supply at the time of planting is usually enough to provide for a fairly good growth of the small trees. As the tree grows, however, it requires more plant food elements. This low level of plant food sooner or later becomes inadequate for supplying the needs of the trees for vigorous, productive growth. The leaves become increasingly smaller and turn yellowish green. The shoots become short and slender, indicating a lack of plant food. Decrease in yield, reduction in growth, and dieback of twigs eventually result.

Too-close spacing of trees is an important factor in their decline. The trees in the first orchards in the Pacific Northwest were planted at distances of not more than 20 feet apart. These orchards are now, or soon will be, at an age at which the supply of nutrients is not sufficient to maintain 108 trees on an acre of soil in vigorous and productive condition. (See front cover.)

When trees are set 25 feet apart on the same sort of soil, they attain a larger size before exhausting their food supply. But the time finally comes in the life of most orchards when even with the greatest planting distances there is a lack of nutrients. This condition can be remedied only by either reducing the number of trees per acre or adding extra plant food to the soil.

In many cases, taking out trees is the only permanent remedy. It may be necessary to remove as many as one-half of the total number. If the orchard has been planted on the square, the usual method of doing this is to remove every other row of trees on the diagonal. In the case of a 20-foot planting this leaves the trees approximately 28 feet apart on the square. As a rule, in about three years after the removal of the trees, the yield of the orchard is approximately equal to what it was before the orchard was thinned.

In some cases, the trees may show indications of malnutrition before excessive crowding of the trees occurs. In such cases, thinning of the stand of trees will not help. Additional fertilizers must be added to the soil in such instances to remedy matters.

In all cases where experimental work has been done on filbert orchard soils, nitrogen is in lowest supply. Other elements such as sulphur and phosphorus may also be lacking, but not to the same extent as nitrogen. Nitrogen must be included in any fertilizer that is used to add additional plant food elements to the soil. Commercial fertilizers containing 100 pounds of nitrogen, 135 pounds of phosphorus (as P_2O_5), 50 to 120 pounds of sulphur and 100 pounds of potash (as K_2O) per acre have been used successfully for filbert trees and cover crops. This is a heavy application, but it seems to be necessary to bring the trees back to normal growth and production.

The use of this fertilizer seems to delay for a while the need for thinning the stand of trees. It must be done eventually, however, because of the increased growth of the trees brought about by the fertilizers.

Cover crops in the filbert orchards are essential for supplying and maintaining a usable and available supply of organic matter. From the nutritional standpoint, the aim in growing cover crops is not so much to increase the supply of organic matter in the soil as it is to have a supply of fresh material breaking down in the soil and releasing plant food materials that are usable by the trees. With good cultural practices the increase of organic matter in the soil by the growing and turning under of cover crops will be negligible, but that practice will provide an annual supply of available plant food materials.

In old orchards, cover crop growth is often so poor that it does not pay unless the fertilizers mentioned above are used. Advice as to the best cover crops to grow and the commercial fertilizer to use in the different localities on the various soils on which filberts are grown may be obtained locally from county agricultural agents.

INSUFFICIENT MOISTURE

Lack of soil moisture during the dry season is another important cause of the decline of filberts. To take care of the needs of the tree during the dry summer months, large quantities of water must be stored in the soil during the rainy season. If the soil is shallow and the organic matter content low, there will not be enough water stored to take care of the needs of the trees during the summer months. The deeper the soil, the greater will be the amount of water that can be stored. Here again, close spacing of the trees will cause a moisture deficiency much earlier in the season than when they are properly spaced.

When the ground gets too dry, water must be added by irrigation, or the number of trees drawing upon this reserve supply of moisture must be reduced. Since irrigation can be used on only a

few of the orchards, the only remedy available for the other crowded and weakened orchards is to thin the stand of trees as previously discussed. Even if there is a sufficient supply of nutrients in the soil or if they are added by the use of fertilizers, a shortage of moisture would prevent the trees from using them. Nutrients and moisture are intimately associated, and both must be in good supply.

COMBINED EFFECT OF TWO OR MORE OF THE FOREGOING CAUSES

In some orchards two or more of the foregoing diseases or conditions may be present. If this is the case, the decline of the orchard will be faster and more pronounced.