

The Causes and Prevention of Tree Losses in Young Filbert Orchards

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LOSSES of trees in young filbert orchards vary from a negligible number up to 50 per cent. It has been estimated that, on the average, about 10 per cent of the trees in young plantings die before they reach five years of age. During the past several years, losses in many 2- to 5-year-old plantings have been considerably above the average, in some cases over 50 per cent of the trees dying before they reach four years of age. This increase in the mortality of trees in young orchards has led to a renewed study of all possible factors associated with the death of filbert trees in young plantings. The object of this paper is to present the conclusions deduced from these studies and to outline a program of orchard management designed to mitigate tree losses in young orchards.

FACTORS ASSOCIATED WITH DEATH OF YOUNG FILBERT TREES

There are a number of agencies which can cause young filbert trees to die. The various causal factors fall into two general categories, as follows: (a) parasitic and (b) nonparasitic.

Parasitic agencies. There is only one parasitic disease of filberts of any importance in the Pacific Northwest; namely, *bacterial blight*.

Nonparasitic agencies. Among the nonparasitic agencies which can cause filbert trees to die are (1) sunscald, (2) winter injury, (3) drought, (4) improper drainage, (5) rodents and (6) insect pests.

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A discussion of each of these factors is presented herewith as a basis for a program of orchard management which will lessen the mortality in young filbert orchards.

Bacterial blight. Bacterial blight, commonly known as filbert blight, is the only infectious disease of filberts of any consequence in the Northwest. This disease is due to a specific bacterial organism,¹ as yet unnamed, that bears a very close resemblance to *Phytophthora juglandis* (Pierce) Bergey et al., the cause of walnut blight. This disease is widely distributed in the Pacific Northwest. It has been found by the senior author in practically every orchard and nursery visited in Oregon and Washington, except in a small section in the extreme northern part of Washington.

Filbert blight, in practically all cases, is brought into a planting on nursery stock, from which source rain and man spread it further. Shears or knives used in pruning or suckering may easily be contaminated with blight bacteria by accidentally cutting through an active canker. (See Figure 1, A.) Unless a disinfectant is used on the tools, the germs will be carried to adjoining trees where centers of infection will be established. From these centers the disease will be spread further by rain.

There is considerable evidence to indicate that young filbert trees are predisposed to infection by various unfavorable factors such as winter injury, drought, improper drainage, etc. The tissues of devitalized trees apparently offer little, or no, resistance to infection and subsequent invasion by the blight pathogen. It is important, therefore, that the trees be kept healthy and vigorous to lessen the severity of the disease in the event of infection.

The incidence and severity of filbert blight can be reduced appreciably by (1) using a disinfectant on the tools when pruning and suckering the trees, (2) by cutting out sources of infection, and (3) by the timely application of bordeaux mixture.²

Sunscald. One of the most important, if not the chief, nonparasitic agency associated with the devitalization and death of young filbert trees is sunscald. The bark of young filbert trees is quite thin and subject to injury by the hot rays of the sun, particularly if the trees are planted shallower in the orchard than they were in the nursery, in which event there is left exposed a tender, very thin-barked area at the base of the trunk. Unless some protection from the hot rays of the sun is afforded this part of the tree it is likely to be injured during abnormally hot weather.

The attention of the senior author was first directed to the important role played by sunscald in 1935. In the spring of that year, a small experimental filbert orchard was planted on the College farm at Corvallis, Oregon. No protectors of any sort were used around the tree trunks. In July of the same year, shortly after an abnormally hot period, dark brown areas in the bark of the trunk on the southwest side and at or near the ground line were noted in from 50 to 75 per cent of the trees. (See Figure 1, B.)

¹ *Phytophthora* sp.

²For a more detailed discussion see Extension Bulletin 486, *Filbert Blight and Its Control*.

Most of the affected trees were so nearly girdled by the injuries that many of them died later in the summer.

Winter injury. Although filberts are naturally hardier than most kinds of fruit trees, they are subject to injury by low temperatures, especially if abnormally cold weather should occur before the trees become fully dormant. Protracted periods of freezing weather accompanied by cold, dry north winds cause more damage than freezing temperatures of short duration with little or no wind. Moreover, the damage is often worse when snow is on the ground and clear weather prevails during the cold period. This is because the tissues on the south and southwest sides of the tree thaw

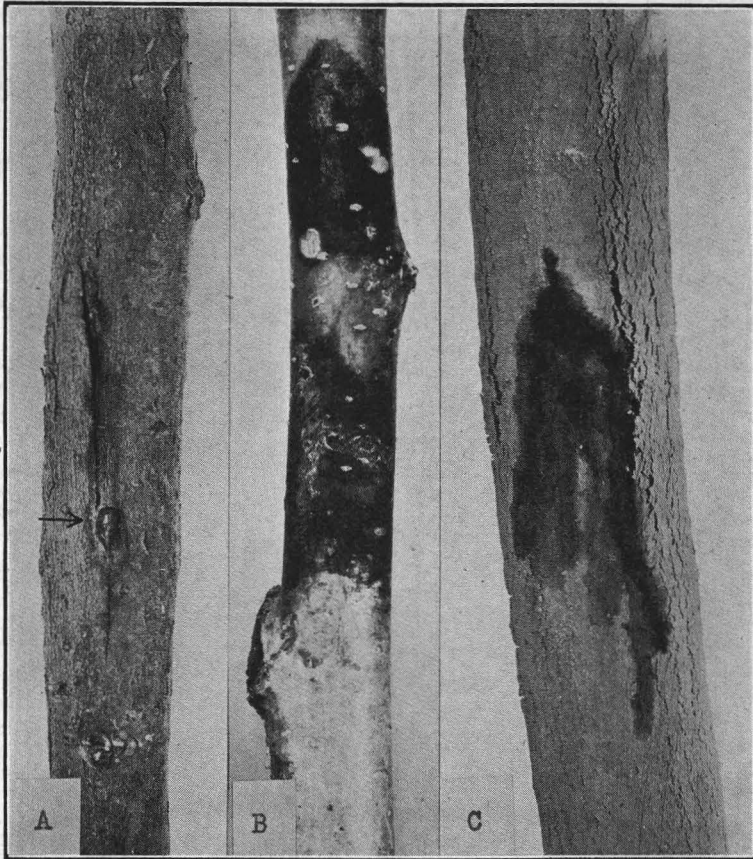


Figure 1. A, bacterial blight canker on the trunk of a young filbert tree. Bacterial exudate, denoted by arrow, is coming from the canker. B, sunscald on the south side of the trunk of a young filbert tree. C, Winter injury on the trunk of a young filbert tree. Note "sap" coming from the injured area.

out during the day and freeze during the night. This alternate freezing and thawing frequently results in the death of the tissues in strips on the south and southwest sides of the trunk. (See Figure 1, C.) That filberts are injured by unseasonably early periods of freezing temperatures was clearly shown by what occurred during the unseasonably early and protracted cold period that occurred in the Pacific Northwest during the last few days of October and the first few days of November, 1935, when the trees were still in full leaf and the terminal portion of shoots of the midsummer and late summer growth were still succulent or semisucculent. A decided increase in the mortality of young filbert trees occurred the following year, and indeed young trees are still dying from the effects of that freeze. Even bearing orchards were injured more or less, depending on the maturity of the trees when the freezing weather occurred. In the state of Washington, particularly in the northern part, 5- to 7-year-old filbert trees died from the effects of that freeze. There are certain varieties that are apparently more susceptible to winter injury than others. In general, the Brixnut and DuChilly varieties have been injured more severely than the Barcelona and Daviana varieties, although these varieties have not escaped damage entirely.

While little, if anything, can be done to prevent winter injury if the temperatures drop too low, some protection from the injurious effects of alternate freezing and thawing can be obtained by shading the south and southwest sides of the tree trunks or by painting them with a good exterior whitewash.¹ The whitewash reflects the heat rays of the sun, and reduces the fluctuations in temperature that are the cause of much damage.

Young trees may need to be forced into dormancy in the fall in order to lessen the severity of injury. To accomplish this it may be necessary to cease cultivating the soil about July 1 and allow the weeds to grow during late summer and early fall. The weeds will take up the surplus moisture, thereby contributing to early dormancy.

There is some evidence to indicate that an application of bordeaux mixture (4-4-50) applied to the trees immediately after a period of unseasonably early or abnormally cold weather may aid in protecting the injured tissues from infection and extensive invasion by filbert blight bacteria.

Drought. While filbert trees of a bearing age seldom succumb to drought, young trees, 1 to 2 years of age, may do so, particularly if they do not possess a good root system to start with and if they were not cut or headed back when planted. Planting in the late spring frequently increases the mortality from this cause, especially if the rainfall should be below normal the first season.

Improper drainage. A lack of proper drainage can cause the death, either directly or indirectly, of young filbert trees. The importance of

¹A whitewash formula developed by O. T. McWhorter, Extension Horticulturist of Oregon State College, and Wray Lawrence, county agent of Wasco County, Ore., which has proved very satisfactory, is as follows:

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

Water slake the quicklime; combine the skim milk and water and then add to the slaked lime while still warm; the whitewash should be the consistency of house paint; apply to trees with brush.

proper drainage becomes apparent when attention is called to the fact that the greatest loss of trees frequently occurs in low, wet spots in the orchard. If improper drainage does not, of itself, kill the trees it decreases their vigor to such an extent as to predispose the tissues to infection by the filbert blight pathogen, or renders them liable to attack by borers and other pests.

Rodents. Rodents, notably rabbits, gophers, and field mice, may also cause the indirect death of young filbert trees. During the winter, particularly when snow is on the ground, rabbits and field mice sometimes gnaw the bark from the lower part of the trunk and girdle the trees. By burrowing beneath young filbert trees and cutting off the roots, gophers and moles may contribute to the dying of trees.

Insects. Borers are about the only insects that attack the trunks and branches of filbert trees. Two kinds of borers have been found on filberts; namely, a shot hole borer¹ and the flat headed apple-tree borer.² These insects, however, apparently attack the trees only after they are first devitalized by winter injury, sunscald, drought, or blight. The importance of keeping the trees vigorous and healthy is obvious.

Combined effect of two or more of the foregoing factors. The results of recent studies indicate that the greatest loss of young filbert trees takes place when one or more of the aforementioned nonparasitic factors and bacterial blight become associated. A great increase in the mortality of young filbert trees occurred during the spring and summer following the severe winter of 1935-36. Microscopic examinations and many isolations disclosed the presence of the blight pathogen in the dead or injured areas on the trunk and branches of many trees that were free from cankers prior to the November 1935 freeze. It is believed that the tissues, weakened by the freeze, offered little or no resistance to infection and extensive invasion by the filbert blight bacterium. Similarly, other unfavorable factors such as improper drainage, drought, sunscald, etc., that lessen the vigor of the trees, may predispose them to infection and serious damage by the blight pathogen.

DETAILED PROGRAM OF ORCHARD MANAGEMENT DESIGNED TO REDUCE TREE LOSSES IN YOUNG FILBERT ORCHARDS

While it is practically impossible to prevent the loss of a small percentage of young trees, the tremendous losses that have recently occurred should be reduced in prospective plantings by following a consistently careful program of orchard management. A detailed program of orchard management is given here that covers the period of time from the selection of the site to the time the trees come into bearing. This program, if followed, should result in a reduction of tree losses in young orchards. The

¹*Anisandrus dispar* (Fabr.)

²*Chrysobothris femorata*.

full outline as given may be more exacting than some growers care to follow. In such cases the program can be adapted to local needs.

Location of orchard. One of the most important factors, if not the chief factor, that determines the length of life and productivity of the orchard, is the location of the planting. In selecting a suitable location a number of factors must be considered, among the more important of which are depth, fertility, and drainage of the soil. The soil should be at least 8 feet deep and preferably deeper before any obstruction to root penetration is encountered. A deep soil has a greater reserve of moisture and fertility for the trees to draw on than a shallow soil. This is an important consideration particularly in unfavorable growing seasons. The soil should be fertile, with a plentiful supply of organic matter, and well drained since filberts will not thrive in "water-logged" soils. The location preferably should be protected on the north or northeast by a natural windbreak of some sort to mitigate the ill effects of cold, drying north winds which sometimes accompany cold periods, as in 1935. The site should also have good air drainage.

Planting stock. Only the best nursery stock obtainable should be planted. The trees should have an extensive system of lateral roots massed within a space of from one to three inches in order to reduce to a minimum the amount of sucker-bearing wood. Trees with but few or no lateral roots should be discarded. Since filbert blight can and has been introduced into many plantings on nursery stock the trees should be free from blight scars or sunken, dead areas in the bark.

Time of planting. The trees should be planted in the late fall or winter as early as the soil is in condition to be handled. The trees should be planted as soon as they are received from the nursery. Planting the orchard early will permit the root system to become well established before growth starts in the spring. Early planted trees with a well established root system generally make a vigorous, strong growth the first season, while late planted trees make but little growth and may even succumb to drought or other unfavorable conditions.

Treatment of trees at time of planting. Filbert trees should be cut or "headed" back at the time of planting. In digging the trees in the nursery a great number of roots are broken off, thereby materially reducing the water-absorbing capacity of the plant. Unless the top portion of the tree is cut back the root system remaining will be unable to provide sufficient moisture to take care of the needs of the plant. Trees are headed at a height of 18 to 30 inches. Low headed trees not only make a stronger, more vigorous growth but the lower limbs aid in preventing sunscald by shading the trunks.

Trees that are whips require no more attention after heading back. If branched, the remaining laterals can be cut back to the trunk and the tree treated as a whip, or the laterals can be cut back to one or two buds and used as the foundation for the framework of the tree.

As an added protection against blight infection, the trees can be pruned before planting, and the tops dipped in bordeaux mixture 4-4-50 to kill any blight bacteria that might have accidentally come in contact with the pruning cuts, and to guard against bud infection during the fall and winter. If the trees are pruned after planting, the spray can be applied subsequently.

Setting the trees. In planting the trees a hole about twice as large as needed should be dug and then refilled half full with loose, top soil. A mound of dirt should then be built up within the hole and the tree set on this mound, spreading the roots in a circle and downward at about a 45 degree angle. The trees should be planted at about the same depth they were standing in the nursery, unless absolute protection is given the tender bark that was below the surface. Cover the roots with fine soil and pack down firmly with the hand to avoid air spaces around the roots. Then fill the hole up with the soil. If the orchard is in a windy location, it is advisable to tie the tree to a stake until it takes root. A lath placed on the southwest side makes a good stake and in addition shades the trunk, thereby aiding in preventing winter injury and sunscald. During the planting operations care should be taken to prevent the roots from drying out. The root system should be covered with moist earth or wet burlap or kept in a barrel of water until planted.

Care of the trees the first year after planting. After the trees are planted, painting the trunks and lower scaffold branches with whitewash will reduce the damaging effects of alternate freezing and thawing, if such weather occurs during late fall or winter.

As an added protection against winter injury and sunscald, a protector of some sort should be placed around the trunk and left there for two or more years. Newspaper mats make an excellent and inexpensive protector. Yucca boards, roofing paper, and a number of other materials also can be used for this purpose.

If rabbits are abundant in the vicinity of the orchard, to prevent them from gnawing the bark and girdling the trees, it is advisable to place a closely-woven wire guard around the lower half of the trunks.

In the spring the orchard should be disked or plowed just as soon as the ground is workable in order to discourage weed growth and conserve the moisture. After the trees have made a normal growth, weeds can be permitted to grow in the orchard to prevent a late fall growth of the trees. Cover crops planted early will serve the same purpose and aid in a soil-building program.

About the middle of August a treatment of bordeaux mixture 4-2-50 should be applied to the trees to guard against the possibility of infection of the buds by the blight pathogen during the winter to follow.

It is a good plan to give the exposed parts of the tree trunks and lower scaffold branches another coat of whitewash in late August or early September to aid in preventing winter injury.

Care of the trees the second year and subsequent years. The first thing to be done in the spring of the second year is to disk or plow the orchard

just as soon as the ground is workable to conserve the moisture and prevent weed growth. The amount of cultivation and the time to "lay by" the orchard should be judged by the behavior of the trees, care being taken not to force a late fall growth that may be injured severely by unseasonably early cold weather.

The suckering and pruning of the young trees should be delayed until late spring or early summer after the critical period for blight infection is largely over since wounds made during the winter and early spring do not heal over readily and may serve as avenues of entry for the blight bacteria.

To prevent the spread of blight by pruning implements which may accidentally become infected by cutting through blight cankers on diseased trees, it is advisable to sterilize the pruning and suckering tools with a good disinfectant, such as Reimer's solution, the formula for which is as follows:

Bichloride of mercury	1 part by weight
Cyanide of mercury	1 part by weight
Water	500 parts by weight

This solution should be kept in a glass container since it is corrosive and loses its germicidal properties after coming into contact with metal. It is a deadly poison if taken internally, and should be labeled and kept in a safe place away from children.

While it is impractical to sterilize the tools between every cut they should, at least, be sterilized between trees. The use of this sterilizing solution on pruning and suckering tools is particularly advisable when pruning and suckering young trees two to four years of age, since infections on the trunks during this period may and frequently do result in the eventual girdling and death of the tree.

Pruning wounds one-half inch in diameter or over, particularly if made in the fall or winter, should be painted with bordeaux mixture 5-5-50 or 6-6-50 until the cuts are dried out. After this, a good wound dressing such as bordeaux-linseed-oil paste, should be applied to the wounds to prevent the entrance of blight and bacteria and wood rotting fungi. Bordeaux-oil paste is made by stirring raw linseed oil into one of the commercially prepared powdered bordeaux mixtures until a thick smooth preparation the consistency of house paint is formed.

A cover crop should be sown in late summer or early fall of the second year, and in subsequent years, to maintain the fertility of the soil and to take up the excess moisture which will tend to cause the trees to enter the dormant state earlier in the fall and mitigate damage from unseasonably cold weather.

The trees should be sprayed again with an application of bordeaux mixture 4-2-50 in mid-August to aid in the control of filbert blight.

It is also a good plan to give the trunks of the trees another coat of whitewash to aid in the prevention of winter injury.

The program during the third year and subsequent years is essentially the same as outlined for the second year.