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WHITE PINE BLISTER RUST CONTROL IN CONNECTICUT

J. E. RILEY, JR.

In Cooperation with Bureau of Plant Industry
United States Department of Agriculture

Connecticut
Agricultural Experiment Station
New Haven

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HOW TO PREVENT BLISTER RUST DAMAGE TO WHITE PINE

White pine, Connecticut's most valuable forest tree, is seriously threatened by the white pine blister rust. The greatest single factor at the present time in the control of the blister rust is the elimination of the European black currant. The growing, sale or possession of this plant is prohibited by law in the State of Connecticut. Help control the blister rust by destroying all European black currants wherever found.

1. Uproot all currant and gooseberry plants throughout the white pine and for a surrounding distance of 900 feet.

2. Pull the bushes. Do not cut them off at the ground. Grub out the root crown and main roots in order to prevent sprouting and hang the bushes so as to prevent the roots coming in contact with the ground.

3. Make sure that there are no European black currants within one mile of the pine stand. Notify the Connecticut Agricultural Experiment Station in case the owners do not destroy them.

4. For free advice and inspection write to the Station Forester, Connecticut Agricultural Experiment Station, Box 1106, New Haven, Conn.

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The bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

WHITE PINE BLISTER RUST CONTROL IN CONNECTICUT

J. E. Riley, Jr.

INTRODUCTION

Many pine owners are misinformed as to the nature of the white pine blister rust. This bulletin seeks to explain the life history of the disease, to discuss the need for its control and to show the status of control work in the state. It offers some suggestions that the pine owner may adapt to his problem of protection.

Importance of White Pine

Connecticut has no more valuable tree than the white pine and its protection and perpetuation is of prime importance to a sound forest program. Throughout most of the state it is one of the trees most suitable for reforestation and everywhere it is a tree to be encouraged in natural stands. It should not be used in pure plantings unless the owner is prepared to protect it from the weevil and it should not be planted at all unless it is protected from the blister rust through the elimination of currant and gooseberry plants, as described elsewhere in this bulletin. There has been a good deal of misconception concerning the practicability of growing white pine because of these two enemies but, given proper protection, it can be safely raised and will yield net returns as high, if not higher, than any other timber species in Connecticut. Frothingham in his bulletin "White Pine Under Forest Management," Bulletin 13 of the United States Department of Agriculture, says, "Of all the trees of eastern North America, white pine best combines the qualities of utility, rapid growth, heavy yield and ease of management." No other tree offers such a combination of advantages.

The wood of the white pine is light in weight, soft, and evenly textured. It takes a pleasing finish and has very little tendency to warp. Its durability is demonstrated in the many century-old

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Author's Acknowledgments. The author wishes to express his appreciation for the constructive criticism of the manuscript by Roy G. Pierce of the office of Blister Rust Control, United States Bureau of Plant Industry, and of others in the Department of Agriculture. The photographs used in the text of the publication were made by the federal office of Blister Rust Control, except those from the New York Conservation Department and the New York Agricultural Experiment Station, Geneva, which were obtained through the federal office.

houses now standing throughout New England sheathed with the original white pine lumber.

The two most serious enemies of the white pine in this region are the white pine weevil, *Pissodes strobi,* described in the appendix, and the white pine blister rust, *Cronartium ribicola* Fisch. The white pine blister rust is a plant parasite that threatens not only serious damage to the present crop, but like the chestnut blight on the chestnut, it may, if not controlled, destroy the commercial value of the species. Fortunately, this disease, although it cannot be entirely eradicated, can be and is being controlled in Connecticut, as it is in the other white pine growing states. Before discussing the work of blister rust control, let us first consider the history of the blister rust, its nature and how it acts.

HISTORY

The blister rust is not of recent origin, although it is comparatively new to this country. In 1854, Dietrich, a German botanist, reported it in northwestern Russia on pine and Ribes as two distinct fungi. The relationship of the previously supposed separate fungi was shown by Klebahn of Germany in 1888. It has been known in Europe, England, Scotland, Siberia and Japan for many years. Spaulding, in Bulletin 206, United States Department of Agriculture, states that losses as high as 100 percent have been reported in Europe. Moir (Bulletin 6, American Plant Pest Committee) reports that in Norway, Sweden, Denmark and Belgium the use of white pine in the regeneration of forests has been practically discontinued because of the rust. There the American white pine is an exotic tree and the native five-needled species are of comparatively little importance, whereas currants and gooseberries, especially the European black currant, constitute a highly valued food crop.

The rust is now known to have existed in this country at Kittery Point, Maine, since 1898, having in all probability been imported on English black currants planted there about that time. It was found at Geneva, N. Y., on Ribes in 1906. Reliable evidence points to the fact that it had been discovered on nursery white pine at Philadelphia in 1905.[1] It is supposed to have existed in Pomfret, Conn., on imported white pine since 1902. Several of the eastern states had been for a few years previous to 1909 importing white pine stock from Europe and not until after the trees had been planted out was it discovered that they were diseased. In Connecticut, C. A. Metzgar first found it in the

[1] Phytopathology, 7: No. 3, 224-225, June, 1917, R. G. Pierce. Also published in Bull. 239 of Pennsylvania State College, School of Agriculture and Experiment Station, entitled "The Rusts of Pennsylvania," by Kern and other authors, May, 1929.

spring of 1909 on some imported white pine stock that he was planting in Wilton. He sent specimens to the Connecticut Agricultural Experiment Station, where the infection was identified as the white pine blister rust.

When the disease was first discovered in Connecticut it was hoped that by prompt destruction of all diseased pine the rust could be eradicated. However, by 1915 it was found that the disease was present on wild Ribes and in 1916 a state wide inspection in coöperation with the United States Department of Agriculture convinced the authorities that the rust was permanently established and that protection to pine through the elimination of Ribes was the only practical control. Since that time the natural pine areas of the state have been examined for the presence of wild currant and gooseberry plants and many thousands have been uprooted and destroyed.

The white pine blister rust is now found in New England, New York, Pennsylvania, New Jersey, Michigan, Minnesota, Wisconsin, Washington, Oregon, Idaho and Montana and will eventually be established throughout the natural range of the white pines in this country. In Canada it is found in the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and British Columbia.

NATURE OF THE RUST

Blister rust is caused by a parasitic fungus known as *Cronartium ribicola* Fisch. It is neither insect nor worm, as is sometimes supposed, but a low form of plant life that lives alternately on the white or five-needle pines and on the leaves of all species of currant and gooseberry plants. In the white pine it grows in the bark and kills the tree by girdling. Death occurs from three to twenty years after infection takes place, depending upon the size of the infected tree and number and location of the cankers. The fungus reproduces itself by means of seed bodies called spores.

LIFE CYCLE

The spores enter the tree through the breathing pores of the needles. The spores germinate, sending a thread-like growth, invisible to the naked eye, into the tissue of the needles. From there the fungus grows downward into the twigs, branches and trunk, eventually girdling the tree. Its presence can usually be detected after it has been in the tree two years or more, by swellings of the bark called cankers. These are characterized by an orange-yellow or a yellow-green discoloration at their advancing edge and, in one stage, by small blood-clot colored areas known as pycnial spots, which contain a sweet-tasting liquid, the function

a

b

c

d

FIGURE 35. *a*, Fruiting stage of blister rust on young white pine; *b*, Fruiting canker on trunk of older tree (note that the bark in the center of the fruiting canker has been eaten by rodents); *c*, First summer stage of blister rust on flowering currant; *d*, Second summer stage of blister rust on European black currant leaf (the stage that produces spores, which infest pine).

NOTE—Plates *a* and *d* are presented by courtesy of N. Y. Cons. Dept.; *c* by courtesy of N. Y. Exp. Sta., Geneva.

of which is unknown. When the disease has been in the tree three years or more the bark on the cankered area cracks open, exposing orange-yellow blisters. These blisters are another positive identification of the rust. They appear in the early spring and are in evidence for several weeks. When they break, the orange-yellow powder within, composed of millions of spore bodies, is spread by the winds.

If these spores come in contact with the under side of currant or gooseberry leaves and the moisture conditions are right, many spores germinate and grow into the leaf, thus causing the first summer stage of the rust on these plants. In two or three weeks rust-colored spots appear on the under side of the infected leaf. These spots contain the summer spores, which spread the rust locally on currants and gooseberries. From late June until the leaves drop in the fall, brownish, hair-like growths replace the rust-colored spots in increasing numbers. These outgrowths produce the fall spores, which infect pine and thus complete the life cycle.

CONTROL MEASURES

There are several interesting facts in connection with this life cycle, a knowledge of which makes possible practical control measures. They are—

1. The spring spores from pines cannot infect other pines. They infect the leaves of currants and gooseberries only. This infection may occur over long distances.

2. The summer spores from currants and gooseberries likewise cannot infect pines. They simply intensify the disease locally on currants and gooseberries.

3. The fall spores from currants and gooseberries spread the disease to white pines. The infecting range of these spores is short, ordinarily not more than 900 feet.

4. The cultivated English black currant will take infection from white pine over a distance of one hundred miles or more, and will transmit it to pines a mile away. The English black currants, therefore, act as infection centers and constitute an especially grave menace to white pines.

All true currants and gooseberries, both wild and cultivated, belong to the genus Ribes and hereafter in this bulletin the generic name Ribes will be used in place of currants and gooseberries. Control measures may be briefly stated as—

1. The elimination of Ribes throughout pine areas and for a surrounding distance of 900 feet.

2. The destruction of all English black currant plants, *Ribes nigrum,* within a mile of the pine stands.

Such control work can be effectively carried on by pine owners, but experience has shown that more effective and thorough initial work is obtained by a state-supervised crew under trained leader-

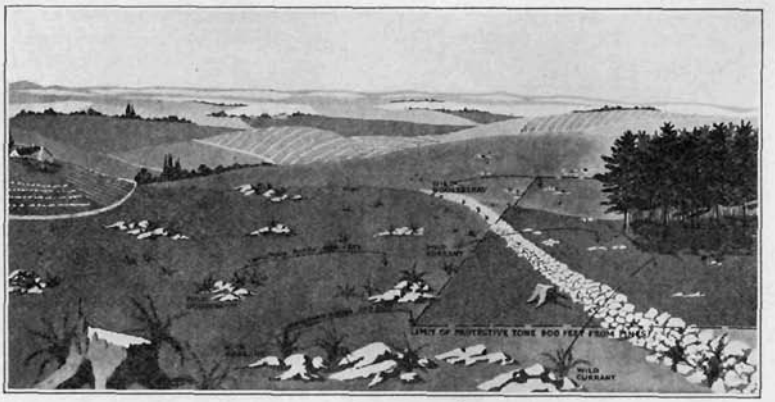


FIGURE 36. This stand of pine is afforded practical protection from the blister rust because there are no currants or gooseberries within 900 feet of the stand and no European black currants within one mile.

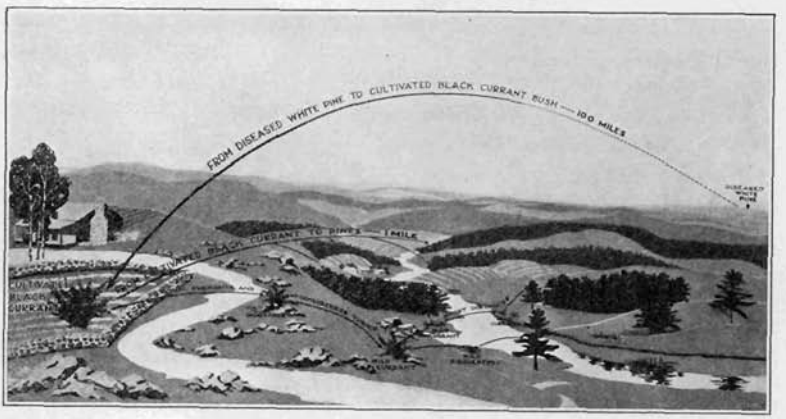


FIGURE 37. The European black currant will take infection over a distance of 100 miles from diseased white pine. This bush may be responsible for transmitting the disease to pines a mile away.

ship. Crew men employed on job after job, and often year after year, learn to know the various currants and gooseberries in their association with other vegetation and consequently become expert in locating them. Also from a knowledge of Ribes growth and

location gained through experience, trained scouts are able to protect many pine areas where Ribes are few with a minimum of effort and expense.

On the other hand there are certain advantages to the pine owner if he himself eradicates the wild Ribes on his land. He learns to identify the various species of Ribes and their habits and is therefore in a better position to keep his pine areas free from these plants, than if others did the work for him. His personal participation in the work results in a keener appreciation of the situation and a more intelligent interest in pine protection. For the information of those who wish personally to carry on the control work and are interested in identifying the species found, a description of the currants and gooseberries commonly found in Connecticut will be included in the appendix.

HOW TO RECOGNIZE THE BLISTER RUST

There are several signs by which the blister rust may be positively identified in the field and others by which the presence of the rust in a tree may be indicated from a distance. One or more of these indications or signs will always be in evidence after the disease has been in the tree two years or more.

"Flags." This term is applied to the discolored foliage of a branch or portion of a tree infected with the rust. When the fungus has been in the tree long enough to cause partial or total girdling of the infected part, the needles often take on a sickly yellow color peculiar to rust-infected trees. These "flags" may, however, vary from slightly "off-color" needles to the red-brown color of dead leaves. Such flags are not positive identification of the rust, but serve to call attention to a tree that is abnormal. Closer inspection reveals other signs.

Cankers. When the rust has been in the tree two years or more a swelling occurs on the bark of the infected twig or limb. This swelling is called a canker. The canker bears certain signs that positively identify the white pine blister rust. Around the advancing edges may usually be seen an area of yellow-green to orange-yellow discoloration. This discoloration becomes more apparent when the canker is wet and it positively identifies the rust.

Pycnial spots. The year previous to the appearance of the blisters, or fruiting bodies, small blood-clot colored areas form on the bark of the canker. The color varies from a reddish brown to almost black. Within these spots is a sweet tasting liquid, which oozes out in clear drops. These pycnial spots are another positive identification of the rust. Very often when the pycnial spot disappears, it leaves a characteristic scar.

Blisters. Three years or more after infection takes place and a year after the pycnial spots appear, the bark at the canker cracks

open and exposes bean-shaped blisters that are yellow in appearance, but in reality are composed of a white or colorless membrane within which is an orange-yellow powder composed of millions of seed bodies, or spores. These blisters appear in the early summer and last only a few weeks, when they break, liberating the spores, which are disseminated by the wind and leave the membrane clinging to the blister pits. These blisters are unmistakable evidence of the rust.

Old cankers. Old cankers are characterized by cracked bark, more or less evidence of blister pits, often constricted areas below the canker and swollen areas above the canker. If the branch or trunk containing the canker is not dead, the typical yellow-green or orange-yellow discoloration at the advancing edge of the canker may be in evidence. An exudation of pitch is often found on or below the older cankers. On dead cankers the discoloration, pycnial spots or blister pits may not show because of the deteriorated condition of the bark.

Rodent work. Field mice, squirrels and other rodents apparently like the blister rust infected bark. Often this bark is eaten to the bare wood. Such rodent work rarely occurs on white pine bark uninfected by the rust.

Sometimes these signs are partially obliterated by the presence of secondary fungi that gain entrance in the tree already weakened by the rust, but one or more of the above described signs will practically always be in evidence. Doubtful specimens may be sent to the Connecticut Agricultural Experiment Station for identification.

Blister rust on Ribes. Fruiting bodies on infected Ribes appear in early June on the under side of the leaf. They are rust-colored spots, a few in number at first, but as the season progresses they become more numerous, until sometimes they nearly cover the under surface of the leaf. The only other disease that they are likely to be confused with is the cluster cup fungus, but the difference is easily seen under an ordinary magnifying glass. The yellow cluster cup fungus spot, appearing on the upper as well as the lower surface of the leaf, is circular in shape and is composed of a group of perfectly circular cup-shaped depressions imbedded in the tissue of the leaf, usually toothed at the edge. The white pine blister rust is a rust-colored spot, irregular in shape, that appears only on the under surface, although there may be a dead area on the upper surface above the fruiting bodies.

Another kind of fruiting body of the blister rust appears on the under side of the leaf in late June and continues to increase in numbers until the leaves drop in the fall. These are brown hair-like growths about one-quarter inch in length, which take on a grey color in wet weather. They are the fruiting bodies that have been previously mentioned as producing the spores that carry the disease to the white pines.

Several tree diseases and insect pests are commonly mistaken for the white pine blister rust, but confusion may be easily avoided by a moment's close observation. In the appendix of this bulletin the few tree pests most often mistaken for the rust are briefly described and the means of distinguishing them from the blister rust are pointed out.

BLISTER RUST CONTROL IN CONNECTICUT

Authority

Authority for the control of the white pine blister rust is found in Sections 2106 and 2117 of the General Statutes of 1918. These have been briefly summarized by Filley and Hicock in Bulletin 237, as follows—

1. A general plant pest law authorizing the Director of the Connecticut Agricultural Experiment Station to control insects or diseases which are, or may become, serious pests to economic plants. He is given the power to destroy infected plants, prohibit or regulate the transportation of the same and to establish quarantine in such areas and against such pests as he may deem necessary. (G. S. 1918, Sec. 2106.)

2. A blister rust law authorizing the Director of the Connecticut Agricultural Experiment Station to control the white pine blister rust. He is given the power to order white pines uprooted and to destroy all wild currant and gooseberry plants and those under cultivation if infected. (G. S. 1918, Sec. 2117.)

In the past it has not been necessary to take drastic measures to enforce these laws. The blister rust control work has been conducted on a basis of coöperation, and the Station has enjoyed a gratifying support in its program of control from individuals and towns and from associations of pine owners.

On July 1, 1929, a European black currant law became effective, whereby the possession of the English black currant is prohibited. Chapter 172 of the Public Acts of 1929 reads:

SECTION 1. Any person who shall grow, plant, propagate, cultivate, sell, transport or possess any plant, root or cutting of the European black currant, or *Ribes nigrum,* shall be fined not less than five dollars nor more than twenty-five dollars.

SEC. 2. The Director of the Connecticut Agricultural Experiment Station is authorized to seize and destroy any plants, roots or cuttings of said European black currant found in the state.

Organization

The blister rust control work in Connecticut is conducted under a coöperative agreement between the United States Department of Agriculture and the Connecticut Agricultural Experiment Station.

The Station Forester, designated as Federal Collaborator, is the administrative head of the organization and he obtains his regulatory authority from the Director of the Station, who is charged by law with control of plant pests. Assisting the Station Forester is a State Leader, who exercises general supervision over the field work. One or more federal agents are employed on educational work, gathering data and organizing local coöperation. Several state scouts and crews, the latter working under the direction of experienced state foremen, carry on the eradication of Ribes under the immediate supervision of the agents.

Since 1922 the coöperative agreement between the United States Department of Agriculture and the Connecticut Agricultural Experiment Station specifies in effect that federal funds shall be used for education, experimentation, collection of data and supervision only, and not for actual eradication of currant and gooseberries. State funds are used for collection of data, direction of eradication crews, and some crew labor.

Individual Coöperation

In the early years of the control work, when it was hoped that the disease could be eradicated, no attempt was made to enlist the coöperation of the pine owner. As it became apparent that blister rust was here to stay and that pine protection had become a matter of local control, the coöperation of individual pine owners, associations of pine owners and towns was sought on the grounds that blister rust control was as much an individual and local problem as a state responsibility. Part of the financial burden of control is being gradually shifted from the state to the individual, although it is recognized that the state must continue to keep in touch with the situation through systematic inspections of pine areas, and that it must guide and supervise the control work.

A re-eradication problem will always exist, although the amount of re-eradication should diminish from year to year as control work diminishes the number of Ribes, and as the closing in of the pine canopy so shades the ground as to prevent Ribes reproduction. There is still a need for a good deal of research, particularly along lines of control methods, Ribes regrowth and improved forest practice. This is a function that can be best performed by the federal and state agencies who have the personnel and facilities for carrying on such work and for making the results available to pine owners.

Nursery Sanitation

Of utmost importance to the success of the control work is the insurance of disease-free stock for reforestation and ornamental plantings. The interstate movement of white pines and of currant

and gooseberry plants is prohibited by federal quarantine No. 63, except under strict compliance with its very stringent provisions. Distribution of Connecticut grown stock is legally possible within the state only under permit from the state nursery inspector.

Stock showing a serious disease, such as the blister rust, is destroyed. This inspection, however, does not in itself guarantee that the Connecticut grown white pine stock is free from the rust when shipped, because it is impossible in many cases to recognize the disease by field inspection until the rust has been in the tree two or more years. Therefore, the only assurance to the purchaser of such white pine stock that it is free from the rust is when it has been grown under Ribes-free conditions. Federal quarantine No. 63, applying only to interstate shipments, provides among other

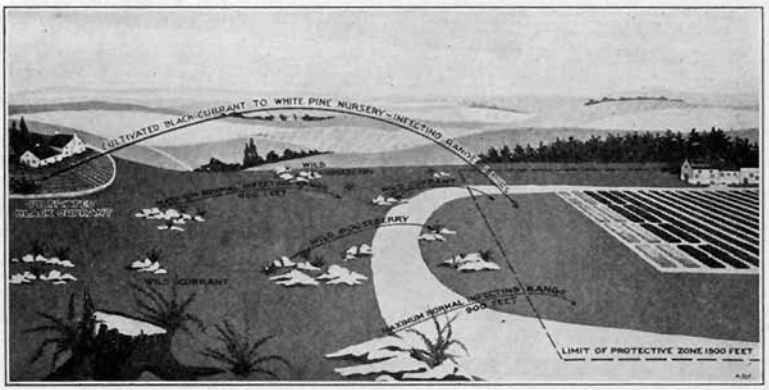


FIGURE 38. The white pine in this nursery is given complete protection because no currants or gooseberries are within 1500 feet and there are no European black currants within one mile.

regulations that all stock certified for interstate shipment shall be grown from seed in an approved control area. This control area, extending 1,500 feet around the white pine growing block, must be free from all wild and cultivated currant and gooseberry bushes and in addition there must be no European black currant plants within one mile of the pine block.

In order to give the same protection to the Connecticut grown white pine stock distributed within the state, such control areas should be established around all Connecticut white pine growing nurseries. This matter of nursery sanitation has brought a commendable response from the Connecticut nurseries growing white pine. There are now ten nurseries establishing such sanitation zones in coöperation with the Connecticut Agricultural Experiment Station, and as the advantages of such sanitation become recognized

it is likely that the number of white pine growing nurseries maintaining control areas will increase. Those now coöperating are:

Barnes Brothers Nursery Co.	Yalesville
Bristol Nurseries, Inc.	Bristol
Elm City Nursery Co.	Woodmont
North-Eastern Forestry Co.	Cheshire
Outpost Nurseries	Ridgefield
A. N. Pierson, Inc.	Cromwell
C. H. Sierman	West Hartford
Southport Nursery	Southport
Verkades Nurseries	Waterford
H. J. Zack Co.	Deep River

Black Currant Eradication

The greatest single hazard to the white pine in Connecticut at the present time is the presence of the European black currant throughout the state. It is so susceptible to the disease, it will take infection from so great a distance and will transmit it to pine so far, that control work in Connecticut will not be on a satisfactory basis until this species of Ribes has been entirely eliminated. As previously stated, the legislature has prohibited the growing, sale, transportation or possession of all roots, cuttings and plants of this species. States adjoining Connecticut have also banned it, either through legislative action or by proclamation from properly constituted authority.

PRESENT STATUS OF CONTROL WORK

On the accompanying map the cross-hatched areas indicate those towns where the needed initial eradication of Ribes is completed. The remaining towns within the natural white pine area of the state are scheduled for working in 1930. The natural white pine area of Connecticut lies north of the heavy black line; the area of abundant wild Ribes lies north of the dotted line. These latter two are more or less arbitrary divisions based upon a pine survey of 1919-1921 and reported in Bulletin 237.

During the past eleven years, 1919-1929 inclusive, approximately 219,000 acres of pine land have been freed from wild Ribes and 22,700 acres of this has been re-eradicated. More than 1,700,000 wild currant and gooseberry bushes have been destroyed and approximately 17,300 cultivated currants and gooseberries have been removed. Undoubtedly much work has been done by individuals on their own land, of which no record has been made. The cost of this work varies greatly with varying local conditions, type of labor employed and favorable or unfavorable seasons. The chief factors in the eradication costs, however, are the kind, size and number of Ribes encountered, denseness of undergrowth and,

occasionally, topographic difficulties. In the early years of eradication, when the work was almost entirely in areas of heavy Ribes concentrations, a season's work averaged 75 cents to 93 cents per acre; later when the eradication work was done on areas of lighter Ribes concentrations, the average cost for the season was from 11 cents to 56 cents per acre. The increased efficiency gained through experience is also a contributing factor to the lower costs in the later years. The average per acre cost over the eleven years period is 31 cents and the average number of Ribes per acre destroyed is 7.77.

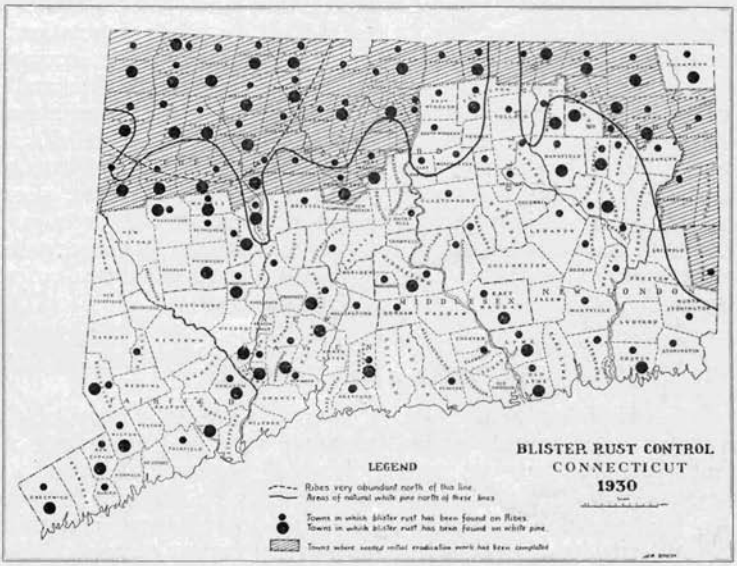


FIGURE 39. Map of Connecticut showing present status of blister rust control work.

It must be borne in mind that the costs per acre mentioned represent averages for all eradication work done during the years specified. They include areas thoroughly and systematically covered in crew eradication and areas eradicated by scouts alone. This latter type of eradication, which will not be described here, can be done often at a fraction of the cost of crew work. Pine owners eradicating Ribes on their own land, however, should use the crew method only, and the cost of such work, at prevailing day labor wages, will probably be a dollar or more per acre covered. The reason why pine owners are urged not to use the scouting method is that experience has shown that only trained and experienced men can secure satisfactory eradication of Ribes under most conditions by the scouting method.

EFFECTIVENESS OF RIBES ERADICATION

In order to determine the effectiveness of Ribes eradication in preventing or reducing blister rust infection, a number of studies have been made throughout New England and New York where eradication work is being carried on. They invariably show that where good eradication work was done, the amount of subsequent infection has been reduced to a point that does not jeopardize the productiveness of the stand. It is not necessary to obtain 100 percent eradication of Ribes in order to secure effective control of the disease. In fact, in many areas 100 percent eradication of Ribes can be secured only at a prohibitive cost. There are often large numbers of seedling Ribes hidden by other vegetation in proximity to older Ribes, or in locations favorable to the accumulation and germination of seed that are of such small size and so shaded by associated vegetation that they do not expose enough leaf surface to be a serious factor in the spread of the disease. Studies have shown that a large majority of such seedlings are killed off when they are small. This statement, however, should not be taken as justifying careless eradication. It is only by systematic and careful work that the currant and gooseberry leaf surface can be reduced to a point assuring practical control of the disease.

BLISTER RUST DAMAGE

No attempt has been made to determine the total damage that blister rust has already caused to white pine in Connecticut and other white pine growing states. It would be a difficult and expensive survey and its value would not justify the expense involved. The determination of the total financial losses already resulting from the rust would not help materially in future control. There is plenty of evidence, however, that shows what blister rust will do when it is once established and lives unchecked over a number of years in pine stands where Ribes are near.

Blister rust is an insidious disease and its real significance is not apparent to the casual observer. On many acres in Litchfield County white pine reproduction is being killed as fast as it appears. In numerous small areas of Connecticut infection on older trees runs 25 percent to 60 percent of the stand and many trees are already dead. Young trees are particularly susceptible to blister rust infection; they are quickly killed and within a few years all evidence that they were once on the ground is gone. This constitutes the most serious aspect of the blister rust menace and it is the one least likely to be observed.

Initial eradication and some re-eradication of Ribes has been accomplished throughout a large part of the white pine areas in the northeastern states. How much damage would have resulted

had not this work been done is unknown, but there is every reason to believe that it would have been large. Studies made throughout the northeastern states in a great many areas where the rust has

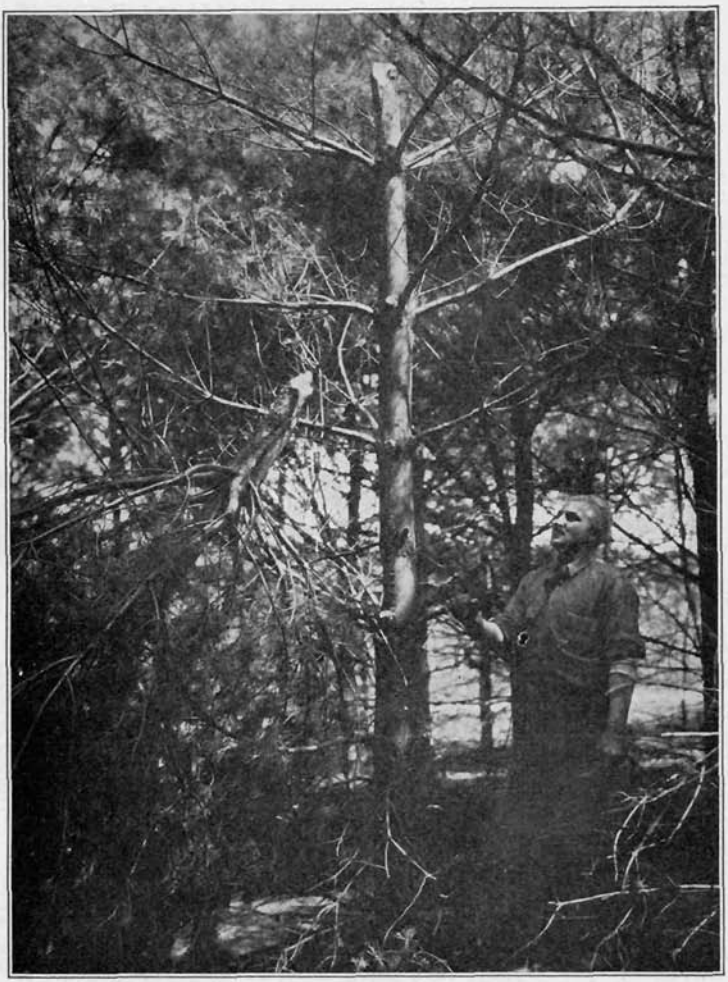


FIGURE 40. Top of tree broken off where blister rust girdled the trunk.

gone unchecked for a number of years show a high percent of infection. On numerous plots studied the infection occurring over periods of 5 to 15 years runs from 50 percent to 95 percent of the total number of trees on the plots.

Although blister rust is responsible for the death of a large percentage of the trees on many small areas in Connecticut it has to date caused comparatively small loss throughout the pine sections as a whole. This relatively light loss to pine in sections where Ribes are numerous is due to the application of control measures generally throughout the pine areas.

FUTURE CONTROL POLICY

The Connecticut Agricultural Experiment Station will continue to take advantage of the coöperation of the United States Department of Agriculture while such coöperation is available. The Station will maintain a small state organization to complete needed initial eradication of Ribes in pine areas, to organize and supervise the re-eradication work, to eliminate the European black currant throughout the state and to further nursery sanitation. It will keep abreast of the developments in control work and make such knowledge available to the pine owners. It will continue to be the policy of the Station to make inspections when requested and to give advice and assistance as far as limited personnel and funds permit.

It is impossible to make satisfactory progress on these projects without the moral and financial coöperation of the pine and Ribes owners, nurseries and others directly affected by the blister rust situation. It will be the task of the Station to acquaint the public with the high value of white pine and of the danger from the blister rust, and to stimulate control work through personal contact and publications.

The Station will scout pine areas from time to time in order to ascertain Ribes and pine infection conditions and, as far as funds permit, it will inform pine owners when re-eradication of Ribes is needed and organize and supervise control work when conditions warrant.

APPENDIX

Insects and Diseases Commonly Mistaken for Blister Rust on White Pine

Under this heading it is proposed to discuss the insects and diseases most often mistaken for the blister rust, but only to the extent of identifying them and differentiating them from the rust. Additional information on the nature, economic importance and control of the insects may be obtained from the Entomology Department of the Connecticut Agricultural Experiment Station, and information regarding the tree diseases may be had by consulting the Botany Department. Material from the Station publications is freely used here.

White Pine Tip Weevil. This is one of the two serious pests of white pine in Connecticut. The white pine weevil is a small brown snout-beetle that feeds upon the bark of the leading shoot of the white pine for a few days in early May. The female then punctures the bark and deposits its eggs, which develop minute white grubs that feed upon the inner bark for a short while and then usually burrow downward into the pith. These grubs become fully grown in less than two months and then excavate cells within which they pupate for ten days or so. They emerge as adult beetles during July and part of September.

The first indications that the weevil is present in the leader are small, clear drops of pitch, which ooze out of the punctures in the bark made by the adult beetle in depositing her eggs. The pitch dries on the stem in whitish spots and sometimes runs down the stem. Along in July the tip of the affected leader curls over and gradually turns brown. Further evidence of the weevil may be seen by splitting the affected stem, which reveals the grub tunnels, the white grubs, the pupal cells, or the beetles ready to emerge, depending upon the time of year the inspection is made. The curling of the leading shoot or affected top side shoot, the pitch drops on the stem, the circular holes from which the beetle emerges or such evidence within the twig as has been described, all identify the weevil or its work. A moment's observation with these points in mind will differentiate it from the blister rust.

The Pine Bark Aphids. The pine bark aphids are small sucking insects that cover themselves with a white cottony substance and are often found at the base of the needles, on the twigs and in patches covering large areas on the trunks of the trees. They have a complicated life history that need not be discussed here. They bear no resemblance to blister rust damage, unless it is to the pitch streaks that often occur on the older blister rust cankers; yet they are sometimes reported as blister rust by those who simply observe something unusual on the tree.

Ant Damage. A less common injury to white pine but one easily mistaken for the blister rust is the work of the mound building ants. Occasionally some or all the young pines for a radius of 15 or 20 feet surrounding the ant mound are dead or dying from ant injury. Such damage rarely occurs except in open stands where plenty of sunlight reaches the floor, because the mounds are not built in shaded areas. In order to prevent the shading of the mounds, the ants inject a substance into the bark that kills the bark cells and thus girdles the tree. The result is often a constricted area at the affected part with a swollen area above, which in this respect resembles the blister rust cankered areas. In case of ant damage, however, there are no orange-yellow or yellow-green discoloration at the outer edge of the affected bark, no pycnial spots and no blisters or blister pits. Moreover, the ant mound will be found close to the injured trees.

Needle Blight. The so-called needle blight is usually a physiological condition of the tree due to one of several causes, such as (1) late frosts, (2) sun scald, (3) winter injury of the sap conducting tissue, (4) a drying of the needles due to a sudden thaw in late winter or early spring that starts excessive transpiration from the needles when the roots cannot replenish the lost moisture because of the frozen condition of the ground, or (5) unusually dry summers. Such injury is sometimes restricted to one side of the tree. It is often identified only by eliminating other possibilities and correlating the injury with known climatic conditions. It can be easily distinguished from blister rust damage by the absence of cankers with their identifying signs previously described. The only resemblance to blister rust damage is in the partially dead needles.

Nectria-Like Fungus. A branch disease of white pine very likely to be mistaken for blister rust cankers is caused by a Nectria-like fungus that produces a roughening of the branch, and is sometimes accompanied by a slight swelling. It may be readily distinguished from the blister rust because it lacks the peculiar discoloration at the advancing edge of the canker; there are no pycnial spots, blisters or blister pits. Instead, there are small reddish fruiting bodies, about the size of a pin head, on the cracked bark.

Common Currants and Gooseberries in Connecticut

The wild currants and gooseberries are difficult to distinguish specifically, although they may be readily identified as belonging to the group of plants botanically known as Ribes. Since all native wild Ribes are susceptible to the blister rust and will transmit it to pine they may all be grouped in the same rough category as to the desirability of eradication. The cultivated Ribes, with

the exception of the European black currant, *Ribes nigrum,* may also be thus classified. The latter, however, because of its high susceptibility and because it transmits the rust to pine for long

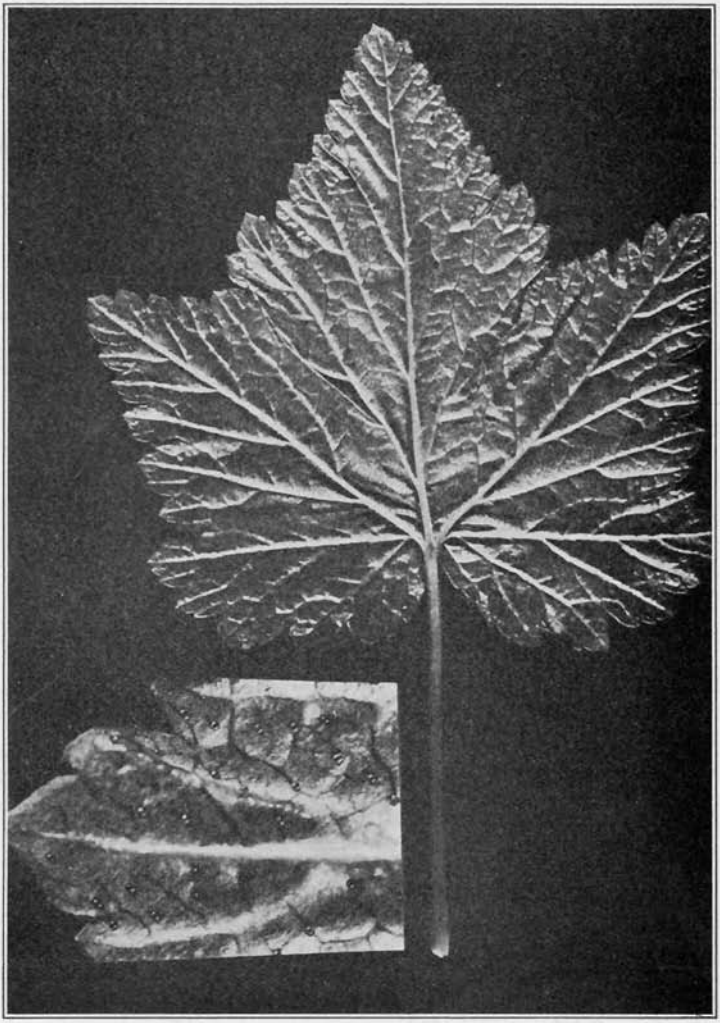


FIGURE 41. European black currant, *Ribes nigrum.* Insert shows the resin dots on the under side of the leaf.

distances, should be distinguished from the others. It calls for special consideration in the work of controlling the white pine blister rust.

In describing the Ribes of Connecticut the use of botanical terms has been avoided and an attempt has been made to simplify the description as much as possible. The flowers have not been described because a brief description of them necessitates the use of technical terms probably unfamiliar to the majority of people. There is considerable variance among botanists as to the use of both common and scientific names for some of the Ribes. The names given in the Connecticut Botanical Society Catalogue of Flowering Plants and Ferns are used here. The local ranges are taken from the Station blister rust control records and the descriptions are based on the Standard Cyclopedia of Horticulture, by L. H. Bailey, and on Gray's New Manual of Botany as revised by Robinson and Fernald.

A rough identification of the Ribes of Connecticut may easily be made in the field by types of Ribes. They may be grouped into four types. The first three comprise the currants, which are characterized by smooth stems, without spines or bristles, except *lacustre;* leaves heart-shaped and large except *lacustre, aureum,* and *odoratum;* branches round, except *americanum;* racemes or flower clusters many flowered.

Group I. Black Currants. Characterized by black fruit, and golden yellow or amber resin dots on the underside of the leaves. To this group belong the

A. *Cultivated European Black Currant, Ribes nigrum* Linn. This currant has resin dots only on the under side of the leaf. The stems are round. It seldom escapes from cultivation. The leaves and stems have a strong disagreeable odor when crushed.

B. *Wild American Black Currant, Ribes americanum,* Mill. This currant has resin dots on both sides of the leaf, although those on the upper side are sometimes hard to see without a magnifying glass. The stems, particularly on the newer growth, are angular. The odor of the leaves and stem when crushed is heavy and disagreeable, but not nearly so noticeable as that of the European black currant. It is usually found growing wild, but it is sometimes cultivated. Found throughout the state.

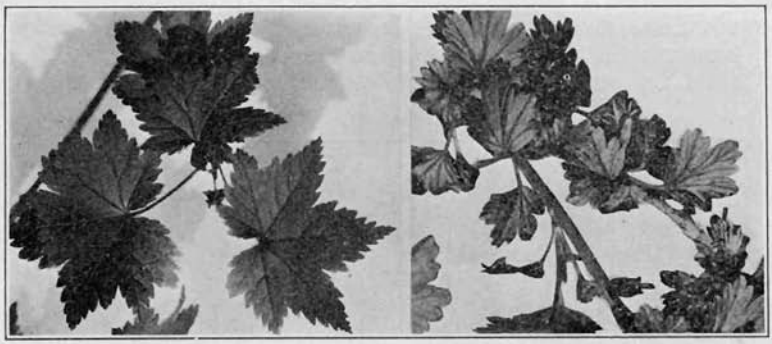
Group II. Flowering Currants, spice bush or clove bush. Characterized by small leaves, thick and leathery, resembling in outline a gooseberry leaf more than the usual currant leaf. Flowers yellow with a pleasing odor. Found under cultivation throughout Connecticut.

A. *Flowering Currant, Ribes aureum,* Pursh. Leaves are wedge-shaped at base and smaller than those of odoratum, either hairy or smooth. Fruit black, red or yellow.

B. *Flowering Currant,* Spice Bush, Clove Bush, *Ribes odoratum,* Wendl. Leaves square-shaped at base, smooth. Fruit black.

Group III. Red Currants. Characterized by red or white fruit. To this group belong

A. *Cultivated Red and White Currants, Ribes vulgare,* Lam. Bushes erect, occasionally five feet in height. Fruit red, white or striped, juicy. Found growing wild as well as under cultivation. Common in northern Connecticut, growing wild in fence rows along roadsides, in moist woods and on the borders of swamps. Less often found growing wild in southern Connecticut.



a *b*

FIGURE 42. *a,* Skunk currant, *Ribes prostratum; b,* Smooth gooseberry, *Ribes oxyacanthoides.*

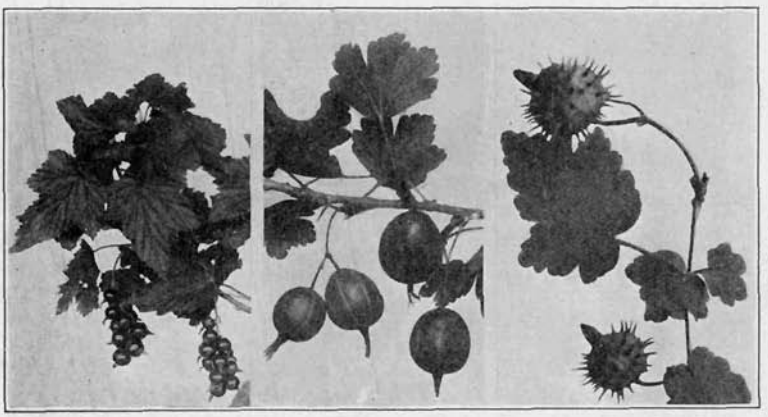
B. *Skunk Currant, Ribes prostratum,* L'Her. Found only growing wild. It is a reclining plant, with spreading stems and upright branches. It emits a strong, disagreeable odor when crushed. Has a very limited range in Connecticut. Reported only in Colebrook, Norfolk, northern Salisbury, and on Canaan Mountain. Very prevalent in Colebrook, Norfolk and on Canaan Mountain, less so in northern Salisbury.

Group IV. Gooseberries. Gooseberries are characterized by nodal spines and often bristly stems and fruit. They usually grow erect. The racemes or flower clusters have few flowers. The fruit of the wild species range in color from red to a dark purple.

A. *Prickly Gooseberry, Ribes cynosbati,* Linn. Sometimes reaches a height of six to seven feet. Branches spreading. Spines one to three at base of leaf stalks and one-quarter to two-fifths inches long. Stem bristles are few and weak or none. Leaves are usually heart-shaped at the base, often downy under-

neath. Fruit is red, prickly, edible. Very prevalent throughout northwestern Connecticut in dry woods, pastures, thickets and in moist places. It is less prevalent in northeastern Connecticut and rare in central and southern Connecticut.

B. *Smooth Gooseberry, Ribes oxyacanthoides,* Linn. Called by some authors *Ribes hirtellum.* Rarely reaching a height of four feet. Branches slender, usually unarmed, sometimes with small spines; occasionally the base of vigorous shoots are bristly. Leaves are usually wedge-shaped at the base, smooth or occasionally slightly downy. Leaf stem often with long hairs. Fruit smooth, purple, edible. Prevalent throughout northeastern Connecticut, principally in swamps but also found on dry locations. It is less prevalent in the northwestern part of the state, and rather rare in central and southern Connecticut.



a *b* *c*

FIGURES 43. *a,* American black currant, *Ribes americanum; b,* Cultivated gooseberry, *Ribes grossularia; c,* Prickly gooseberry, *Ribes cynosbati.*

C. *Cultivated Gooseberry, Ribes grossularia,* Linn. There are several varieties of the cultivated gooseberry. Varies in growing habit from upright bushes, reaching three feet in height, to low reclining bushes. It sometimes escapes from cultivation.

Two wild Ribes very rarely found in Connecticut do not fit into any of these four groups. They are the swamp black currant, *Ribes lacustre,* Poir. and the swamp red currant, *Ribes triste,* Pall. The swamp black currant has slender weak stems covered with dense bristles. The leaves resemble the prickly gooseberry, but are more slender and more deeply lobed; the fruit is purple to

black, and bristly. The swamp red currant is a low shrub with creeping, often rooting stems; the stems and branches are smooth; leaves are large, broader than long and resemble a red maple leaf; they are densely hairy underneath; fruit small, smooth and a smoky-purple color.

Where to Plant White Pine

The contents of this pamphlet may tend to create the impression that white pine is not a desirable tree to plant nor to favor in forest management. Such is not the case. As stated in the introduction, there is no more valuable forest tree in Connecticut than the white pine and there is no tree more likely to pay good returns on money wisely invested in its care. On the other hand, it planted in areas where Ribes are numerous, white pine is a decided risk. To obtain best results it should be planted on areas where Ribes are naturally scarce and where Ribes eradication may be made at a reasonably low cost. Southern Connecticut has few wild Ribes and is favorable to the growing of white pine in this respect.

Avoid planting white pine around swamps in northern Connecticut, because of the prevalence and difficulty of eradicating Ribes. It is best to plant white pine in mixture with other species, preferably hardwoods, in order to lessen the weevil danger. Mixed planting with hardwoods, however, should not be undertaken without first obtaining the advice of a competent forester as to species of hardwoods to use, spacing and relative numbers and position of the species used. Such advice may be had free by writing to the Station Forester, Connecticut Agricultural Experiment Station, Box 1106, New Haven.

Always eradicate currants and gooseberries as instructed before planting white pine.