

Biology and Management of Beech Bark Disease

Michigan's Newest Exotic Forest Pest

by

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Beech bark disease is one of the latest exotic pest problems to plague Michigan forests. Beech bark disease refers to a complex that consists of a sap-feeding scale insect and at least two species of *Nectria* fungi. Beech bark disease begins when American beech (*Fagus grandifolia*) becomes infested with beech scale (*Cryptococcus fagisuga* Lind) (= *Cryptococcus fagi* Baer.). The tiny scale insects, found on the tree trunk and branches, feed on sap in the inner bark. White wax covers the bodies of the scales. When trees are heavily infested, they appear to be covered by white wool. Minute wounds and injuries caused by the scale insects eventually enable the *Nectria* fungus to enter the tree. *Nectria* kills areas of woody tissue, sometimes creating cankers on the tree stem and large branches. If enough tissue is killed, the tree will be girdled and die. Other trees may linger for several years, eventually succumbing to *Nectria* or other pathogens. Some infected trees will break off in heavy winds — a condition called “beech snap.” Dense thickets of root sprouts are common after trees die or break.



Beech bark disease begins when beech scale infests a tree.

Managing beech bark disease in Michigan will be challenging. Both the scale insects and the fungal spores can be transported in the wind. Eventually beech scale and beech bark disease will affect beech trees throughout Michigan. The goal of this bulletin is to help you understand the biology and impacts of this new pest and potential management options.

Distribution: Beech scale was accidentally introduced into Nova Scotia in 1890 on ornamental beech imported from Europe. By the early 1930s, the scale and associated *Nectria* fungi were found throughout the Maritime Provinces in eastern Canada and in localized areas of Maine. Much of New England and parts of New York were affected by 1960, and the disease

had expanded into northeastern Pennsylvania by 1975. Beech bark disease has continued to spread through much of Quebec, northern Pennsylvania and, most recently, northeastern West Virginia. Localized infestations of beech scale have also been found in Virginia, North Carolina, Tennessee, Ohio and Ontario.

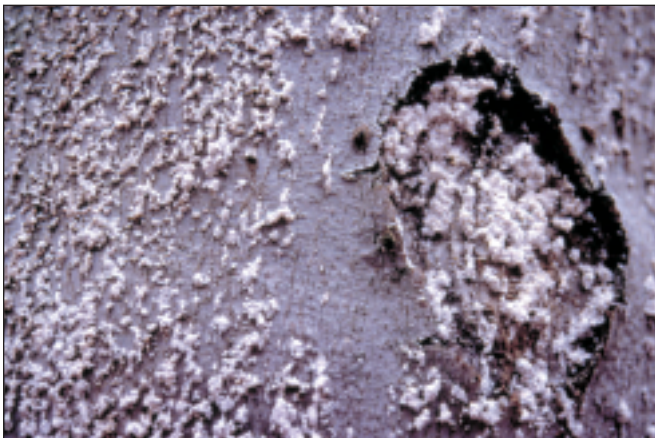


Beech scale and beech bark disease were discovered in Michigan in 2000. To date, affected beech trees have been found in several counties in the northwestern Lower Peninsula and in areas of the eastern Upper Peninsula. As detection efforts continue, other infested areas will likely be found.

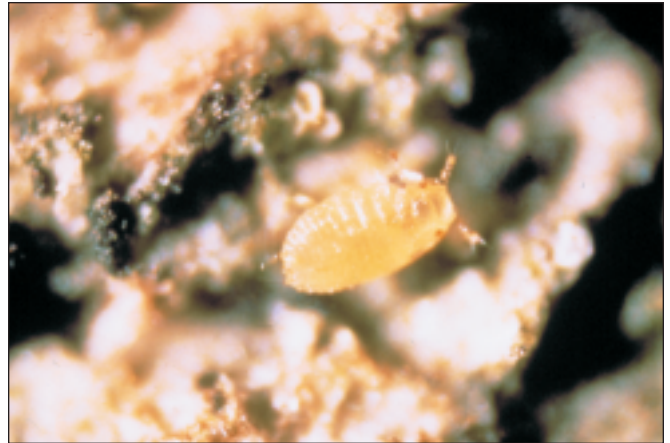
Beech Scale

Beech scales are yellow, soft-bodied insects that are 0.5 to 1.0 mm long as adults. They feed on American and European (*Fagus sylvatica*) beech trees. Adult scales are legless and wingless and have only rudimentary antennae. Several glands secrete the white, wooly wax that covers their bodies. Scales reproduce by parthenogenesis, which means that all beech scales are females and no mating occurs. This form of reproduction enables scale populations to build rapidly when suitable hosts are present.

Life cycle: Beech scale has one generation per year. Adults lay pale yellow eggs on the bark in midsummer, then die. Eggs are attached end-to-end in strings of four to seven eggs. Eggs hatch from late summer until early winter. The immature scales that hatch from eggs are called crawlers or nymphs. Unlike adults, crawlers have functional antennae



Beech bark scales secrete a white waxy covering that looks like wool.



An immature beech scale.

and legs and can move about. When a crawler finds a suitable location on a host tree, it forces its long, tubelike stylet into the bark and begins to suck sap from the tree. Once a crawler begins to feed, it will molt to the second stage. Second-stage crawlers have no legs and are immobile. They produce the white wax that eventually covers their bodies. Second-stage crawlers overwinter and molt to the adult stage the following spring.

Mortality factors: Crawlers that fall from trees or are washed off during heavy rains in late summer and autumn usually die. Severely cold winter temperatures (i.e., -35 degrees F) that persist for at least a few days may kill some overwintering crawlers, but others will be insulated by snow or protected by moss. A small twice-stabbed ladybird beetle, *Chilocorus stigma* (Say), feeds on this scale and is common in Michigan. Though this predator will reduce scale numbers on some trees, it cannot control an infestation.

Spread: When eggs hatch, crawlers may remain under the body of the adult or move to other areas of the same tree. Some of the wingless crawlers are blown to other trees. A small number of crawlers may be carried for long distances in air streams above forest canopies. Birds probably transport crawlers short distances and perhaps long distances during migratory flights. In addition, the beech scale infestations in Michigan, West Virginia and Ohio all centered on campgrounds or scenic areas, suggesting that



humans likely play a role in moving scales long distances. For example, transporting infested beech firewood between midsummer and early winter could allow mobile, first-stage crawlers to infest new areas.

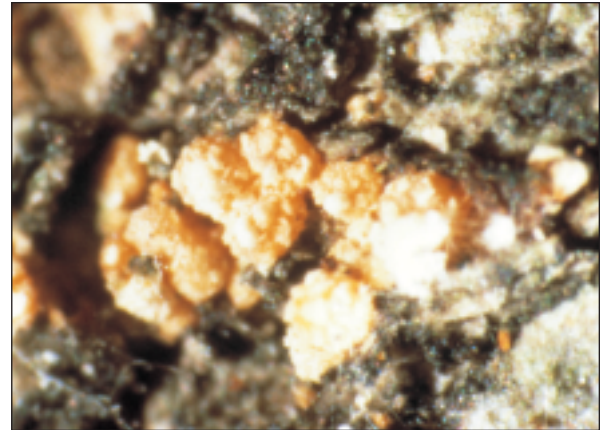
Symptoms of scale infestation: Crawlers prefer to colonize areas of the tree where the bark is rough. Newly infested trees usually have the first small spots or patches of “white wool” on the trunk around areas of rough bark. Infestations often start near old branch stubs, under large branches, or sometimes beneath mosses or certain lichens. As the scale population builds, the entire trunk and large branches of the tree may be covered with white wool.



Beech scales first become established on rough areas of the bark, such as old branch stubs.

Nectria Fungi

Three species of *Nectria* fungi are associated with beech bark disease in North America. *Nectria galligena* is a native pathogen that causes perennial cankers on many hardwood species. It rarely affects beech, however, unless beech scale is present. Another species, *Nectria coccinea* var. *faginata*, is an exotic pathogen that was introduced from Europe. Often, the native *Nectria* species is the first to invade trees infested by beech scale, followed by the exotic *Nectria* species. A third *Nectria* species, *N. ochroleuca*, has been found in association with beech bark disease in Pennsylvania, West



Perithecia of *Nectria ochroleuca* are light-colored.

Virginia and Ontario, Canada. The asexual form of *N. ochroleuca* (*Gliocladium roseum*) has also been found on beech trees in Michigan.

Both the native and exotic fungi produce fruiting bodies called perithecia. Perithecia of *N. galligena* and *N. coccinea* var. *faginata* are tiny and bright red and occur in clusters on living or dead bark. Perithecia of *N. ochroleuca* are lighter in color — usually salmon or pink. Each perithecium is filled with sacs of spores. These spores are the sexual stage of the fungi. Spores are released from perithecia in the fall and can be carried in the wind. On some infected trees, perithecia are abundant, causing large areas of the bark to appear red. In Michigan and some other areas, however, perithecia can be difficult to find.



Perithecia of the exotic pathogen *Nectria coccinea* are bright red.



may be more resistant to *Nectria* invasion. In contrast, large, overmature trees, trees with rough bark, and trees with wounds, broken tops or other obvious problems are most likely to be infested by beech scale and most vulnerable to *Nectria* infection.

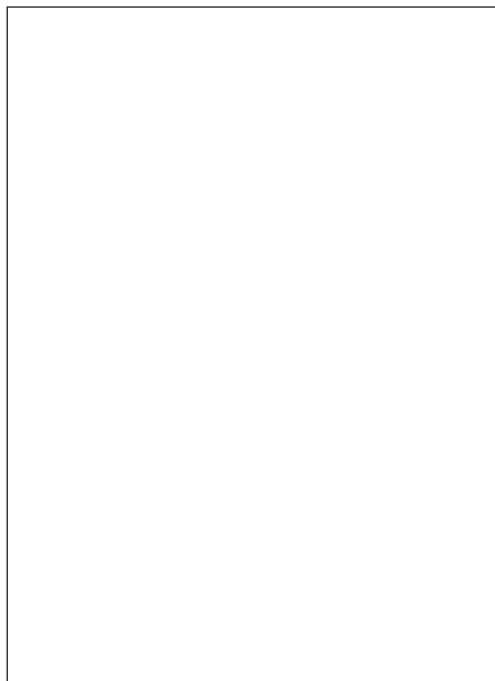
Use harvest systems that minimize injuries to beech root systems. Root injury can cause extensive root sprouting, especially if roots are injured in spring.

Consider using herbicides to control beech regeneration.

Herbicides may be needed to control beech regeneration, especially following selection or shelterwood harvests. Glyphosate (Roundup, Accord), triclopyr (Garlon) or 2,4-D + triclopyr (Crossbow) have been used effectively to control beech sprouts or advanced regeneration.

Survey stands regularly to detect the arrival of beech scale. Scale infestations usually begin on the trunks of large trees, often around branch stubs or other rough areas.

Favor regeneration of other tree species via selection or planting.



Heavily infested trees appear to be whitewashed.

are growing near heavily infested trees. These trees may be resistant or at least partially resistant to beech scale. Resistant trees often have smooth bark, but this may not always be the case. Resistant trees may occur in clumps or groups if they originated as root sprouts. However, resistant trees that regenerated from seed may be scattered through the stand. In eastern Canada, five to six trees per acre were resistant to beech scale. Identification and retention of potentially resistant trees is an important step for conserving the beech resource over the long term.

Identify trees for salvage.

Discriminate against trees that are heavily infested with beech scale. Large, overmature trees with rough bark and trees with evidence of decay, broken tops or other injuries are likely to succumb to beech bark disease. Retaining some of these trees for wildlife habitat will not affect spread or impact of beech bark disease. Generally, increasing species diversity and shifting the beech component toward smaller, more resistant size classes will reduce the impact of beech bark disease.

Beech regeneration may require control with herbicides, as noted above. If left uncontrolled, root sprouting is likely to result in dense

beech thickets that are aesthetically unpleasing, have little wildlife value and inhibit regeneration of other species. Dense regeneration from root sprouts will also increase susceptibility of the stand to beech bark disease over the long term.

Maintaining some beech in the overstory is often desirable, especially where wildlife habitat is an important management objective. Beech is frequently the primary nut producer in northern hardwood stands, and this hard mast

The Advancing Front

Survey stands that are infested with beech scale or considered to be within the Advancing Front to determine the extent of the beech scale infestation, identify potentially resistant trees and prioritize trees for salvage. Enter stands that are infested with beech scale first.

Identify, mark and retain resistant trees. In stands that are infested with beech scale, look for trees that have no beech scale or low numbers of scale, especially when these trees



provides an important food source for many animals. In stands where oak, hickory or hazel are abundant, beech mast may be less important.

Favor regeneration of other tree species via selection or planting.

Do not transport beech firewood or logs from infested stands to uninfested areas between midsummer and late fall. First-stage crawlers are mobile and might move from infested wood to live beech trees. This could establish beech scale infestations in new areas.

The Killing Front

Tree mortality usually starts soon after *Nectria* invasion begins. You may find tar spots, clusters of tiny, red perithecia and patches of dead bark on infected trees.

Beech scale may actually be less abundant on these trees because the scale insects will not survive on areas of wood that have been killed by *Nectria*.

Identify, mark and retain resistant trees as described above.

Salvage dead or declining trees with thin crowns and yellowish foliage. These trees are often invaded by secondary decay fungi that can degrade wood within 2 to 3 years. Remove trees with sunken lesions or large patches of dead wood — these trees are likely to have defects. Consider retaining some large trees to provide wildlife habitat.



Affected trees with lesions in the Aftermath Forest.
Photo by Michael Montgomery.

Prioritize harvest of trees that are heavily infested by beech scale and/or infected by *Nectria*.

Consider control of beech regeneration with herbicides as described above.

Do not transport beech firewood or logs from infested stands to uninfested areas between midsummer and late fall to prevent beech scale infestations from becoming established in new areas.

The Aftermath Forest

Aftermath forests are characterized by dense stands of infested beech sprouts and seedlings and a scattering of larger, residual trees in varying condition. Clumps of resistant or partially resistant trees may be present.

Beech saplings grow quickly when

overstory trees are killed and may be able to compartmentalize cankers. These trees, however, often have sunken lesions, patches of dead bark and deformities that lead to defects. Trees with convoluted bark are seldom killed outright by *Nectria* but grow slowly and remain weak. These trees will have low value and volume.

Salvage dead and dying trees. Small, defective or diseased trees can often be sold for fuelwood or chips.

Retain trees that are free of scales and Nectria and trees with few scales, especially if the trees have smooth bark. Resistant trees will be very obvious in the aftermath forest.



Beech Trees in Recreation or Urban Areas

Beech snap is common when trees have patches of dead bark resulting from *Nectria* infection. These dead patches are often invaded by other decay fungi or ambrosia beetles, which further predispose the tree to breakage. This creates a hazard to people and personal property when large beech trees occur in campgrounds or other recreation areas or near homes.

Trees posing a hazard to people or property should be removed. In areas where beech is a dominant species, planting or encouraging the regeneration of other tree species before beech scale reaches your area increases reforestation options and can soften the impact of the eventual loss of most large beech trees in the area.

When high-value ornamental or yard trees are of concern, some protection from beech bark disease is possible by controlling the beech scale. Note that this is not a one-time treatment. This exotic insect is now a permanent resident of our forests. Continued protection is necessary to prevent scales from reinfesting trees and creating the wounds that allow invasion of the *Nectria* fungi.

Physical control: Scale insects can be removed by scrubbing a tree with a soft brush, using water from a high-pressure nozzle on a garden hose or similar means. It is difficult, however, to remove scales from the upper part of the trunk or crown of large trees.

Oils: Dormant and horticultural oils are petroleum-based products that cover and suffocate soft-bodied insects such as aphids, spider mites and scales. Oils may be useful in controlling scales, but they should be applied only when trees are dormant.

Insecticides: Registered insecticides can be used to control scales. Efforts are underway to identify effective products and optimal timing.

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Dead or dying hazard trees in a camping area may require removal.



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