Beech bark disease (*Cryptococcus fagisuga and Neonectria* spp.)

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Hosts: Beech (*Fagus grandifolia*), European beech (*Fagus sylvatica).*

General information: Beech bark disease (BBD) affects American beech trees throughout much of their natural range in North America. The disease is typically a result of the infestation and feeding by the beech bark scale, *Cryptococcus fagisuga,* predisposing beech trees to infection by two fungi: *Neonectria coccinea* var. *faginta* and sometimes *N. galligena*. Another scale, the *Xylococculus betulae*, has been observed to be commonly associated with the disease in Maine, but its significance to the disease complex is unknown. The BBD complex arrived ca. 1920 on a shipment of infected European beech seedlings from Europe. Since its introduction, BBD has spread steadily and is now found as far west as Wisconsin. The beech scale is sedentary for most of its life. Although, after adults lay eggs in mid- to late summer, beech scale crawlers (tiny mite-like life stage of the scale) move to new feeding sites and can be transported by wind, and even wildlife, to new beech trees. As the crawlers settle into a feeding site, preferably bark crevices, the scales form a waxy covering. Colonies of these scales look like white streaks or blotches on the bark (Fig. 1). After feeding for some time the scales reproduce asexually at a rate of one generation per year. Some inner-bark necrosis (death) is caused by the beech scales themselves, although most damage is due to infection by the fungal pathogen.

Symptoms and Signs: The causal fungi enter the tree via bark wounds caused by the scale (either bark cracks from dead portions of bark drying out or actual feeding wounds). Spores are spread by wind and water (rain splash). Scattered cankers with diffuse (irregular, blotchy) margins develop. Woundwood and callus form under the bark causing a pock-marked and deformed outer appearance. As cankers spread under the bark, branch and crown dieback occur, progressively worsening and resulting in tree death. Structures of the fungi can be seen growing on the bark in either an asexual stage (cream-colored patches) or the sexual stage (clusters of small, red spore-producing structures called perithecia, Fig. 2).

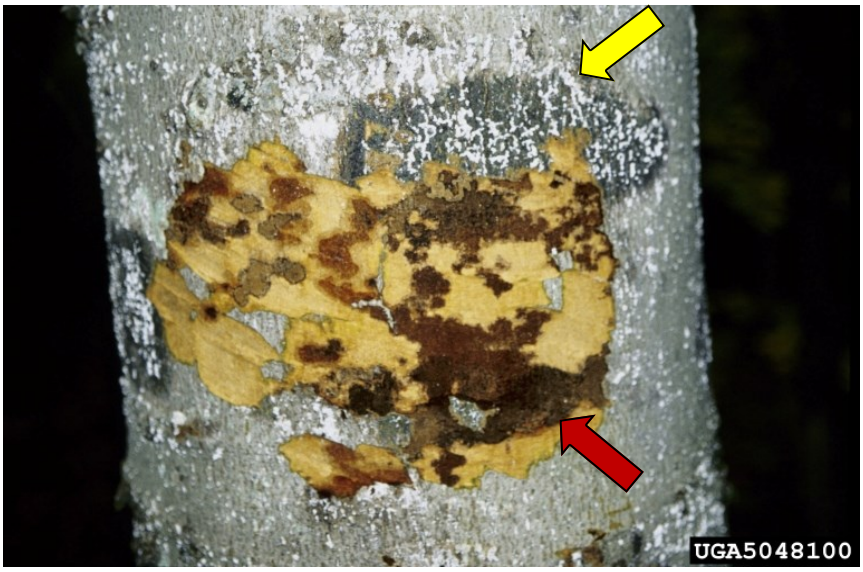

Figure 1: A beech tree with numerous spreading cankers with irregular borders caused by *Neonectria* spp. infection (red arrow). Note the white patches on the bark that are groupings of beech scale insects covered with a protective, feathery wax coating (yellow arrow). (*Photo by Joe OBrien, USFS, Bugwood*)

Figure 2: Small red perithecia, measuring less than a millimeter wide, are the spore-producing structures of the causal fungus. These are often seen on the bark of BBD-infected beech trees. (*Photo by Joe OBrien, USFS, Bugwood*)

The stages of Beech bark disease in a forest can be characterized in the following way: 1) The scale is introduced and its population builds over several years. This is called the advancing front and is followed by 2) high populations of scale predisposing beech trees to infections by *Neonectria* spp. fungi, and heavy tree mortality called the killing front. This stage is followed by 3) endemic populations of scale, occasional tree mortality, some residual big trees, and remaining individuals with varying resistance to the scale. This last stage is referred to as the aftermath forest (Adapted from Shigo, 1972) and consists of thickets of small-diameter beech trees that impede or prevent the establishment of other, more economically valuable and diverse species.

Management: Traditional insecticide/fungicide and biorational (substances with fewer negative ecological impacts) management tools have not proven effective in controlling BBD. While high-value trees in urban settings are more easily protected, there are no practical measures available for landscape-scale management of the disease. Some resistance to beech bark scale attack, and therefore beech bark disease, has been identified among native and European beech trees, although the exact mechanism of resistance is not fully understood, but is thought to be related to physical and chemical bark characteristics. Resistant trees should be preserved if possible.

From a woodlot management perspective, areas infested with BBD represent a major challenge. The aftermath forest is characterized by a cycle of root sprouting and growth of beech sprouts, followed by disease susceptibility as the trees grow, with tree death typically occurring before the trees are mature enough to produce beech nuts and before the trees reach a size suitable for firewood.

Figure 3:(left) Callus formation resulting in pock marking symptoms following infections by the BBD disease complex. (*Photo by Maine Forest Service)*. Figure 3 (right) An aerial view of an area where BBD had killed most of the larger-diameter beech trees and vigorous root sprouting has occurred, dominating the understory. (*Photo by Maxwell McCormack*)

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