DISEASES OF BIRCH

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PAPER BIRCH and yellow birch are not attacked by pathogens that cause widespread killing. Most of their diseases are associated with accidents and negligence. The major problems are discoloration and decay associated with wounds on low-vigor trees. Many of these problems could be alleviated through better management. And better management depends on better understanding of the problem.

The purpose of this paper is to outline briefly the major diseases of birch. Detailed accounts of the diseases of birch *(Hepting 1969)*, the processes that result in discoloration and decay *(Shigo 1967)*, and a photo guide to these defects *(Shigo and Larson 1969)* have been published.

Discoloration and Decay

Discoloration and decay are the major internal defects in birch. The processes that result in these defects are initiated by wounds. On low-vigor trees wounds heal more slowly and the defects develop faster.

Some discoloration results from chemical processes initiated by wounds in the absence of microorganisms. When the wounds remain open, microorganisms invade them. The first to infect are bacteria and non-decay fungi. These in turn are followed by decay fungi if conditions favorable for infection persist. A sequence of events and successions of organisms follow wounding. Many factors affect the incidence and severity of the defects. Tree vigor, environment, severity of wound, and time are the most important. In early stages of the processes, the wood is sound but discolored; in later stages it is discolored and altered slightly; and in still later stages it is decayed.

Where It Begins

These are the major begining points for the processes that result in discoloration and decay:

Branch stubs.—All trees have branches, and all trees lose some branches during their lives. When trees are vigorous and branches are small, openings left by the dead branches heal quickly and no defect forms. This is the rule and not the exception. But the time for branch wounds to heal increases as tree vigor decreases and branch size increases. The longer the healing period, the longer the time for defects to develop. Because tissues formed after wounding are seldom discolored, the diameter of the central core of discolored wood is the diameter of the tree when it was wounded.

Mature trees with small, well-healed stub scars have small central cores of discoloration. Trees with large, poorly healed stub scars have large central cores of discoloration.

Stem stubs.—Defects associated with stem stubs have the same diameters as the stub, and they go downward.

Basal stubs.—Defects associated with basal stubs that are above the root collar are the same as those associated with branch stubs. Basal stubs that join the stem below the root collar seldom cause defects in the main stem. These stubs sometimes are entrance points for root-and butt-infecting organisms.

Sprout stems.—Indicators above the base should be considered first, and then the condition of the base. Small basal sprouts can be cut with little harm to the dominant stem.

Logging wounds.—Wounds on low-vigor trees cause more defect than wounds on high-vigor trees. Wounds on trees with well-healed branch stubs cause less defect than wounds on trees with many poorly healed branch stubs. Less defect is associated with wounds that have rough dark wound faces. Wounds that are not severe usually have white, hard wound faces. More defect is associated with small deep wounds than with large shallow wounds. Insect holes in the wound indicate

slightly more defect than would be expected from an uninfested wound.

The shallow roots of birch make it susceptible to root wounds near skid trails. This is a major cause for the decline of birch in logged areas. These weakened trees are attacked by many weakly parasitic organisms. The danger here is to give these organisms more attention than the primary cause of the decline. Trees, like all organisms, can withstand only so much stress.

Root and butt rots.—Birch will grow on shallow soils and in mixtures with conifers in stands that have had a long history of cutting. The roots of the cut conifers often are infected with *Armillaria mellea.* Here are all the ingredients for a root-rot problem. When the roots of birches are infected and weakened by *A. mellea,* the bases of the trees may crack, a condition called collar crack. Other decay fungi may infect the basal cracks. Infected trees on shallow soils often are broken or uprooted by the wind. Fallen trees with rotted roots are indicators of root-rot areas. Basal cracks on fir also are good indicators of such areas. Birches with collar crack should be cut as soon as possible.

Increment-borer wounds. — Discolorations develop faster in birches than other northern hardwoods. Discolored streaks several feet long can develop in a few years from increment-borer wounds. Increment borers should not be used on high-quality trees.

Red heart.—This term is often used to describe tissues in a wide variety of disease conditions. Yet, red heart does have a specialized meaning: it denotes tissues infected by bacteria alone, or by bacteria and non-decay fungi. The wood has a foul odor and is high in moisture content, pH, and minerals. But the tissues in the early stages of the discoloration processes and the discolored cores of birch that are sound should not be called red heart. Red heart tissues usually collapse upon drying, and a condition called honeycombing sometimes results. The tissues will check along the rings rather than in a radial direction. True red heart should be avoided for quality products.

Cankers.—Target-shaped cankers are common on low-vigor trees. These cankers are good indicators of both poor vigor and poor sites. Young cankered trees should be discriminated against, and when many such trees occur in an area, the area should be considered unsuitable for growing quality birch.

Most cankers are incited by *Nectria galligena.* The fungus, which usually infects through branch stubs, produces minute bright red lemon-shaped fruit bodies at the margins of the canker.

When trees infected with *Poria obliqua* are cankered by *Nectria galligena,* the black masses of fungus tissue produced by *P. obliqua* sometimes push out through the cankers. These trees are of no value.

Sapsuckers.—The yellow-bellied sapsucker, *Sphyrapicus varius,* causes a variety of injuries on birch. The birds may drill short rows of holes scattered about the bole, which results in streaks of discoloration. Or they may drill rows of holes at one locus on the bole, which may cause discolorations and ring shakes; on paper birch, black swollen bands are indicators of such defects. Or the birds may girdle the tree by drilling many holes around the bole at one locus, which usually kills the tree, particularly if it is weakened first by other agents. Because sapsuckers often nest in aspens, weakened birches near aspen sites are especially vulnerable.

Squirrel wounds.—The red squirrel *Tamiasciurus hudsonicus* bites the thin bark on young trees. These wounds may be infected by microorganisms.

Ambrosia beetle wounds.—The ambrosia beetle, *Xyloterinus politus,* infests trees weakened by various agents. When the weakened trees die, the beetles complete their life cycle in these trees. But, when infested trees recover, the beetles leave. However, the minute increment-borer-like holes remain, and discolorations develop. Small holes in the lenticels are indicators of such defects. These holes may be infested by a scale insect, *Xylococculus betulae,* which woodpeckers peck out for food.

Other Diseases

Seed diseases.—Little is known about the diseases of seeds and seedlings. Many insects feed on the seeds while they are still on the tree. And, many fungi infect the seeds injured by the insects. Some of the more important fungi belong to the genera *Coniothyrium* and *Alternaria.*

Leaf diseases.—Although many fungi infect the leaves of birch, they cause very little damage.

Birch dieback.—The cause of birch dieback has never been determined to everyone's satisfaction. But most workers agree that this disease, which decimated large areas of birch in the Maritime Provinces of Canada and throughout northern New England in the 1930's, was probably initiated by one or more stress factors. The literature on this disease is voluminous.

Principal wood-inhabiting microorganisms in birch.—Three types of microorganisms infect birch: bacteria, non-decay fungi, and decay fungi. In the past, almost all attention was given to the decay fungi. But now some attention is being given to the other microorganisms.

Bacteria are some of the first microorganisms to infect wounds. They abound in wetwood and are often associated closely with non-decay fungi. The wood that harbors these microorganisms is high in moisture content, pH, and minerals. The principal bacteria are species of *Bacillus* and *Pseudomonas.* Detailed studies are needed to elucidate the role of bacteria in the processes that result in discoloration and decay.

Most of the non-decay fungi are dark in color. Some produce pigments that are water-soluble. Certain metals, especially manganese, affect pigmentation. The principal non-decay fungi are species of *Phialophora* and *Trichocladium canadense.* Other important non-decay fungi in birch are species of *Fusarium* and *Ascocoryne.* Species of *Hypoxylon* are also important discoloring fungi. These fungi can also cause decay.

Many decay fungi also infect birch. The most conspicuous of these is *Poria obliqua,* which forms large black masses of fungus material on the infection sites. *Fomes igniarius* forms large black shelf-like fruit bodies. A variety of this fungus, *F. igniarius* var. *laevigatus,* is associated with advanced decay and sunken cankers on mature and overmature trees. The fruit body of this fungus is flat. One of the most important decay fungi, *Pholiota squarrosa-adiposa,* produces fruit bodies that last only a few weeks. The fruit body is light tan to orange and is the shape of a mushroom. Other species of this fungus may also be important.

Stereum murraii and other species of *Stereum* cause some decay. *Polyporus versicolor* will infect the dead wood on wound faces, as will other species of *Polyporus. Lenzites betulinus* is of minor importance.

Armillaria mellea is an important fungus that decays the roots of trees and may also act as a root parasite when the tree is under great stress. The fruit body is a mushroom. Black strands of fungus material, called rhizomorphs or shoestrings, are formed by this fungus. White thin fans of fungus material form under infected bark. An orange moist spot at the base of a tree is a good external sign of infection. *Fomes applanatus,* which produces the so-called artist's conk, will also infect the roots and base of birch.

Fomes pinicola is worth mention because it is one of the few fungi that will infect both hardwoods and conifers. It incites a brown rot in birch. The fruit body is shelf-like and hard, and because it has a tan to light red upper margin, it is sometimes called the red-belt fungus.

Many other fungi attack birch after the tree is killed. Most noticeable are *Fomes fomentarius,* which has a white, hard, hoof-like fruit body; and *Polyporus betulinus,* which has a white, leathery, shelf-like fruit body.

Conclusions

What can we do now with the information we have? For young growing stock we can determine with fair accuracy the poor-risk trees. Some important indicators of such trees are poorly healed branch stubs and cankers. Such trees should be removed from the stand or the stand should receive special attention, including fertilization and pruning. For mature trees we can determine with fair accuracy the internal defects associated with external signs. Then trees should be selected for the highest value product that their quality will yield. These are things that can be done. Of course, whether they are done or not depends on many other factors.

The major responsibility now for the pathologist is to continue to probe more deeply into the diseases of birch to expose further the mysteries and to clarify the confusion in terminology. With better understanding of the diseases, better methods for prevention and control of defects can be established. And this is the key to better management.

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