top dieback (i.e., 50% or more of the crown devoid of live foliage) should be removed and destroyed. Pruning is not likely to provide practical or successful protection for a tree in this condition and will contribute little toward its recovery or aesthetic appearance.

Control of the bronze birch borer with chemical insecticide application is not usually effective because the spray materials do not reach the larvae under the bark. Insecticide application aimed at controlling adults may be only partly successful because of the extended adult stage, which lasts several weeks. Effective insecticides for this would require long-residual active ingredients or more than one seasonal treatment.

For the most recent information on chemicals available for control of this insect, call Agriculture and Agri-Food Canada's Plant Industry Directorate in Ottawa (toll-free) at 1-800-267-6315.

Chemical pesticides are toxic to humans, animals, birds, fish, and beneficial insects. Follow all instructions and precautions listed by the manufacturer.

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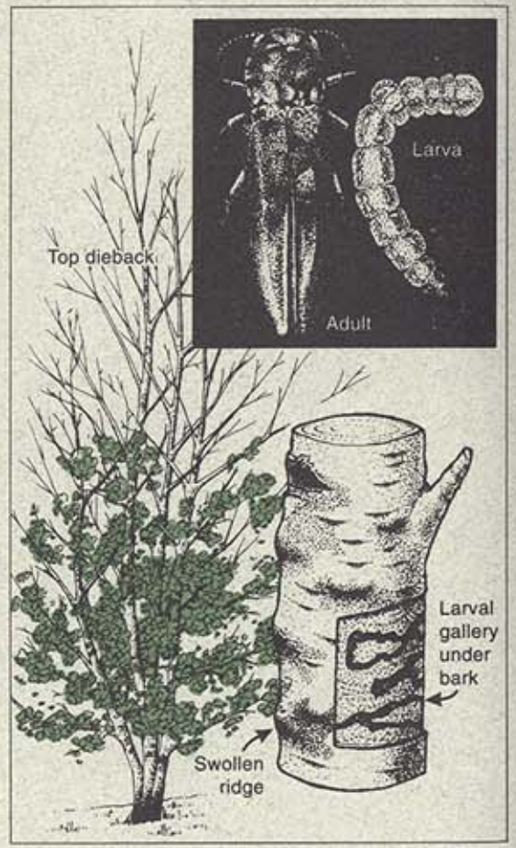
Bronze birch borer



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Distribution and Hosts

The bronze birch borer (*Agrilus anxius* Gory) is native to North America and is an important insect pest of birches. In Canada this insect is distributed from Newfoundland to British Columbia but is most common throughout the southern regions. In the United States the bronze birch borer extends as far south as Idaho, Colorado, Ohio, and New Jersey.

While the bronze birch borer is known to attack all native birches, injury is most commonly reported in the prairie provinces on native white or paper birch and on the exotic European white birch, including the 'weeping' varieties. These species are grown extensively as ornamental and shade trees in urban, park, and rural landscapes. Infestations of the bronze birch borer may also occur in natural forests of white birch, but its impact in forests in the prairie provinces has never been assessed and is probably of minor significance.

Symptoms and Damage

The bronze birch borer is often considered a secondary insect of birch because most of the injury it causes is associated with trees under stress from other factors such as prolonged defoliation, stem decays, heavy pruning, bark stripping, drought, and mechanical injury. Its attacks can contribute to the further decline and death of trees. Borer populations may build up on stressed trees, however, and then move on to attack apparently healthy trees. Attack injury has mostly been associated with older, well-established trees beyond the sapling stage.

Drought stress leading to dieback of the tree crown may be the most common precursor of bronze birch borer attack. Birch has a shallow rooting system and may undergo stress during periods of spring and summer drought accompanied by high temperatures; this is particularly true of planted birch. Dieback begins when a tree is altered physiologically and is characterized by the death of uppermost twigs and small branches. It is a progressive process that proceeds downward from the treetop. A tree weakened by initial dieback is attractive to the bronze birch borer, which may attack and lay its eggs over the entire main stem and at the base of large branches. Eggs and larval development in the uppermost parts of the tree tend to be the most successful, whereas their survival on the lower, healthier portions of the tree is mostly unsuccessful. Subsequent yearly attacks therefore result in progressive dieback of the crown and the death of the tree within a few years.

The crowns of birch may be classed in various categories of vigor, based on their degree of branch and stem dieback, in order to risk-rate them for borer attack. Healthy crowns without dieback are not at risk, and signs of bronze birch borer attack may first appear on a tree that has developed distinct twig and branch dieback in the top part of the crown; thereafter, the attacks—as well as the success of larval survival—tend to increase in direct proportion to crown dieback. All significant tree injury is caused by the larvae that feed under the bark in winding tunnels in the cambium (wood interface) and occasionally enter the outer sapwood. The tunnels cause a partial girdling of the stem or main branches and disrupt the conduct of water and nutrients. The degree of injury relates to the density and distribution of successful larval feeding tunnels, as well as the condition of the host tree. Early signs of the presence of larvae may also include chlorotic (abnormally yellow) leaves and sparse foliage in the upper crown.

Feeding tunnels constructed in healthy branch and stem tissues are usually incomplete and unsuccessful; they subsequently heal over with callus tissue, leaving conspicuous swollen ridges on the outer bark surface. These ridges are diagnostic indicators of previous unsuccessful attacks and remain visible for many years. Successful attacks are indicated by the presence in the outer bark of adult exit holes that are D-shaped, 3–4 mm high, and appear on dead or dying portions of branches and stems.

Causal Agent

The adult bronze birch borer is a beetle, 7–11 mm in length, flat, elongate in shape, and olive-green to black with a metallic bronze overtone. The adults emerge from dead birch wood from mid-June until early August, with numbers peaking in mid-July, and they live for about three weeks. They feed on the leaves of birch, aspen, and alder but cause no significant injury. Adult borers are strong fliers and search out suitable host trees to begin egg-laying, commonly on open-grown trees and those in cut areas, and on damaged or declining trees. Egg-laying continues over the next 3–4 weeks until mid-August. Eggs are creamy white and 1.3–1.5 mm long; they are deposited in groups in crevices on the tree stem or under loose bark scales and are usually more abundant on unshaded areas of bark. They hatch in about 2 weeks, and the young larvae burrow directly through the bark to the cambium where they then construct their meandering tunnels. During their excavation the larvae penetrate into the wood to molt, overwinter, or change food media. A larva passes through five growth (instar) stages, and at maturity it is flat, elongate, legless, and up to 35 mm long, with a brown head and white body and forcepslike spines at the end of the body. Pupation occurs in the spring in a small cell constructed by the larvae at the end of its tunnel. Larval development in the prairie provinces extends over 1 or 2 winters, depending on the condition of the host tree, the time of egg-laying, and seasonal temperatures.

Prevention and Control

Insect parasitoids may effectively control a large portion of bronze birch borer eggs and larvae, while woodpeckers are known to prey on prepupae and larvae under the bark, especially in early spring. Most larval mortality, however, results from host condition. Weather factors such as cool wet conditions may delay or reduce adult flight and egg-laying.

A healthy, vigorously growing birch tree is most resistant to dieback and to bronze birch borer attack. Proper and frequent tree care should be maintained; this includes scheduled watering, fertilizing, and control of defoliating and leaf-mining insects. The tree must be thoroughly watered during periods of drought or if growing on sandy soils. Preventative measures should also include frequent examination of tree crown, especially of a mature tree, for evidence of twig and branch dieback, chlorosis of leaves, thinning of foliage, and the presence of healed-over larval wounds visible as swellings on the external bark. European white birch may be more prone to dieback and attacks by the bronze birch borer than native birches.

When a tree exhibits early top dieback symptoms, dead tops and branches should be pruned in late fall, 30–50 cm below the dead wood or below the last D-shaped exit hole. Fall pruning is more advisable than spring pruning because it avoids excessive sap bleeding, and the fresh wounds in the fall may be less attractive to adult borers as egg-laying sites. All pruned materials should be burned or chipped to destroy any larvae present under the bark. A tree with advanced