



## Hemlock Woolly Adelgid (HWA)

Hemlock woolly adelgid is a destructive, introduced pest of forest and ornamental hemlock trees.

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Adult adelgids are soft-bodied insects, almost too small to see with the naked eye. The adelgids feed at the bases of hemlock needles, causing the needles to die. Heavy infestations can kill trees in as little as four years, but some trees can survive for a several years. A tree's tolerance to the insect attack correlates to

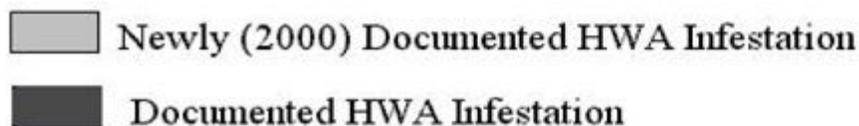
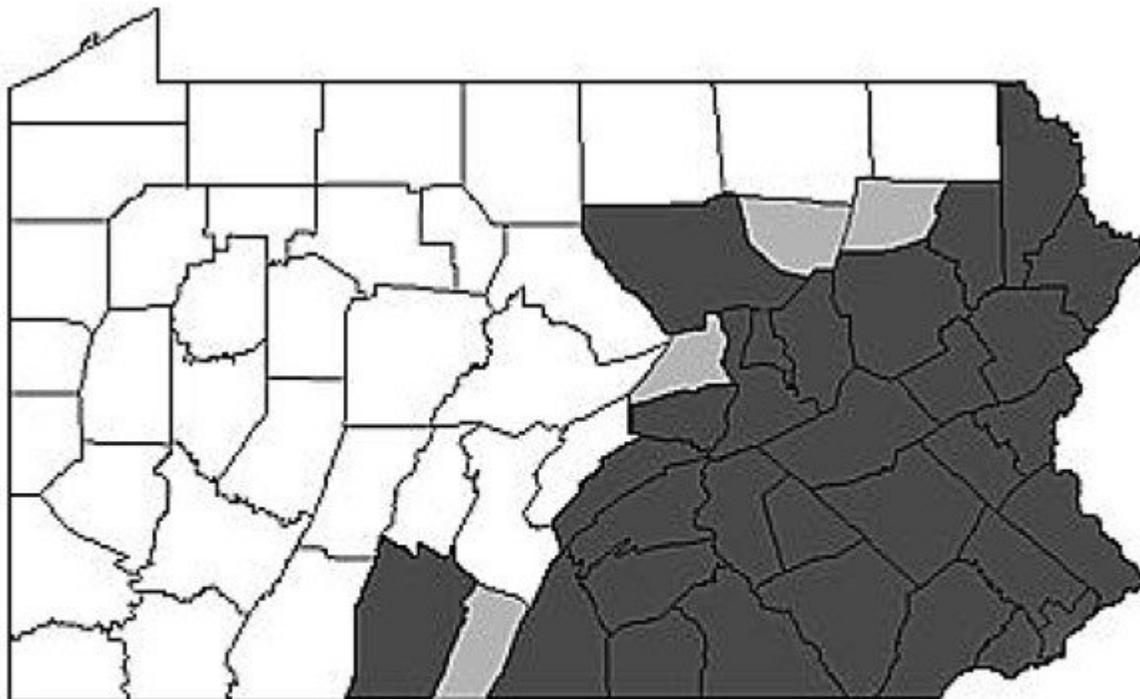
stress factors, such as drought.

HWA is believed to be native to Japan and China. In Asia this insect causes few problems, because there are several beetles that feed on HWA and host trees show resistance to the insects. HWA appeared in the western United States in 1924. Experts believe that the adelgid was brought to North America on imported ornamental hemlocks. In the west, the adelgid is found on mountain hemlock (*Tsuga mertensiana*) and western hemlock (*Tsuga hereophylla*). Both species show resistance.

The first reports of HWA in the East were in Virginia around 1950. Pennsylvania's first HWAs appeared in the late 1960s. In the East, adelgids attack eastern hemlock (*Tsuga Canadensis*) and Carolina hemlock (*Tsuga carolinian*). Both of these species,

and any cultivars of these species, show little or no resistance to the insect. Many trees of these species have died.

HWA made its way into Pennsylvania in 1973. Since then, HWA has spread to 34 counties in the southern and eastern parts of the state. Wind, birds, and mammals disperse the insects. Once in a hemlock tree, the adelgid crawls to the base of a hemlock needle and begins to feed. To feed, the HWA inserts its feeding stylets, or mouthpiece, into the underside of the base of a needle. The adelgid feeds on the tree's nutrients. Feeding causes the needles to die, turn gray, and drop from the tree. Buds are also killed by the feeding behavior, resulting in no new growth on the infested branches. Dieback of major limbs occurs within two years. Branch dieback progresses from the bottom of the tree up to the top. In many cases, the tree eventually dies.



The life cycle of the hemlock woolly adelgid is complex, involving both hemlock and spruce (*Picea* spp.). Each year three generations develop on a hemlock tree. In the spring two generations hatch from the eggs laid in the white cottony ovisacs found on the branches of hemlock trees. One generation, the winged seuparai, leave the hemlock in search of spruce trees. Once a spruce tree is found, the insects mate and

lay eggs. In Asia, the eggs hatch and feed on the spruce tree. For unknown reasons, the eggs laid in spruce trees in North America do not hatch.

The other generation, known as non-winged progrediens, feed on the hemlock and lay eggs in June. The third generation, or sistens, hatches in July. These non-winged insects begin feeding and soon enter a period of dormancy. In October the dormancy is broken and the sistens begin to feed again. In early February the sistens mature and lay eggs in cottony, white ovisacs on the bottom of hemlock branches, from which the sexuparae and progrediens will hatch in the following spring.

Because of the adelgid's small size, one of the best ways to determine if a hemlock tree is infested with HWA is to look for white cottony egg sacs at the base of the needles. These sacs will be present all year, but are more prominent in early spring. Dieback and death are also signs of heavy infestation.

There are many steps homeowners can take to prevent and control HWA infestation. The following list suggests some of these measures:

- Water hemlock trees during periods of drought to reduce stress. Stress increases the risk of insect attack.
- Remove dead and dying branches.
- Take care when moving plants, logs, firewood, and bark chips from infested to uninfested areas. Take special care between March and June because this is when HWA is very abundant.
- Plant resistant ornamental varieties.
- Apply chemical insecticides to infected trees.
  - Horticultural oil and insecticidal soap are very effective at controlling adelgids. These insecticides are only affective against soft-bodied insects, such as adelgids and aphids. Two sprayings are usually required.
  - Injecting or implanting chemical insecticides into the stem in mid-May can control HWA for up to six months. These applications can cause harm to the tree because the bark is damaged during the application.
  - Introducing systemic insecticides into the root system can also control HWA for approximately a half year. This application method does not harm the tree, but can only be applied to healthy trees that are taking up water and nutrients through their roots. If the trees are not taking up water and nutrients, the insecticide will not enter the tree.

- Before using any chemical insecticide, check with the local extension agent or state pesticide guidelines to identify which insecticides are registered for use and to learn appropriate times for application.
- Fertilize trees after adelgids have been controlled. Nitrogen fertilizers in the sap may actually help adelgids thrive and increase reproduction.



While chemical insecticides efficiently control HWA in a landscape setting, these insecticides are not appropriate in forest settings. Full insecticide coverage is hard to achieve because of the expense of spraying entire stands, the distances between hemlock stands, and because hemlocks often grow near sensitive stream areas. Because of these factors, scientists are researching alternative means to control HWA.

The most promising method being tested is the use of biological controls. Scientists are exploring the option of introducing one of the five predatory beetles known to feed on HWA. Efforts are focusing on the coccinellid beetle (*Pseudoscymnus tsugae*), native to Japan. The beetle feeds on all stages of HWA, and its life cycle is synchronized with the adelgid's cycle. Another advantage of this beetle over other HWA predators is it can survive the winter months. There are several sites where testing is underway, however, the beetle is not yet available for distribution.



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