

## Hemlock Woolly Adelgid / HWA (*Adelges tsugae*)



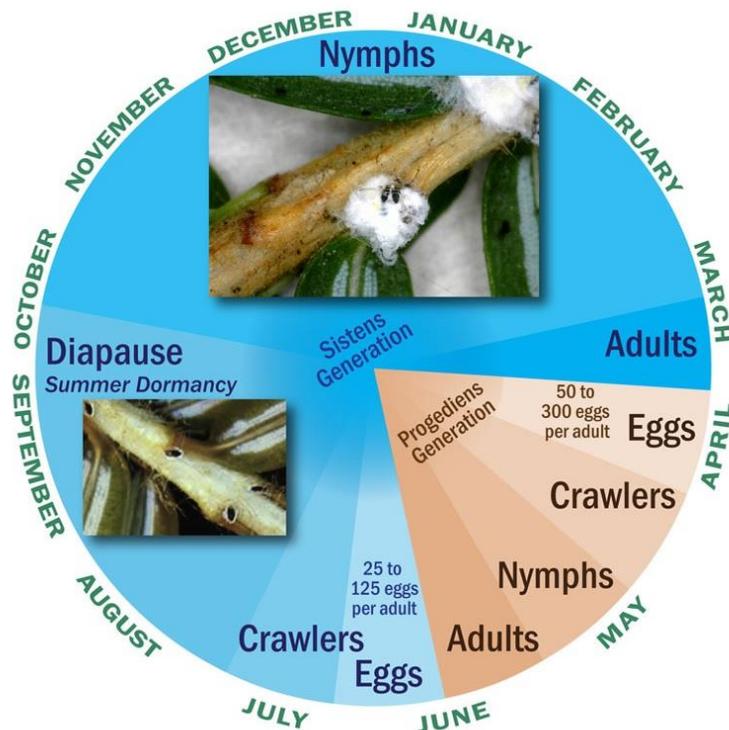
Native to Asia and the western US, HWA was first discovered in the eastern US in 1951, where it is a major pest on our Eastern and Carolina Hemlock. It [feeds](#) on the sap of tender hemlock shoots, and the resulting desiccation causes the tree to lose needles faster than it can replace them. If left untreated, **most** trees continue to decline and eventually die within a **5-10 year period** after the initial HWA attack.

Most tree service companies use a single soil-injected insecticide to treat for HWA because it's cheap (at least for them). However, based on the latest [research](#), RTS uses a **two-insecticide protocol** applied March-November via basal bark spray. Typically, with this protocol, control begins in **1-2 months**, kill rates are **85%+**, and residual efficacy is **4-5 years**. Adding the second insecticide and using a basal spray offers many advantages over a single soil-injected insecticide – e.g. **faster acting, safer for pollinators, less chance of groundwater contamination**, etc.

An **organic** option in the form of Horticultural Oil (HO) applied via contact spray can also control HWA. However, since it must be applied more frequently, HO typically costs 2-3x more on an equal protection basis.

Treatment of **all** trees on a given property is recommended as HWA spreads from tree-to-tree when the first instar crawler stage and sticky egg sacs are carried by wind, birds, and/or forest animals. The rate of spread depends upon a number of factors, but typically averages **about 10 miles per year** in the WNC area.

## HWA Life Cycle in WNC



The life cycle of the HWA in WNC is complex with **two generations annually**.

### Sistens Generation (from the Latin "to halt")

Begins in early July, when first instar nymphs, also known as "crawlers," hatch from eggs laid by adults in early June. These nymphs move and seek out suitable feeding sites at the bases of hemlock needles. After attaching, they then enter a stage of dormancy, or diapause, during the hot summer months.

In the cooler conditions of mid-October, the attached nymphs break dormancy, resume feeding, and develop into adults over the winter months. By late March, they are fully matured, and proceed to lay up to 300 eggs each. **These mature adults and eggs are highly concealed by the characteristic white, woolly covering, which is most visible around this time.**

### Progediens Generation (from the Latin "to proceed")

Begins in late April, when the eggs laid by the adults in late March, hatch. This generation does **not** experience a diapause, and quickly develops from "crawlers" to adults by early June. These adults then proceed to lay up to 125 eggs each, which later hatch into "crawlers" in early July to reinitiate the sistens generation.

# Options for Protecting Hemlock Trees from Hemlock Woolly Adelgid

**Hemlock woolly adelgid** (*Adelges tsugae* Annand), a tiny aphid-like insect native to Japan, is one of the most damaging invasive forest pests in eastern North America. Since it was discovered in 1951 in Virginia, this pest has been spreading across much of the range of eastern hemlock (*Tsuga canadensis*). It has killed hundreds of thousands of hemlock trees in eastern states, including much of New England, Pennsylvania, parts of New York and the Appalachian mountains. Localized populations of hemlock woolly adelgid (HWA) were recently found in areas of Ottawa and Muskegon counties in western Lower Michigan. Surveys are underway and other infestations may be detected.

Photo by James Wiefelich, MSU



White waxy ovisacs of hemlock woolly adelgid will be found at the base of needles.

## Biology and impacts of HWA

These adelgids feed at the bases of needles by inserting their long stylets into the woody shoots and sucking up moisture and nutrients. For much of the year, HWA life stages are protected beneath the white “wool” on the hemlock shoots. This “wool” is actually strands of wax secreted by the adelgids as they feed. Two generations of HWA occur each year, and all individuals are females. This means that HWA numbers can build rapidly. Native predators do not control HWA populations, and no parasitoids are known to attack this pest. Extremely cold

Photo by Andrew Tluczek, MSU



Filaments of wax are secreted by hemlock woolly adelgids as they feed.

winter temperatures have caused some HWA mortality in the eastern United States, but populations may build back up within a few years. Although hemlock woolly adelgids cannot fly, life stages can be blown by the wind or transported on birds, animals or even on clothing. Long-range spread of HWA occurs when people transport and plant infested hemlock nursery trees into new areas.

In Michigan, more than 170 million hemlock trees are growing in landscapes, forests and areas along streams or rivers. All of these hemlocks are vulnerable to HWA. High densities of HWA will cause needles and buds to die. Canopies become thin, and foliage often takes on an unhealthy grayish green color. Trees typically succumb after four to 10 years of infestation, depending on the vigor of the tree, winter weather and the density of the HWA population. Additional stress from drought, poor growing conditions or other pests can result in more rapid mortality.

Photo by Deborah McCullough, MSU



This declining hemlock tree has been severely affected by hemlock woolly adelgid.

## Options for HWA control

Fortunately, valuable hemlock trees can be effectively protected from HWA. For now, Michigan arborists and property owners will need to rely on recommendations developed in eastern states. Eventually, we hope to evaluate and refine HWA control tactics for Michigan conditions. It will be important to keep up to date with the HWA situation in Michigan, particularly in or near areas where HWA is already established.

## Systemic insecticides

In the eastern United States, many hemlock trees are regularly treated with systemic insecticides containing imidacloprid or dinotefuran. These products are most often applied as a soil drench, a soil injection or a basal bark spray to the lower 4 to 5 feet of the trunk. Systemic insecticides are carried in the cells that transport water from the roots to the foliage. These products should ideally be applied to hemlocks in spring or fall, when soils are not extremely dry nor saturated. As with any insecticide, be sure to read and follow the directions on the label. There are restrictions on the amount of imidacloprid or dinotefuran that can be applied per acre per year. This may be an important consideration when multiple hemlocks on a given property are infested.

**Imidacloprid** products move relatively slowly into trees, up the trunk, and into the branches and shoots where the HWA feed. It may take up to a year for the insecticide to be fully distributed throughout the canopy and control HWA, especially on large trees. A single imidacloprid application, however, should control HWA for at least five years, and one study reported seven years of HWA control.

Many products containing imidacloprid are available, but some can be applied only by professionals who are certified pesticide applicators. Other products can be purchased online or at garden stores by homeowners who wish to treat hemlocks on their own property. Products available to homeowners are applied as a soil drench around the base of the tree. The amount of insecticide needed will be based on the diameter of the



Photo by Sara Tanis, MSU

Insecticides to protect hemlock trees can be applied as a soil drench.

tree measured at 4.5 feet above the ground. Mix the proper amount of insecticide with water in a bucket, following label directions. Rake needles and leaves away from the base of the hemlock to expose the soil, then carefully pour the correct amount of solution around the base of the trunk. Professional applicators can apply imidacloprid as a soil drench or as a soil injection (e.g., with a Kiortz soil injection device).

Time-release tablets with imidacloprid (Core-Tect<sup>®</sup>) are also sometimes used for HWA control. Tablets are placed just below the soil surface near the trunk of the tree using a bulb planter, dibble bar or similar tool. The imidacloprid is released when the tablets are moistened by rain or irrigation. These tablets may be appropriate when several trees on a given property must be treated. Because the full dose of imidacloprid is released over a two-year period, twice as many trees per acre per year can be treated with the tablets than with other application methods.

**Dinotefuran** is much more water-soluble than imidacloprid. Because of this, dinotefuran products move into and through a hemlock tree much faster than imidacloprid and will provide rapid control of HWA. Dinotefuran is a particularly good choice when trees are heavily infested, especially when the trees are already declining because of HWA feeding or other problems. Dinotefuran, however, does not persist nearly as long as imidacloprid. It will control HWA for one to two years but will then need to be reapplied.

Dinotefuran (e.g., Safari 20SG) can be applied as a soil drench, following label directions. Dinotefuran, however, is more often applied as a basal trunk spray with a garden sprayer or backpack sprayer. Use low pressure and spray the entire circumference of the trunk from the base of the tree up to 4 or 5 feet above the ground. Follow the label directions for mixing and applying the solution as a basal



Photo by Sara Tanis, MSU

Insecticides can be applied as a basal trunk spray.

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trunk spray. A few squirts of WD-40 into the sprayer can help reduce the foaming that often occurs when dinotefuran is mixed with water. Thoroughly wet the bark of the tree, but avoid spraying to the point of heavy runoff. You may need to go around the tree two or three times to apply the proper amount of solution.

**Note:** Dinotefuran products are also recommended for effective control of elongate hemlock scale (*Fiorina externa* Ferris). This invasive pest feeds by sucking sap from hemlock needles. Although it is much less serious than HWA, high densities of this scale insect can be found on many hemlock trees in western Michigan, including trees that are also infested with HWA.

Photo by Sara Tanis, MSU



Elongate hemlock scale is common in many areas of Michigan. White or yellowish scale insects are found only on the needles.

Photo by Sara Tanis, MSU



Hemlock woolly adelgid (top), a healthy hemlock shoot (middle) and elongate hemlock scale (bottom).

### Basal trunk sprays with dinotefuran and imidacloprid

To protect heavily infested hemlock trees, applicators in New York are now applying basal bark sprays with a tank mix of imidacloprid and dinotefuran. This combination represents the best of both worlds — rapid control to help struggling trees recover plus long-term control to prevent HWA reinfestation. Regulatory officials from the Michigan Dept. of Agriculture and Rural Development (MDARD) have determined that basal trunk sprays of imidacloprid (as well as dinotefuran) or a tank mix of the two insecticides are consistent with the FIFRA 2ee rules unless this application is specifically prohibited by the label of the imidacloprid product. Applicators considering applying imidacloprid alone or mixed with dinotefuran should carefully review the imidacloprid label to ensure that there are no statements prohibiting basal trunk sprays or a tank mix.

**Note:** Applying imidacloprid as a basal trunk spray may be appropriate in some situations where long-term protection from HWA is desired but rapid HWA control is not necessary. For example, a basal trunk spray of imidacloprid could be a good choice when trees are lightly infested but still remain healthy or when apparently uninfested trees are growing adjacent to or near infested trees.

Recommendations from New York<sup>1</sup> suggest mixing 9.0 ounces (dry weight) of Safari 20SG plus 12.8 fluid ounces (fl oz) of imidacloprid 2F per gallon of water in a garden sprayer (or backpack sprayer). To determine the amount of solution to make, assume you will need to apply 1.5 to 2.0 fl oz of solution per diameter inch to thoroughly wet the lower portion of the trunk. At an application volume of 1.5 to 2.0 fl oz per diameter inch, 1 gallon of solution (128 fl oz) will treat approximately 64 to 85 diameter inches. You will need to calibrate your sprayer (with water) to ensure that you apply the correct amount of solution. When using a garden sprayer, add water in known increments (e.g., 2 fl oz) and use a permanent marker to mark and label levels of solution on the sprayer. This allows you to monitor the amount of spray applied to an individual tree by checking the level of solution in the sprayer. Alternatively, you can determine the time required for the sprayer to deliver 1.5 or 2.0 fl oz at a constant pressure, then multiply that amount of time by the diameter of the tree.

### Careful use of systemic insecticides

When applying systemic insecticides, take precautions to avoid environmental contamination or effects on non-target insects. Hemlocks often grow near streams or rivers, and insecticides applied to the soil could potentially move into waterways. Avoid soil drenches or soil injections of imidacloprid and dinotefuran when trees are within 75 feet of a water body. Because hemlocks are wind-pollinated, they are unlikely to attract honeybees or other pollinators that can be affected when imidacloprid or dinotefuran insecticides are used on flowering plants. Avoid applying either insecticide as a soil drench or soil injection if flowering plants or shrubs are planted around the hemlock trees you wish to protect. Applying the insecticide(s) as a basal trunk spray should minimize these concerns because little insecticide will reach the soil. Always follow the directions on the label of whatever insecticide product you choose.

### Horticultural oils and insecticidal soaps

Other options for controlling HWA include spraying infested trees with horticultural oils (e.g., Sunspray<sup>®</sup> oil) or insecticidal soaps. These products are generally used for control of soft-bodied insect pests such as aphids, mealybugs and adelgids. Oils and soaps are not toxins. They act by suffocating the insects, disrupting their cellular membranes, or dissolving the external wax that protects the insects from desiccation. These products can be applied

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by homeowners and used on hemlock trees near water. Oil or insecticidal soaps are applied by spraying the limbs and shoots of the trees and are effective only if the adelgids are thoroughly covered by the oil or soap. Research in New England showed that small hemlocks could be adequately protected from HWA with sprays of horticultural oil or insecticidal soap. Thorough coverage, however, is very difficult to achieve with larger trees. Multiple applications may be needed, even on relatively small trees. Unlike systemic insecticides, these products do not persist and will not prevent trees from becoming infested or reinfested by HWA. Most recommendations suggest applying oils or soaps in spring or fall when immature life stages are present, but other guidelines indicate summer applications of horticultural oil can be effective. Avoid applying oils or soaps when temperatures are below 45 degrees F or above 75 degrees F to prevent injury to needles.

Photo by Deborah McCullough, MSU



White waxy ovisacs of hemlock woolly adelgid.

### Insecticide cover sprays

Several conventional insecticide products, such as pyrethroids, are registered for control of HWA on hemlocks in landscapes. These products are applied by spraying the foliage of infested trees. The popularity of these insecticides has waned in recent years, in part because they are generally less effective than systemic insecticides. Sprays applied during summer will presumably reduce the number of immature adelgids, but as with any spray, adequate coverage is difficult to achieve. In contrast to

systemic insecticides, these insecticides will not control HWA life stages that are well-protected by the waxy ovisacs. Moreover, these products are toxic to other organisms, including beneficial predatory insects, pollinators and aquatic invertebrates. A synthetic pyrethroid spray applied for HWA is sometimes followed by an outbreak of spider mites two to six months later because the spray killed predatory mites that would otherwise keep spider mites in check. As with any insecticide, be sure to follow directions on the label when using these products.

### Maintain hemlock health

In addition to protecting valuable trees from HWA infestation, you can take steps to maintain the health of hemlocks in your landscape. Avoid compacting the soil around hemlocks, and be careful with snowplows, weed whips or lawn mowers, which can wound trees. Young hemlocks may benefit from irrigation during dry spells. Do not fertilize trees that are infested with HWA. Like other sap-feeding insects, the adelgids produce more offspring when fertilization increases nitrogen levels in the tree. Be sure that you do not contribute to the spread of HWA in Michigan by transporting infested trees, limbs or other material into new areas. If you live in or near areas that are known to have HWA infestations, be aware of regulations that affect hemlock transport and disposal.

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<sup>1</sup>Whitmore, M. 2014. Insecticide treatment of hemlock trees for hemlock woolly adelgid, *Adelges tsugae*, in New York state. Dept. of Natural Resources, Cornell University.

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