The balsam woolly adelgid (*Adelges piceae*) is frequently and mistakenly referred to as the balsam woolly aphid. While related to aphids, it belongs to an entirely different family of "sucking" insects. This pest, an imported insect of European stock, arrived on the North American continent about 1900. It has become a notorious pest of native true firs (*Abies* spp.), and of some exotic true fir species. It has been a major pest to Christmas tree growers in true fir growing regions for many years. Its pest status has risen recently with a dramatic increase in the planting of host species. Balsam woolly adelgid attacks true firs in public and private landscapes as well as in plantations.

**Biology and Description**

Reproduction is parthenogenic—that is, "females give rise to more females." Thus, this species is composed only of females within the populations of North America. Since no mating is involved, a single individual can start a colony.

The wingless adult female, about \(\frac{1}{25}\)-inch long, and dark purple to black, covers itself with waxy secretions, which form a white, woolly mass. At the appropriate time, a female begins to lay eggs within the wool. She can produce in excess of 200 amber-colored eggs.

The newly hatches "crawlers" (the first stage nymphs) are about one-third the size of an adult. They are yellow to amber colored with red eye spots. Shortly after hatching, the crawler finds a place on the bark to insert its mouth parts and feed. Favorited sites are branch nodes of the canopy, under lichens, or in bark crevices on the main stem and large branches. A large number may also settle on the twigs of new growth, especially around the buds. They then transform, without molting, into a wax-fringed resting stage. This is the stage in which the insect overwinters. Two more nymphal stages, resembling the adults, follow before maturity is reached.

Two to four generations of balsam woolly adelgid can occur each year. Two generations are the most common in the mountainous regions of the West and in some areas of the East Coast. A partial third generation occurs in certain areas of the eastern United States; a partial fourth generation occurs in the lowlands of Oregon and Washington.
Winter hibernation normally ends in late April or early May. Most developing adelgids in two-generation populations reach the adult stage by late June or early July in mountainous areas. The last generation of adults in these mountainous regions becomes abundant in late September and early October. Egg laying continues into November. The sequence of development in areas having three and four generations per year is similar. In the lowlands (below 1200 feet elevations) of the Pacific Northwest, where the bulk of true fir Christmas trees are grown, overwintering nymphs have, in some years, broken hibernation as early as mid-January, producing adults by February. However, few eggs laid by these adults hatch before early April.

Swelling or gouting of branch nodes and terminal buds are typical symptoms

Adult balsam woolly adelgids secrete a waxy, white woolly mass for protection, center above.

This tree, center below, had over 100 adelgids per square inch on the trunk; it died within 3 years.

A large true fir in serious decline after years of repeated infestations of canopy attack.

Dispersal

The newly hatched crawlers are the only stage capable of directed movement. Because they are so small, they are easily carried long distances by the wind. This is believed to be a major means by which they travel from tree to tree. "Hitchhiking" via birds, animals, people and vehicles or equipment accounts for some spread.

Feeding and Economic Impact

The two types of injury to true firs that are caused by balsam woolly adelgid are strikingly different. Canopy injury is characterized by twig damage that results in gouting or swelling of branch nodes and terminal buds, bud inhibition, needle thinning and long-term decline. It may take a few years for these symptoms to
become noticeable and a few more years for such a tree to die. When the adelgid inserts its mouth parts to feed on nutrients within the tree tissues, it also injects saliva. The saliva may contain a toxin that produces this variety of responses.

The second type of injury is seen when the pest attacks the bole or stem. Here, the saliva causes a type of compression growth to form in the sapwood, which ultimately reduces the flow of nutrients and water between the roots and canopy. During such attacks, populations on the trunk can reach densities of 100 or more adelgids per square inch of bark surface. Lower densities can kill a tree within 2 or 3 years. Bud and branch node swelling is also associated with this kind of damage, but it rarely becomes noticeable because the tree dies so rapidly.

Conditions which favor attack vary. The site appears to be a key point. Trees located on good sites, at low elevations, and growing in well-spaced conditions are attacked first, or more often. Frequently, trees planted out of their ranges, such as alpine fir in landscapes and parks, are more susceptible to attack than they are in their normal habitat.

Balsam woolly adelgid attacks only *Abies* or true fir species. North American species are the most sensitive to attack, led by fraser fir (*A. fraseri*), noble fir (*A. procera*), and shasta fir (*A. shastensis*) in the Pacific Northwest. Grand fir (*A. grandis*), and especially balsam fir (*A. balsamea*) are also susceptible.

Certain species of *Abies* react differently to the feeding of balsam woolly adelgid. For example, when *Abies alba* (European silver fir) is attacked, certain cells collapse, causing "pathological" bark formation. This, in turn, deprives the adelgid of its food supply and the attack ceases. The effect on the tree is minor. But when trees such as *Abies balsamea* (balsam fir) are attacked, both swelling and attack continue, and the effect on the tree is major unless the adelgid is chemically or naturally controlled.

**Control**

Low winter temperatures provide the most effective natural control. Certain stages of this insect are more susceptible to cold than others. For example, adults are unable to stand temperatures below 3°F. Temperatures of -15 to -30°F are effective as a natural control. In cold winters only those insects on the trunk below the snow line survive. The predominating mild winters west of the Cascade Mountains offer few possibilities for control, while colder winters in eastern Washington may help control this pest.

Effective native predators were relatively nonexistent when this pest first arrived. In recent years, several beetle, midge, and wasp predators have been introduced. To date, there is little evidence that these introductions have led to significant control before tree decline begins. This is particularly true of Christmas tree stands. In a cultured environment, chemical control is almost always necessary when balsam woolly adelgid is found.

Applications of pesticides must be appropriately timed to be effective. As many as 60% of adults may survive a chemical application because of their protective waxy wool covering. Therefore, apply pesticides when the population is in a more or less "naked" nymphal stage. Spraying at bud break or close to bud break appears to be one of the best times. A thorough bud break application should be
adequate unless infestations are extremely high.

Knowledge of recurrent summer and fall nymphal peaks will help time a later spray if the spring application was not wholly effective, or if one was not made then. Timing later sprays can be tricky, and depending on altitude and geographical location, may not be easily scheduled. Monitor the pests with a good hand lens to determine when ensuing populations will be most vulnerable.

Helicopter applications have only limited success in field situations, because the crawlers are generally well hidden on the undersides of branches, on the trunk, and under bud scales. Ground application is necessary to penetrate all parts of the tree. Trees showing signs of attack should probably be soaked literally from top to bottom, including the trunk.

Chemicals for the control of balsam woolly adelgid include Thiodan, Sevin, and Asana. Adelgids are not listed on the Thiodan and Sevin labels. Use these insecticides in accordance with label directions for controlling aphids. Use discretion where Sevin and Asana are concerned, since use of these can lead to mite build-up. If they are selected, it may be necessary to include a miticide. Due to bee hazard, do not apply Asana at rates of greater than 0.1 pound per acre if blooming weeds are present. Rates of 0.1 pound per acre or less can be applied in the late evening when bees are not foraging.

Sevin is also extremely hard on bees. A slow killer, it is carried back to the nest by foraging workers, and initiates a more extensive bee kill in the colony. If blooming crops or flowers are present under or near the trees, avoid the use of Sevin.

If blooming plants are present, Thiodan can be used at rates over 0.5 pound per acre during the late evening when bees are not foraging. At rates of 0.5 pound per acre or less, Thiodan may be used in the early morning before bees are foraging. Whichever product you select, be certain to follow all label instructions and precautions.

Landscape applications by homeowners are restricted to formulations of Thiodan or Sevin labeled for this purpose on either ornamentals, in general, or fir trees in particular.

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**Warning**
The law requires that pesticides be used as the label directs. Uses against pests not numbed on the label and low application rates are permissible exceptions. If there is any apparent conflict between label directions and the pesticide uses suggested in this publication, consult your county Extension agent.
Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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