



# Christmas Tree Notes

## Balsam Woolly Adelgid

CTN-020

### Introduction

The balsam woolly adelgid (*Adelges piceae*) (BWA) is a tiny, soft-bodied insect which appears when adult as a white, woolly spot on true firs. The adelgid was introduced from central Europe where it feeds on silver fir. These firs have developed resistance to the pest and are not seriously harmed by it. Fraser fir is the most seriously affected of all fir species by BWA feeding and will be killed after several years of infestation. Before death occurs, BWA damage seriously affects the growth and appearance of the tree and limits the ability of the tree to be marketed. This introduced pest is largely responsible for the decline of Fraser fir in the natural fir-spruce stands in western North Carolina, southeastern Virginia and eastern Tennessee and continues to pose a serious threat to Fraser fir Christmas tree growers in the southern Appalachians. Adelgids are small and difficult to find on the tree. It takes several months before trees develop symptoms of insect damage. Because of this, BWA can increase unnoticed and cause serious losses to unsuspecting Christmas tree growers. Luckily, BWA spreads slowly. Through conscientious scouting and control, serious losses can be avoided.

### The Balsam Woolly Adelgid Lifecycle

Sometimes incorrectly called the balsam woolly aphid, the BWA is actually very different from an aphid. Aphids continually walk around on a plant, probing plant cells with their feeding tubes. Adelgids are sedentary pests, much like a scale insect. The crawler is the only stage in the BWA lifecycle which can move from place to place. All other stages feed from the same location from a feeding tube sunk into the bark which can not be moved.

The lifecycle of the BWA is especially interesting because in North America the males that are needed to complete the lifecycle are not produced because the

alternate host is not present. In Europe, the BWA alternates between fir and spruce trees similar to the pine leaf adelgid in western North Carolina that feeds on white pine one year and red spruce the next. Since males are only produced on the alternative host, in North America the BWA reproduces parthenogenically. This means that females lay eggs that are exact replicas or clones of themselves. This is of benefit to the grower as it reduces the likelihood of the insect developing resistance to any given pesticide.

The BWA overwinters as an immature nymph. These are small, black, and tent-shaped with a row of short white waxy filaments running down the middle and around the edge. The nymphs start to mature to the adult in March or April. As nymphs mature, they get plumper and produce a woolly covering of wax to protect themselves from predators. The purple-black adult is completely hidden from view by this covering.

Honey-colored, oblong eggs are laid in a clutch behind the female. In the laboratory, females have been reported to produce as many as 200 eggs but the number produced in nature is far fewer and may be dependant on the vigor of the host tree. Eggs hatch within a month to produce the next stage in the lifecycle, the crawler.

The crawler is similar in appearance to the egg, only with eyes and legs. The crawler has no mouthparts. It must search out a suitable site to feed within several days or die. Once the crawler finds a suitable site, it never moves again. It molts in place to the nymph and sinks its feeding tube into the bark which is as long as it is. Feeding throughout the rest of the insect's life will occur in specialized cells just below the bark. The insect will eventually molt to the adult and lay eggs in that same spot. Though the nymphs and adults do not crawl about, legs are still apparent when the insect is examined under the microscope.

During the growing season, a nymph will molt to an adult in about one month. There are 2 to 3 generations produced each year. More generations may be produced at lower elevations. The different generations are not synchronous and during the growing season all stages of the BWA – egg, crawler, nymph, and adult – can often be found. This complicates control as the eggs are not affected by pesticide applications.

## How BWA Moves into Your Trees

Only the crawler can move to a new tree. Since crawlers are only present from April through October, the rest of the year the BWA cannot infest healthy trees. Spread into uninfested trees occurs when crawlers are blown by the wind or are carried by birds into new areas. The source of these insects can be natural stands of Fraser fir or other sources of untreated trees such as Fraser fir grown as yard trees or abandoned Christmas tree plantations. The adelgid can also be brought into a new area on seedlings pulled from natural stands. Isolated plantations of Fraser fir may never be bothered with the BWA in western North Carolina.

## How BWA Damages Trees

Fraser fir is extremely sensitive to BWA feeding. The tree tries to protect itself by producing reaction wood, sometimes called rotholz, which is a type of wood produced in response to an injury. This wood is very hard and limits the proper movement of water, nutrients, and hormones through the tree. The internal water stress will slow and distort plant growth and eventually kill the tree. Even an infested tree with no visible symptoms will be more likely to shed needles once it is harvested. Heavily infested trees should not be marketed. The tendency for these trees to shed their needles and the stiff branches that are produced also make infested trees unsuitable as a source of foliage for wreaths and roping.

## Excluding BWA from Your Trees

The first line of defense against the BWA is to exclude the insect, as much as possible. The only possible source of BWA is true firs. The crawlers can be blown many miles by the wind, but the closer the source of insects are, the more likely trees will become infested. Since crawlers do not have wings, it is merely by chance that they are blown onto another fir tree.

Remove any large Fraser fir that cannot be easily sprayed. If neighbors have fir in their yards or have

abandoned Christmas trees, do everything possible to either cut down those trees or treat them with an insecticide, even if you have to do it yourself. Always treat seedlings that are pulled from natural stands with an insecticide. Seedlings can either be dipped in an insecticide labeled for root dips, such as Talstar (esfenvalerate), or sprayed with a labeled insecticide. Be sure to use appropriate personal protective equipment when handling insecticide-treated seedlings.

## Finding BWA in Trees

Scouting is the only way to know if BWA is in your trees. To scout, observe trees for symptoms of BWA damage. A tree showing symptoms has been infested since before bud break of that growing season.

Symptoms include:

- ◆ Flat top or weak terminal (often at a 45° angle to the tree trunk). This is usually the first and most noticeable symptom.
- ◆ Gouting (swelling around the shoot nodes) and swollen internodes
- ◆ Dead shoots or branches
- ◆ Reduced shoot growth
- ◆ Wilted appearance to the shoots
- ◆ Stiff, inflexible trunk
- ◆ Reaction wood or rotholz (observed when trees are cut or when branches are removed). Affected growth rings will have red wood which is much harder than the healthy, creamy white wood produced in previous years when the tree was uninfested. Counting the number of the growth rings with reaction wood will reveal how long the tree has been infested.

Any of these symptoms can be caused by other problems. A stiff trunk, for instance, can be found in trees grown on windy ridges or having nutrient deficiencies. A weak top is caused by poor shearing when more than one shoot is left that has the capability of becoming the terminal. Therefore, to confirm that the symptoms are due to BWA, look for the white wool of the adult female on the trunk of the tree. These insects are often found under the branch/trunk union, though they can be found anywhere on the trunk, branches, buds and shoots. Swollen buds should also be examined for adelgids. This is a good way to observe the adelgids during the winter months when adults are not present and the overwintering nymphs do not have the covering of white wool.

To make sure a white spot is BWA, cut off the bark and examine it with a magnifying lens. Dried resin or lichens may also appear on the bark as a white spot, but with magnification it is easy to distinguish between these which are smooth and adelgids with their covering of wool.

## Scouting for BWA to Prevent Damage

To prevent BWA from causing damage to trees, scout every year from the time trees are waist high until harvest. Scout trees sooner in a rotation if they are near large, untreated Frasers. The goal is to find symptoms of BWA the first year that trees exhibit them. The easiest time to examine trees is in August and September after the tree has completed growing for the year and symptomatic trees can first be observed. Scouting in the winter is harder as only nymphs are present and these have not yet produced the white woolly covering that is visible to the naked eye. When scouting in the winter, examine symptomatic trees for swollen buds and look at these with a magnifying lens for nymphs.

In order to find the first trees showing BWA symptoms, it is necessary to scout the field in a systematic fashion. Enter the field at one corner, stepping two to four rows in. Walk the full length of the row, scanning from side to side up to five rows in each direction depending on the size of the trees. You need to see the terminal of every tree in the field. In a field of 6-8 foot trees, you may only see three rows well. When you reach the end of the row, step over six to ten rows depending on tree size. Continue this pattern until you've covered the entire field. Feel free to leave the row you are walking in to examine a tree, but be sure to return to that row as you continue to scout. In this way you can be sure to see the terminal of every tree in the field.

Any tree with dead branches or a crooked terminal should be examined for BWA. Try to rock the tree back and forth to determine if the trunk is stiff, then examine both sides of the trunk for BWA. If no adelgids are found, flag the symptomatic tree and reexamine it in a month or so. BWA may be in the adult stage by then and easier to find.

## Controlling BWA

If any BWA are found, it will be necessary to treat the field before bud break of the following year, unless all of the trees are to be harvested that fall. There are insect predators present in western North Carolina that will feed on BWA, but they will not

completely eliminate all the adelgids in a field. Spot treatment of the field is only possible if the trees are less than a year from harvest, and only a small portion of the field has BWA.

It is best not to treat for BWA unless it is found in your trees. Preventative treatments do not work because eventually the pesticide will degrade and become ineffective. Spraying unnecessarily wastes time and money, and may create problems with other pests such as spruce spider mites, hemlock rust mites, and scale insects. However, some growers that are in areas with abundant Christmas tree production do choose to treat trees when they are between 3 to 5 feet regardless if the pest is found. In such areas, it is almost guaranteed that BWA will become a problem eventually and at this size, trees are easier to treat and require less pesticide.

Trees can be treated for the balsam woolly adelgid any time of year. However, certain times of the year have greater advantages, either because it is cooler and more comfortable to spray, or because the same pesticide application will control other pests as well.

The first consideration is if some trees will be harvested from the infested block that year. If some trees are to be harvested, it is best to wait until after harvest so less pesticide is required and there is less exposure of pesticides to workers handling trees.

The second consideration is what material is going to be used. If certain pesticides are being considered such as horticultural oil, insecticidal soap or Lorsban 4E, it is necessary to apply them in the winter, the only time of year when there are no eggs present. Typically there are no BWA eggs found from October through March, but be sure to scout before treating to make certain.

The third consideration is what other pests are present. Growers needing to treat for the rosette bud mite in June may consider trying to control BWA as well, though care must be taken at that time of year not to damage the new tender growth with the high-pressure spray. Many growers will wait until February through April to treat for BWA to also control the balsam twig aphid and/or hemlock rust mite. The balsam twig aphid can also be controlled when BWA treatments are made from August through October with Talstar or other synthetic pyrethroids. Treatments made in the fall after August appear to have less impact on natural predators and therefore less problems with subsequent mite flairs-ups. If elongate hemlock scales are in your trees,

consider using Asana + Dimethoate, either just prior to bud break, or from July through early September to get the best control of both pests. Be sure to scout for other pests before deciding on when to treat for woolly adelgids.

## Culling Trees

Heavily infested, badly damaged trees often will not recover even after treatment. Pesticide applications never result in 100% control and these trees will only serve as a source of BWA to reinfest other trees.

Trees that will never make a saleable Christmas tree should be cut down and burned. Only do this when crawlers are not present. Otherwise you may spread crawlers to healthy trees when the infested ones are carried out of the field.

## Getting Good Coverage

Good control requires complete coverage of the tree. Getting good coverage is more important than the choice of insecticide. Good coverage is easiest with a high-pressure sprayer. Expect to use several hundred gallons of spray per acre. The amount of water used will increase as the trees grow taller and denser.

Spray trees from at least two directions. The base of the tree trunk and under the branch/trunk union are two difficult places to reach. Butt-pruning trees and mowing tall weeds before treatment will improve spray efficiency. Practice spraying trees with water and checking immediately to see if the entire tree is wet.

Don't try to treat too many rows at a time. Two rows are usually all that can be covered well. The most efficient spray pattern is to treat the two rows on one side while walking up the row, then treat the two rows on the other side as you walk back down the row. In this way, both sides of the tree will be sprayed.

Also treat stumps of trees cut within the last 6 months, and stumps with live branches still on them. Adelgids will survive on cut stumps for several months.

In fields where some trees have been harvested, it may be hard to remember as you move through the field which trees have been treated and which have not. A dye can be added to the spray mix that allows you to see which trees have been treated. These dyes wash off after several rains.

Small acreage growers needing to treat only a few hundred trees may also get good coverage using a

backpack mistblower. Contact your county extension agent to determine the feasibility in your situation and to determine the appropriate rate.

## Pesticides Labeled for BWA Control

Materials labeled for BWA control as of November 2009 include:

- ◆ Asana (esfenvalerate) (9.6 oz./100 gal.)
- ◆ Astro (permethrin) (16 to 32 oz/100 gallons)
- ◆ Horticultural oil (2 gal./100 gal.)
- ◆ Insecticidal soap (2 gal./100 gal.)
- ◆ Lorsban 4E (chlorpyrifos) (2 qt./acre)
- ◆ Provado 1.6 F (imidacloprid) (4-8 oz/acre)
- ◆ Talstar (bifenthrin) (40 oz/acre)
- ◆ Thionex (endosulfan) (2/3 qt./100 gal.)

Note that the Lorsban, Provado, and Talstar are labeled on a "per acre" basis. That means to get the full rate, the gallons that will be applied per acre must be estimated. If 400 gallons were used for instance, the rate of Talstar would be 10 ounces per 100 gallons. However, if 600 gallons were actually applied, mixing 10 oz/100 gallons would result in a rate of 60 oz/acre which exceeds the labeled rate. If 600 gallons of water per acre are used, 6.7 oz would be mixed with 100 gallons.

Asana, Astro, Talstar and Thiodan can be used any time of year that trees can be treated. Lorsban and insecticidal soap should only be used from November through March. Any other time of year, a second application with these materials will be necessary after four weeks to control the crawlers that hatch from the egg. Horticultural oil should only be used from December through March because it may burn foliage if trees are not dormant. Be sure to have good agitation in the spray tank when using oil or trees may be burned and control compromised.

Using any of the synthetic pyrethroids (Asana, Astro and Talstar) may cause an increase of the spruce spider mite and especially hemlock rust mites. Care should be taken to scout for these pests as much as 18-months after application. Treatments made in the fall are not as likely to create problems with hemlock rust mites but problems can still occur.

There is no benefit to combining more than one of these materials for BWA control. However, it may be necessary to add other materials to control other pests. Dimethoate may be added to also control the rosette bud mite or elongate hemlock scale. Adding Dimethoate will also have a knock-down effect on mites, though control may only last several weeks.

Longer lasting mite control can be achieved by adding a better miticide if mites are present at treatment. Though Talstar controls the spruce spider mite, it does not have activity against the hemlock rust mite. Also, several of these materials may burn trees if sprayed during hot, humid weather. Be aware that mixing insecticides together can increase the risk of burn.

### Scouting after Treatment

A month after treatment, check to see if trees have developed any more white, woolly spots. Examine new and old spots under a microscope or with a hand lens to see if the adelgids are dead. This is done by pricking the insect with a pin or the point of a pocketknife. If the adelgids are dead, they will appear dried up. If they are alive, pricking them will produce a spot of purple liquid. Another way to tell if the adelgids are dead is to rub your fingers across the white wool on the bark. If the insects are alive, they will leave a purple smear. Consult your local Cooperative Extension Agent to help you determine if controls were successful. Continue to scout for

BWA the following year and throughout the growing season to see if the pest has reinfested your trees.

Many pesticides used for BWA control can make hemlock rust mites and spruce spider mites worse. Be sure to scout for these pests on a regular basis for as long as a year after treatment.

### Will One Treatment Last Three Years?

Many growers feel that treatment for the BWA should last three years. This is not always the case. How soon a field needs re-treatment depends on several factors. If the field is heavily infested, it may require re-treatment the following year. Large trees (over 10 feet) often require more frequent treatment. Fields near natural stands, abandoned Christmas tree plantations and Fraser fir yard trees may need more frequent treatment. In addition, if spray coverage was poor, or horticultural oil or insecticidal soap were used, the BWA population will rebound more quickly. Only conducting a thorough yearly scouting will determine if re-treatment is necessary.

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Original Christmas Tree Note written September 1993. Update November 2009

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