How to Speak Christmas Tree:

Managing Insect Pests Through IPM

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Managing insect pests is one of the most critical aspects of Christmas tree production. Effective management of insects is both challenging and important because it has implications for tree health and quality, costs of operation, and protecting the environment. Integrated Pest Management (IPM) seeks to integrate management options to both (1) keep pests below damaging levels and (2) avoid wasting money on unnecessary or ineffective tactics. In this edition of 'How to speak Christmas tree,' we continue our discussion of IPM for Christmas trees, focusing on key concepts and terms related to IPM for insect pests.

Figure 3 – *Spider mites can cause foliage to have a bronzed appearance. Image: USDA Forest Service Northeastern Area, bugwood.org*

Insect pests and their close relatives, mites, are common and can be damaging pests of Christmas trees. The extent and costs of injury caused by insects varies depending on the species of insect, the density of the insect population, the type of insect feeding, and the age and vigor of the trees. Seedlings and young trees can be particularly vulnerable because it takes only a few insects to injure or kill them. However, older, larger trees may also be injured depending on the type of feeding an insect does and the abundance of the pest.

Insects feed on Christmas trees in many ways. They can chew on or inside the needles, tunnel inside the shoots or under the bark, or even feed on roots. Some insects suck sap from the needles, buds, or shoot, reducing vigor and sometimes creating wounds in the bark that allow fungal spores to enter the tree. Others cause galls (swollen areas) to form on branches or shoots.

Insects are one of those unique groups of organisms that change form at least once during their lifetime. This is important to Christmas tree growers because different life stages of an insect may cause different types of damage. For example, sawfly larvae, which look much like caterpillars, are common defoliators of pines and other conifers. Adult sawflies, however, are non-feeding and cause no damage to trees.

Insects that feed on conifer trees will go through either **simple** metamorphosis or **complete** metamorphosis. Metamorphosis is the change in the insect's body as it develops. Species with **simple** metamorphosis have a similar appearance to adults. They feed then molt, which involves splitting and shedding their exoskeleton – their outer skin. Molting must occur for insects to grow. After more feeding, nymphs molt again and so forth. After the last molt, the insects are adults. Adults are generally larger than nymphs, are mature and can reproduce and many, but not all species, have wings as adults.

Insects with simple metamorphosis include grasshoppers, thrips, spittlebugs, aphids, scales, and mites.

Complete metamorphosis is more evolutionarily advanced. Insects with complete metamorphosis hatch from eggs as larvae. Larvae feed and molt to grow and develop, much like insects with simple metamorphosis. Once larvae finish feeding, however, they go through pupation, typically in some type of cocoon. During pupation, the insect's cells take on new forms and functions. For example, when a caterpillar that uses its legs to walk and its mouthparts to chew on foliage finishes feeding, it spins a cocoon and pupates. A moth, which has wings and a long proboscis to suck nectar from flowers, eventually emerges from the cocoon. Most of the advanced groups of insects have complete metamorphosis, including beetles, moths and butterflies, sawflies, bees, ants, and wasps, along with flies, mosquitoes and midges.

Managing insect pests is one aspect of Christmas tree production where applying IPM principles and practices can have a major impact on the success (or failure) of a farm operation. Tree selection, regular scouting, conservation of beneficial insects, and judicious use of insecticides only when needed can all contribute to effective and sustainable management of insect pest populations and damage.

***Figure 2.** – The USDA Christmas Tree Pest Manual is the ultimate resource for growers to identify potential pest problems.*

Tree selection

As with other forms of IPM, selecting the right tree species for a given location can improve the ability of the trees to resist, tolerate or recover from pest damage. A few insects are generalists and able to feed on a variety of tree species. However, most insects are specialists and will only affect one or a few closely related species of trees such as pines or true firs. Information about which pests affect specific trees is helpful in identifying the pest that may be currently affecting your trees, but it is also useful for avoiding species that may be common and problematic. For example, Scotch pine hosts an array of insect pests, many of which can require control to produce a quality tree. This species is often best suited to experienced growers that have good knowledge of pest management, can tell the difference between pests and beneficial insect predators, and are well versed in the appropriate use of pesticides and spray equipment.

Figure 2. – *The USDA Christmas Tree Pest Manual is organized by types of tree damage to help growers diagnose potential pest issues.*

Scouting

Scouting is the cornerstone of IPM and is essential to effective management insect pests. There is simply no substitute for regular inspections of fields to head off pest outbreaks and minimize serious damage. Effective scouting involves walking through fields in a systematic, usually zig-zag, pattern to examine trees for signs and symptoms of insect pest infestation. **Symptoms** are the damage the insect causes to the tree; **signs** are evidence of the insects themselves.

When scouting fields, growers should keep a copy of the Christmas Tree Pest Manual handy (Fig. 1). The USDA Christmas Tree Pest Manual, 3rd Edition, includes color photos of virtually all insects, as well as diseases, animals and abiotic problems that affect conifer trees. This manual provides recommendations for scouting, including the time of year and how to sample trees for specific pests. It also includes guidelines for diagnosing different types of insect pest problems, determining if control measures are needed and if so, how to control specific pests (Fig. 2). The Christmas Tree Pest Manual (E2676) is available for $5.00 plus mailing from MSU Extension Christmas Tree Pest Manual (msu.edu).

Key signs and symptoms to watch for when scouting fields include:

Discolored Foliage, such as yellowing needles or red needles, can result from many different types of insects feeding. Mites, which suck nutrients from needles, for example, can cause foliage to take on a bronzed appearance (Fig. 3) (see page 21). Flagging refers to a shoot or branch with red, dead needles (Fig. 4). Insects such as Pales weevil or Zimmerman pine moth feeding at the base of the affected shoot or branch can cause flagging. When all or nearly all foliage on a tree is red, it usually means the tree cannot transport water (Fig. 5). This can be caused by root-feeding insects, bark beetles or animal feeding that girdle the base of the tree.

Blackened Foliage and/or Bark often indicates insects such as soft scales, aphids, or spittlebugs have been feeding on the tree. These insects suck sap from foliage or shoots and excrete sugary honeydew. Black, sooty mold grows on the honeydew.

Needle Loss is a common symptom of many insect and disease injuries (Fig. 6). Notched, broken, or hollowed-out needles indicate insect feeding. Insect foliage feeders will strip off clusters of needles, often in a characteristic pattern.

Figure 4. – *Terminal shoot flagging caused by white pine weevil. Image: Steven Katovich, bugwood.org*

Figure 5. – *Rapid death of trees is often linked to root issues that interfere in with water uptake such as root collar weevil (shown here) or root rot pathogens. Image: Steven Katovich, bugwood.org*

Figure 6. – *Needle defoliation caused by European sawflies. Image: Steven Katovich, bugwood.org*

Figure 7. – *Balsam twig aphids can cause stunting and curling of fir needles. Image: Steven Katovich, bugwood.org*

Look for the insect or its frass, webs, cocoons, or cast skins on the surrounding foliage and beneath the injury; these are all signs of insect feeding.

Deformed and Stunted Tissue Insects can cause galls, swellings, and other kinds of abnormal growth on needles, shoots, stems, or roots (Fig. 7). Past injuries from insects, disease, or animals may eventually cause excessive branching, forking, and crooking. Once weakened by injury or stress, trees may grow more slowly. Although economically important, this growth loss may be difficult to detect and diagnose.

Pitch Flow When insects feed or tunnel in the shoots, branches, and stems of living conifers, pitchy sap flows from the point where they entered the tree. Canker and shoot blight diseases may cause a similar response.

Wood Shavings Insects living in dying or dead stems and branches often produce fine sawdust or coarse slivers of wood. Piles of this material may be on the ground or found adhering to the bark.

Insect Parts and Structures Insects often leave behind evidence. Learning to recognize this evidence can help you find and identify pest populations before damage becomes severe. For example, as insects feed and grow, they must periodically shed their outer skin to accommodate changes in size. Cocoons or cast skins of nymphs or larvae can sometimes be found near the injury. This evidence can often be used to identify the species of insect.

Small pellets of waste (frass) left by foliage-feeding insects can often be found near or beneath damaged foliage. Spittlebug nymphs produce white, frothy masses resembling spittle on the twigs or branches of trees. Part the mass carefully to see the small, soft insect.

Control

When a serious pest is abundant, the best strategy may be a combination of simple treatments rather than a single drastic action. In some cases, this may involve using a chemical insecticide but these products should be considered a last resort.

The strategies suggested here will not completely eliminate pests from your plantations. Instead, these strategies work to bring pest populations down to acceptable levels and keep them there. An acceptable level merely means the trees will not be killed or degraded at the time of harvest. You can keep pests at acceptable levels by practicing prevention and some combination of manual, mechanical, biological, cultural, and chemical control methods.

Biological Control

Natural enemies, such as predators, parasitoids, and pathogens, can play a significant role in pest control. When natural enemies become permanent residents in Christmas tree fields, pests are less likely to increase to damaging levels. These beneficial organisms include predators like ladybugs (which devour aphids and scales by the thousands), lacewings (adults and larvae), spiders, and predatory mites. Parasitoid wasps and flies are unique and highly specialized insects that lay their eggs within or on the body of pest insects. The immature wasps develop by feeding on the pest insect. You can attract beneficial predators and parasitoids to your fields by leaving edge rows or occasional strips or clumps of flowering plants.

Growers can purchase beneficial predators and parasitoids from biocontrol suppliers. Lacewings, for example, are sold commercially and can be distributed on trees infested with aphid or scale insects. Once the lacewings become adults, however, they typically fly off to find other prey. Be sure to know exactly what insect pest you need to control and do research on

the biocontrol organisms you are considering. Be sure the biocontrol agents will feed on your pest species.

Products with *Bacillus thuringiensis var. kurstaki*, known as "Bt" or "Btk", can be sprayed on trees to control foliage-feeding caterpillars. Bt products only kill caterpillars that actually consume the sprayed needles. Best of all, the bacterium is not harmful to other nontarget organisms, including pets, birds, fish and humans.

Chemical Control

Most conventional chemical insecticides will kill most insects, and because of this, they have been used too often in lieu of other control methods. If you must use chemical insecticides, it is important to know the species of your insect pest, choose the proper products, apply the product at the correct time and life stage of the insect, and ensure the product is applied to the infested portion of the tree at the correct dose. Mistakes are not only costly; they can be harmful to the applicator, non-target insects including beneficial predators and parasitoids, and the environment.

Insecticides are grouped in a few different ways. Certain insecticides are *systemic*, meaning they are taken up by the plant and then control the insect when it feeds on the plant. *Contact* insecticides, as the name implies, kills insects that move across a sprayed surface. A few insecticides are *selective* and only affect certain types of insects. Most, however, are *broad-spectrum* and will kill nearly all types of insects.

Improper use of a pesticide might rid your plantation of a pest but may very well trigger another, more serious problem. Overspraying, especially with broad-spectrum products, can cause secondary pests such as mites, aphids, and scales to rapidly build to damaging levels. This occurs when an insecticide application kills valuable parasitoids and predators, as well as the target pest. This potential problem with secondary pests is a good reason to consider chemical insecticides only as a last resort.

Before applying insecticides, growers should refer to the USDA Christmas Tree Pest Manual (Christmas Tree Pest Manual (msu.edu)) and the Michigan Christmas Tree Pest Management Guide (available on-line, search: 'Christmas tree pest management guide') for details on timing and registered insecticide products. These references provide information about the typical timing of pest emergence and optimal windows for control. Proper spray timing is critical to effective control. Poorly timed applications can be completely ineffective, wasting the growers' time and money, killing pollinators and other non-target insects and releasing insecticide into the environment with no benefit. Moreover, poorly timed sprays often make pest problems worse by reducing populations of beneficial insects that can keep pest insects under control.

Evaluate Your Control Efforts

To be truly effective, IPM should be part of the day-to-day workings of your Christmas tree operation, from species selection to premarket inspection. This includes regular, careful monitoring, even after a control treatment. By evaluating your treatments, you can determine which management techniques were successful and which were not. You can then continue using the best techniques and minimize insect pest damage by design, not by chance.

Summary

Insect pests are an unpleasant fact of growing Christmas trees and all fields will have some insects present. The goal of an IPM program for your farm is to manage insect pests in a way that keeps pests below damaging levels and is environmentally and economically sustainable. Key steps for IPM programs include:

- Avoid tree species that are 'magnets' for common pests in your area
- Match species to site and maintain trees so they are vigorous and can use their own defense systems to ward off pests
- Provide habitat for beneficial insects and birds that prey on insect pests (e.g., maintain vegetative buffers around fields)
- Protect beneficial insects by avoiding unnecessary insecticide sprays
- Maintain a regular scouting program. This will alert you to the presence of pests before they become major outbreaks and will enable you to evaluate the effectiveness of control efforts
- Track growing degree days (GDDs) and emerging pests via MSU Enviroweather and MSU Extension News to optimize timing of control
- Apply chemical insecticides judiciously and as a last resort