

# Management of White Pine Weevil in Spruce

by Robert C. Wilson and Edward J. Bechinski

## INTRODUCTION

The white pine weevil, *Pissodes strobi*, is a native North American insect that poses a serious threat to spruce and pine trees transcontinentally across the northern regions of the U.S. and adjoining Canada. It infests and kills the main shoot (terminal leader) of young trees (Fig. 1), causing formation of multiple trunks and bushy-topped trees.

The weevil is of major concern to commercial nurseries and landscape businesses as well as homeowners. It causes significant damage to the aesthetic and structural qualities of landscape trees and economic damage through loss of growth and marketability. White pine weevil also infests both natural and managed forest stands. This publication focuses on weevil management in commercial nurseries and home landscapes.

## HOST RANGE

*Pissodes strobi* was named the white pine weevil because it first was found on eastern white pine. In the West the insect sometimes is called the spruce weevil because it almost exclusively attacks spruce rather than pine trees. It does not attack western white pine, our Idaho state tree, but readily infests native and non-native spruces. Colorado spruce, Norway spruce, Sitka spruce, Engelmann spruce, and Serbian spruce are preferred hosts, though it has been recorded rarely in certain pine species as well as Douglas fir. Some spruces—like Lutz spruce (a natural hybrid of Sitka and white spruce)—seem to have an innate resistance to the weevil and only rarely suffer damaging infestations.

In the prairie provinces of Canada, white pine weevil is considered a serious pest of jack pine, red pine, and Scots pine, and an occasional pest of mugho pine. To our knowledge, white pine weevil does not attack these pines in Idaho.

## INSECT IDENTIFICATION

The adult insect is a 1/4-inch long weevil that is mottled brown (Fig. 2). This cryptic coloration makes it hard to detect on the trees. Like all weevils, the mouthparts are prolonged into a snout that bears a pair of chewing mandibles (teeth) at the tip.

Adults are the only life stage that directly can be seen crawling on trees; all remaining life stages (eggs, larvae, and pupae) only occur beneath the bark of infested trees.

Larvae are small creamy-colored C-shaped legless grubs with reddish brown heads. Larvae only are visible by scraping away the outer bark of infested terminal shoots (Fig. 3).



**Figure 1.** Top kill in Colorado blue spruce is caused by white pine weevil after it infests and kills a spruce tree's main shoot. Photo by Scott Tunnock, USDA Forest Service, [www.forestryimages.org](http://www.forestryimages.org)

## SEASONAL BIOLOGY AND DAMAGE

A single generation develops annually. Adult weevils overwinter in the soil litter, typically under host trees that had been infested during the previous growing season. Overwintering adults become active in the spring as soon as daytime air temperatures consistently reach 50°F. Seasonal activity often begins as soon as snow has melted. Both male and female weevils feed by chewing on the bark of terminal shoots, causing some sap to flow from these punctures.

**Egg laying.** Egg-laying female weevils especially seek out vigorously-growing, 4-to-25-ft. tall trees in open, unshaded habitats with leaders at least 1/2-inch in diameter. Here



**Figure 2: Adult white pine weevil** is 1/4-inch long and mottled brown. Adults are the only life stage that directly can be seen crawling on trees. Photo by Dave Powell, USDA Forest Service, [www.forestryimages.org](http://www.forestryimages.org)



**Figure 3: Mature weevil larva in chip cocoon** is visible only by scraping away the outer bark of infested terminal shoots. By the pupal stage, much of the top 18-inch of stem has been chewed up under the bark, causing needles to turn brown. Photo by Ladd Livingston, Idaho Department of Lands

females lay eggs within punctures they chew just below the terminal bud on the dormant leader during April to June.

Each female lays about 100 eggs spread out among different trees. Several females may lay eggs in the same tree, so a single leader can have just a few eggs to potentially many dozens of eggs. Weevils do not lay eggs in side branches.

Eggs hatch about when the buds break. Larvae burrow into the stem just under the bark and feed on the sap-conducting phloem tissue, eventually girdling the stem. This injury causes the top to wilt, a key symptom for detecting this pest. Grubs develop through four larval stages, reaching their mature size by July (Fig. 3). Mature 4th-stage larvae build chip cocoons inside the stem where they pupate.

**Damage.** By the pupal stage, much of the top 18-inches of stem has been completely chewed up underneath the bark, and needles will begin to turn brown. Larval tunneling and girdling typically extend far enough down the shoot to kill both current-season and prior-season growth. Shoot regrowth from lateral buds below the dead leader results in forked trees with competing leaders. Repeated attack of these secondary leaders ultimately results in stunted, bushy-topped trees.

**Adult weevils.** When the adult weevils mature, usually in August, they chew out of the stems, leaving a 1/8-inch exit hole that is visible to the naked eye (Fig. 4). Ten to 20 adults may emerge from a single stem. Adults briefly feed on needles and bark but seldom cause significant damage.

They then drop to the ground and seek shelter in the litter and soil under the tree for the winter. By fall, tree tops will be dead, have shed their needles, and have developed a characteristic shepherd's crook shape (Fig. 1). Adults normally live 1 year but can live up to 4 years. They do fly and have been observed traveling more than 1/2-mile, but most frequently travel only short distances or simply crawl to their host.

Research in spruce plantations showed that pest colonization nearly was eliminated when new stands were located more than 1/3-mile from existing weevil infestations.

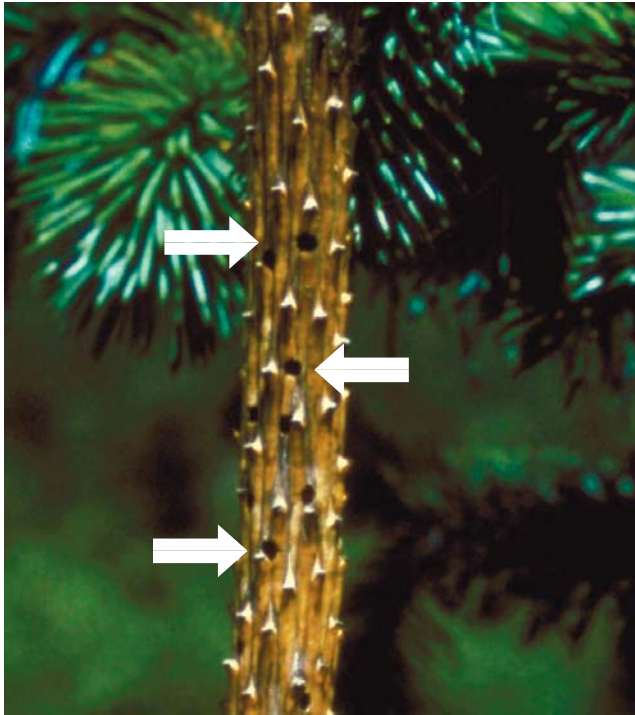
## PEST MANAGEMENT

Effective management of the white pine weevil requires an integrated approach that ideally brings together biological, horticultural, and mechanical pest control methods with the judicious use of insecticides. No single control method by itself can provide adequate pest suppression. Further, although larvae are the damaging life stage, management tactics must be directed at adults as well as at the immature stages.

### Biological controls

Dozens of naturally occurring predatory and parasitic insects that kill the immature life stages of white pine weevils are known from the Pacific Northwest region. Natural enemies include *Lonchaea corticis* (Family: Lonchaeidae) fly larvae that prey on the pupal stage of white pine weevil and a diverse community of tiny braconid, chalcid, and ichneumonid wasps that parasitize last-stage weevil larvae and pupae within infested tree leaders.

None of these beneficial agents has been studied in Idaho. Other than minimizing use of broad-spectrum insecticides directed at aphids or other early-summer tree pests, when the adult stages of these bioagents are present on trees, there are no known practical ways of manipulating these beneficials to increase their impact. None are available commercially for purchase and mass release.



**Figure 4: Emergence holes** are left by adult weevils chewing out of the stems, usually in August. The 1/8-inch exit hole is visible to the naked eye. Ten to 20 adults may emerge from a single stem. Photo by Dave Overholser, USDA Forest Service, [www.forestryimages.org](http://www.forestryimages.org)

### Mechanical controls

Without intervention, weevils reinfest the same tree from which they emerged or disperse to nearby trees and expand the infestation. Removal and destruction of infested shoots while larvae or pupae are still present is an effective way to break the damage cycle. However, because adults can live several years, and especially because adults can invade uninfested areas by flying from nearby infested trees, it is necessary to monitor for and prune-out infested leaders every year until trees exceed a susceptible size (30 feet).

**Examine often.** Examine trees at least every other week for evidence of wilting in the terminal leader (Fig. 5) through June and July to identify infested trees. Closer examination by peeling back any soft bark will reveal if weevil larvae are present.

**Pruning.** Make pruning cuts in sound wood below the point of weevil damage but immediately above the next uppermost undamaged whorl of branches. Remove all but the single most vigorous side shoot immediately below the cut terminal; this lateral branch will regrow as a replacement leader.

**Staking.** Once the terminal has been removed, some corrective work is needed to prevent the tree from developing a crook in the trunk or forming multiple leaders. A stiff rod or stake can be tied to the tree top. Then bend a strong lateral branch up and tie it to the rod. The earlier in the season this is done, the straighter the trunk ultimately will be.

**Remove competing branches.** Other branches may try to grow upwards naturally. Or, if no action is taken, several new tops may develop. These should be cut off to leave only one strong terminal. This will preserve the structure of the tree



**Figure 5: Wilted top** of Colorado spruce is an indicator the tree is infested with white pine weevil. Photo by Whitney Cranshaw, Colorado State University, [www.forestryimages.org](http://www.forestryimages.org)

and ensure healthy growth. Note that these new leaders can be attacked by white pine weevil in subsequent years. Once trees exceed 30 feet, they are rarely attacked by the white pine weevil (Turnquist and Alfaro 1996).

**Destroy pruned shoots.** Destroy pruned shoots by burning or by burying; otherwise grubs will continue development to adult weevils within the pruned tree material. If emergence holes are present, the pest already has escaped as adults, and removal of the terminals will not provide any pest management benefit.

**Band with sticky tape/paint.** Another mechanical control that contributes to pest suppression is banding the base of main top shoots with sticky tape. This tactic can reduce egg-laying by entrapping female weevils as they crawl on leaders. Painting the base of the trunk with a sticky material has been practiced in southern Idaho. This can trap weevils that crawl up the trunk in the spring, although overall impact of this treatment has not been evaluated.

### Horticultural controls

**Avoid drought stress.** Although egg-laying weevils seem to prefer vigorously growing trees, healthy, strong trees also have some natural capacity to kill young weevil grubs by increased pitch flow at the feeding site. When only a few grubs are present, a well-watered tree can drown insect larvae in resin. Do not allow trees to become drought stressed, because this especially reduces their ability to “pitch-out” insects. Large transplanted spruce in residential settings especially are susceptible to injury.

### MONITORING, THRESHOLDS, AND INSECTICIDES

Only a limited number of insecticides are available for white pine weevil control (Table 1). Insecticides labeled for application on spruce trees to control bark beetles or wood-boring beetles probably also would kill white pine weevils, but it is University of Idaho policy only to recommend products that specifically include both the target plant (spruce trees) and the target pest (white pine weevil).

However, Federal law does allow for pesticide applications against pests not specifically included on the label as long as the plant or other application site is listed on the label. In all cases, if spruce trees are not listed, you have the wrong pesticide product.

**For homeowners.** The only insecticide available for use by homeowners is acephate tree implants.

**For professionals—foliar contact insecticides.** All of the remaining insecticides in Table 1 are solely for use in commercial nurseries or by licensed professionals. Homeowners might best consider contracting with a local landscape pesticide applicator for treatment of residential spruce trees.

Many of the insecticides in Table 1 are contact poisons. These are applied as foliar sprays during the spring to kill adult weevils before they lay eggs. Contact insecticides kill female weevils as they crawl on treated foliage or chew through bark prior to laying eggs. These insecticides do not penetrate bark and so cannot kill eggs or larvae already present inside terminal shoots.

**Spray timing and coverage are critical**

Apply contact insecticides as soon as spring weevil activity begins, especially treating the leader and the needles, bark, and terminal shoots of upper branches. With the exception of pyrethrin insecticide, the contact products in Table 1 generally provide 7-to-10-days of residual killing action from a single spray. Pyrethrin deactivates in sunlight within one day of application.

In addition to spring applications, contact insecticides theoretically could be applied again in late summer and early fall when larvae mature to adults and do some host feeding. While this strategy would reduce local numbers of overwintering adult weevils, it would not necessarily eliminate the need for insecticide applications again the following spring to kill beetles that fly in from nearby untreated areas.

**Timing for foliar sprays.** Spots of sap oozing from egg punctures chewed by female weevils on terminal shoots indicate that seasonal pest activity has begun, and that insecticides, if needed, immediately should be applied. But formal economic thresholds do not exist for making insecticide spray decisions; commercial operators will have to decide from past experience and current observation if foliar sprays are cost-effective.

**Activity begins when snow melts.** Adult weevils are cryptically colored, making them difficult to detect by visual inspection of trees. Observations in southcentral Idaho show that adult activity begins as soon as snow melts. One general guideline is to begin visual inspections for adult weevils on warm (>50°F) sunny early-spring days when there still are patches of snow under trees.

**Monitoring beetles with traps.** In the eastern U.S., nursery operators monitor spring flight activity of white pine weevil by using a Tedders trap, a free-standing 2-foot tall pyramid-shaped vane trap originally designed to detect other species of weevils in tree fruit and nut crops. The Tedders trap can be modified to monitor white pine weevil by baiting it with

**Table 1:** Insecticides for white pine weevil control on conifers. Products are listed alphabetically and not by order of effectiveness or recommended use. ALWAYS READ AND EXACTLY FOLLOW THE PRODUCT LABEL. Information in this table does not substitute or replace instructions printed on the product label.

active ingredient	product name(s)	manufacturer	application method	killing action	plants or sites approved for application	restricted use pesticide (RUP)	signal words
<b>Products for homeowners</b>							
acephate	ACECAP 97 Systemic Insecticide Tree Implants	Creative Sales	tree implants	systemic	fir, pine, spruce	no	caution
acephate	Systemic Insecticide Bullets	Bonide Products, Inc.	tree implants	systemic	fir, pine, spruce	no	caution
<b>Products for commercial nurseries or professional pesticide applicators</b>							
avermectin*	Vivid II	Florida Silvics	microinjection*	systemic	ornamental trees	no	warning
bifenthrin	OnyxPro	FMC	foliar spray	contact	field and container-grown conifers, Christmas trees	yes	warning
diflubenzuron	Dimilin 25W	Crompton Crop Protection	foliar spray	contact	conifer and forest nurseries, Christmas trees, trees in landscapes & recreational areas	yes	caution
gamma-cyhalothrin**	Proaxis	Helena Chemical Company	—	contact	conifers	yes	warning
lambda-cyhalothrin**	Warrior with Zeon Technology	Syngenta	—	contact	conifers	yes	warning
oxydemeton methyl	MSR Spray Concentrate	Gowan Company	foliar spray	contact & systemic	Christmas trees, field-grown nursery stock	yes	warning
pyrethrin	Pyronyl303 EC	Prentiss Incorporated	foliar spray	contact	Douglas fir, pine, spruce	no	caution

Products for commercial or professional use either are TOO HAZARDOUS for the general public or NOT PACKAGED in small quantities suitable for home use

RUP (Restricted Use Pesticide) ONLY for use by certified (licensed) pesticide applicators

\* Avermectin ONLY can be applied via Tree Tech microinjection system

\*\*Product is labeled for "pine weevils" or "pine weevil species" rather than specifically "white pine weevil"

small containers of grain alcohol (ethyl alcohol, not isopropyl rubbing alcohol) and turpentine. These solvents are believed to mimic the natural scents of pine trees and so attract weevils to traps where they can be counted.

Trap counts simply show that weevils are present; they do not capture enough insects to reduce damage from subsequent grub infestations. We have no experience in Idaho with the modified Tedders trap. Nursery operators who want to try Tedders traps can purchase them from Great Lakes IPM, online at <http://www.greatlakesipm.com>. Specific details about trap use in the eastern U.S. are described by the Pennsylvania Department of Agriculture, <http://ctrees.cas.psu.edu/pdfs/whitepinewvtraps.pdf>. No sex pheromone has yet been identified for the white pine weevil.

### **Systemic insecticides**

Table 1 shows that a few white pine weevil insecticides (acephate, avermectin and oxydemeton methyl) have systemic killing action—they move internally in the tree with the sap flow. Systemics not only kill adult female weevils as they chew egg-laying punctures in the bark, they additionally can control pre-existing larval infestations.

Acephate systemic insecticide is formulated as tree-implants, small cartridges that contain dry concentrated insecticide; these are designed to be permanently placed within a hole drilled into the tree trunk.

Avermectin systemic insecticide is available to professional arborists as the Tree Tech microinjection system, a plastic container prepacked with liquid insecticide that is temporarily placed via a feeder tube within a hole drilled into the tree trunk.

Both of these products are best suited for individual high-value trees in landscapes rather than large-scale plantings in commercial nurseries or tree plantations. Oxydemeton methyl is the only systemic suited for widespread use in commercial nurseries.

### **Health hazards**

With the exception of diflubenzuron, all of the insecticides in Table 1 are neurotoxins, chemicals that kill by interfering with the normal functioning of the nervous system. As nerve poisons, these insecticides pose at least some hazard to human health and non-target wildlife via accidental exposure. The relative risks of any pesticide to human health can be judged by the label signal words, where “warning” designates products that are at least 10-fold more toxic than those labeled “caution.” None of the white pine weevil insecticides carry the “danger – poison” signal words that designate the most highly acutely toxic category of pesticides.

In contrast to these neurotoxins, diflubenzuron instead interferes with the ability of insects to form a normal exoskeleton; it poses reduced hazards to animals except insects and related arthropods that have exoskeletons. White pine weevil adults treated with diflubenzuron produce abnormal eggs that do not hatch into larvae.

**Remember:** When using pesticides, always read and follow the label.

## **FOR FURTHER READING**

Furniss, R.L. and V. M. Carolin. 1977. *Western Forest Insects*. USDA Forest Service. Misc. Pub. No. 1339.

Turnquist, R.D. and R.I. Alfaro. 1996. *Spruce Weevil in British Columbia*. Canadian Forest Service Forest Pest Leaflet.

**PESTICIDES DISCLAIMER**

ALWAYS read and follow the instructions printed on the pesticide label. The pesticide recommendations in this UI publication do not substitute for instructions on the label. Due to constantly changing pesticide laws and labels, some pesticides may have been cancelled or had certain uses prohibited. Use pesticides with care. Do not use a pesticide unless both the pest and the plant, animal, or other application site are specifically listed on the label. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock. Trade names are used to simplify the information; no endorsement or discrimination is intended.

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