

Management Options

Western spruce budworm populations usually are kept low by a combination of predators, parasites, adverse climatic conditions, or inadequate food supply. Spiders, insects, and a variety of birds are important predators. Adverse weather conditions, particularly sudden freezes in late spring, may kill large numbers of larvae. A major factor in ending long-term outbreaks appears to be starvation from inadequate or nutritionally poor food sources. However, this may not be a factor in urban situations. Cultural practices such as thinning, watering, and fertilizing, which promote tree vigor, may help trees survive repeated attacks.

Microbial insecticides - A microbial insecticide registered for use against the western spruce budworm is the bacterium *Bacillus thuringiensis* (BT), a naturally occurring, host-specific pathogen that affects only the larvae of lepidopterous insects. It is environmentally safe to use in sensitive areas such as campgrounds or along rivers or streams where it may not be desirable to use chemical insecticides. Users should contact State or Federal Forest Health Specialists regarding formulations, dosages, and timing of treatment.

Chemical insecticides - When necessary, western spruce budworm populations can be substantially reduced with chemical insecticides. Large forested areas can be aerially sprayed for short-term protection, and individual trees can be sprayed using ground equipment.

Chemicals currently registered for use against the budworm include acephate, malathion, carbaryl, and methomyl.  If spraying is needed, State or Federal Forest Health Specialists should be consulted for treatment timing, formulations, dosages, and the most current information on registered insecticides.

Silviculture - There are a variety of silvicultural management practices available to prevent or reduce the impacts of the western spruce budworm. These include both even- and uneven-aged regeneration systems, and intermediate treatments on stands not ready for harvest. The most serious damage, particularly on small or younger forests, occurs in relatively pure stands of Douglas-fir or stands with a mixture of true firs and Douglas-fir. Thus, the susceptibility of some forests may be minimized by increasing the complement of non-host species and reducing the percentage of Douglas-fir and true firs. Hardwood trees and pines are not hosts for this insect and even spruce is not a preferred host.

Maintaining a healthy forest or tree provides the best natural defense for preventing or reducing the severity of western spruce budworm outbreaks. Providing diverse habitat for insectivorous birds, mammals, and other insects may minimize or prevent western spruce budworm outbreaks. Proper snag management, leaving adequate woody residues on the site, and enhancing the edge effect, diversifies habitat. Natural predators and parasites are not as effective during outbreaks as they are when populations are at lower levels. Their presence at low population levels may prevent an outbreak from occurring.

 *Pesticides used improperly can be injurious to humans, animals, and plants. Follow directions and read all precautions on the label. Consult your local county agriculture agent or State extension agent about restrictions and registered uses of particular pesticides.*

Conclusion

Managing the forest resource to reduce the impact of the western spruce budworm is an ongoing process of evaluating forest stand and site conditions. Management strategies developed to meet resource objectives should consider potential western spruce budworm impacts.

Forest stewardship and homeowner landscape plans should be developed to minimize the effects of western spruce budworm defoliation. Species diversity is a key component to mitigate the effects of western spruce budworm and maintaining forest and tree vigor where practical will enhance the tree's ability to tolerate feeding damage caused by this insect.

For additional information, contact any USDA Forest Service or State Forestry Office in your area.

USDA Forest Service,
Forest Health Protection:
Ogden Field Office, 801-476-9720
Missoula Field Office, 406-329-3511
Coeur d'Alene Field Office, 208-765-7342
Boise Field Office, 208-373-4227

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United States Department of Agriculture
Forest Service
Northern and Intermountain Regions

Western Spruce Budworm in the Interior West



Extensive tree mortality caused by a prolonged outbreak of the western spruce budworm.

Introduction

Western spruce budworm is the most common and widespread insect defoliating Douglas-fir and true firs in the west. Larvae will also feed on pines and other conifers when populations reach outbreak levels. Larvae initially feed on new needles throughout late spring and early summer causing a red-halo appearance on outer portions of infested branches.

Defoliation from budworm is most damaging in Douglas-fir and true fir forests that are uneven-aged or have multiple canopy layers. Large outbreaks have occurred across the West because of the current abundance of Douglas-fir and true firs in forests. Historically, the range of Douglas-fir and true firs, and associated budworm outbreaks, were limited by periodic fires. Length of outbreaks can range between 5 and 30 years depending upon site quality and available hosts.

Damage from defoliation can result in reduced vigor, growth loss and increased susceptibility to attack by other insects and diseases. Mortality from repeated and heavy defoliation rarely exceeds about five percent of large mature trees and is typically confined to smaller, suppressed and pole-sized trees. Outbreaks of budworm can be prolonged, and defoliation more severe during periods of drought. Bark beetle attacks on heavily defoliated trees may be higher during periods of drought.

Heavy budworm caused defoliation can result in increased fire risk over the short-term and impact visual quality of forested areas near homes and along scenic corridors. Although large numbers of trees with red needles can increase the short-term risk of wildfire, small tree mortality resulting from heavy budworm defoliation can result in reduced fire hazard over the long-term.

There are several management options to reduce damage and potential mortality from western spruce budworm. These include thinning forests to reduce the number of canopy layers and spraying with insecticides. The life history, effects of defoliation, and

management alternatives to reduce western spruce budworm impacts is the focus of this brochure.

Description

The western spruce budworm passes through four distinct life stages: egg, larva, pupa, and adult. **Eggs** are oval, light green, and about 1.2 mm long and overlap like shingles. **Larvae** pass through 6 stages of development (instars) as they mature. They start out very small, yellow-green in color with a brown head, and finish as a 1 to 1-1/2" olive-brown caterpillar also with a brown head. Each body segment of the mature larva is marked with a pair of ivory-colored spots. **Pupae** are 1/2" to 5/8" long, brown, broad at the head end and narrow toward the tail. They are brownish-yellow or brownish-green at first, and later turn reddish-brown. **Adult** moths are about 1/2" long and have a wing-spread of about 1". They are typically small, mottled, rusty-brown in color, but color may vary from tan to nearly black.



Late instar stage of the western spruce budworm

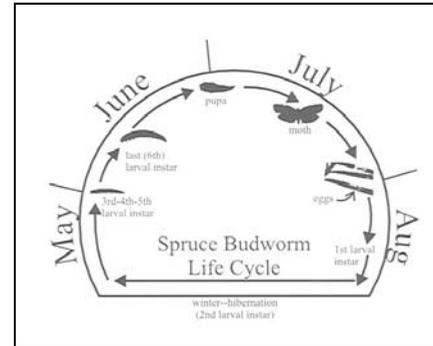
Adult and pupal stages of the western spruce budworm.



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Life History and Habits

The western spruce budworm completes one cycle of development from egg to adult within one year. Temperature plays a major role in the timing of the life cycle. In mid-to-late summer, females will lay up to 150 pale-green eggs on the underside of needles in an overlapping, shingle-like fashion. Eggs hatch in about 7 to 10 days.



Typical life cycle of the western spruce budworm.

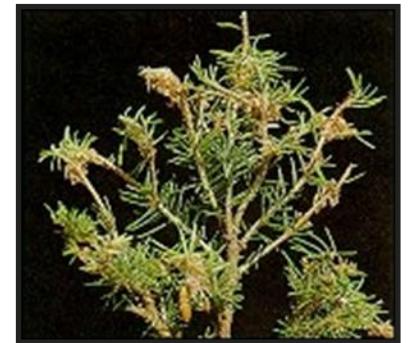
These first-instar larvae do not feed, but molt once and then spin cocoons to hibernate on rough bark surfaces or lichens through the winter. They re-emerge in the spring and feed on year-old foliage, closed buds, or developing vegetative or reproductive buds. Following bud break, the larvae move into the new growth. As larvae consume new, expanding foliage, they spin webs among the needles towards the tips of branches, which serve as an established feeding site and shelter from predators and other environmental effects. They quickly retreat to this shelter when disturbed.

Larvae pass through six instar stages and mature in 30 to 40 days after initial feeding in the spring. Larvae then pupate in webs of silk they have spun. Pupation lasts about 10 days during mid-July and through August, either in their feeding webs or on twigs or

branches. Adults emerge from the pupal stage to mate, with females capable of laying eggs the following day.

Evidence of Infestation

You can see evidence of western spruce budworm damage year-round. Dead branches or sparse foliage may indicate feeding from previous years. Look for larvae or pupae from May through July in silken nests of webbed, chewed needles. Buds and current year foliage, at the tips of branches, are chewed by larvae, including flowers and developing buds. Affected trees will have a scorched or blighted appearance. Several consecutive years of defoliation can result in growth loss, tree deformity, top-kill, mortality, and reduced seed production.



Douglas-fir needles fed on and webbed together by western spruce budworm larvae.

During a western spruce budworm outbreak, between 75 to 100 percent of foliage can be consumed, especially if the outbreak has occurred over a multiple year period. Defoliated trees appear reddish-brown in color. Older infestations may include dead gray trees that were previously defoliated.