

# TECHNICAL NOTES

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Forestry - 25

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## WESTERN SPRUCE BUDWORM

(*Choristoneura occidentalis*, Freeman)

Northcentral, northeast, southeast Washington, and northeast Oregon has experienced several years of an outbreak of western spruce budworm. This insect is a defoliator, with the most common host trees in our area being Douglas fir (*Pseudotsuga menziesi*); grand fir (*Abies grandis*); Engelmann spruce (*Picea engelmannii*); subalpine fir (*Abies lasiocarpa*) and western larch (*Larix occidentalis*.) The budworm larvae also occasionally feed on Pacific silver fir (*Abies amabilis*.) There are several species that the insect only marginally impacts; these are western hemlock (*Tsuga heterophylla*); lodgepole pine (*Pinus contorta*); ponderosa pine (*Pinus ponderosa*); western white pine (*Pinus monticola*) and whitebark pine (*Pinus albicaulis*.)

### DAMAGE

This insect attacks the leaves (needles) of all host trees. Most damage is obvious when the tree is viewed from a distance. Damage by this insect should not be confused with frost damage. The top portion of the crown of the affected trees will look very sparse; almost wind whipped in appearance. In multi-storied, unevenaged stands, young trees, generally less than five (05) feet tall and on (01) to two (02) inches in diameter can be seriously defoliated. Severe defoliation can occur in young pole sized stands and trees below the general level of the canopy.

Mature stands can withstand several years of partial defoliation, though repeated defoliation will result in top killed trees. Adult insects favor the taller more dominant stems in a stand.

Dispersal redistributes budworms within the crown and between trees and stands. It may occur at any points in the life cycle of the insect. It is common for the younger larvae to be carried by the wind to other trees. This can be significant because the taller trees are preferred by the egg laying adults. Larvae are also blown to the shorter, intermediate or overtopped trees. Major frontal systems moving through an area can disperse egg-laying adults over a wide area.

The primary impact of budworm defoliation is reduced growth. Trees, which are under some form of stress due to long-term drought or injury of some kind, are highly susceptible to attack. At time, larger dominant trees are severely defoliated and top-killed, but survive because the tree will produce adventitious foliage throughout the crown.

All trees attacked and severely defoliated become subject to attack and damage by other opportunistic insects and diseases. The defoliation weakens the tree and allows other pathogens to invade. Bark beetles are of special concern and can result in severe mortality in the defoliated stand.

In addition to defoliation, budworm larvae feed heavily on developing seed cones of host trees. The resulting devastation to seed cone production is especially serious in seed orchards, stands that have

been harvested, seed trees left to regenerate the next stand, and in areas where it is difficult to regenerate naturally.

Spruce budworm larvae do not restrict their cone eating activities to a single cone. Second and third stage larvae will feed on newly developing conelets that soon shrivel and dry up. As these cones become unsuitable for food, the larvae will move to another cone or on other foliage. In some Douglas fir stands, all cones will be destroyed or severely affected, especially in locations where budworm densities are very high and cone crops are light. When there has been top killing of host trees due to persistent defoliation, cone crops will be affected for many years even though the budworm population may have declined.

**QUICK IDENTIFICATION OF BUDWORM ATTACK BY ASSESS TREE DAMAGE:**

- FOLLIAGE WITH SCORCHED OR BLIGHTED APPEARANCE AT THE TIPS
- NEEDLES BOUND TOGETHER WITH WEBBING AT THE BRANCH TIPS
- DEFOLIATION CAUSED BY 1 INCH OR SMALLER CATERPILLARS
- CATERPILLARS BROWN WITH GREEN MARKINGS, WHITE SPOTS ON SIDES, NOT HAIRY, TOPKILL OR DEATH FOLLOWING DEFOLIATION

**DESCRIPTION**

Moths of both sexes are similar in appearance, though the female is more robust than the male. The forewings are gray or orange-brown in bands or streaks. There is usually a white dot on the wing margin.

Eggs are oval, light green and are laid on needles of host trees in an overlapping, shingle like manner.

Larvae develop through six stages as described in the following diagram:

Figure 1. - the life cycle of the spruce budworm. (This illustration and cover are by Kathy Simpson. The University of Michigan, Ann Arbor.)

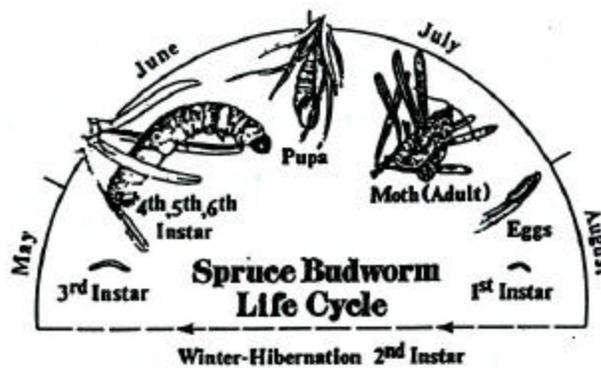


Figure 1 — The life cycle of the spruce budworm. (This illustration and cover art by Kathy Simpson. The University of Michigan, Ann Arbor.)

**Life cycle:** Adults lay eggs in a shingle-like fashion on the underside of needles in midsummer. Eggs hatch in about 10 days. The larvae molt once, then hibernate for the winter on rough bark surfaces in the canopy and down the bole. In the spring, larvae re-emerge and begin to tunnel into older foliage, or float away on silken threads. After about two weeks, they move on to expanding buds and finish with the new foliage. Larvae spin webbing among the needles of expanding shoots, and feed until disturbed or the shoot is completely destroyed. When feeding on new foliage early in the summer, budworms construct a shelter by binding the needles together at the tips with webbing. They retreat to this shelter when disturbed. In midsummer, they pupate either in their feeding webs or in other webs in the foliage. Adults emerge from the pupae and fly to seek a mate. At night, females emit pheromones to attract males; after mating, females begin to lay eggs a day later.

Dispersal redistributes budworms within the crown and between trees and stands. It may occur at any point in the life cycle, but most commonly, it is the younger larvae that are carried by the wind to other trees. This can be significant as the tallest trees are preferred by the egg-laying adults, and larvae are blown to shorter, intermediate or overtopped trees. Adults are also dispersed by wind currents and over a long range by frontal systems.

Throughout most of its range, the western spruce budworm completes the cycle of development from egg to adult in 12 months. Moths emerge from pupal stages in late July or early August. When larvae hatch, they do not feed immediately, but seek shelter under bark scales or in among lichen. They spin a silken tent in which they spend the winter.

They emerge from their winter home in May to late June and search for year old needle growth on which to feed. As new needles appear, the larvae begin to feed on this preferred food. They will consume all new growth before reverting back to year old and older needles. On western larch they will sever the terminal and lateral shoots.

Identification of the larval stages is accomplished by recognition of the coloration of the stage of development. In stage one, the larvae hatched from the egg is yellow-green and a brown head. In stage two, third, and four they are orange or cinnamon in color with a black head and collar. The fifth and sixth stage results in a budworm that has a reddish-brown head marked with black triangle, black collar and pale olive-brown bodies marked with small whitish spots. In the pupal stage, the budworm is brownish-yellow or brownish-green at first, and then they turn a reddish-brown. In this pupal stage, they are broader at the head than at the tail. The mature larva, with a tan or light chestnut-brown head and collars, has an olive or reddish brown body with large ivory colored areas. This insect can easily be confused with sawflies and the Douglas fir tussock moth. Tussock moths are "hairy" while budworms are not.

## CONTROL

There are currently two recognized methods of control. Chemical and microbial insecticides. Large damaging infestations with high insect populations can be substantially controlled with judicious use of chemicals. A microbial insecticide registered for use against the western spruce budworm is the bacterium, *Bacillus thuringiensis*, a natural occurring, host specific pathogen that affects only the larvae of Lepidopterous insects. Non-industrial private forestland owners can also participate with larger owners, public and private, who may be using this method of control.

As with all chemical use, care and attention to sue labels is a must. Only persons authorized to apply such chemicals should do so. Small non-industrial forestland owners can work the adjacent landowners as a group, or work the larger public and private landowners if they are going to attempt chemical control.

Silvicultural methods of control are limited. Generally, an outbreak of this pest has resulted because the stand is essentially a monoculture. Stands that are under stress from abiotic adversities such as drought are susceptible to attack. In areas where there is a potential for infestation and the stand structure is mixed species such as pine, larch, Douglas fir and true fir, it may be advisable to manage for pine and larch. It is important to recognize the potential for infestations, then manage the stand to increase non-host species.

Ideas for limiting damage may include:

- On warm dry sites, choose a species well-adapted for the site such as pine and larch. This may involve planting these species, along with thinning or eliminating true firs.
- On good fir sites, encourage species diversity through an on-going thinning and planting program. Western larch is more resistant to the budworm than are true firs or Douglas fir. Western red-cedar, western hemlock and all pine species are not considered to be more than occasional hosts. It is suggested that climax species, which are the major host species for the budworm, should not make up more than one-third (33%) of the stands.
- Use silvicultural treatments to maintain stands at proper stocking level to maintain or increase stand vigor. Use standards and specifications contained in the NRCS Field Office Technical Guide, Section IV, to obtain optimum stand conditions. Thinning from above will not reduce stand susceptibility to spruce budworm attack.
- Because of the attack patterns of this pest, it is best to manage even-aged mixed stand patches rather than uneven-aged stand structures. Clearcutting, seed tree cuts or shelterwood cuts may be used as appropriate. If using seed tree or shelterwood cuts, remove the overstory within 10 years.
- Remove intermediate and overtopped host species in a middle-aged stand.
- Harvest at an appropriate time so the stand does not become overmature and thus increase the chance and opportunities for pest attacks.
- Harvest scheduling should concentrate on cutting the most susceptible stands first and quickly regenerating the site with vigorous shade intolerant species.

## REFERENCES

Insecticides for Control of the Spruce Budworm, USDA Forest Service,  
Cooperative State Research Service, Agriculture Handbook 615

Western Spruce Budworm, Forest Insect and Disease Leaflet 53, USDA Forest Service

Forest Health Notes, USDA Cooperative Extension, Washington State University  
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