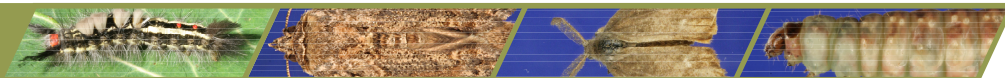




Insect Production Services

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version 2.1



Biology of the Spruce Budworm (*Choristoneura fumiferana*)

INTRODUCTION

The spruce budworm, *Choristoneura fumiferana*, is a major defoliator of coniferous forests across North America. Although spruce budworm prefer balsam fir, they also readily attack white, red and black spruce and may even be found feeding on tamarack and hemlock. Trees become weakened after four to five years of successive defoliation and may attract other insects and disease. Tree mortality occurs if trees undergo severe defoliation for six to eight years. In Canada, recorded outbreaks of spruce budworm date as far back as 1704. These outbreaks occur on average every 20-30 years and can remain within an area for ten years. The last major epidemic in Canada occurred from the 1970s to the mid 1980s.

LIFE CYCLE

Spruce budworm produce one generation a year (univoltine) and have four stages to their life cycle: egg, larva, pupa and moth. In July and early-August, females lay overlapping eggs in elongate rows on fir and spruce needles. These rows are two to three eggs wide and can contain up to 150 eggs per mass. The eggs are light green, about 1mm long by 0.2mm wide. They hatch 7-14 days after oviposition. There are six larval stages (instars) before pupation. First-instar larvae are very small and light green in color. Often times, the larvae will spin a thread of silk and get carried to other trees by the wind. This process of dispersal is termed "ballooning". These larvae immediately seek suitable shelter to overwinter, such as old flower bracts and cracks in bark. The tiny first-instar larvae spin silk shelters to wrap themselves in. Within this shelter, called a hibernacula, the larvae shed their skins and moult into yellow-coloured second-instars. During this overwintering stage, called diapause, they remain dormant until spring. In late April and early May, before tree buds begin to expand, the second-instars emerge from their hibernacula and move toward the tips of the tree branches. Early feeding occurs on staminate flower buds or old needles. Larvae will mine old needles until vegetative buds begin to expand. Once these buds swell, the larvae bore into them and begin feeding



within the protection of the bud cap. Here, they moult into the third-instar and continue to feed until the buds expand. Fourth- and fifth-instars create feeding shelters and stay hidden by tying newly flushed needles together with silk until they have consumed the entire bud. From the

second- to the fifth-instar, larvae remain similar in appearance, from a grey to yellow colour. When they moult into their sixth-instar, they are brown-black with a cream colored longitudinal stripe down each side and distinctive white spots on each body segment. Once a bud is ingested, older instars will move to new shoots and then to other trees in search of food. It is at this stage that they are eating voraciously and the most destructive. By mid- to late-June, larvae cease feeding and metamorphize into pupae, usually within old foliage. Male pupae have four rings around the abdomen whereas females have three rings. Around ten days later, adult moths emerge from late-June through to mid-July. They are small with characteristic "bell shaped" wings and are reddish-brown to grey in colour. Moths will mate and deposit their eggs preferably on a healthy tree. They are able to travel very long distances, especially if they are transported by wind or storms.

DAMAGE AND NUISANCE

The first sign of an infestation is the occurrence of silk webbing on branch tips. Also, bud caps will remain on infested shoots long after all others have been shed. When an epidemic begins, most defoliation occurs in the top portion of the forest crown. Infested stands turn a reddish color because partially eaten needles on the tree start to die. Over time, these dead needles fall, tree tops turn grey and entire stands are eventually decimated when heavy defoliation persists over four or five successive years. Defoliation weakens trees and makes them more susceptible to other types of insect damage, diseases and harsh conditions such a drought. Commercially, spruce budworm

outbreaks have the potential to seriously affect timber and non-timber boreal forest resources, reducing annual growth and timber volumes. Young trees in the understory often die after only three years of defoliation, greatly reducing future timber prospects. In urban areas, large populations of spruce budworm can greatly reduce aesthetic values of homes and recreational areas because they also attack ornamental firs and spruces.

NATURAL CONTROL

Natural factors such as disease, predators, parasites and adverse weather all play very important roles in controlling budworm. Less than half of the larvae survive to adulthood, however, this amount could still lead to epidemics. Forest land owners have the option of integrating control tactics such as biological insecticides, silvicultural practices and chemicals. At the present time at least four natural viruses are endemic to North America including granulosi, entomopox, nucleopolyhedrosis and cytoplasmic polyhedrosis viruses. Use of these viruses as biological insecticides is considerably more expensive than chemicals and not always effective. However, the bacterial pathogen B.t. (*Bacillus thuringiensis*) is more cost effective and the most common biological insecticide used on Crown land for budworm control today.

Unfortunately, B.t. degrades in sunlight and washes away in rain easily so it offers a very narrow window for control.

WHAT CAN I DO?

For private landowners, controlling budworm may prove difficult. The greatest problem is getting to the larvae because they stay hidden so well within needles, buds and feeding shelters. If there are small trees, few in number, manual removal is a possibility. If spraying is necessary, B.t. is available at most gardening centers and is much safer to use than chemicals. Spraying chemical insecticides might also greatly affect natural budworm predators and non-target species, so read the label carefully and follow instructions stringently before using such products.

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