

1. Bacterial pathogens of insects

Diseases caused by biological agents, such as bacteria, often drastically reduce insect populations naturally. Varieties of *Bacillus thuringiensis* (*B.t.*) are the best known of such bacteria. They carry a protein toxic to the gut cells of a broad range of Lepidoptera larvae, including the spruce budworm, hemlock looper and tussock moth.

B.t., is used in a variety of commercially available microbial insecticides and has been used successfully in many countries for over 15 years. In Canada, for instance, *B.t.* is used against pests that attack cabbage and other vegetables.

Canadian forestry research on *B.t.* focuses on explaining the mode of action at the cellular level (the active principle in *B.t.*), devising improved serological techniques leading to better identification of more toxic strains of *B.t.*, and developing application methodology and strategy.

Several aerial applications of *B.t.* have been made against the spruce budworm in Quebec, Ontario, Nova Scotia, New Brunswick, Newfoundland and Manitoba and against the false western hemlock looper in British Columbia. These tests achieved significant larval reduction.

2. Viral pathogens of insects

Viruses are also an important natural pathogen of insects. For two decades, the virology unit of the Forest Pest Management Institute at Sault Ste. Marie, Ontario has conducted research on insect viruses in collaboration with other Canadian, American, British, French, German and New Zealand scientists. They are working on virus identification and mode of action and determining methods for mass production of viruses.

Canadian research has isolated and identified about 20 viruses from several major groups of forest pests, including the eastern and western spruce budworms, the two-year-cycle spruce budworm, the tussock moth, several sawflies, the tent caterpillar and some loopers.

The most significant advances by Canadian researchers, made with nuclear polyhedrosis viruses, may soon lead to using viruses for insect pest control. These viruses have been isolated from the European spruce sawfly, the European pine sawfly and the red-headed pine sawfly. Because their virus type has no morphological affinity with any known plant or animal viruses, they are more likely to be environmentally safe. Nuclear polyhedrosis virus ended a catastrophic outbreak of the European spruce sawfly



left

(top) Chemical spraying of infested forest.

(bottom) Mature larva of the hemlock looper.

right

(top) Egg of the hemlock looper on lichen.

(middle) European pine sawfly larvae.

(bottom) Red pine damaged by the European pine sawfly.