



Early Intervention Strategy – Pheromone Development

The spruce budworm (*Choristoneura fumiferana*) is the most serious pest affecting forests in eastern North America. Records indicate that spruce budworm outbreaks are cyclical, occurring every 30 to 40 years. The last extensive outbreak in eastern Canada reached its peak in the 1970s, damaging more than 50 million hectares (ha). An outbreak is currently occurring in Quebec, and populations are on the rise in New Brunswick. Scientists from Natural Resources Canada's Canadian Forest Service (CFS) are focusing their efforts on an early intervention approach to keep budworm populations below threshold levels. One important area of research under this early intervention involves the use of pheromones to disrupt the mating behaviour of the spruce budworm.

Early Intervention Strategy

In February 2014, funding was announced to support research projects aimed at testing an early intervention strategy (EIS) to control spruce budworm outbreaks before populations reach epidemic levels. Scientists are examining a more strategic approach to budworm management, where areas with rising populations or "hot spots" are treated with control products early in the outbreak cycle.

Insect populations can be controlled at different stages in the insect's life cycle. In the past, land managers focused on the larval stage and sprayed severely affected areas with chemical and biological insecticides. The bacterial insecticide *Bacillus thuringiensis kurstaki* (Btk) and the insect moulting hormone tebufenozide (Mimic®) are the only two products currently registered by the Pest Management Regulatory Agency to control budworm populations in larval form. Although large-scale application of control products could keep many of the affected trees alive, the high cost of such a program does not make it a viable option for the next outbreak.

Pheromones

Pheromones are chemical compounds emitted by a species that act as messengers within or between species and may provide an alternative to the use of pesticides in the fight against the spruce budworm. They trigger social responses in members of the same species and are increasingly being used in pest management. Pheromones occur naturally and are species-specific, meaning that the spruce budworm pheromone only affects this insect and therefore poses no risk to humans or other animals.

One aspect of an insect's life that is hugely affected by pheromones is its reproductive or mating behaviour. These powerful insect behaviour modifiers can be chemically synthesized and deployed against insects by luring them to traps or disrupting mating cycles.

The primary sex pheromone for the spruce budworm is a two-component blend of 95/5 E/Z11-tetradecenal. The 95/5 refers to the percentage of each of the two isomers (E/Z) that constitute the blend. Isomers are molecules that have the same molecular formula but have different chemical structures and characteristics. Mating disruption studies conducted over a 30-year period resulted in the commercial registration of the pheromone-based product, Hercon Environmental's DISRUPT MICRO-FLAKE®. Although many studies have demonstrated that mating disruption occurs, it remains unclear if pheromones are a viable option for controlling spruce budworm populations.



Application of a pheromone product on a test site

Field Testing of Pheromones

CFS research scientists Dr. Peter Silk and Dr. Eldon Eveleigh are co-leading the project, each bringing more than 30 years of experience working with the pheromones and ecology of the spruce budworm. Silk and Eveleigh are field testing the efficacy of a recently developed four-component blend that has shown very promising results in laboratory trials as being more efficacious than the current two-compound blend. In addition to the new four-component blend and an untreated control, Silk's trials will also include the currently registered two-component blend (95/5) and a cheaper "off-blend" (87/13) that has performed as well as the 95/5 blend in laboratory testing.

Pheromones are powerful behaviour modifiers that affect how insects react to their environment. Their use in mating disruption could add a valuable tool in the arsenal forest managers have at their disposal to control spruce budworm populations, especially when budworm numbers are low. The field testing currently being undertaken using the recently developed four-component blend could provide a more effective mating disruption tool than is currently available. Silk and his team plan to continue their research on the efficacy of pheromones over the next few years.



Collecting spruce budworm moths after 48 hours in a trap

Mating Disruption Project Activities

1. Rear male and female budworm moths at the Atlantic Forestry Centre lab in Fredericton, New Brunswick. The male and female moths will be reared separately to prevent any contact before being set in cages in the field.
2. Apply the pheromone formulations on the three treatment blocks at a concentration of 50 g/ha of active ingredient.
3. Attach 20 cages on small Christmas tree-sized balsam fir in each of the four treatment blocks.
4. Place four male and four female budworm moths in each of the cages. The moths will be collected and replaced with a new set of moths every 48 hours for several weeks and the female moths examined to determine if mating has occurred.

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