

Spotlight on Emerald Ash Borer Parasitoids

The emerald ash borer has killed millions of ash trees since it was first discovered in North America in 2002. This exotic pest from Asia arrived without its natural enemies.

One of the means of biological control currently being tested to fight this invader has involved releasing parasitoid wasps known for their high levels of parasitism in their native range. This could help reduce the density of the pest's population to acceptable levels, thereby protecting the ash trees. So where do we stand at the Canadian Forest Service with respect to this invader?

Biology Fundamentals

- Biological control involves the use of a living organism, called a "natural enemy," to control the population of a harmful organism. Natural enemies can be predators, parasitoids or pathogens (e.g. viruses, bacteria or fungi). The type of biological control used can be either classical or augmentative. In the former case, the agent used is exotic. In the latter case, the agent is indigenous, but its population is insufficient to control the insect in question.

- Parasitoids are organisms that, in their adult stage, seek out and attack hosts in or on which to lay their eggs, which then become larvae. These feed on the host and kill it.

Emerald Ash Borer: An Insect With Free Rein?

The emerald ash borer has few natural enemies in Canada, and our ash species lack defence mechanisms against it since they did not evolve alongside this pest, nor did any of its potential natural enemies. This is why monitoring tools that



Emerald ash borer.
Photo: Joseph Moisan Deserres,
MAPAQ

allow detection of infestations (traps, removal of bark from branches) remain important in the fight against this pest. However, once the emerald ash borer is found in a natural environment, our means of fighting it are limited. These means consist of systematic injection of insecticide into healthy or mildly infected trees, felling trees that are too infested, augmentative biological control with an entomopathogenic fungus, and classic biological control with exotic parasitoids.

A Tool in our Arsenal

The Canadian Forest Service has begun a biological control project in Canada using parasitoid wasps from Asia. This project follows a protocol from the United States Department of Agriculture which had selected and tested the parasitoids. The Canadian Food Inspection Agency evaluated

the potential risks of introducing these parasitoid wasps as being very low for indigenous *Agrilus* species and authorized their use after a rigorous approval process. The research project involves the introduction of wasps into the natural environment over a period of 2 years, and then verifying if they have become established or not in the 3rd year.

The Species Used in Canada

Three species of parasitoid wasps are used in Canada to fight against the emerald ash borer: *Oobius agrili*, *Tetrastichus planipennis*, and *Spathius galinae*.

In order to introduce these wasps in a forest setting, emerald ash borers (at the egg or larval stage) containing one or several developing parasitoids are placed on ash trees. The adult parasitoids will exit the emerald ash borer and will then seek out other hosts to attack. With *Spathius galinae*, live adults are released in the forest. Without emerald ash borers, the parasitoids cannot reproduce and will die. These wasps do not sting humans.

Three species of parasitoid wasps are used in Canada to fight against the emerald ash borer:



A. *Oobius agrili*.
Photo: Joseph Moisan Deserres, MAPAQ
B. *Tetrastichus planipennis*.
Photo: Joseph Moisan Deserres, MAPAQ
C. *Spathius galinae*.
Photo: Sydney Drew, NRCan

	<i>Oobius agrili</i>	<i>Tetrastichus planipennis</i>	<i>Spathius galinae</i>
Origin	China	China	Russia
Adult length	~1 mm	2.7-4.1 mm (female) 1.6-2.2 mm (male)	2.7-5.6 mm (female) 2.8-4.6 mm (male)
Stage at which the emerald borer is attacked	Eggs on ash's bark	2 nd to 4 th instar larvae underneath the ash's bark	3 rd or 4 th instar larvae underneath the ash's bark
Number of parasitoids produced per emerald ash borer	1	4-172	31-47
Number of generations per year	2	≥2	≥2
Other species attacked	3 species of <i>Agrilus</i> , but prefers the emerald ash borer	None	1 species of <i>Agrilus</i> , but prefers the emerald ash borer
Note	-	The thickness of the bark they can pierce is limited by their short ovipositor	This ectoparasitoid develops outside the emerald ash borer

Monitoring and Future Work

To evaluate the success of a biological control program, it is necessary to start by confirming the establishment of the agent, and to then measure its impact on the pest population. *Tetrastichus planipennis* has established at 76% of Canadian sites. Once established, the parasitoids are capable of dispersing and colonizing new sites, spreading 3–4 km/year, and up to 14–27 km/year in the case of *Tetrastichus*, which could allow them to spread everywhere emerald ash borers are found in the country. The presence of parasitoids on experimental sites in Canada and the United States tends to reduce the mortality of ash trees and increases the regeneration of ash, particularly with *Tetrastichus*. In part, these parasitoids contribute to the conservation of ash trees and, from now on, will be part of our tools to fight this exotic pest. Research is ongoing.



Ash logs containing emerald ash borer larvae infected by *Tetrastichus planipennis*.
Photo: NRCan

Useful links

<https://www.nrcan.gc.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/top-forest-insects-and-diseases-canada/emerald-ash-borer/13377>

<https://www.nrcan.gc.ca/science-and-data/research-centres-and-labs/forestry-research-centres/great-lakes-forestry-centre/insect-production-and-quarantine-laboratories/13467>

<https://inspection.canada.ca/plant-health/invasive-species/insects/emerald-ash-borer/faq/eng/1337355937903/1337356019017>

<https://inspection.canada.ca/plant-health/invasive-species/insects/emerald-ash-borer/wasps/eng/1371137262586/1371137530758>

https://cfs.nrcan.gc.ca/publications?id=35845&lang=en_CA

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