

Frequently Asked Questions

Bacillus thuringiensis var. israelensis (Bti)
Bacterial Larvicide



Updated: 3 May 2020

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Category 1: Operations and Treatment Need

Question 1: Why do we use a larvicide product to control mosquitoes?

Most mosquito control programs focus on one complex of mosquitoes, those that develop in floodwaters, primarily during the Spring freshet. These mosquitoes come out in areas where predation is relatively low, and in numbers that overwhelm the ecosystem. Appropriately conducted larval controls can significantly reduce the severity and duration of these infestations.

Mosquito control products primarily target the larval (aquatic) or adult stages of the mosquito lifecycle. Controlling mosquitoes in the larval stage before they emerge as adults better focuses treatment, as larval mosquitoes are located within a more predictable and confined area than adult mosquitoes. Fewer treatments are required if they are timed appropriately, reducing program costs and environmental impact of treatment. Finally, the bacterial larvicides utilized by MBL have considerably fewer non-target and indirect effects associated with inadvertent exposure than adult mosquito control pesticides.

Question 2: How are bacterial larvicides different from other pesticides?

*The larval control product utilized by Morrow BioScience Ltd. (MBL) certified pesticide applicators is Aquabac®. The active ingredient is a soil-borne bacterium, *Bacillus thuringiensis* var. *israelensis* (Bti). The efficacy of Bti relies upon the natural bacterium and associated toxin protein to be ingested by the mosquitoes. The toxin protein requires four specific receptors found within the gut of mosquitoes to activate the toxin. With few exceptions within the Dipteran taxa, the four receptors found within mosquitoes are lacking in other taxa. Thus, the Bti is considered non-toxic to, fish, amphibians, reptiles, mammals, and most insects.*

The non-target and/or indirect effects of other mosquito control products, however, are almost all higher. For example, adult mosquito control products with malathion inhibit cholinesterase, which is a neurotransmitter enzyme. As such, non-target or indirect exposure to this active ingredient can be toxic to other aquatic organisms, birds, and mammals. The mode of action for Bti is relatively simple and with a high degree of species specificity. Receptors within the mid-gut region of the mosquito larvae are specific to the toxin proteins that are produced alongside each bacterial spore. After the mosquito larvae ingest the toxin protein, disruption of the larval mid-gut cells occurs because of cleavage of the protoxins by mid-gut proteases. This event causes considerable damage to the wall of the gut and quickly leads to larval death (Boisvert and Boisvert 2000).

Question 3: What is involved in this type of treatment?

Morrow BioScience Ltd. (MBL) certified technicians conduct site larval monitoring prior to treatment. Bti treatments target the 3rd instar stages to target the primary feeding stages and to leave early instar larvae as food for others within the ecosystem. Treatments are conducted in compliance with the IPM Act. Larvicide will be applied via hand, a backpack sprayer, or helicopter as determined by the qualified MBL technician. Aerial treatment notices will be posted and will remain on site for a minimum of 1 week. The posted public notice will include the following information:

- *The trade name and active ingredient of the larvicide;*
- *The date and time of the larvicide treatment;*
- *The purpose of the treatment;*
- *Precautions to be taken to prevent harm to people entering the treatment area;*
- *The PMP confirmation number and*
- *The contractor's contact information.*

Question 4: Can I do this on my own property?

Residential mosquito control products are available for purchase at local stores. The use of commercial pesticides on private land now requires a Residential Applicator Certificate (RAC). Residents do not require a RAC to use Domestic class pesticides on their property. Residents can apply pesticides listed on Schedule 2 and 5 without a RAC. The RAC is free to obtain on-line, see www.mytrainingbc.ca/homepesticideuse/ for more information.

It is extremely important that residential treatments ONLY occur in self-contained and man-made bodies of water. This could include constructed ornamental ponds, un-used pools, or other reservoirs located and constructed solely on the related property. Water bodies that are connected to a natural environment should be reported to local authorities who can assess the need for, and appropriateness of, treatments.

Question 5: Where are the Aquabac® treatments applied?

Aquabac® (Bti) treatments may be applied within the client's purview, with compliance to the product label, provincial legislation, and regional legislation. These treatments primarily take place in floodwaters associated with the freshet.

Question 6: Do land owners have the right to refuse Aquabac® treatments?

Land owners have the right to refuse access.

Question 7: I do not want/will not allow Aquabac® treatments on my property, are there any alternatives?

The most effective control method for mosquitoes around a residence is to reduce, remove, or refresh standing water where mosquitoes can breed. Specifically:

- *Empty water in old tires, buckets, toys, and flower pots*
- *Refresh water in bird baths, fountains, wading pools and animal dishes at least every 3 days*
- *Clean roof gutters and ensure proper drainage*
- *Fix leaky sprinklers and outside faucets*

Question 8: When Aquabac® is applied by helicopter in high traffic areas, how will residents be warned?

Treatment notices will be posted prior to treatment and will remain on site for a minimum of 1 week. The posted public notice will include the following information:

- *The trade name and active ingredient of the larvicide;*
- *The date and time of the larvicide treatment;*
- *The purpose of the treatment;*
- *Precautions to be taken to prevent harm to people entering the treatment area;*
- *The PMP confirmation number and*
- *The plan holder(s) contact information.*

Question 9: How is Aquabac® applied?

MBL qualified technicians use back pack blowers and helicopters to apply Aquabac®.

Question 10: How long does it take for Aquabac® to have an effect on larval mosquitoes?

- *Larval mosquitoes are affected within hours of Aquabac® exposure.*
- *Within 48 hours, the efficacy rate is between 85-100%.*

Category 2: Personal Non-Target Effects

Question 1: Will Aquabac® (Bti) harm my pets?

- *Because Bti targets certain larval Dipteran species (mosquitoes, biting flies, fungus gnats), it is highly unlikely that pets will be harmed from Bti exposure.*
- *When tested on lab animals, acute oral and dermal LD₅₀s (median lethal dosage where 50% of the test subjects are killed) were all greater than the highest dosages tested. These dosages are far greater than those likely to be experienced in the field.*

Question 2: Could Aquabac® treatments harm humans?

Toxicological studies indicate an extremely low toxicity profile where test animals are concerned (See Question 1, above). To be registered for use in Canada, products must be proven to be non-toxic to test animals at label-specified application rates. Allowable human exposure rates are 10-fold less than the No Observed Adverse Effect Levels (NOAEL) established for test animals, leaving a large buffer for potential inter-species differences between test animals and humans.

Question 3: How far away and for what length of time should people be from Aquabac® treated sites?

Safe distances for the public to maintain are suggested during aerial treatments to avoid being hit by small corn granules impregnated with Bti spores. However, there is no toxicity-based reason to avoid the area. Additionally, there is no restricted-entry interval (REI) for microbial pesticides, such as Bti. As such, the public may be in the treatment area during back-pack application or immediately following aerial application.

Category 3: Environmental Effects

Question 1: How does Aquabac® directly affect non-target aquatic invertebrates, fishes, terrestrial invertebrates, birds, and terrestrial vertebrates?

- *Aquatic organisms: Aquatic organisms (non-target invertebrates & fishes) are generally not affected by Bti exposure.*
- *Terrestrial invertebrates: Bti is considered non-toxic to the majority of terrestrial invertebrates. However, certain studies have shown impacts on some Lepidoptera (butterfly) when in their larval form and some Nematode eggs (although certain Nematode species' eggs increased following Bti exposure). It is important to consider the low likelihood that Lepidoptera larvae will be exposed to Bti at the rate required to illicit negative impacts.*
- *Birds: No toxic effects with exposure tests.*
- *Terrestrial vertebrates: Toxicity tests on lab animals, acute oral and dermal LD₅₀s (median lethal dosage where 50% of the test subjects are killed) were all greater than the highest dosages tested. These dosages are far greater than those likely to be experienced in the field.*

Question 2: How long does Aquabac® remain active in the water?

The field half-life for Bti in water ranges from approximately 4 hours to 5 months, depending on UV exposure and organic content of the water. The higher the UV exposure, the shorter the half-life. The higher the organic content, the longer the half-life. The great majority of Bti spores will become ineffective within 24 hours of application in a field setting using Aquabac® - the primary product utilized by MBL. Other products may allow for Bti spores to be continuously released in the water column for up to 30 days.

Question 3: What is the soil half-life of Aquabac®?

Bti is a soil-borne bacterium, so is naturally found in soil environments. However, in its active form, it can persist for months in basic soil conditions. Bti's toxin proteins are rapidly broken down in soils with a pH < 5.1.

Question 4: What is the mode of action for Aquabac® (Bti)?

The mode of action for Bti is relatively simple and with a high degree of species specificity. Receptors within the mid-gut region of the mosquito larvae are specific to the toxin proteins that are produced alongside each bacterial spore. After the mosquito larvae ingest the toxin protein, disruption of the larval mid-gut cells occurs because of cleavage of the protoxins by mid-gut proteases. This event causes considerable damage to the wall of the gut and quickly leads to larval death (Boisvert and Boisvert 2000).

Question 5: If I notice any effects that I think might be connected to an Aquabac® treatment, who should I contact?

Should an individual feel that they, or their pet, have been affected by a treatment, then they should see their doctor. It is extremely unlikely that any malady is related to the treatment, but worth seeing a certified medical practitioner for clarification (and to determine what the cause may be so a treatment can be offered). The affected individual needs to have information about the application from the contract applicator (product name, where the larvicide was applied, when, etc.). If more information is needed, then they should contact the Operations Program Coordinator at MBL for specific information surrounding the potential indirect or non-target effects of the larvicide. If the person wishes to contact someone beyond MBL, they should be directed to contact Health Canada and report a pesticide incident. If a sufficient amount of information has been provided, Health Canada can determine whether or not the effect is due to that product's exposure. The forms can be found at: <http://www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/incident/index-eng.php>

Category 4: Registration and Permitting

Question 1: Who registers pesticide products in Canada?

- The Pest Management Regulatory Agency regulates all pesticides and pesticide applications in Canada under the Pest Control Products Act.

Question 2: Where can I go to get more information on the product?

- Health Canada's Public Registry has information on all registered pesticides and the pesticide regulatory system. <https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public/protecting-your-health-environment/public-registry.html>

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