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Technical Bulletin

Barmac Mosquito Biolarvicide Products

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Barmac Bti is a microbial larvicide containing *Bacillus thuringiensis* subspecies *israelensis* (Bti or Bt H-14), a naturally occurring soil bacterium that produces protein toxins (insecticidal crystal protein ICP) and a spore. The insecticidal activity of Barmac Bti formulations and all Bti formulations is due to the presence of the protein toxins. The spore has no effect on the larvicide activity. Barmac Bti formulations are unique and specifically manufactured to enhance larvicidal effects of the protein toxin and to ensure the toxin's biological stability.

Two formulations of Barmac Bti are available from constantly replenished stock: Barmac Bti 1200 Biological Larvicide aqueous suspension, 1,200 ITU/Mg and Barmac Bti 200GR Corn Cob Granule, 200 ITU/Mg (produced in a 10/14 mesh size for better canopy penetration and easier dispersion via air operated equipment). The potency of Barmac Bti is controlled within specific limits using a bioassay procedure based on toxicity to larvae of *Aedes aegypti*. Quality control bioassays are conducted prior to release of each lot product. Other laboratories conduct analyses on each lot to assure there are no microbial contaminants present in the formulations.

MODE OF ACTION:

Mosquito larvae are killed by ingesting the protein crystal (delta endotoxin). The crystal is broken down in the larval midgut by a combination of enzymes and the alkaline gut environment. The epithelium of the midgut is destroyed resulting in gut paralysis, complete loss of ionic regulation between the midgut and hemocoel, and larval death. Because the Barmac Bti must be ingested to be effective, the products do not affect pupae, adults, or late larval stages when active feeding has ceased. Death of larvae is rapid, often occurring within one hour at field use rates. Complete mortality occurs in the laboratory within 24 hours. Barmac Bti 200 is specifically formulated to enhance its effects on mosquito larvae. Particle size is small, averaging 2 to 10 microns, but a significant amount of the formulated crystal protein is in agglomerated form so that ULV deposition is enhanced. These particle size characteristics improve both ground and aerial applications.

EFFECT ON NON-TARGET ORGANISMS/ENVIRONMENTAL FATE:

Barmac Bti is naturally occurring and safe to the environment. It shows no cross resistance to chemical larvicides and is especially well suited for use in areas where there is demonstrated resistance to organophosphates or pyrethroids. Barmac Bti does not persist in soil or water. The protein crystal separates from the aquatic environment and settles to the bottom. They are deactivated by becoming food for other microorganisms or being absorbed into soil or other organic particles. Spores do not recycle or regenerate in the field.



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INVERTEBRATE TOXICOLOGY:

Bacillus thuringiensis subspecies *israelensis* (Bti) has no toxic effects on beneficial insects such as lady bird beetles, honeybees, mayflies, dragonflies, damselflies, stoneflies, caddisflies, and true bugs. Among Diptera Chaoborous species *Ephydra riparia*, *Musca domestica*, *Odontomyia* species, and *Polpedilum* species are not susceptible to Bti. Some mortality occurs among *Chironomus pulmosus*, *Chironomus stigmaterus*, *Dixa* species, *Goeldichironomus holoprasinus* and *Palpomyia* species but at rates of 10 to 1,000 times the field use rates for mosquito control. Some mortality has been observed against *Toxorhynchites* larvae that ingested prey immediately following intoxication. Filter feeding first instar *Toxorhynchites* larvae are as susceptible to Bti as mosquito larvae. Later instars are relatively insensitive to Bti when intoxicated prey are absent.

OTHER NON-TARGET SPECIES:

No toxicity was observed against crustacea including copepod species, *Gambia*, oysters, shrimp, crabs, molluscs, flatworms and amphibia. In addition to safety to non-target vertebrates and invertebrates, Bti based larvicides have been used in large-scale mosquito and blackfly control programs for 20 years with no adverse effects on humans.

FORMULATIONS:

Barmac Bti 1200 is an aqueous suspension specifically formulated to meet the needs of the mosquito control industry. The product is a tan, aqueous suspension. Formulation characteristics have been manipulated to suspend the active ingredient in the feeding zone of mosquito larvae for an extended period of time. Barmac Bti 1,200 is a partially agglomerated aqueous suspension with a potency of 1,200 ITU/mg. Physical characteristics are: (1) viscosity; <1,200 cps, and (2) specific gravity; 1.06 to 1.10. These physical characteristics permit ULV ground and aerial application and also provide desirable suspension qualities when mixed with water. The formulation contains a high concentration of individual spores and protein crystals as well as agglomerated crystals. The agglomerates improve deposition when the formulation is applied ULV. The high number of individual spores and protein crystals enhances and prolongs the suspension of the product in the mosquito feeding zone.

Barmac Bti 200GR is a granular formulation using corncob grit as the carrier. It is available in a 10/14 mesh size and is effective against mosquitoes in a variety of habitats.

Barmac Bti products are distributed in Australia by Globe Pest Solutions.

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