**Introduction to Biopesticides Registered for Mosquito Control**

*Bacillus thuringiensis var israelensis (Bti)*, *Bacillus sphaericus* and *methoprene* are three biopesticides that may be applied to standing water and other breeding sites (e.g. stormwater retention areas, ditches, or ponds) for the purpose of selectively reducing populations of mosquito larvae or “wrigglers” that hatch from eggs. Biopesticides include products derived from naturally occurring bacteria and insect growth regulators (IGRs). Bti has been used worldwide as a biological pesticide since 1980 for mosquito control. Bti was registered by EPA in 1983 and has been used as a Best Management Practice (BMP) option to manage mosquito larvae.

**How is Bti regulated in Washington?**

Distribution and use of Bti and other pesticides in Washington are subject to compliance with federal and state regulations including the Washington Pesticide Control Act (15.58 RCW), the Washington Pesticide Application Act (17.21 RCW), and General Pesticide Rules (WAC 16-228). Larvicides are registered by WSDA as state restricted use pesticides (RUP) or general use pesticides that are home and garden use only pesticides. Larvicides designated as state RUP products may require a National Pollutant Discharge Elimination System (NPDES) permit before making an application. Permitting information is available from the Washington State Department of Ecology. Environmental Health information is available from the Washington State Department of Health (DOH).

**What are home and garden use only pesticides?**

"Home and garden use only pesticides" means any pesticide determined by WSDA to be packaged, labeled and marketed in a manner that clearly indicates the product is intended for personal use by the general public in and around a residence. Mosquito larvicides that are labeled for “home and garden use only” and applied only to waters that will not drain off of the property are generally exempt from NPDES permitting requirements.

**Which Bti products are registered?**

WSDA and WSU provide guidance on Bti and other larvicides registered for control of mosquito. Product selection may be based on the species, life stage, habitat, population, temperature, non-target impacts, resistance management, and cost. Some species, such as *Anopheles* and *Culex*, may require the higher labeled rates to achieve acceptable control. Bti products are formulated as liquid concentrate, granular and dust. The granular forms are useful against mosquito larvae (e.g. *Culex* spp.) found in used tires and other artificial containers. *B. sphaericus* may be a better choice than Bti when targeting larvae in turbid water with high organic content (e.g. animal waste lagoons). Refer to the American Mosquito Control Association Bulletin No. 7 or WSU’s publications, “Pest Management for Prevention and Control of Mosquitoes” and “Pesticide Regulations on use of Mosquito Larvicides”, for more information on Bti.
How does Bti work?
Mosquito larvae must eat the Bti-formulated product containing dormant bacterial spores. Crystals, which are known as Insecticidal Crystal Proteins (ICP) or delta-endotoxin, are produced during Bti sporulation. The mosquito larvae stop feeding and die when these proteins are converted into toxins that work by damaging the gut wall of mosquitoes. This reaction cannot take place in humans and other mammals. Bti is effective against the early stages of mosquito larvae and does not affect mosquito eggs, mature larvae, pupae, or adults. The length of effectiveness can vary between formulations and environmental conditions. More information on the mosquito life cycle may be found on WSU’s web page or DOH’s Guidance for Surveillance, Prevention, and Control of Mosquito-borne Disease web page.

What are some benefits of using Bti?
Bti is inherently less toxic than conventional pesticides and has relatively minimal impact upon most non-target organisms. According to EPA, the toxicology of Bti is well-established and exhibits minimal to nonexistent risk to humans, pets, birds, aquatic organisms (e.g. fish and invertebrates), non-target plants and honey bees. Bti is one of two biological pesticides that may be applied for mosquito control in certain sensitive sites in Washington due to its increased margin of safety. EPA reports that the use of biopesticides can reduce the use of other pesticides (e.g. adulticides) when used as part of an IPM program. Refer to DOH’s for answers to common health-related questions on Bti or EPA’s web site for other advantages of using Bti.

When should Bti be used?
Mosquito (larval and adult) and bird-based surveillance, historical records (dates of previous treatment), mapping, experience, and current temperature and wind conditions are useful in determining when to apply Bti. Pesticide applicators with Mosquito Control Districts in Washington State systematically monitor field reference sites to determine when applications are necessary. These licensed and trained applicators follow uniform treatment standards before applying Bti in accordance with world standards that comply with federal pesticide (EPA) and other state regulations. They may use counts from traps (e.g. light or CO2-baited Encephalitis Vector Survey) as timing-indicators for treating potential problem areas with pesticides. The Center for Disease Control (CDC) recommends alternating biorational larvicides and IGRs annually or at longer intervals to prevent the onset of pesticide resistance. Reducing incidents of mosquito-borne disease, such as West Nile virus, can be aided by effective mosquito control.

References
- Antonelli A., T. Murray, and C. Daniels. 2007. Pest Management for Prevention and Control of Mosquitoes with Special Attention to West Nile Virus. WSU-Puyallup PLS-121.
- Pesticide Licensing for Professional Mosquito Control. WSDA AGR Pub 640-118 (N/10/04).