



FAQ 3. What kinds of insecticides are used and when?

A variety of insecticides is needed for modern-day mosquito control. Insecticides are used only when and where other types of control are not practicable. (See FAQ 4 for alternative control methods.) The Mosquito Control Section utilizes insecticides as an important component of its **Integrated Pest Management (IPM)** program. IPM refers to the best use of **a combination of the most practicable control methods** for treating pest problems (only when and where they occur) in the most efficacious, environmentally-compatible, and cost-effective manner possible.

There are two basic types of mosquito control insecticides – **larvicides** for control of larval or immature mosquitoes and **adulticides** for control of flying or resting adults. All insecticides that we use are registered by the U.S. Environmental Protection Agency (EPA) for the types of applications we perform. Insecticide applications are done only when and where we have indications of unacceptable or intolerable numbers of mosquitoes undergoing larval development or already on-wing. These mosquitoes must also be problematic biters of humans or other mammals. Indications of when and where spraying is necessary are derived through **an extensive and intensive field surveillance/monitoring effort**, involving a variety of detection efforts – e.g. larval sampling (“dipper counts”); landing rate counts (i.e. numbers of adult female mosquitoes that land on a field inspector per minute); nightly adult light trap collections; detection or occurrence of disease viruses or other pathogens within mosquitoes themselves or in sentinel organisms; the numbers and patterns of public complaints received; etc. Spraying is not done unless threshold criteria are exceeded for these various indicators.

Spray applications might be performed aerially using fixed-wing aircraft or helicopters for larvicides or adulticides, or might involve truck-mounted applications of larvicides (via “pump truck”) or adulticides (via “foggers”). Larviciding to treat small areas or container habitats is often done on foot, using backpack sprayers or hand-tossed formulations. The choice of type of insecticide and application method is dependent upon the type of species to be controlled, the life stage(s) targeted for control, and the type of habitat or location where the application will occur. Since in almost all cases larviciding involves less direct exposure of people to insecticides than adulticiding, we **always prefer to larvicide first and to adulticide only as a last resort.**

The timing of our insecticide applications and the application methods are also determined by weather conditions (e.g. air temperature, wind speed and direction,

humidity, rainfall). Weather conditions must be considered in our performing appropriate and allowable treatments. When dealing with saltmarsh mosquito larval control, we must also take into consideration daily tide stages and the monthly lunar tide cycle too. For spring woodland-pool species control, we are often racing against the calendar to complete our aerial larviciding before forest canopy leaf-out prevents effective spraying. We face many problems when trying to treat urban or congested areas – think about all the things you might have to deal with when trying to operate a truck-mounted adulticide sprayer as one encounters crowds of people along the streets, traffic jams, or detours in an effort to prescriptively apply uniform amounts of an insecticide. This is one reason why you might see inner-city ground adulticiding being performed at 3:00 am rather than 5:00 pm.

Our frontline larvicides are *Bacillus thuringiensis israelensis (Bti)* (e.g. VectoBac, VectoLex, Teknar or Aquabac, which are all bacterially-produced insecticides), *methoprene* (e.g. Altosid, a juvenile growth hormone mimic), and *spinosad* (e.g. Natular, derived from soil bacterium), all of which can be applied in liquid or granular formulations. Bti, methoprene, and spinosad are state-of-art, third-generation pesticides that are classified as “biorational” products. A final type of larvicide that we use is *monomolecular surface film (MMF)* (e.g. Agnique or Arosurf). MMF is used to treat larvae or pupae (usually hand-applied to breeding habitats).

Our aerially-applied adulticide to treat problem mosquitoes is *naled* (Trumpet or Dibrom, an organophosphate), which is equally effective against freshwater or saltmarsh mosquitoes. Another category of adulticides that we use is synthetic pyrethroids, which seem to be more efficacious when applied by truck-mounted sprayers (“foggers”) than by aircraft. The primary synthetic pyrethroid that we use for ground “fogging” is *sumithrin* (e.g. Anvil), although alternatives such as *resmethrin* (e.g. Scourge) or *permethrin* (e.g. Permanone, Biomist, Aqua-Reslin) are also available and used around the country. Natural pyrethroid derivatives such as *pyrethrin* (e.g. Pyrenone) can also be used. Unfortunately, in comparison to *naled*, synthetic pyrethroids don’t seem to be as efficacious against saltmarsh mosquitoes or as good for aerial applications.

It is important that we have this diversity of mosquito control insecticide products, since we need versatility in dealing with different target species, different life stages, different types of habitats, varying weather conditions, and special concerns for avoiding potential non-target impacts. We must also avoid the overuse of any one product against local mosquito populations to try avoid possible **insecticide resistance** (which undercuts effective control) among our target species. Insecticide resistance can arise through overly-aggressively targeting certain species or life stages with a single product, such that the small percentage of any species population that might be naturally resistant to whatever insecticide is being used then greatly multiplies because of its insecticide “resistant” or immune nature, to then dominate future generations of the target species. It’s important to be able to use and rotate a variety of insecticides in our control work and to also adopt new insecticides whenever possible and appropriate.