Concerns on Pesticides Used for Mosquito Abatement

In September 2013, the Environmental Epidemiology Program (EEP), Utah Department of Health, received an inquiry from a public servant regarding concerns of possible health effects from exposure to pesticides associated with Utah's mosquito abatement programs.

Background

Mosquitoes are found throughout the world and many transmit pathogens which may cause disease. These diseases include mosquito-borne viral encephalitis, dengue and yellow fever, malaria, and filariasis. Most of these diseases have been prominent as endemic or epidemic diseases in the United States in the past, but today only the insect-borne (arboviral) encephalitides occur annually, and dengue fever occurs periodically in this country.

The West Nile virus is the currently the most well-known encephalitis-causing mosquito-borne disease. West Nile was first identified in the United States in 1999. Human cases of encephalitis range from mild to very severe illnesses that, in a few cases, can be fatal. These viruses normally infect birds or small mammals. During such infections, the level of the virus may increase in these infected animals facilitating transmission to humans by mosquitoes.

Dengue fever is a viral disease transmitted from person to person by mosquitoes. It is usually an acute, nonfatal disease, characterized by sudden onset of fever, headache, backache, joint pains, nausea, and vomiting. While most infections result in a mild illness, some may cause the more severe form of this disease known as Dengue hemorrhagic fever. This condition is characterized by severe rash, nosebleeds, gastrointestinal bleeding and circulatory failure resulting in Dengue shock syndrome and death.

Disease carrying mosquito species are found throughout the U.S., especially in urban areas and coastal or inland areas where flooding of lowlands occurs.

In Utah, the first mosquito abatement programs were started in 1943 in locations where hospital facilities were treating soldiers wounded in WW II (Brigham City, Salt Lake City, etc). The goal

of these programs was to ensure that soldiers infected with malaria did not transmit the disease to uninfected Utahns. Since that time, the Utah mosquito abatement program has expanded to a 24 district initiative covering most of the state. The latest district addition was the Cache county district in 2004.

Mosquito Abatement

Mosquito abatement is carried out by three strategies that correspond to the three stages of mosquito life-cycle: feeding larvae, non-feeding larvae, and adult insects.

Feeding larvae

At this stage insect development, abatement strategies do not include pesticide usage. Bacterial strains (bacillus sphaericus and bacillus thuringiensis israelensis) that are not a risk to humans or animals are used. These bacteria are eaten by the feeding larvae and are toxic to the stomach and digestive tract of the insect.

Non-feeding larvae

Also at this stage of insect development, abatement strategies do not include pesticide usage. When the larvae are nearly ready to change into flying mosquitoes, they stop feeding, and the bacterial strains are no longer effective for controlling the insect. At this stage, an oil surfactant is used to reduce the water surface tension. Reduced water tension means that these tiny insects swimming underwater cannot break the surface of the water to get to oxygen causing them to suffocate.

In Utah, mineral oil has been used as a surfactant but is being replaces by vegetable-based oils, particularly coconut oil. The relatively small quantities of oil surfactants used pose no risk human or non-insect animal health. This strategy can pose a problem to other small swimming insects.

Adult Mosquitos

Adult mosquito abatement involves the use of chemicals that are specifically toxic to the insect. These chemicals are often referred to as insecticides, pesticides or adulticides.
In Utah, the Chemical: There are three general categories of mosquito pesticides in use: Pyrethrins and pyrethroids, organophosphates, and synthetic hormones.

Pesticides used in Utah

Pyrethrins are two chemicals taken from chrysanthemum flowers that are poisonous to mosquitoes. The sun destroys pyrethrins very fast so when they are used in mosquito control, most of the chemicals are gone within an hour after sunrise. Pyrethrins are a small portion of the total liquid in pesticides made with them – most of the liquid is water or mineral oil.
How they work: Pyrethrins block the movement of information from the mosquito's brain so its heart no longer beats and it cannot breathe.
Danger to people and pets: Most people are not harmed by these chemicals when they are used in mosquito spraying. People who are allergic to pyrethrins may feel a tight or tingly feeling under their skin, soreness around their eyelids, or a scratchy throat. When used correctly, pyrethrins will not kill fish.

Pyrethroids are man-made chemicals that are almost the same as pyrethrins. In Utah, Zenivex is a pyrethroid used for mosquito abatement. Pyrethoids last longer in sunlight than pyrethrins (up to a couple of days). Most of the liquid in adulticides is either water or mineral oil.
How they work: Like pyrethrins, pyrethroids block the movement of information from the mosquito's brain so its heart no longer beats and it cannot breathe.
Danger to people and pets: Most people are not harmed by pyrethroids used in mosquito spraying. People who have allergies to these chemicals may feel a tight or tingly feeling under their skin, soreness around their eyelids, or a scratchy throat. Pyrethroids can kill fish if they accidentally get into water where fish live.

Piperonyl Butoxide or PBO is a chemical that is added to pyrethrins or pyrethroids to make them work better.

How it works: When PBO is mixed in the mosquito spray, it makes it harder for the mosquito to get rid of the pesticide from their body. When PBO is used, less active ingredient is needed to kill mosquitoes.
Danger to people and pets: The small amounts of PBO a person or pet could come into contact with during mosquito spraying would not harm them. Mineral oil is often the main ingredient that other chemicals are mixed with to make adulticides. If skin is coated with mineral oil, minor problems like a burning feeling or a rash can occur. The tiny amount of mineral oil a person could get on their skin from spraying mosquitoes would not cause any problem. Mineral oil is not harmful when swallowed.
Contact with pyrethrins, pyrethroids, PBO, and mineral oil from mosquito spraying has not been shown to cause long-term health problems in humans or animals.

Organophosphates are occasionally used where pyrethroids and pyrethrins may not be allowed, or they are simply more effective in some situations such as rural agricultural areas. Organophosphate pesticides can be more dangerous to people than pyrethroids and pyrethrins, but their use is sometimes necessary. If the same pesticide is used for a long time to spray adult mosquitoes, the mosquitoes can become immune to that pesticide and will not die when sprayed. Mosquito control programs can make sure more commonly used pesticides will stay effective by occasionally using a different chemical to kill adult mosquitoes. This is called "rotating" pesticides. There are two chemicals of this type used to spray mosquitoes in Utah. Both of these chemicals have been used in mosquito control for more than 40 years.

Malathion and Naled are organophosphates that are used in Utah.
How it works: Organophosphates bind to and inhibit chemicals in the nervous system that break down the neurotransmitter acetylcholine. This results in paralysis and death for the insect.
Danger to people and pets: Organophosphates can be harmful to people who work with them and do not follow safety rules. People who come into contact with large amounts of these chemicals can have headaches, become dizzy, feel sick to their stomach, or even die. Coming into contact with small amounts of these chemicals from spraying mosquitoes does not harm

people or pets because the body gets rid of them quickly. No chronic health effects have been seen in people where these chemicals are routinely used for mosquito spraying.

Synthetic hormones are chemicals used for mosquito abatement that are not classic pesticides, but rather substances that mimic naturally-produced chemicals in the insects.

Methoprene, which is sold under the trade name Altosid, is an insect growth regulator.
How it works: It is considered a biochemical pesticide because rather than controlling target pests through direct toxicity, methoprene interferes with an insect's life cycle and prevents it from reaching maturity or reproducing.
Danger to people and pets: Methoprene showed no significant adverse toxicological effects in any human health effects screening studies. The pesticide has very low acute oral and inhalation toxicity potential, and is not an eye or skin irritant (it has been placed in toxicity category IV, the least toxic category, for these effects). The results of these screening tests and other available studies on methoprene indicate that it is of low toxicity and poses little risk to people and other non-target species.

Conclusions

Though any pesticide can be dangerous in an uncontrolled situation, the well-studied health impacts of mosquito abatement chemicals give confidence that their usage is warranted. Public health consists of trade-offs, and controlling the potentially epidemic spread of dangerous diseases far outweighs the possibility of very minor health effects that could result from pesticide use. The EEP supports the mosquito abatement program in Utah and underscores the importance of this program in promoting and protecting the continued health of Utah’s residents. In closing, the EEP recommends that concerned citizens take steps to protect their own health by consulting their physician if they feel they have experienced an unhealthy exposure to pesticides.

Policy Recommendation: The EEP recommends that the UDOH support ongoing mosquito abatement programs in Utah with no change to current mosquito abatement management practices.

References

ATSDR 2003. TOXICOLOGICAL PROFILE FOR MALATHION.
http://www.atsdr.cdc.gov/toxprofiles/tp154.pdf

ATSDR 2003. TOXICOLOGICAL PROFILE FOR PYRETHRINS AND PYRETHROIDS.
http://www.atsdr.cdc.gov/toxprofiles/tp155.pdf

EPA 1991 EPA R.E.D. FACTS- Methoprene.
http://www.epa.gov/oppsrrd1/REDs/factsheets/0030fact.pdf