



Insecticides and Repellents Used for Mosquito Control With Emphasis on Preventing the Spread of West Nile Virus

A Guide For Healthcare Providers

These guidelines were developed to assist health care providers in answering questions relating to mosquito control measures and preventing the spread of West Nile virus (WNV). Information concerning the insecticide product that may be used, the likelihood of human exposure to the insecticide, signs and symptoms of overt insecticide poisoning, and steps to follow if a person presents to your office with possible insecticide poisoning are included.

Although we do not anticipate pesticide-related poisonings associated with use of insecticide spraying to control the adult mosquito population, the **Connecticut Department of Public Health (DPH) is requesting that suspect cases be reported to the Division of Environmental Epidemiology and Occupational Health by calling 860-509-7742.**

BACKGROUND

WNV is transmitted to humans through the bite of an infected mosquito. In 1999, WNV was responsible for 62 cases of severe illness, including 7 deaths, in New York City and surrounding counties. WNV was isolated in mosquitoes and in 72 crows, 1 hawk, and a crane that died in Fairfield and New Haven counties during September and October, 1999. Although persons living in these areas were at risk of becoming infected, and 78 symptomatic persons were tested, there were no confirmed human cases of WNV.

During the fall of 1999, insecticides were sprayed in several towns in Fairfield and New Haven counties to reduce populations of adult mosquitoes. This year, a comprehensive plan to reduce mosquito populations has been developed. If these

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measures are not effective, and the risk of human exposure to WNV is considered high or rapidly growing, the application of insecticides, either by ground or air, may be done to reduce the potential threat to people.

MOSQUITO CONTROL PRODUCTS

The product most likely to be used in Connecticut for controlling adult mosquitoes is Scourge. Scourge contains resmethrin (18%) and piperonyl butoxide (54%), with the balance petroleum distillate and inert ingredients. Resmethrin, is a synthetic pyrethroid insecticide similar chemically to natural insecticides that are derived from chrysanthemum flowers (pyrethrins). The pyrethroids are neurotoxins. Selective toxicity of pyrethroids in insects (compared to mammals) can be explained by higher intrinsic sensitivity of the insect sodium channel isoforms, by temperature dependent effects of pyrethroids (greater at 20° than 37° C), and by higher rates of metabolic degradation in mammals (1-4).

Piperonyl butoxide also has some intrinsic insecticidal activity and provides synergistic activity when applied with pyrethrins. It does this by inhibiting mixed function oxidase enzymes that degrade pyrethrins and are responsible for increased resistance in target insects. Piperonyl butoxide is found in many different topical pyrethroid preparations used by humans (gels, liquids, and shampoos) for treatment of lice.

In addition to using insecticides to kill active adult mosquitoes, it may be necessary to recommend the use of insect repellents during outdoor activities in areas where there is a higher risk of exposure to infected mosquitoes. A recent review found that although more than 20,000 compounds have been studied as insect repellents, little is

known about how they act on their target insects, and other insect species may react differently to the same repellent. Moreover, of all the tested repellents, DEET (N, N-diethyl-3-methylbenzamide, previously called N,N-diethyl-m-toluamide)-containing products are the most effective and best-studied agents for reducing the risk of bites from essentially all species of mosquitoes. DEET is available in concentrations of 5-100% in multiple formulations including solutions, lotions, creams, gels, aerosol and pump sprays, and impregnated towelettes. Under most conditions, a high concentration of DEET is not recommended, and products with 10-35% DEET will provide some protection for at least 1-2 hours.

EXPOSURE POTENTIAL TO INSECTICIDES

Generally, there is no need to relocate during spraying. The following common-sense steps recommended by the EPA will reduce possible exposure to pesticides during spraying..

- Look for notices about spraying in the newspapers and stay tuned to radio and TV for announcements.
- Whenever possible, remain indoors with windows closed and window-unit air conditioners turned off when spraying is taking place.
- Do not let children play near or behind truck-mounted applicators when they are in use.
- People who suffer from chemical sensitivities or feel spraying may aggravate a preexisting health condition, may consult their physician or the DEP's Pesticide Division (see next section) and take additional measures to avoid exposure or its possible consequences to them.

The Mosquito Management Program recommends the following additional common-sense steps to minimize the low-level potential for irritive effects from Scourge and toxicity to fish.

- Avoid direct contact with surfaces that are still wet from pesticide spraying. Do not allow children to play in areas that are still wet until they have dried. (approximately 1 hour.)
- If you have to remain outdoors, avoid eye contact with the spray. If you get pesticide spray in your eyes, immediately rinse them with water.
- Cover ornamental fish ponds to avoid direct exposure.

Workers involved in the mixing and application of these products have the greatest risk of exposure. These personnel, however, are specifically trained to use these pesticides safely, to be aware of the signs and symptoms of overexposure, and to seek medical attention promptly for possible toxicity.

TOXIC EFFECTS OF PYRETHROIDS/PIPERONYL BUTOXIDE INSECTICIDES

Resmethrin (and other pyrethrin compounds) may be absorbed by respiratory, gastrointestinal or transcutaneous routes. They DO NOT cause cholinesterase inhibition. Resmethrin is only slightly toxic to humans after acute inhalation or dermal absorption, and slightly toxic to practically non-toxic by ingestion (5). The low toxicity of resmethrin may be attributable to limited absorption and rapid biodegradation by mammalian liver enzymes. In addition, pyrethrins have low efficacy on neural activity at mammalian body temperatures, and generally effect mammalian nerve sodium channels less than those of lower animals. In humans, most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. Chronic toxicity testing of resmethrin in animals has documented hepatomegaly and hepatotoxicity, thyromegaly and thyroid cysts after treatment with high doses (25-250 mg/kg, p.o., QD) for months to years. These dosage levels are many-fold higher than those expected in the human population following repeated use of Scourge for mosquito control.

Clinically, the signs and symptoms of resmethrin toxicity in humans following extremely high exposures by any route include incoordination, twitching, loss of bladder control, and seizures. Erythema and irritation (numbness, tingling, burning or itching) may occur at sites of dermal exposure (5).

Piperonyl butoxide has limited dermal absorption on contact. The risk of acute toxicity is very low for the concentrations of piperonyl butoxide in Scourge that would be encountered by the public. Large absorbed doses of piperonyl butoxide could, in theory, enhance the toxicity of some insecticides. Exposure to high concentrations of piperonyl butoxide may cause significant health effects, including skin irritation, respiratory symptoms (wheezing, coughing, shortness of breath or burning sensations of the oropharynx or

chest), vomiting, diarrhea, anorexia, and mild central nervous system depression. It is recommended that a victim of significant exposure to piperonyl butoxide be transported immediately to a hospital for monitoring and stabilization, even if asymptomatic when first seen (6).

TOXIC EFFECTS OF DEET

DEET is generally well tolerated when applied to the skin, although tingling, mild irritation, and sometimes desquamation have occurred following repeated applications. DEET has caused contact dermatitis and, in some cases, exacerbation of pre-existing skin diseases. Toxic encephalopathic reactions have occurred in rare instances following dermal application, mainly in children, where extensive applications of products containing high concentrations of DEET were used (contrary to label instructions). Manifestations of toxic encephalopathy include altered behaviors, headache, restlessness, irritability, ataxia, rapid loss of consciousness, hypotension, and seizures.

The American Academy of Pediatrics (AAP) reports that no definitive studies exist in the scientific literature about applications of safe DEET concentrations for children. The AAP recommends a cautious approach, using products containing 10% DEET or less for children. In addition, they offer specific precautions when using DEET that include:

- Read and carefully follow all label instructions before using the product. Young children should not apply DEET to themselves,
- Wear long sleeves and pants when possible and apply repellent to clothing. A long-sleeved shirt and snug collar and cuffs are best. The shirt should be tucked in at the waist. Socks should be tucked over pants, hiking shoes, or boots.
- Apply DEET sparingly only to exposed skin. Do not use DEET underneath clothing.
- Do not use DEET on the hands of young children. Avoid the eye and mouth areas.
- Do not apply DEET over cuts, wounds, or irritated skin.
- Wash treated skin with soap and water upon returning indoors. Wash treated clothing.
- Avoid using sprays in enclosed areas. Do not use DEET near food.
- Wash the exposed areas of the body if an allergic reaction is suspected.

Discretion should be exercised when recommending DEET for persons who have acne, psoriasis, an atopic predisposition, or other chronic skin conditions. People with particular concerns about potential toxicity from DEET should limit application of the repellent to their clothes. One should be cautious with this approach as DEET-repellents may damage some synthetic fabrics (rayon and spandex), plastics (watch crystals and eyeglass frames), leather, and painted or varnished surfaces. DEET products generally do not damage nylon or natural fiber (cotton or wool) products (7).

SENSITIVE POPULATIONS

Although most people should not experience symptoms given the low level of exposure, some individuals may be particularly sensitive to these agents. Such individuals could experience short-term, temporary effects such as skin, eye, and mucous membrane irritation, as well as exacerbations of conditions such as asthma.

The CT Department of Environmental Protection (DEP) has a registry dedicated to chemically sensitive individuals. If you have a patient that is chemically sensitive, they may register with the DEP by sending their name, address, and the names and addresses of their neighbors to the CT DEP Pesticide Division at 79 Elm Street, Hartford, CT 06106. The registry is used when someone has hired the services of a pesticide contractor to do work on their property. The contractor is required to check DEP's registry database prior to applying the pesticides, and notify nearby residents listed. Prior to performing ground spraying, the DEP will notify everyone in the registry at potential risk.

RECOMMENDATIONS FOR MANAGEMENT

Generally, therapy for overexposures to pyrethrins or piperonyl butoxide is supportive; no specific antidotes are available. If a patient presents with history, signs, and symptoms consistent with pesticide poisoning, the Poison Control Center (800-343-2722) should be contacted for recommendations. All confirmed or suspected cases of pesticide poisoning should be reported to the Connecticut DPH, Division of Environmental Epidemiology and Occupational Health at 860-509-7742.

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OTHER SOURCES OF INFORMATION

Additional and more detailed information on the diagnosis and treatment of pesticide poisoning can be found in the United States Environmental Protection Agency publication, "Recognition and Management of Pesticide Poisonings, 5th Edition". This publication can be accessed through the EPA website at: <http://www.epa.gov/pesticides/safety/healthcare>.

For further information about WNV, go to the CT DPH website at: www.state.ct.us/dph.

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6. National toxicology program, piperonyl butoxide Website: [<http://ntp-db.niehs.nih.gov>].
7. Fradin MS. Mosquitoes and mosquito repellents: a clinician's guide. *Ann Int Med* 128: 931-40, 1998.

Mosquito Management Program Information

Department of Environmental Protection

Website—<http://dep.state.ct.us>
(860)424-4184—Latest information on test results, spray locations, and protective measures.
(860)642-7630—Technical questions regarding mosquitoes, and mosquito control measures.

Department of Public Health

Website—<http://www.state.ct.us/dph>
(860)509-7994—WNV prevention, symptoms, and infections in people.
(860)509-7742—Effects of pesticides on people.

Department of Agriculture

Website—<http://www.state.ct.us/doag>
(860)713-2505—WNV infections in domestic animals, including livestock, poultry, and pets.

Connecticut Agricultural Experiment Station

Website—<http://www.state.ct.us/caes>
(203)974-8500—Mosquito trapping.

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