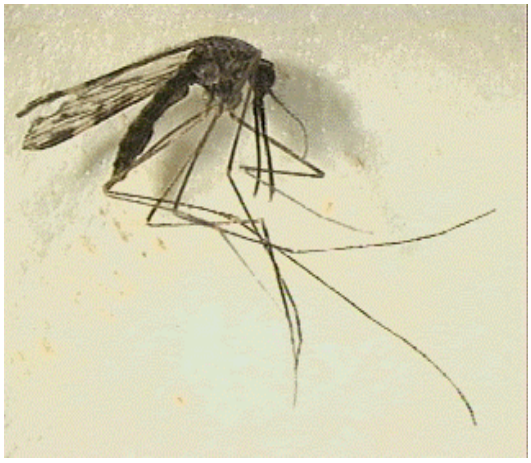
The Health Effects of Pesticides

Used for Mosquito Control



A Report By:

Citizens Campaign for the Environment
and
Citizens Environmental Research Institute

August, 2002

THE HEALTH EFFECTS OF PESTICIDES USED FOR MOSQUITO CONTROL

This report is a product of Citizens Campaign for the Environment (CCE) and Citizens Environmental Research Institute (CERI). CCE is an independent, member-supported, not-for-profit environmental organization with a mission to build citizen involvement and understanding of policies and actions designed to protect the natural environment and public health. CCE represents an active and vocal membership of over 80,000 citizens.

CERI is a not-for-profit, research and education organization with a mission to advance sound environmental science that promotes and advances progressive environmental policies, practices, and a better understanding of the link between environmental quality and a livable and healthy planet.

CCE and CERI have been actively involved in efforts to advance a better understanding of the impacts and risks associated with the widespread use of pesticides to control mosquitoes. This work gained greater urgency when West Nile Virus was first discovered in New York in 1999.

For more information or additional copies of *The Health Effects of Pesticides Used for Mosquito Control*, contact either CCE or CERI at:

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The Health Effects of Pesticides Used for Mosquito Control

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What are Pesticides?

Pesticides are chemical or biological substances used to kill or repel targeted organisms. All pesticides are poisons. In many cases they are designed to impact the immune, reproductive, or nervous system of insects. Concerns exist over the safety of present day pesticides. For the purpose of this report, the focus is on health effects of pesticides that are currently used for controlling mosquito populations throughout New York.

Which Pesticides are Used to Control Mosquitoes?

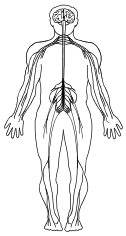
Four pesticides are commonly used for mosquito control. The trade names of these pesticides are:

- Scourge
- Anvil
- Permethrin, and
- Malathion.

Scourge, Anvil, and Permethrin are pyrethroid (synthetic) insecticides.
Malathion is an organophosphate insecticide.

What Should You Know About These Pesticides?

SCOURGE (active ingredient: Resmethrin) is a synthetic pyrethroid insecticide. Pyrethroids affect the nervous system. They have been linked with liver and thyroid problems and they can also interfere with the immune and endocrine systems. Scourge contains the synergist (a chemical that increases the effectiveness of the active ingredient), pipernyl butoxide, which is classified by the EPA as a possible human carcinogen.



ANVIL (active ingredient: Sumithrin) is a synthetic pyrethroid insecticide, which may affect the central nervous system.

Anvil contains 10% pipernyl butoxide. Sumithrin was shown to demonstrate significant estrogenicity in a 1999 study.[1] at the Mt. Sinai School of Medicine. This means it may promote tumor growth in cancers of the reproductive organs including breast cancer and prostate cancer.

1. Estrogenic and Antiprogestagenic Activities of Pyrethroid Insecticides. ***Biochemical and Biophysical Research Communications,*** October 1998, vol.251, no.3, p.855-859.

PERMETHRIN is a synthetic pyrethroid insecticide and neurotoxin. It is more acutely toxic to children than to adults.

The US Environmental Protection Agency (EPA) has classified it as a human carcinogen and it has been shown to cause immune system damage as well as birth defects.

Note: Pyrethroids are highly toxic to fish, crustaceans, and bees. For that reason, EPA has established restrictions that prohibit their direct application to open water within 100 feet of lakes, steams, rivers, or bays.

MALATHION is an organophosphate insecticide that can cause acute and long-term neurological health problems. Malathion is being reviewed by the EPA for its potential as a low level carcinogen. It is toxic to fish and highly toxic to aquatic invertebrates and amphibians.

What are the Health Effects of Pesticides?

Health effects of pesticides can cause both **acute** and **chronic problems**. Acute health effects appear shortly after exposure to these pesticides and can include: skin and eye irritations, headaches, dizziness and nausea, weakness, difficulty breathing, mental confusion and disorientation, seizures, coma, and death. Chronic health effects may not be apparent until months or years after exposure. Such health aliments include nervous, reproductive, and immune system disorders, and cancer.

Children can be particularly sensitive to exposure to chemicals due to their small body size, immature immune systems and rapid growth cycles. Although everyone is at risk from exposure, the most vulnerable groups are children, pregnant women, the elderly, patients undergoing chemotherapy, and people with compromised immune systems.

All pesticides are associated with some risk of harm to human health and the environment. Every pesticide on the market must be registered with the Environmental Protection Agency (EPA). This registration does not guarantee the safety of the product even when used as directed. In fact, the EPA has officially stated that no pesticide can be considered safe and federal law prohibits manufacturers from making claims that EPA registration of their products means they are safe.

This paper will familiarize the reader with health effects of pesticides used for mosquito control in New York State. The following section summarizes information about the health and environmental risks that people who are exposed to pesticides face. Specific research reports and studies, as well as selected newspaper articles, support the view that further work is needed to find safe, non-toxic alternative to pesticides.

Recent Research on Pesticides, Environmental Risk and Health

1. PESTICIDES AND CHILDREN'S HEALTH

1.A. STUDY: The Five Worst Environmental Health Threats to Children's Health.

SOURCE: *Journal of Environmental Health*, May 1998, vol.60, no.9, p.46 (2).

This article contains information cited from a eport entitled "*Our Childen at Risk*" published by the Natural Resources Defense Council (NRDC, 1997) which discusses environmental exposures that threaten children's health. **Pesticides are one of the five worst threats to children's health**. The other four are **lead, air pollution, environmental tobacco smoke, and drinking-water contamination**.

According to the *Journal of Environmental Health*, "Pesticides have been associated with the development of certain cancers in children, including leukemia, sarcomas, and brain tumors. Many classes of pesticides have been shown to adversely affect the developing nervous system of experimental animals. Parental exposure to pesticides has been linked with birth defects in children. New studies suggest that pesticides may compromise the immune system of infants and children".

1.B. STUDY: Pesticides and PCBs: Does the Evidence Show That They Threaten Children's Health? Phillip J. Landrigan (Professor of Pediatrics and Director of the Center for Children's Health and the Environment, Mount Sinai School of Medicine, New York, NY).

SOURCE: *Contemporary Pediatrics*, February 2001, vol.18, issue 2, p.110 (11).

This journal article looks specifically at the impacts that toxins, such as **pesticides**, specifically **organophosphates, carbamates, and pyrethroids** can have on children.

"Organophosphates and carbamates are toxic to the nervous system,[1] and some of the pyrethroids are believed to be toxic to the reproductive system and disruptive to endocrine function."[2] Two behavioral traits associated with children's exposure to pesticides include "their hand-to-mouth behavior, which increases their ingestion of any toxic chemical in dust or soil, and their likelihood of playing close to the ground". Both of these behaviors increases childrens exposure to "toxins in dust, soil, and carpets, as well as to toxins that form low-lying layers in the air, such as certain pesticides".

1. Blondell J: "Epidemiology of pesticide poisonings in the United States, with special reference to occupational cases". *Occupational Medical State of the Art Review*, 1997; vol. 12, p.209.
2. Garey J, Wolff MS: "Estrogenic and anti-progestagenic activities of pyrethroids insecticides". *Biochemical and Biophysical Resource Communications*, 1998; vol. 251; p.855.

2. PYRETHROIDS

2.A. STUDY: Pyrethroid Insecticides: Poisoning Syndromes, Synergies, and Therapy. David E. Ray; Philip J. Forshaw.

SOURCE: *Journal of Toxicology*, March 2000, vol.38, issue 2, p.95.

This article discusses poisonings due to pyrethroids. "Two basic poisoning syndromes, Type I and Type II, are seen. Type I pyrethroids produce reflex hyperexcitability and fine tremor. Type II pyrethroids produce salivation, hyperexcitability, choreoathatosis, and seizures. Both produce potent sympathetic system activation. Local effects are also seen: skin contamination producing paresthesia and ingestion producing gastrointestinal irritation".

2.B. STUDY: Estrogen Potential of Certain Pyrethroids Compounds in the MCF-7 Human Breast Carcinoma Cell Line. Vera Go; Joan Garvey; Mary S. Wolff; Beatriz G.T Pogo.

SOURCE: *Environmental Health Perspectives*, March 1999, vol.107, issue 3, p.173 (5).

This article presents research concerning the estrogenic potential of pyrethroid compounds found in insecticides. Discussed are the potential of pyrethroids, such as sumithrin and permethrin, to disrupt normal hormone activity and influence cellular pathways.

2.C. STUDY: *OVERKILL*: Why Pesticide Spraying for West Nile Virus May Cause More Harm Than Good. William C. Sugg, III; Kim DeFeo.

SOURCE: Toxic Action Center and Maine Environmental Policy Institute, July 2001, p.1 (54). http://www.toxicsaction.org.

This report discusses how pesticides, such as pyrethroids, used for mosquito control, are not effective control agents and at the same time are harmful to human health. *"***Adulticiding, or spraying to kill adult mosquitoes, has not yet been proven effective. The Centers for Disease Control and Prevention state that ground and aerial spraying is usually the least effective mosquito control technique**[1]**"** (p.3). Also included in the report are health effects of pyrethroids such as "**asthmatic breathing, sneezing, nasal stuffiness, headache, nausea, incoordination, tremors, convulsions, facial flushing and swelling, and burning and itching sensations**" (p.9). "**Pyrethroid insecticide poisoning can be of unexpectedly long duration. Pyrethroids can produce reflex hyperexcitability and fine tremor, salivation, choreoathetosis (involuntary movements), and seizure**" (p.9). "**Several studies indicate that pyrethroids disrupt the endocrine system by mimicking the effects of the hormone estrogen, which can cause breast cancer in women and lowered sperm count in men**" (p.9).

An article from *Environmental Health Perspectives* referred to in the report concludes, *"***the specific chemicals associated with children's brain cancer were pyrethrins and pyrethroids (which are synthetic pyrethrins, such as permethrin, tetramethrin, allethrin, resmethrin and fenvalerate) and chlorpyrifos"**[2] *(p.10).* "**Northwestern University Medical School conducted a series of investigations at Northwestern's Department of Molecular Pharmacology and Biological Chemistry in Chicago, and has found neurological damage from pyrethroids**". (p.10)

1. Centers for Disease Control. Epidemic/Epizootic West Nile Virus in the Unites States: Revised Guidelines foe Surveillance, Prevention, and Control, April, 2001. http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-apr-2001.pdf

2. Pogoda, Janice M. and Susan Preston-Martin, Household Pesticides and Risk of Pediatric Brain Tumors, Environmental Health Perspectives, November 1997, vol. 105, no. 11, p. 1214-1220.

2.D. STUDY: Estrogenic and Antiprogestagenic Activities of Pyrethroid Insecticides. Joan Garey; Mary S. Wolff.

SOURCE: *Biochemical and Biophysical Research Communications*, October 1998, vol.251, no.3, p.855 (5).

This article discusses a study of four frequently encountered pyrethroids, (fenvalerate, **sumithrin**, *d-trans* allethrin, and **permethrin**) that were tested for estrogen and progesterone agonist/antagonist activities. **The study concluded that "through hormonal pathways, exposure to certain pyrethroids may contribute to reproductive dysfunction, developmental impairment, and cancer"**.

2.E. STUDY: Pyrethroids (Pyrethrum and Permethrim): Health Effects. (Chapter in book)

SOURCE: *Toxics A to Z: A Guide to Everyday Pollution Hazards*, John Harte et al., University of California Press; Berkley, California.

"The EPA classifies permethrin as a possible human carcinogen on the basis of animal studies in which mice developed tumors at high dose levels. Allergic responses range from mild to severe skin rashes to sneezing and other respiratory problems, such as asthma, sinusitis, and bronchitis." (p.389).

2.F. STUDY: Chromosome/Genetic Damage Evident in Immune System Cells from Permethrin.

SOURCE: *Teratogenesis, Carcinogenesis, and Mutagenesis*, 1994, vol.14, p.31 (8).

Researchers at the National Center of Sandid Ambiental in Madrid Spain found that "**the pesticide permethrin is able to induce structural chromosome aberrations** (deformaties) **in human immune system cells as well as in the reproductive cells in laboratory animals**". As the researchers stated in the article "we can say that permethrin is a clear clastogenic (genotoxic) agent in two different cell systems".

2.G. STUDY: The Effect of Pyrethroid-based Liquid Mosquito Repellant Inhalation on the Blood-Brain Barrier Function and Oxidative Damage in Selected Organs of Developing Rats.

SOURCE: *Journal of Applied Toxicology*, 1999, vol.19, issue1, p.67 (6).

In this study, two-day-old rat pups were allowed to inhale the mosquito repellent (MR) (18 hours a day) for 8 days (postnatal days 2-9). "Rats exposed to the MR were further withdrawn from the exposure for 8 days (postnatal days 10-17) to study whether the changes induced following inhalation are reversible. **Results have shown an increased Blood-brain Barrier (BBB) permeability. This suggests a delayed maturity of the BBB system.** Brain glutathione (GSH) levels were also decreased (17%) in the exposed individuals". These and other results of this study suggest that there is a possibility of health risks, such as BBB permeability which can cause neurologicl problems, due to exposure to pyrethroids-based mosquito repellants, especially when exposure takes place at an early age.

2.H. STUDY: A Case-Control Study of Pesticides and Fetal Death Due to Congenital Abnormalities. Erin Bell, Irva Hertz-Picciotto, and James J. Beaumont. Department of Epidemiology, School of Public Health, University of North Carolina, Chapel Hill, NC. and Beaumont Epidemiology, Davis, CA.

SOURCE: *Epidemiology*, March 2001, vol.12, no.2, p.148 (9)

This study examines the effects on fetal health (or rather the effects on prevalence of fetal death) of five categories of pesticides applied in residential areas in ten California counties. These five categories are **pyrethroids**, phosphates, carbamates, halogenated hydrocarbons, and endocrine disruptors. "**The results of this study show an increased association between fetal death due to congenital abnormalities and several classes of pesticides when exposure occurs during the 3rd-8th weeks of pregnancy**". This association held true for all five categories of pesticides. There was no difference in result depending on the application method of the pesticides. (In other words, aerial and ground spraying yielded the same results). Furthermore, the risk is highest for those living within the same square mile as the pesticide application.

2.I. **STUDY: Watching the Clock**. Jeff Howell.

SOURCE:*NewScientist*, July 4,1998, vol.159, no.2141, p.49.

This article reports tests which have shown that **permethrin retains its toxic effects two years after it was sprayed.** Circulating dusts were proven to contain permethrin.

3. ORGANOPHOSPHATES

3.A. STUDY: Malathion. Loretta Brenner.

SOURCE: *Journal of Pesticide Reform*, Winter 1992, vol.12, no.9, p.29 (9).

This article examines the health effects of Malathion in human and animal studies. Malathion is detrimental because it effects the nervous system by inhibiting the enzyme, acetylcholinesterase (AchE), that breaks down acetylcholine, a chemical essential in transmitting nerve impulses across junctions between nerves. Without functioning AchE, acetylcholine accumulates to produce rapid twitching of voluntary muscles, incoordination, convulsions, paralysis, and ultimately death. Acute toxicity reactions in humans include headaches, nausea…blurred vision and pupil constriction, slowed heartbeat, respiratory depression, paralysis, coma, as well as muscular damage (after inhalation). Birth defects, reproductive problems, and genetic damage have been associated with alathion exposure in humans and animals. Furthermore, Malathion has the potential to contaminate ground and surface water. In California, five of twenty-eight county water systems tested were contaminated with malathion[1] and storm drains in Santa Clara County (where aerial sprays of malathion had been used for eradication programs) concentrated Malathion and malaoxon, eventually draining into San Francisco Bay.[2] Drift and aerial spray mosquito control programs can expose people to levels of Malathion that can cause the aforementioned health effects.

1. Howard, P.H. (ed.) 1991 Handbook of environmental fate and exposure data for organic chemicals. Volume III. *Pesticides*. Chelsea, MI: Lewis Publishers.

2. Oshama, R.J. et al. 1982. A characterization of sequential aerial Malathion applications in Santa Clara Valley of California, 1981. California Department of Food and Agriculture Environmental Hazards Assessment Program. (April.) p.12. *Cited in* Residents Against Spraying Pesticides. 1984. Environmental concerns. Unpublished report. Los Angeles, CA.

3.B. STUDY: Immune System Weakens After Malathion Exposure. University of Virginia.

SOURCE: *The Journal of Immunology*, vol.140, p.564 (7).

According to the *Journal of Immunology,* **Malathion contains chemical impurities which have been found to weaken immune system function, including a weakening of a type of white blood cell called "cytotoxic lymphocytes" (which attack cancer cells and virus infected cells).** These lymphocytes can also attack viruses in the body. Malathion has been shown to significantly weaken the cytotoxic lymphocyte's ability to perform their job effectively. Since it has been shown that people with weakened immune systems are more likely to develop encephalitis, paradoxically, it must be considered that malathion has the potential in itself to increase encephalitis cases as the spraying of malathion can weaken a person's immune system, thereby making them more vulnerable to the disease.

3.C. STUDY: Human Birth Defect Suspected from Malathion. Department of Clinical Genetics, Erasmus University, Rotterdam. Department of Child Neurology, University Hospital, Utrecht.

SOURCE: *Teratology*, 1987, vol.36, p.7 (3).

Malathion has been shown to cause birth defects in a variety of animals and at lower levels than other pesticides. Researchers suspect that Malathion caused the birth defect known as "amyoplasia", which is "a disorder characterized by almost total absence of skeletal muscle", in an infant girl who died soon after birth. The main researcher, Dr. D Lindhout, suspects this because "the mother used a malathion head lice shampoo during the 11th and 12th week of her pregnancy". Dr. Lindhout stated that malathion was a suspect in this birth defect because "when administered to adult animals, malathion and related thiophosphonates stimulate, and subsequently inhibit, the nicotinic sites in skeletal muscle, resulting in muscle weakness and paralysis. Neonates (newborn babies) are far more sensitive to these agents than adults, mainly because of a slower rate of detoxification of the metabolite (the metabolite in this case would be the liver breakdown of malathion which has been shown to be far more toxic than malathion itself)". Furthermore, "there was no genetic history of this problem in the mother or the father's family and there was no evidence of drug use by the mother", except for the use of Malathion head lice shampoo during early pregnancy.

3.D. STUDY: Intestinal Disorders in Children Born After California Spraying. Department of Preventative Medicine, University of Southern California, Los Angeles.

SOURCE: *Epidemiology*, January 1992, vol.3, p.32 (8).

This study shows evidence of harm to human health after aerial sprayings of Malathion over human populations. It was found that "children who had been exposed to Malathion during the second trimester of pregnancy were showing over two and a half times more gastrointestinal disorders (affecting the stomach and small intestines) in comparison to children not exposed to Malathion during pregnancy".

3.E. STUDY: Child Leukemia and Aplastic Anemia After DDVP Exposure. Drs. Jerry D. Reeves; David A. Driggers; Vincent A. Kiley. Department of Pediatrics, David Grant Medical Center, Travis Air Force Base, California.

SOURCE: *The Lancet*, August 8, 1981, p.300.

This study reviews the cases of seven children with bone marrow disorders that have been observed by physicians at Travis Air Force Base Medical Center in California. The physicians believe that organophosphate pesticides caused the blood disorders, in all cases. "All blood disorders occurred shortly after exposure to the pesticides DDVP/propoxur and malathion. Six of the patients had aplastic anemia and one had acute lymphoblastic leukemia".

3.F. STUDY: Poisons on Pets: Health Hazards from Flea and Tick Products[1]. David Wallinga, M.D.; MPA; Linda Greer, Ph.D.

SOURCE: *Natural Resources Defense Council*, November 2000, p.57 (74).

This report discusses children's risks to the toxic effects of organophosphates. "It is now widely accepted that among a child's developing organs, the brain - as well as the developing immune, reproductive and endocrine systems – are particularly sensitive to chemical injury". Recent studies propose the nature of adverse affects induced by organophosphate in young developing brains. "Exposure to even a single, low-level dose of organophosphates, during particular times of early brain development, can cause permanent changes in brain chemistry as well as changes in behavior, such as hyperactivity".

1. Information adapted from *Appendix A: Children's Vulnerability to Organophosphates*.

3.G. STUDY: Poisons on Pets: Health Hazards from Flea and Tick Products[1]. David Wallinga, M.D., MPA, and Linda Greer, Ph.D.

SOURCE: Natural Resources Defense Council, November 2000.

Pet products contain a number of different kinds of pesticides. This report focuses on organophosphate (OPs) insecticides, which are of greatest concern because they are designed to poison the brain and nervous system and pose many potential health effects. *Long-term effects are of particular concern for fetuses and infants, because of the OPs' possible impact on learning, behavior and other functions of the nervous system later in life. Several organophosphates in pet products also pose a risk for cancer…and emerging evidence links organophosphates exposures to the development of asthma in some people. The most common chronic complaints following OP exposure include irritability, problems with memory and concentration, muscle weakness, confusion, depression and blurred vision…these persistent symptoms can all be plausibly traced to disrupted function of the nervous system.*

1. Information adapted from Chapter 2: Health Effects of Insecticides Found In Pet Products.

4. NEWS ARTICLES

4.A. ARTICLE: "Workers Say Chemicals Used in Mosquito Spraying Made Them Ill." *Susan Saulny.*

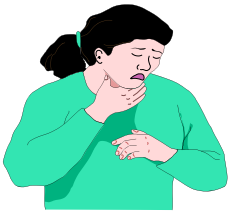
SOURCE: *The New York Times*, January 25, 2001, Sect.B, p.2.

This article discusses the story of five men who sprayed pesticides for mosquito control for a city contractor. The exposure to the chemicals made them sick. *The men's symptoms included dizziness, difficulty in breathing, headaches, diarrhea, joint pain, and shakiness. The label for Anvil states that the pesticide is 'harmful if absorbed through the skin; avoid contact with skin, eyes, or clothing."*

4.B. ARTICLE: "Artist: I'm a Victim of Skeeter Spraying." *Michael R. Blood.*

SOURCE: *DailyNews*, September 9, 2000.
http://www.nydailynews.com/200009-09/News_and_Views/City_Beat/a-79389.asp

This article tells of how a Manhattan women ended up in the hospital after she was exposed to Anvil during a spraying for mosquitoes. *"It burned. It itched. I was coughing, I was choking…my vision is blurry. I have terrible nausea. I threw up three days in a row…"* said



the artist who lives in Inwood.

4.C. ARTICLE: "Town Probes Park's Spraying" *Jim Rogalski.*

SOURCE: *Times-Union*, Albany, New York , June 27, 2001.

This article reports on the incident where Malathion was sprayed on a ball field in Moreau, NY during a soccer game causing thirty-seven people to be hospitalized. A total of 37 youth softball players and spectators ranging in age from 6 to 52 were rushed to Glens Falls Hospital for respiratory problems from exposure to anti-mosquito fog sprayed from a truck.

CONCLUSION

This paper has illustrated the potential health effects of pesticides used for mosquito control. It has presented the documented need for policy change to find safer, non-toxic alternatives to pesticides. *Citizens Campaign for the Environment* believes that the residents of New York have a right to be protected from unnecessary environmental health risks. In order for these right to be guaranteed, all states need to move away from the use of pesticides and to find a more effective, non-hazardous way to control mosquitoes.

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