The Toxicology of Pesticides Used to Control Mosquitoes

A Case Study of the 2004 West Nile Virus Epidemic in Maricopa County, Arizona

By Al Brown

POLYTECHNIC CAMPUS

RISK MANAGEMENT CASE STUDY

Vector species present for WEE, SLE, WNV, Dengue, Yellow Fever, Zika and Chikungunya

Source: Maricopa County Environmental Services Department; and ADHS 2021

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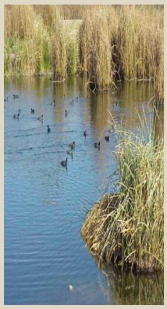
6000 Culex sites



Source: Maricopa County Environmental Services Department; 2005

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Integrated Mosquito Management

- **Maricopa County uses integrated mosquito management to control mosquitoes.**
- **This includes breeding site elimination, public education, application of larvicides, active disease surveillance network and use of adult mosquito control pesticides only if necessary.**
- **Maricopa County follows national mosquito control program guidance from CDC and other national organizations.**

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Disease Severity
Maricopa County Cases

WNV Confirmed Cases:	**355**
WNV Confirmed Encephalitis:	**112**
WMV Confirmed Fevers:	**91**
WNV Confirmed Meningitis:	**117**
WNV Confirmed Symptomatic Viremic Donors:	**22**
WNV Confirmed Unknown:	**13**

Based on MCPHD Case Classification Criteria

Source: Maricopa County Public Health Department; January 2005

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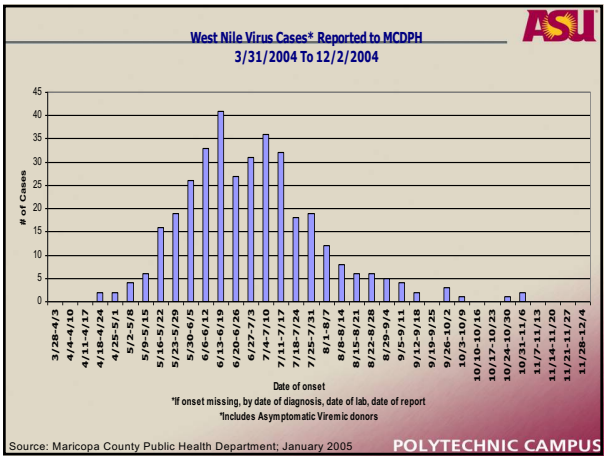

Source: Maricopa County Public Health Department; January 2005

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June 25, 2004 Johnny Dilone, Environmental Services (602) 506-6611

FIRST HUMAN DEATH FROM WEST NILE VIRUS

County Supervisors Pledge $ 1 Million to "Fight the Bite"

(Phoenix) – Maricopa County Supervisors' Chairman Andy Kunasek late this afternoon asked that $1 million dollars be taken from the County Reserve Fund to be used in the fight against the West Nile Virus. The money will be used by the Maricopa County Department of Environmental Services to beef up fogging operations to kill mosquitoes.

United States House of Representatives
J.D. Hayworth
Listening to Arizona's Fifth District

For immediate release: July 30, 2004

CONTACT: Press Secretary Larry VanHoose (202) 225-2190

Hayworth: Federal Funds Set Aside
For West Nile Emergencies
Contacts CDC for help to stem Maricopa outbreak

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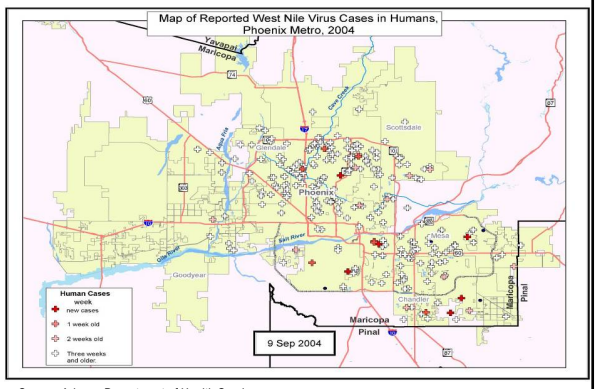

Source: Arizona Department of Health Services; Division of Public Health Services; September 2004

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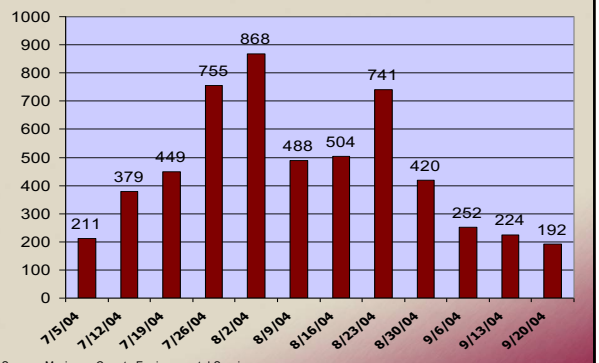
Number of Mosquito Complaints Filed Each Week



Source: Maricopa County Environmental Services Department; 2005

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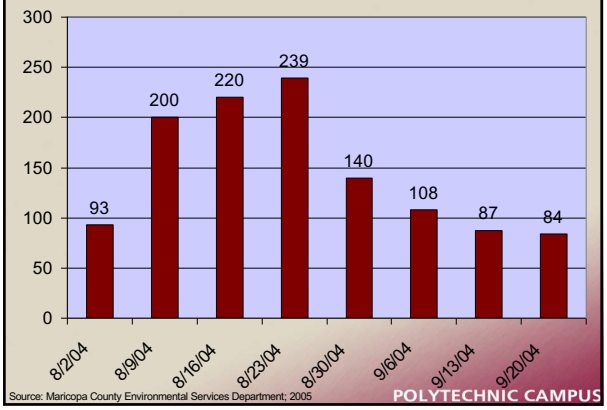
Number of Green Pool Complaints



Source: Maricopa County Environmental Services Department; 2005

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Source: Maricopa County Environmental Services Department; 2005

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Arizona Department of Health Services

Office of the Director
150 N. 18th Avenue, Suite 500
Phoenix, Arizona 85007-3247
(602) 542-1023
(602) 542-1062 FAX

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JUL 26 2004
MCESD DIRECTOR'S OFFICE

ARIZONA DEPARTMENT OF HEALTH SERVICES

ADMINISTRATIVE ORDER 2004-01
(Emergency Measures for West Nile virus)

CNN.com
SEARCH
HEALTH
West Nile Virus
Pools fueling West Nile in Phoenix

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Source: Maricopa County Environmental Services Department; 2005

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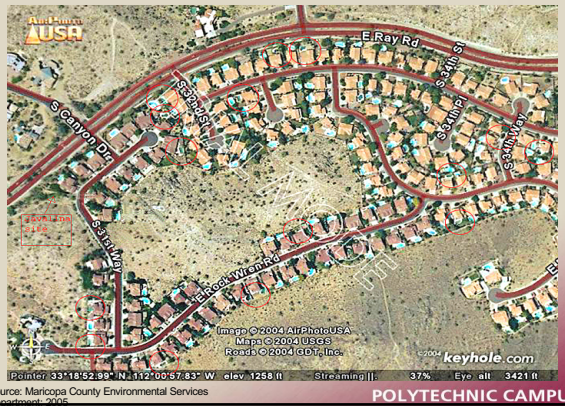

Source: Maricopa County Environmental Services Department; 2005

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Mosquito Sampling in Maricopa County in 2004

- **1,310 total mosquito samples**
- **101 pool samples tested positive**
- **The estimated minimum infection rate was 20 to 40 per 1000 mosquitoes**
- **The expected infection rate is 1 or 2 per 1000 mosquitoes**

Source: Maricopa County Environmental Services Department; 2005

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Pesticides Evaluated for Adult Mosquito Control

- Malathion (organophosphate)
- Resmethrin (synthetic pyrethroid)
- Phenothrin (synthetic pyrethroid)
- Permethrin (synthetic pyrethroid)

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MALATHION

•Malathion inhibits acetylcholinesterase in humans and insects

•Cholinergic poisoning in humans causes a range of symptoms from headache, drowsiness, difficulty breathing, cardiac arrhythmias, confusion, coma, seizures and paralysis

•Malathion oxidizes in air to a more potent oxon analogue

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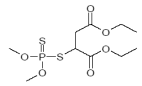
Table 4-1. Chemical Identity of Malathion

Characteristic	Information	Reference
CAS Nomenclature	Diethyl[(dimethoxyphosphino -thioyl)thio]butanedioate	CAS 2001
Common name	Malathion	Howard and Neal 1992
Synonym(s)	1,2-Di(ethoxycarbonyl)ethyl O,O-dimethyl phosphorodithioate	Howard and Neal 1992
Registered trade name(s)	Cekumal Fyfanon® Malixol® Maltox®	Farm Chemicals Handbook 2000 Howard and Neal 1992 Farm Chemicals Handbook 2000 Howard and Neal 1992
Chemical formula	$C_{10}H_{19}O_6PS_2$	Howard and Neal 1992
Chemical structure	 Butanedioic acid, [(dimethoxyphosphinothioyl) thio]-, diethyl ester (malathion)	

Source: Toxicological Profile for Malathion; CDC/ATSDR, September 2003

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Toxicity Guidance

Minimal Risk Level

An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects.

ATSDR uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive MRLs for hazardous substances. They are set below levels that might cause adverse health effects in the most sensitive population.

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Toxicity Standards and Guidance

- **Recommended Exposure Limit (REL) = NIOSH (National Institute for Safety and Occupational Health) time weighted average concentration for up to a 10-hour workday in a 40 – hour work week.**
- **Reference Concentration (RfC) = An estimate of a continuous inhalation exposure to the human population that is likely to be without an appreciable risk of deleterious non-cancer effects during a lifetime. RfC is expressed in mg/m³ or ppm.**

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Toxicity Standards and Guidance

- Reference Dose (RfD) = **An estimate of the daily exposure to the human population to a potential hazard that is likely to be without deleterious effects over a lifetime. The RfD is operationally derived from the NOAEL from human and animal studies. RfDs are not applicable to cancer effects.**

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Table 2. Regulatory Standards and Guidance Values for Malathion

Standard/Guidance	Value	Reference
Clean Water Act Maximum Contaminant Level(MCL)/Maximum Contaminant Level Goal(MCLG)	N/A	EPA 2002
Safe Drinking Water Act: 1- and 10-day Health Advisories (Child)	0.2 mg/L	EPA 2002
Reference Dose (RfD)	0.02 mg/kg/day*	EPA 2002
Safe Drinking Water Act: Drinking Water Equivalent Level (DWEL)	0.7 mg/L	EPA 2002
Safe Drinking Water Act: Lifetime Health Advisory	0.1 mg/L	EPA 2002
Occupational Standards: Occupational Safety and Health Administration Permissible Exposure Limit (PEL) 8-hour time-weighted average	15 mg/m³ (skin)	OSHA 2003
National Institute for Occupational Safety and Health/Centers for Disease Control and Prevention (NIOSH/CDC) Recommended Exposure Limit (REL)	10 mg/m³ (skin)	NIOSH 2003
NIOSH/CDC Immediately Dangerous to Life or Health	250 mg/m³	NIOSH 2003
ATSDR Oral Minimal Risk Level (MRL) Intermediate and Chronic	0.02 mg/kg/day	ATSDR 2001
ATSDR Inhalation MRL, Acute	0.2 mg/m³	ATSDR 2001
ATSDR Inhalation MRL, Intermediate	0.02 mg/m³	ATSDR 2001
Department of Transportation Reportable Quantity	100 pounds	DOT 2002
Environmental Protection Agency Reportable Quantity	10 pounds	ATSDR 2001

* EPA is reviewing the information in an application for reregistration of malathion and may shortly modify the RfD and establish an RfC.

Toxicologic Information about Insecticides Used for Eradicating Mosquitoes; CDC/ATSDR, April 2005

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Malathion: Chronic Health Effects

There is no evidence that malathion affects the ability of humans to reproduce. There is also no conclusive proof that malathion causes cancer in humans, although some studies have found increased incidence of some cancers in people who are regularly exposed to pesticides, such as farmers and pesticide applicators. The International Agency for Research on Cancer (IARC) has determined that malathion is unclassifiable as to carcinogenicity to humans.

Source: Toxicological Profile for Malathion; CDC/ATSDR, September 2003

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Synthetic Pyrethroids

- **Pyrethroids are synthetic esters derived from the naturally-occurring pyrethrins**
- **Pyrethroids are a complex mixture of isomers rather than a single pure compound**
- **Synthetic pyrethroids paralyze insects by prolonging the open phase of the voltage-gated sodium channels when a nerve cell is excited. Tremors and body weight changes were observed in lab animals.**
- **Household use of synthetic pyrethroids can trigger an asthma attack in humans.**
- **Undiluted product may cause skin irritation.**

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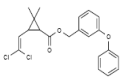
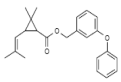
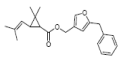
Table 4-2. Chemical Identity of Selected Pyrethroids[a]

Characteristic	Permethrin	Phenothrin	Resmethrin
Synonym(s)[b]	(3-Phenoxyphenyl)methyl3-(2,2-dichloroehenyl)-2,2-dimethylcyclopropane-carboxylate	(3-Phenoxyphenyl)methyl-2,2-dimethyl-3-(2-methyl-1-propenyl)-cyclopropanecarboxylate	[5-Phenylmethyl)-3-furanyl]methyl 2,2-dimethyl-3-(2-methyl-1-propenyl)cyclopropane-carboxylate
Ratio of isomers	(1R, trans):(1R,cis):(1S, trans):(1S, cis)=3:2:3:2[a]	Mixed isomers	20–30% (1RS)-cis-isomers 80–70% (1(RS)-trans-isomers)
Registered trade name(s)	Ambush, Assithrin, Cliper, Coopex, Corsair, Dragnet, Dragon, Kafil, Eksmin, Perkill, Pounce	Sumithrin	Synthrin, Chrysron
Chemical formula	$C_{21}H_{20}Cl_2O_3$	$C_{23}H_{26}O_3$	$C_{22}H_{26}O_3$
Chemical structure			

Source: Toxicological Profile for Pyrethrins and Pyrethroids; CDC/ATSDR, September 2003

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Synthetic Pyrethroids: Standards and Guidance

Table 2. Regulatory Standards and Guidance Values for Resmethrin

Standard/Guidance	Value	Reference
Environmental Protection Agency Reference Dose (RfD)	0.03 mg/kg/day;	IRIS 2003

Table 2. Regulatory Standards and Guidance Values for Permethrin

Standard/Guidance	Value	Reference
World Health Organization (WHO) drinking water guideline	20 µg/L	WHO 2001
Food and Agriculture Organization/WHO accepted daily intake (ADI)	0.05 mg/kg	HSDB 2003
Environmental Protection Agency Reference Dose (RfD)	0.05 mg/kg/day	IRIS 2003

Table 2. Regulatory Standards and Guidance Values for Phenothrin

Standard/Guidance	Value	Reference
World Health Organization acceptable daily intake (ADI)	0-0.07 mg/kg	WHO 1990

Source: Toxicologic Information about Insecticides Used to Eradicate Mosquitoes; CDC/ATSDR, April 2005

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Toxicokinetics of Pyrethroids

- **Pyrethroids are excreted in the urine, feces and breath**
- **Pyrethroids are broken down inside the body into metabolites**
- **High doses of pyrethroids results in build up in fatty tissues**
- **Some pyrethroids may be retained in the skin and hair for longer periods**

Source:Toxicological Profile for Pyrethrins and Synthetic Pyrethroids; CDC/ATSDR, September 2003

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Pyrethroid Chronic Health Effects

- There is no evidence that pyrethroids cause birth defects in humans
- There is evidence from animal studies that pyrethroids might be capable of causing cancer in people. But the evidence comes from animals that ate very large amounts of pyrethroids for a lifetime.
- Pyrethrins are classified as "likely to be a human carcinogen by the oral route" *
- Possible endocrine disrupter at high doses

* Cancer Assessment Review Committee

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EPA Toxicity Rating Scale

Toxicity Label	High Toxicity: Danger	Moderate Toxicity: Warning	Low Toxicity: Caution	Very Low Toxicity: Caution
Oral LD50	<50 mg/kg	50-500 mg/kg	500-5000 mg/kg	>5000 mg/kg
Dermal LD50	<200 mg/kg	200-2000mg/kg	2000-5000 mg/kg	>5000 mg/kg
Inhalation LD50	<0.05 mg/L	0.05-0.5 mg/L	0.5-2 mg/L	> 2 mg/L

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Pesticide Comparisons Page 1

Pesticide	LD50 (oral)	Toxicity	Non-Target Species	Persistence (half life)
Malathion	1522-1945 mg/kg	Low	Aquatic invertebrates, fish, insects	1-8 days (UV resistant)
Resmethrin	1244-4240 mg/kg	Low	Aquatic invertebrates, fish, insects	12 days
Phenothrin	>5000 mg/kg	Very Low	Aquatic invertebrates, fish, insects	12 days
Permethrin	500-4000 mg/kg	Moderate	Aquatic invertebrates, fish, insects	12 days

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Pesticide Comparisons Page 2

Pesticide	Cost (per gal)	Use Restrictions	Notes
Malathion	$38(100% active ingredient)	Surface water	Odor, under EPA review;maloxon formation; RfD=.02 mg/kg/d
Resmethrin	$24.50 (2% active ingredient)	Surface water	Low odor RfD=.03 mg/kg/d
Phenothrin	$44.00 (2% active ingredient)	none	No odor No RfD*
Permethrin	$24.50 (2% active ingredient)	Surface water	Low odor RfD=.05 mg/kg/d

* ADI – 0.07 mg/kg/d

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Piperonyl Butoxide

- **Piperonyl butoxide (PB is a synergist used to enhance the effectiveness of pyrethrin and pyrethroid insecticides.**
- **Toxicity of PB is "Low"**
- **PB has no known reproductive effects**
- **PB is a Group C "possible human carcinogen"**
- **PB has a short half life in the environment (4.3 days)**
- **PB is moderately toxic to fish and highly toxic to aquatic invertebrates**

Source: National Pesticides Telecommunications Network; Piperonyl Butoxide General Fact sheet, November 2000

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Other Ingredients

- **White mineral oil is an adjuvant in the formulation of many pesticides**
- **White mineral oil has "Low" toxicity**
- **White mineral oil is not classifiable as a carcinogen**
- **White mineral oil is used in many food and cosmetic products**

Source: Pesticide Action Network; 2004

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Other Ingredients continued

- **Aromatic hydrocarbons are used as solvents in many pesticide products**
- **Toxicity is "Low"**
- **Not classifiable as a carcinogen**
- **Listed as a "Potentially Toxic Other Ingredient/High Priority for Testing" by EPA**

Source: EPA List of Inert (Other) Pesticide Ingredients; August, 2005
Pesticide Action Network, 2004

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Other Ingredients continued

- Glycol ethers are listed as .4% of the formulation of Anvil.
- There are hundreds of glycol ethers; some are very low toxicity, others have moderate toxicity
- The type of glycol ether present in Anvil was not disclosed by the manufacturer

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Surveillance For Pesticide Related Illness in Nine States, 1999 – 2002 (1)

- **"When administered properly in a mosquito-control program, insecticides pose a low risk for acute, temporary health effects"**

(1) CDC, MMWR, Vol.52, N.27, July 11, 2003

Source: Maricopa County Environmental Services Department; 2005

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Pesticide Facts

- **Anvil 10 – 10 is the preferred pesticide for adult mosquito control**
- **Least toxic pesticide registered for use to control mosquitoes**
- **Toxicity is far less than exposure to environmental tobacco smoke**
- **Degrades rapidly in sunlight**
- **Application rate is extremely low (.3 oz – .5 oz per acre)**
- **Active ingredient is used to control lice on humans at 80 times concentration**

Source: Maricopa County Environmental Services Department; 2005

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Pesticide Safety Precautions

- **Always minimize exposure to any pesticide**
- **Know when applications will occur**
- **Stay indoors with windows closed during the actual spraying**
- **Always wash garden fruits and vegetables before eating**
- **Bring toys or pets inside when pesticides are applied**

Source: Maricopa County Environmental Services Department; 2005

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Comparing Risk of Pesticide Exposure to Risk of Becoming Infected with West Nile Virus

- **Risk of contracting a West Nile Virus infection during the summer of 2004 was 8.6 X 10^{-3} population**
  (Based on Arizona Department of Health Services Estimates)
- **Risk of experiencing an illness from mosquito control pesticides is 2.0 X 10^{-7}**
  (Based on CDC/MMWR, Vol.52.No. 27, July 11, 2003)

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Maricopa County
Environmental Services Department

1001 N. Central Avenue
Phoenix, AZ 85004
Phone 602-506-6611
www.maricopa.gov

June 17, 2004

For More Information: Justin Finestone, Public Information Officer
(602) 506-6611
(602) 420-7874 Pager

Maricopa County Establishes Mosquito Fogging Hotline
Residents can get daily updates on fogging locations

(Phoenix) The Maricopa County Environmental Services Department activated its new Mosquito Fogging Hotline today. Residents can call 602-372-3000 for recorded information on locations of nightly fogging operations. The Hotline will be updated when new treatment areas are identified.

3rd West Nile death reported as county approves fogging

Kerry Fehr-Snyder
The Arizona Republic
Aug. 5, 2004 02:58 PM

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Maricopa County

West Nile Virus Information

August 2006

S	M	T	W	T	F	S
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Fogging / West Nile

mosquito fogging (8/14/2006)

Weather conditions, circumstances and time permitting, the following areas are scheduled to be fogged tonight, August 14, 2006, during the time frame of 10 pm. to 5am. Tuesday morning.

Mosquito spraying for tonight (Monday, August 14th) will be conducted in: Gilbert, Phoenix, Chandler, Mesa, Queen Creek and Unincorporated Maricopa County. In Gilbert: An area from Pecos Road to Queen Creek Road & from Higley Road to Power Road (185). In Gilbert and Unincorporated County Land: An area from Chandler Heights Road to Hunt Hwy & from Higley Road to Power Road (185). In Gilbert and Unincorporated County Land: An area from Pecos Rd to Germann Rd & from Val Vista Drive to Greenfield Road (185). In Gilbert & Unincorporated County Land: An area from Queen Creek Road to Ocotillo Road & from Val Vista Drive to Greenfield Road (185). In Chandler & Unincorporated County Land: An area from Chandler Heights Road to Riggs Road & from Gilbert Road to Lindsay Road (185). In Chandler: an area from Ray Rd to Chandler Blvd & from McQueen Rd to Cooper Rd (167). In Gilbert & Unincorporated County Land: An area from Williams Field Road to Pecos Road & from Lindsay Road to Val Vista (168). In Chandler & Unincorporated county Land: An area from Ocotillo Road to Chandler Heights Road & from Cooper Road to Gilbert Road (184). In Queen Creek & Unincorporated County Land: An area from Queen Creek Road to Riggs Road & from Hawes Road to Signal Butte Road (186). In Mesa: An area from Brown Road to University Drive & from Greenfield Road to Higley Road (151). In Phoenix: An area from Cactus Road to Shea Blvd & from 40th St to 48th (Tatum Blvd) St. (105). In Phoenix: An area from Peoria Avenue to Dunlap Avenue & from 35th Avenue to the Black Canyon Freeway (103).

http://www.maricopa.gov/wnv/fogging/EventsDetailPublishers.aspx?date=8/14/2006&eventID=3089 (1 of 2)2/26/2007 2:23:02 PM

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Selected Pesticide MSDS

Page 1 of 2

Material Safety Data Sheet

Date last revised: 5 March 1999

I. General Information

Chemical Name and Synonyms Sumithrin Piperonyl Butoxide	**Trade Name & Synonyms** Anvil 10+10 ULV
Chemical Family Synergized Synthetic Pyrethroid	**EPA Registration Number** 1021-1688-8329
Proper DOT Shipping Name Environmentally Hazardous Substances, Liquid, N.O.S., Marine Pollutant (d-Phenothrin) [bulk only]	**DOT Hazard Classification** Class 9, UN 3082 [bulk only]
Manufacturer Clarke Mosquito Control Products, Inc.	**Manufacturer's Phone Number** (630) 894-2000
Manufacturer's Address 159 North Garden Avenue Roselle, Illinois 60172	**INFOTRAC (Emergency) Hotline** 1-800-535-5053

II. Ingredients

Principal Hazardous Components	CAS #	Percent
Sumithrin® [3-Phenoxybenzyl-(1RS, 3RS; 1RS, 3SR) 2,2-dimethyl-3-(2-methylprop-2-enyl) cyclopropane-carboxylate]	026002-80-2	10.00%
Piperonyl Butoxide [Alpha-(2-(1-butoxyethoxy)-4,5-methylenedioxy-2-propyltoluene]	000051-03-6	10.00%
White Mineral Oil Aromatic Hydrocarbon	064742-55-8 (-56-9) 064742-94-5	40 – 78% 1 – 15%

III. Physical Data

Boiling Point (°F): Not Established	**Specific Gravity (H_2O = 1):** 0.884
Vapor Pressure (mm Hg.): Not Established	**Vapor Density (Air = 1):** Not Established
Solubility in Water: Emulsifiable	**pH:** Not Applicable
Appearance: Liquid, Clear with a light yellow tinge	**Odor:** Pungent aromatic, similar to smell of mothballs

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CLARKE

ANVIL® 10+10 ULV

Contains An Oil Soluble Synergized Synthetic Pyrethroid For Control of Adult Mosquitoes (Including Organophosphate-Resistant Species) In Outdoor Residential and Recreational Areas.

Precautionary Statements
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

ENVIRONMENTAL HAZARDS

PHYSICAL OR CHEMICAL HAZARDS

DIRECTIONS FOR USE

KEEP OUT OF REACH OF CHILDREN
CAUTION

STATEMENT OF PRACTICAL TREATMENT

CLARKE MOSQUITO CONTROL PRODUCTS, INC.

GROUND ULV APPLICATION

AERIAL APPLICATION

STORAGE & DISPOSAL

SAMPLE LABEL

NET CONTENTS

LOT NO.

FOR MORE INFORMATION CALL: 1-800-323-5727

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Some Concerns Expressed by Residents

- **Pesticides will harm chemically sensitive people**
- **Pesticides make mosquitoes more likely to transmit WNV**
- **The pesticides are contaminated with benzene and other bad stuff**
- **The risk of contracting pesticide-related illness is much greater than the risk of getting WNV**
- **The military uses it as a WMD**

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Critics assail state, county on West Nile

Epidemic blamed on slow response

Kerry Fehr-Snyder
The Arizona Republic
Aug. 12, 2004 12:00 AM

West Nile primer
Another West Nile death in Maricopa County; commissioners approve new funds to fight disease

THE ARIZONA REPUBLIC
ONLINE PRINT EDITION

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August 20, 2004

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One answer to spraying: Don't

Aug. 15, 2004 12:00 AM

Regarding the West Nile virus:

LETTERS

Spray to kill mosquitoes no health risk

I am writing to comment on your guest column by Jim Berlin, (Aug. 4), which unfortunately does Maricopa County-area residents a disservice by misrepresenting the facts of mosquito control products and how they are used.

... classes of insecticides.

The World Health Organization, the public health arm of the United Nations, conducted a thorough assessment of the safety of a specific synthetic pyrethroid, sumithrin (d-Phenothrin) (WHO, Geneva, Switzerland, 1990). Their assessment noted that this compound was very safe and not likely to cause any adverse effects in humans exposed to it, either in the environment or through occupational exposure.

Judicious use of pesticides

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Some Concerns Expressed by Residents

- The pesticides you are using cause heart disease, lung disease, impotence, decreased sperm count, kidney damage, thyroid damage, hormone changes, cancer, ADD, ADHD, early onset of menstruation, high blood pressure, seizures, depression, anxiety, autism, birth defects, bladder control issues, congestion, nausea, vomiting, diarrhea, fever, nosebleeds, asthma, anemia, rashes, swollen glands, muscle aches, brain damage and other maladies

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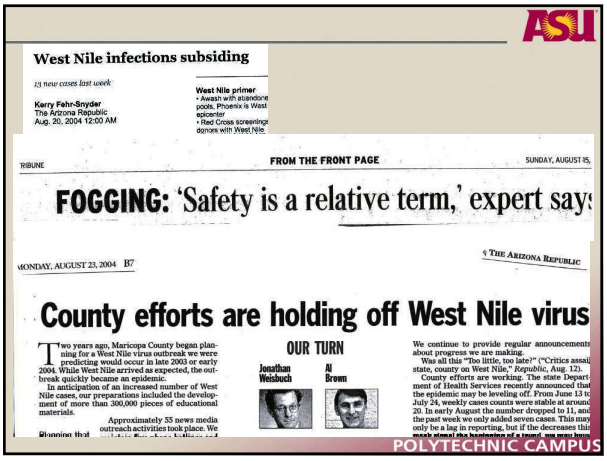

West Nile infections subsiding

13 new cases last week

Kerry Fehr-Snyder
The Arizona Republic
Aug. 20, 2004 12:00 AM

West Nile primer
• Awash with abandoned pools, Phoenix is West epicenter
• Red Cross screenings donors with West Nile

TRIBUNE — FROM THE FRONT PAGE — SUNDAY, AUGUST 15,

FOGGING: 'Safety is a relative term,' expert says

MONDAY, AUGUST 23, 2004 B7 — THE ARIZONA REPUBLIC

County efforts are holding off West Nile virus

OUR TURN

Jonathan Weisbuch

Al Brown

Two years ago, Maricopa County began planning for a West Nile virus outbreak we were predicting would occur in late 2003 or early 2004. While West Nile arrived as expected, the outbreak quickly became an epidemic.

In anticipation of an increased number of West Nile cases, our preparations included the development of more than 300,000 pieces of educational materials.

Approximately 55 news media outreach activities took place. We

We continue to provide regular announcements about progress we are making.

Was all this "Too little, too late?" ("Critics assail state, county on West Nile," *Republic*, Aug. 12).

County efforts are working. The state Department of Health Services recently announced that the epidemic may be leveling off. From June 13 to July 24, weekly cases counts were stable at around 20. In early August the number dropped to 11, and the past week we only added seven cases. This may only be a lag in reporting, but if the decreases this

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Some Concerns Expressed by Residents

- A helicopter sprayed my house with pesticides and I became ill the next day.
- I must leave the Phoenix area until the spraying stops because the pesticide drifts up to 22 miles from where it was applied.
- The spraying should be suspended while President Bush and Senator Kerry are here for their debates.
- If you ban all irrigation water usage, you won't have any mosquitoes to kill with your pesticides.
- Stop spraying my organic garden with pesticides.
- Government doesn't have authority to trespass on my property by spraying it with pesticides.

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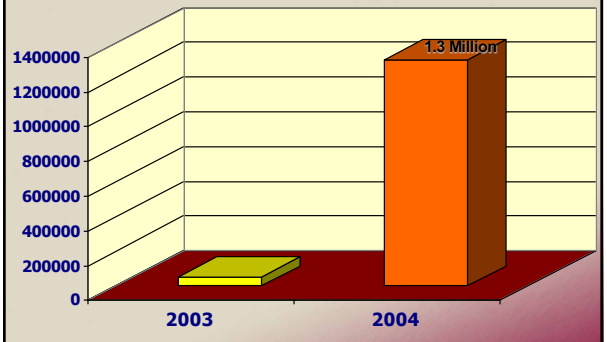
Acres treated with adulticide



Source: Maricopa County Environmental Services Department; 2005

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Is Fogging Effective?

Chandler, Arizona

Before Fogging

5-9-2004 1200 Cx. Tarsalis

After Fogging

6-3-2004 16 Cx. Tarsalis

98.7% reduction

Source: Maricopa County Environmental Services Department; 2005

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Is Fogging Effective?

Scottsdale, Arizona

Before Fogging

8-5-2004 18 Cx.q, 2 Cx.Tarsalis

After Fogging

8-11-2004 2 Cx.q, 0 Cx.Tarsalis

89% reduction Cx.q

100% reduction Cx.t

Source: Maricopa County Environmental Services Department; 2005

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Is Fogging Effective?

Mesa, Arizona

Before Fogging

5-7-2004 **7 Cx.q, 1 Cx.Tarsalis**

After Fogging

5-8-2004 **2 Cx.q, 0 Cx.Tarsalis**

71% reduction Cx.q

100% reduction Cx.t

Source: Maricopa County Environmental Services Department; 2005

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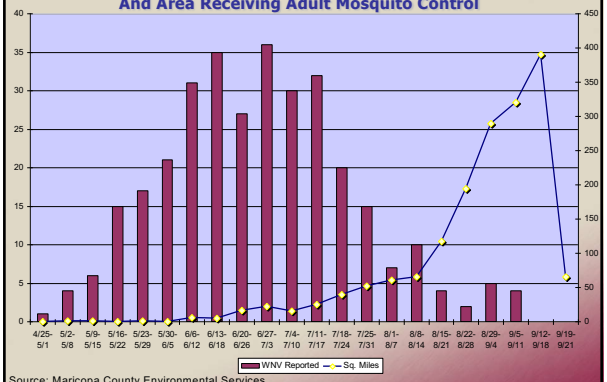
West Nile Virus Cases by Week of Onset And Area Receiving Adult Mosquito Control



Source: Maricopa County Environmental Services Department; 2005

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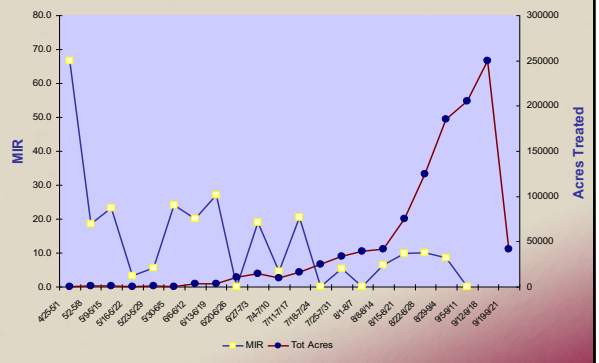
Minimum Infection Rate vs Acres Treated



Source: Maricopa County Environmental Services Department; 2005

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Michigan WNV 2002 (1)

- **Persons living outside of areas treated had a 10.5 times increased risk of WNV infection compared to people living inside treated areas**
- **WNV infection rate in mosquitoes was 7.8 times lower in populations with mosquito control compared to mosquito populations in untreated areas**

(1) Walker, N., Mosquito Management Programs and West Nile Virus in Michigan 2002, National West Nile Virus Conference, Denver, CO 2004

Source: Maricopa County Environmental Services Department; 2005

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Conclusion

- **The selection of a pesticide for widespread application over a metropolitan area must be based on good science and a careful review of all available information.**
- **Current information from EPA is found at:**
- **https://www.epa.gov/mosquitocontrol/controlling-adult-mosquitoes**
- **Your emails are invited at:**

al.brown@asu.edu

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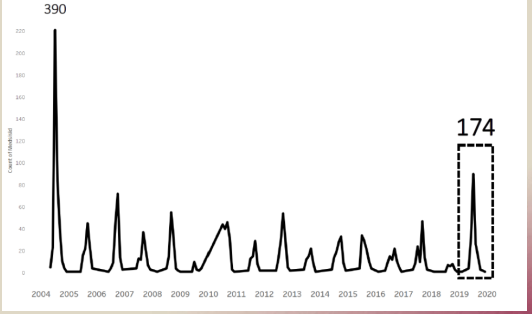
2019 was the 2nd highest WNV season ever reported.



Source: ADHS, 2021

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Vector abundance

Number of mosquitoes of a particular species collected
—————————————
Number of trapping nights

For ex. 1,420 *Culex q.* collected during the summer

Useful as thresholds for mosquito control. However, high mosquito abundance may occur in the absence of virus or detectable virus amplification.

Source: ADHS, 2021

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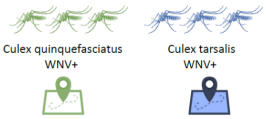
Number of positive pools

A **pool** is a group of **mosquitoes** belonging to the same species.

Total number of WNV positive mosquito **pools** detected in a given surveillance location and period.

For ex. 23 *Culex q.* **pools** WNV positive during the summer



Culex quinquefasciatus WNV+ | Culex tarsalis WNV+

Number of pools without a denominator limits the comparative value and the ability of this index to convey relative levels of WNV transmission activity.

Source: ADHS, 2021

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Vector index

Average number of mosquitoes collected per trap night **X** Proportion Infected

N of Mosquitoes trapped	# Trap Nights	Avg Mosq/Night
80	2	80/2=**40**

N of Positive Pools	N of Mosquitoes in pool tesed	Proportion Infected
1	80	1/80=**0.125**

Vector Index= 40 X 0.125= 0.5

Increases in VI reflect increases in risk of human disease and have demonstrated significantly better predictive ability than estimates of vector abundance or infection rate alone.

Source: ADHS, 2021

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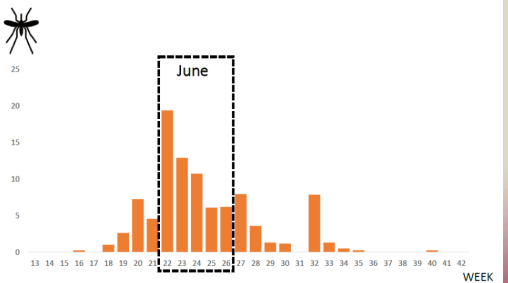
High WNV Vector Index was detected in Maricopa County in 2019.



Source: ADHS, 2021

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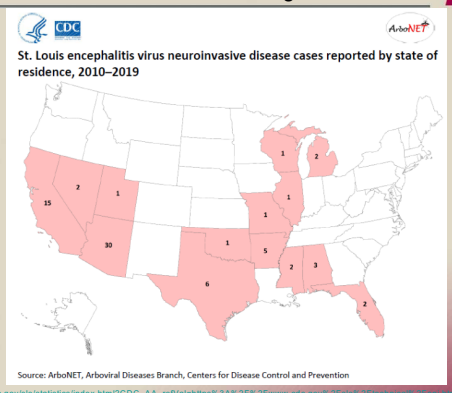
Arizona had the most SLE cases during 2010 - 2019



https://www.cdc.gov/sle/statistics/index.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fsle%2Fsurveillance%2Findex.html

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- Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control; 2003 http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnvguidelines2003.pdf
- Toxicological Profile for Pyrethrins and Pyrethroids; CDC,ATSDR; May 2021 https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=787&tid=153
- National Pesticide Information Center http://npic.orst.edu/wnv/
- Joint Statement on Mosquito Control in the United States from the U.S. Environmental Protection Agency (EPA) and the U.S. Centers for Disease Control and Prevention (CDC) https://www.epa.gov/mosquitocontrol/success-mosquito-control-integrated-approach
- Malathion for Mosquito Control, https://www.epa.gov/mosquitocontrol/controlling-adult-mosquitoes
- Synthetic Pyrethroids For Mosquito Control, 2021 update https://www.epa.gov/mosquitocontrol/permethrin-resmethrin-d-phenothrin-sumithrin-synthetic-pyrethroids-mosquito-control
- Surveillance for Acute Insecticide-Related Illness Associated with Mosquito-Control Efforts --- Nine States, 1999—2002; July 11, 2003 http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5227a1.htm
- Human Exposure to Mosquito-Control Pesticides --- Mississippi, North Carolina, and Virginia, 2002 and 2003 http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5421a1.htm
- Maricopa County Environmental Services Department; Chemical Labels and MSDS, no longer provided online; must do a FOIA
- National Alliance for Informed Mosquito Management; February 23, 2005 http://www.beyondpesticides.org/mosquito/documents/aimm.htm

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- https://www.azdhs.gov/preparedness/epidemiology-disease-control/mosquito-borne/index.php

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