

Mosquito Control Around the Home and in Communities

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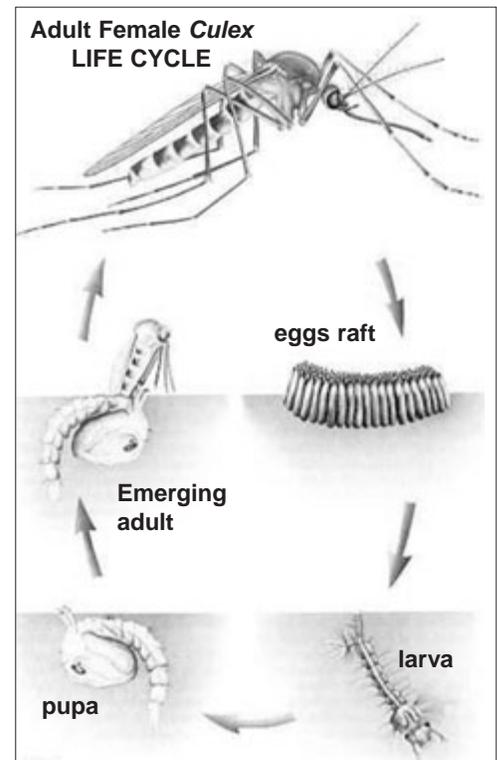
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Mosquitoes are important pests because their biting activity often interferes with our outdoor activities, and they can transmit many disease organisms, including West Nile Virus, to people and domestic animals. Most mosquitoes are active during twilight hours and at night; however, around the home, mosquitoes that breed in discarded containers can be active during the day as well as during twilight hours and at night. Other species are strictly daytime biters, while others bite only at night. Mosquitoes need water to complete their life cycle. They can breed in almost any source of water. Pesticides are only a short-term solution to nuisance mosquito problems. Solving the problem effectively and safely requires:

- Proper identification of the mosquito species.
- Obtaining information about the biology and behavior of these particular species.
- Locating and eliminating breeding sites, particularly artificial sites that may be as close as your own backyard.
- Using appropriate chemical control measures, including personal protection.

Mosquito Life Cycle

All mosquitoes have one common requirement, that being "water," to complete their life cycle. Some



mosquitoes lay individual eggs on the sides of tree holes or discarded containers or in depressions in the ground that will hold water. The eggs can lay dormant for several years. Some eggs will hatch when they are flooded by rainfall. Several flooding and drying cycles are usually required for all of the eggs to hatch that are laid by a particular female mosquito. Other mosquitoes lay eggs directly on the surface of water. The eggs are attached to one another to form a raft, or the individual eggs float on the water. These eggs hatch in 24-48 hours releasing larvae that are commonly called "wrigglers" because you can often see the larvae wriggling up and down from the water surface.

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Generally, the larvae feed on microorganisms and organic material in the water, but some mosquitoes prey on the larvae of other mosquito species and are regarded as beneficial. In about 7-10 days after eggs hatch, larvae change to the pupal or “tumbler” stage in preparation for adult life. Male mosquitoes mate with females one to two days after the females emerge. Female mosquitoes begin to seek an animal to feed on several days after emerging from water. Males do not bite, but they do feed on plant nectar.

Mosquito Breeding Sites

Since mosquitoes need water to complete their life cycle, the source of a mosquito problem can be just about anywhere that water can collect.



Farm ponds and lakes are typically not major mosquito-breeding areas if they contain fish and are free of weeds, algae or floating debris in which mosquito larvae can hide. Municipal and farm animal waste lagoons may become breeding sites. Permanent natural bodies of water, such as swamps, usually contain a wide variety of predatory insects and fish that may keep mosquitoes from reaching severe nuisance levels, although storms, such as hurricanes, may disrupt this system and allow mosquito populations to rise rapidly. In residential areas, our activities often create mosquito-breeding sites or increase production of mosquitoes in natural bodies of water. For

example, road building and maintenance often impede drainage of runoff from rainfall, creating a mosquito-breeding site. Clogged



ditches along roads can become productive mosquito-breeding sites. Storm sewer catch basins are yet another common breeding site. Logging and construction activities often leave tire ruts in the soil. These depressions are ideal breeding sites for

“floodwater” mosquito species. Around the home, objects such as birdbaths, boats, pet-watering devices, discarded tires, plant pots and other such objects collect rainwater and



allow mosquitoes to breed literally right in our own backyard. The stagnant water in unused swimming pools becomes an ideal breeding site. Mosquitoes cannot breed in properly maintained swimming pools where the appropriate pool chemicals are used. You can help reduce mosquito populations by eliminating or properly maintaining the following problem areas:

1. Do not store open containers, tires, etc., on your property where they can collect rainwater. Properly discard them as soon as possible.
2. Check flowerpots for excess water.
3. Flush out the water in birdbaths at least every five days.
4. Store boats, canoes and other objects so that they do not collect rainwater. Remove water that collects in depressions in tarpaulins covering boats and other equipment or objects.
5. Keep rain gutters free of leaves and other debris that prevent water from draining.
6. Correct drainage problems in your yard to prevent rainwater from pooling.
7. Correct or report drainage problems in ditches along public or private roadways.

Mosquito Control

Because some mosquito species can fly far from breeding sites, efforts by individuals to totally control mosquitoes only on their property rarely succeed. **A community-wide effort may be needed to reduce mosquitoes to tolerable levels.** This requires the formation of a local mosquito control program to organize community-wide “clean up” efforts and to determine the need to treat breeding sites or to apply insecticide sprays to control adults.

Repellents

Some personal protection from mosquitoes can be achieved through the use of insect repellents. Many of these products contain **DEET** (N, N-diethyl-meta-toluamide). Select the desired formulation (e.g., lotion, aerosol spray or cream) and apply only as directed on the product label. Repeated use of repellents over a short period of time is not recommended, especially for pregnant women and children. Candles containing oil of citronella are sometimes effective and are often used outdoors to repel mosquitoes. These products work best when there is relatively little air movement to disperse the chemical too quickly. **Avoid splashing water on lit citronella candles.**

Non-Chemical Control Measures

Installing and maintaining tight-fitting screens for doors and windows will help keep mosquitoes out of the home.

Bats and birds, such as purple martins, may consume mosquitoes as part of their diet. You can install nesting boxes around your property to attract these natural predators to the area. However, bear in mind that the feeding activity of insect-eating bats and birds may not be sufficiently selective to cause noticeable reductions in mosquito populations. Also, many major mosquito problems occur at night or dusk/dawn when birds are less active.

Several types of mosquito traps that use radiant heat and/or carbon dioxide to attract mosquitoes are now being marketed in the U.S. These certainly capture mosquitoes and may contribute somewhat to control efforts but are not likely to be the total answer.

What Doesn't Work

Electrocution traps (bug zappers) placed out of doors are **not** effective in reducing or eliminating mosquito populations. Recent studies have shown that less than 1/4 of 1 percent of the insects “zapped” in such devices were actually biting insects. The majority of the insects killed in electrocution traps

are actually beneficial in some form. Electronic mosquito repellers that emit high frequency sound to “repel” mosquitoes have not been shown to be effective. Claims that certain plants placed around a porch or deck will repel mosquitoes are not supported by scientifically based test results.

Chemical Control

Chemical control of mosquitoes primarily targets the adult, but **modifying or eliminating breeding sites is the only solution to severe mosquito problems.** Outdoor foggers will keep mosquitoes away for several hours, but once the chemical dissipates, the mosquitoes return. Spraying thickets or shrubs along the perimeter of your yard helps reduce the population of mosquitoes that rest in these areas; however, use of these insecticide treatments will provide only temporary reduction in mosquito populations.

Insecticides are available for controlling larvae, but their application in either large bodies of water or small artificial breeding sites can be difficult and expensive, particularly for an individual homeowner. Control programs targeting mosquito larvae are best left to trained individuals in county or local government agencies. Most of these chemicals are not selective, and some may even harm beneficial insects and other non-target organisms.

Homeowners wanting to treat small areas, such as birdbaths, garden pools, etc., might want to try bacterial insecticides that are available at many retail stores, garden centers and on-line garden suppliers. One example of these products contains a bacterium known as *Bacillus thuringiensis israelensis* or “Bti.” This bacterium kills mosquitoes but does not harm fish, birds or other wildlife. The product is most effectively used in small breeding sites (100 sq ft or less) and may last up to 30 days depending on temperature. Simply treating all areas of standing water without knowing if these areas are actually sources of the problem is a waste of time and money. Before using bacterial insecticides, consult with your county Extension agent about the life cycle and habitat requirements of mosquitoes in your area.

Table 1. Homeowner Mosquito Control

Pest	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate Per Acre	Precautions and Remarks
MOSQUITO Adults	malathion (Ortho Malathion Plus) 50% EC	9 Tbs (4.5 fl oz)/1 gal water and apply with hand sprayer. Follow label directions	2 fl oz/6,000 sq ft	May injure plants. Do not apply where food crops may be contaminated. May cause spotting on automobile paint finish. Repeat applications as necessary.
	bifenthrin (Ortho)	ready to use		Follow label directions
	cyfluthrin (Bayer Advanced)	ready to use		
	cypermethrin (Martin's Viper)	liquid concentrate		
	lambda-cyhalothrin (Spectracide)	ready to use		
	permethrin (various brands)	ready to use		
	pyrethrins + piperonyl butoxide (various brands)	ready-to-use aerosol		
	resmethrin (various brands)	some formulations are general use and others are restricted use		
	tetramethrin + sumithrin (various brands)	ready to use		
	tralomethrin (various brands)	ready to use		
MOSQUITO Immatures	<i>Bacillus thuringiensis</i> , var. <i>israelensis</i> (Mosquito Dunks, Mosquito Quick Kill Granules)	ready to use follow label directions		
	methoprene (Altosid) 20% EC	3-4 fl oz/gal water	1 gal	Apply when larvae are in third and fourth instar. Methoprene will not kill pupae or adults.
	methoprene (Altosid) briquette 2.1%, 8.6% (Altosid) pellet 4.2% (Altosid) granule 0.27%, 1.5% (Pre-Strike) granule 1.5%	ready to use		Water less than 2 ft; 1 briquette per 100 sq ft deeper or flowing water; 1 briquette per 10 cu ft 2.5 to 10 lb pellet per acre; use high rate in breeding sites with high organic content.

The following mosquito control insecticides are recommended for use by Certified Applicators only.

Table 2. Community Adult Mosquito Control

KEY: MMD = Mass Median Diameter; um = micrometer						
Pest	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate @ 10 mph	Droplet Size Requirements on Label (um)	Precautions and Remarks	
MOSQUITO ADULTS (Ground application)	Malathion 95% concentrate	Use undiluted on aerosol ULV sprayer.	2-4.3 fl oz/min	6-48 mm MMD = 17 um	Do not spray when wind speed is more than 5 mph.	
		Dilute 3.9 to 5.2 gal to 100 gal with No. 2 fuel or diesel oil; use in thermal fog sprayer.			Avoid direct application to vehicles; these insecticides may damage paint. Apply when air temperatures are cool and wind speed is 3 mph or less. Toxic to fish, aquatic invertebrates and wildlife.	
	naled (Dibrom) 87.4% concentrate	10 fl oz to 10 gal No. 2 fuel or diesel oil; use in thermal fog sprayer.	80 gal/hr			Toxic to fish, aquatic invertebrates and wildlife.
		Dilute 0.5 gal to 5 gal with soybean oil or HAN; use in ULV sprayer.	6-12 fl oz/min	11-20 um MMD = 15 um	Do not apply directly to water or to areas where runoff into water is likely to occur.	
	Permethrin 10% to 57% concentrate (Permanone) 10% EC	Apply undiluted or mix with refined mineral or soybean oil.	0.31-15 oz/min depending on dilution	MMD = 8-30 um		
		Dilute 1:20 with water (6.5 fl oz/1 gal of water).				Treat surfaces using coarse wet spray. Spray to runoff.
	permethrin (20%) and piperonyl butoxide (20%) (Aqua-Reslin)	Dilute 1 gal with 2-12 gal water	2.1-9 oz/min depending on dilution	MMD = 8-20 um	Dilute with water only. Toxic to fish and aquatic invertebrates.	
	permethrin and piperonyl butoxide (Permanone 31-66) (Biomist 4+12 ULV) (Biomist 30+30 ULV)	Dilute 1 gal to 2.4 gal with light-weight oil; use in ULV sprayer.	0.5-3 fl oz/min	15-30 um		
		Mix 1:2 with solvent Mix 1:4 with solvent Mix 1:8 with solvent	1.5-6 fl oz/min 2.5-10 fl oz/min 4.5-18 fl oz/min	5-30 um MMD = 10 to 20 um	Dilute Biomist 30+30 with solvent such as mineral oil. Do not apply this product within 100 ft of lakes or streams.	
resmethrin (18%) + piperonyl butoxide (54%) (Scourge)	Dilute 0.67 gal with 1 gal of light mineral oil; use in ULV sprayer.	4.5-9 fl oz/min	MMD = 12 um	Restricted Use Insecticide.		
SBP-1382-40MF (resmethrin) 40% concentrate	Dilute 12.5 fl oz with 1 gal of light mineral oil; use in ULV sprayer.	6 fl oz/min	MMD = 12 um	Restricted Use Insecticide.		
sumithrin and piperonyl butoxide (Anvil 10+10 ULV or 2+2 ULV)	Use undiluted or dilute 10+10 formulation with light mineral oil.	1.3-18.6 oz/min	MMD = 5-25 um			
MOSQUITO ADULTS (Fixed-wing aerial application)	Malathion 95% concentrate	Use undiluted.	2.6-3 fl oz/acre	90% of droplets <100 um MMD = 50-60 um	Aircraft should be operated at 80 mph or more; large droplets may spot car paint. Toxic to fish, aquatic invertebrates and wildlife. Do not apply directly to water or to areas where runoff into water is likely to occur.	
	naled (Dibrom) 87.4% concentrate	Use undiluted.	0.5-1 fl oz/acre	30-80 um		
		Dilute 50-100 fl oz to 100 gal with No. 2 fuel oil or diesel oil.	1 gal/acre			Toxic to fish, aquatic invertebrates and wildlife. Do not apply directly to water or to areas where runoff into water is likely to occur.
permethrin and piperonyl butoxide (Biomist 30+30 ULV)	Use undiluted.	0.33-1 fl oz/acre	MMD = 50 um with no less than 2.5% exceeding 100 um	Product can be applied diluted as long as 1 fl oz/acre of Biomist 30+30 ULV is not exceeded.		
sumithrin and piperonyl butoxide (Anvil 10+10 ULV)	Use undiluted.	3.8-5.7 fl oz/acre	MMD = 15-30 um			

Table 3. Community Immature Mosquito Control

Pest	Insecticide and Formulation	Mixing Instructions and Application Equipment	Application Rate Per Acre	Precautions and Remarks
MOSQUITO Immatures	<i>Bacillus thuringiensis</i> , var. <i>israelensis</i> (Bactimos, Teknar, Vectobac) 50 WP 2 WP 14.3% aqueous conc. 15% aqueous conc. 1.2% aqueous conc. 0.8% aqueous conc.	Dilute with sufficient water to obtain uniform coverage.	6-12 oz 4-16 oz 0.5-3 pt 0.5-3 pt 0.25-2 pt 0.5-2 pt	Only effective against larvae. Can be applied to all breeding habitats, including potable water supplies.
	<i>Bacillus thuringiensis</i> , var. <i>israelensis</i> (Bactimos) briquettes 10%	ready to use		Use one briquette per 100 sq ft of surface area regardless of depth.
	(Bactimos, Teknar, Vectobac) granules 0.2% pellets 0.4%			Apply 4 to 10 lbs per acre with aircraft or ground equipment.
	Malathion 57 EC	2.5 fl oz/gal water	Up to 5 gal in area with heavy vegetation	
	Methoprene (Altosid) 20% EC	3-4 fl oz/gal water	1 gal	Apply when larvae are in 3rd and 4th instar. Methoprene will not kill pupae or adults.
	(Altosid) briquette 2.1%, 8.6% (Altosid) pellet 4.2% (Altosid) granule 0.27%, 1.5% (Pre-Strike) granules 1.5%	ready to use		Water less than 2 ft; 1 briquette per 100 sq ft deeper or flowing water; 1 briquette per 10 cu ft 2.5 to 10 lb pellet per acre; use high rate in breeding sites with high organic content.
	monomolecular surface film (Agnique MMF)		0.2-0.5 gal	Use in conjunction with indicator oil to avoid overtreatment.
	proprietary mosquito control oils (GB-1111, etc.)		1-5 gal	Dosage depends on amount of floatage and vegetation in water.
temephos (Abate) 43% EC 1G 2G 5G	0.5-1.5 fl oz/gal water	1 gal 5-10 lb 2.5-5 lb 1-2 lb		

Information derived from NCSU publication ENT/rsc-6 prepared by C. S. Apperson and M. G. Waldvogel, Extension Entomologists, and 2007 North Carolina Agricultural Chemicals Manual.

All chemical information is given with the understanding that no endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned. Before purchasing or using any pesticide, always read and carefully follow the directions on the container label.

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