MOSQUITO CONTROL

PROFESSIONAL DEVELOPMENT
CONTINUING EDUCATION COURSE

Left, an ancient Mosquito and on the right, a Midge, both of these are preserved in amber (tree sap), and are believed to be 25 million years old.

How do we Fight these Ancient Pests?

- Empty standing water in old tires, cemetery urns, buckets, plastic covers, toys, or any other container where "***wrigglers***" and "***tumblers***" live.
- Empty and change the water in bird baths, fountains, wading pools, rain barrels, and potted plant trays at least once a week if not more often.
- Drain or fill temporary pools with dirt.
- Keep swimming pools treated and circulating and rain gutters unclogged.
- Use mosquito repellents when necessary and follow label directions and precautions closely.
- Use head nets, long sleeves and long pants if you venture into areas with high mosquito populations, such as salt marshes.
- If there is a mosquito-borne disease warning in effect, stay inside during the evening when mosquitoes are most active.
- Make sure window and door screens are "***bug tight***."
- Replace your outdoor lights with yellow "***bug***" lights.

Contact your local mosquito control district or health department. Neighborhoods are occasionally sprayed to prevent disease and nuisance caused by large mosquito numbers. If you have any questions about mosquitoes and their control, call your local authorities.

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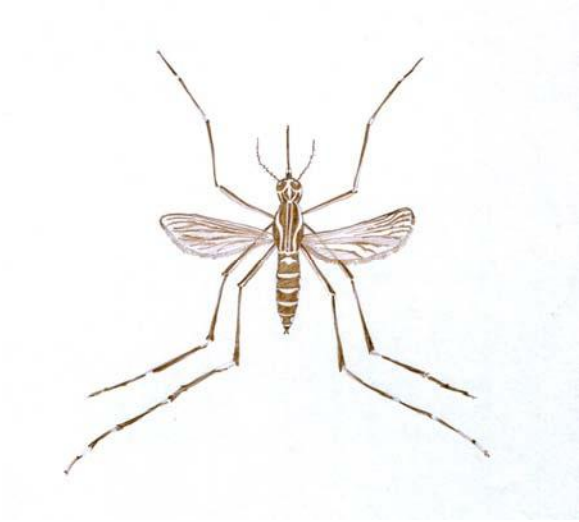

Aedes Aepyti **Yellow Fever Mosquito**

Important Information about this Manual

This manual has been prepared to educate pesticide applicators and operators in general safety awareness of dealing with the often-complex and various pesticide treatment devices, methods, and applications.

This manual will cover general laws, regulations, required procedures and accepted policies relating to the use of pesticides. It should be noted, however, that the regulation of pesticides and hazardous materials is an ongoing process and subject to change over time. For this reason, a list of resources is provided to assist in obtaining the most up-to-date information on various subjects.

This manual is a not a guidance document for applicators or operators who are involved with pesticides. It is not designed to meet the requirements of the United States Environmental Protection Agency or your local State environmental protection agency or health department.

This course manual will provide general pesticide safety awareness and should not be used as a basis for pesticide treatment method/device guidance. This document is not a detailed pesticide or a source or remedy for poison control.

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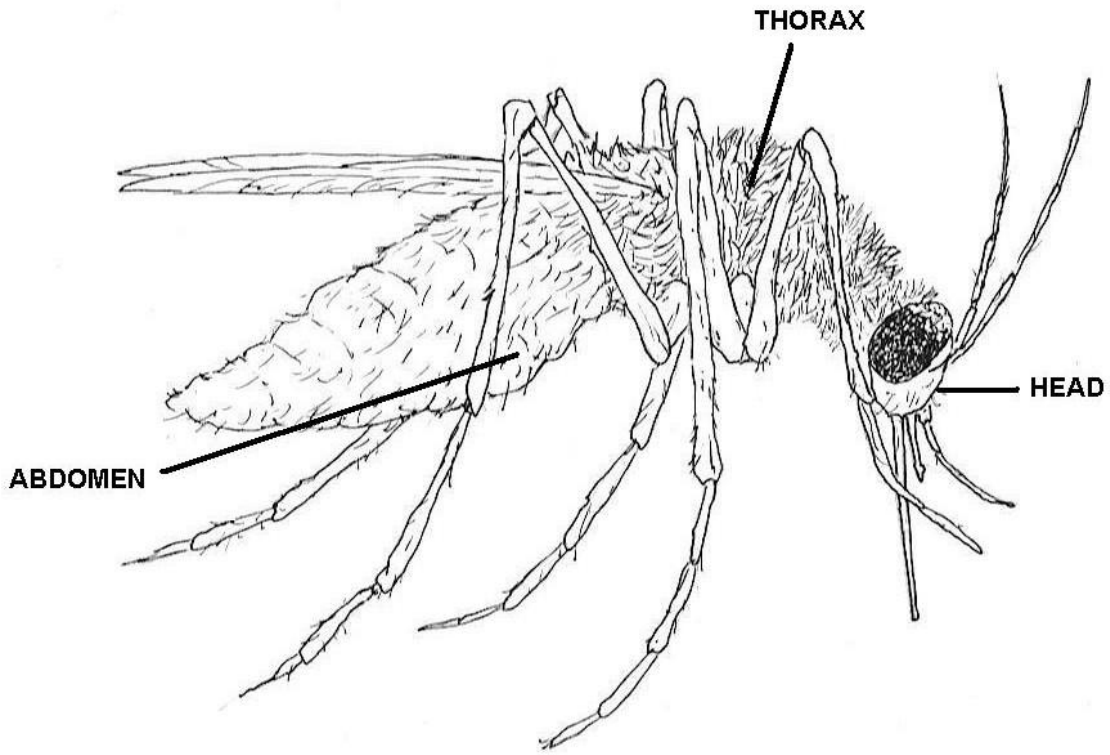
Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables ready to be picked.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse containers. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides.

Never burn pesticide containers.

Individuals who are responsible for pesticide storage, mixing and application should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with the EPA and other appropriate federal, state and local agencies.



MOSQUITO

Mosquitoes are the #1 killer of humans in the world. About 2 million people die each year from a disease resulting from a mosquito bite. The disease is called **Malaria**, and is caused by a small animal, called a *Plasmodium* that gets into people through a mosquito bite.

Only female mosquitoes bite. They use protein from blood to make the shells of their eggs. Male and female mosquitoes eat nectar from flowers - like butterflies and hummingbirds. The female mosquitoes have a problem, though, when they try to suck our blood. When our blood gets outside of our body, the cells tend to stick together.

We know this as clotting and it's why you get a scab when you cut yourself - its scientific name is "coagulation". Coagulation is a big problem for a mosquito who has a very thin tube through which to suck blood. The stuck together blood cells clog her tube and she cannot get good blood through it. To combat coagulation, the mosquito first ***spits*** into us when she bites. She spits a chemical called an "anti-coagulant" that keeps the blood cells from sticking together so she can suck as much as she wants! It is during the spitting phase of biting that the Malarial *Plasmodium* gets into you.

Once inside a mammal, the *Plasmodium* goes through the bloodstream and into the liver where it reproduces. From the liver, the *Plasmodium* cells get into red blood cells and begin to feed. Inside the red blood cells, the *Plasmodium* cells divide and eventually split the red blood cells open and a bunch of new *Plasmodium* cells infect other red blood cells. The cycle continues as the host animal gets sicker and sicker and often dies.

Fortunately, the type of *Plasmodium* that causes Malaria and the species of mosquito (in the genus *Anopheles* "an-off-eh-lees") that spreads it do not live in the United States, but in many other countries (especially in tropical regions), this is a very dangerous disease.

Therefore, a lot of research money is available for the study of Malaria and mosquitoes (which also spread other diseases in much the same fashion).

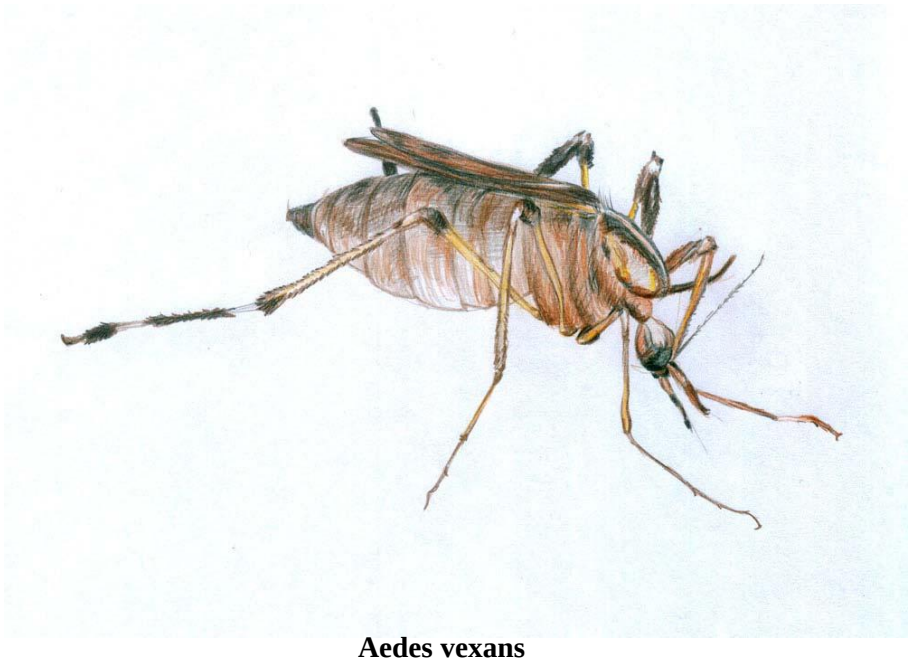
Here is the bad news…
Recent documents found in terrorist's hideout have confirmed the worst possible scenario. Insects are a viable method of carrying diseases that can destroy mankind. Researchers have discovered that 25 species successfully carry viruses and toxins that can easily destroy man. A suitcase of these insects can potently wipe a entire city of all human life.

Terms and Definitions

Mosquito
Mosquito \Mos*qui"to\, n.; pl. Mosquitoes. [Sp. mosquito, fr. moscafly, L. musca. Cf. Musket.] (Zo["o]l.) Any one of various species of gnats of the genus Culex and allied genera. The females have a proboscis containing, within the sheath-like labium, six fine, sharp, needlelike organs with which they puncture the skin of man and animals to suck the blood. These bites, when numerous, cause (in many persons) considerable irritation and swelling, with some pain. The larv[ae] and pup[ae], called wigglers, are aquatic. [Written also musquito.] A mosquito has three body parts. They are the head, the thorax, and the abdomen. It has six legs, two wings and two antennae. (The male and female have different antennae.) The part that sucks our blood is called the proboscis.

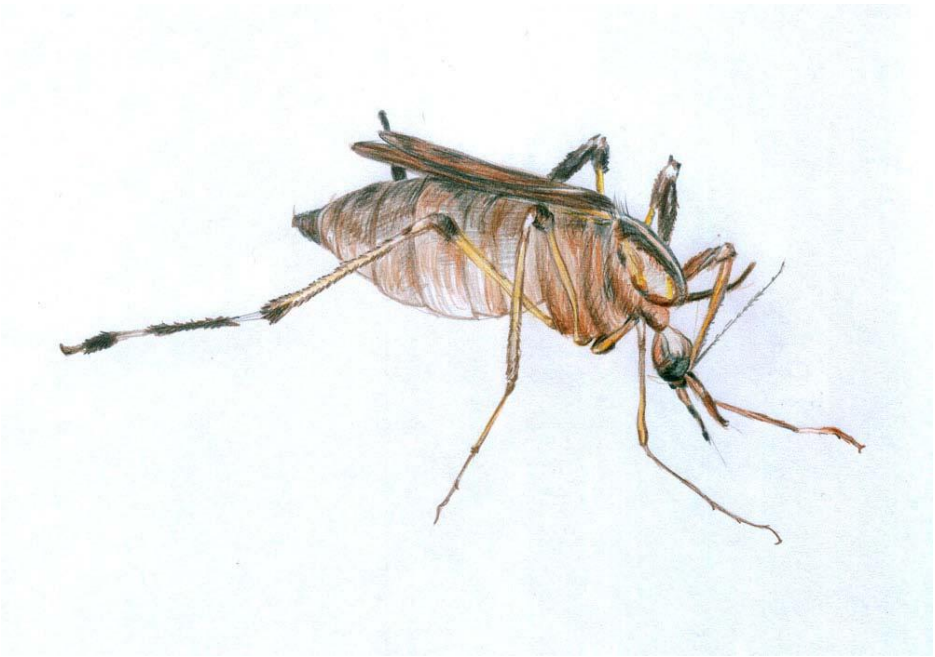
Blood engorged female

Term	Definition
Arbovirus	Any of various viruses transmitted by arthropods and including the causative agents of encephalitis, yellow fever and dengue.
Biological Control	The use of parasites or pathogens to control a pest.
Disease	Condition of the living animal or plant body or of one of its parts that impairs the performance of a vital function.
Encephalomyelitis	Concurrent inflammation of the brain and spinal cord.
Monitoring	Method in which an area is appraised for its mosquito numbers and/or evidence of disease agents within the mosquito population.
Pathogen	Specific causative agent of disease.
Reservoir	Organism in which a parasite that is pathogenic for some other species lives and multiplies without damaging its host.
Surveillance	Method in which an area is appraised for its risk of providing mosquito breeding grounds and subsequent mosquito populations.
Vector	Organism that transmits a pathogen.



Aedes vexans

Floodwater mosquitoes such as *Aedes vexans* lay their eggs in damp places just above the water line of temporary ponds. The eggs hatch after a warm rain and may produce a new generation of adults in as little as a week. Eggs can also remain dormant for over two years during drought conditions. The adults will die from desiccation if exposed to dry sunny conditions and will only emerge from wooded areas at dusk or on dull, humid days.



Psorophora ciliata

Psorophora ciliata is found only during wet summers when other mosquitoes are abundant. Their larvae are carnivorous and each one consumes dozens of smaller mosquito larvae.

Mosquito Introduction

How many kinds of mosquitoes are there?
About 3000 species of mosquitoes have been described on a world-wide basis. Approximately 150-200 are known to occur in North America.

Scientists group species by genus on the basis of the physical characteristics they share. The 3000 mosquito species found in the world are divided among 28 different genera. The genus *Aedes* contains some of the worst pests. Many members of the genus *Anopheles* have the ability to transmit human malaria.

Genera
Here are just a few major genera that occur in the United States: *Aedes*, *Anopheles*, *Culex*, *Culiseta*, *Coquillettidia*, *Psorophora*, *Orthopodomyia*, *Uranotaenia*, *Toxorhynchites* and *Wyeomyia*. It is sometimes more convenient to group mosquitoes by the breeding habitat they use. The major habitat groups found include: "*Snowpool Mosquitoes*", "*Floodwater Mosquitoes*", "*Swamp Breeding Mosquitoes*" and "*Container Breeding Mosquitoes*".

Common Name	**Scientific Name**	**Importance**
Asian Tiger Mosquito	Aedes albopictus	LAC, EEE, SLE, Pest
(banded spring mosquito)	Aedes canadensis	LAC, Pest
Eastern Treehole Mosquito	Aedes triseriatus	LAC
(flood-water mosquito)	Aedes tivittatus	Pest
Vexans Mosquito	Aedes vexans	Pest
Common Malaria Mosquito	Anopheles quadrimaculatus	Malaria, Pest
Cattail Mosquito	Coquillettidia perturbans	EEE, Pest
Northern House Mosquito	Culex pipiens	SLE
Key: **LAC** = LaCrosse Encephalitis **EEE** = Eastern Equine Encephalomyelitis **SLE** = St. Louis Encephalitis		

Why do mosquitoes bite?
Mosquitoes belong to a group of insects that require blood to develop fertile eggs. Males do not lay eggs, thus, male mosquitoes do not bite. The females are the egg producers and "*host-seek*" for a blood meal. Female mosquitoes lay multiple batches of eggs and require a blood meal for every batch they lay. Few people realize that mosquitoes rely on sugar as their main source of energy.

Both male and female mosquitoes feed on plant nectar, fruit juices and liquids that ooze from plants. The sugar is burned as fuel for flight and is replenished on a daily basis. Blood is reserved for egg production and is imbibed less frequently.

Why do mosquitoes leave welts when they bite?
When a female mosquito pierces the skin with her mouthparts, she injects a small amount of saliva into the wound before drawing blood.

Why are some People more Attractive to Mosquitoes then others?

Scientists are still investigating the complexities involved with mosquito host acceptance and rejection. Some people are highly attractive to mosquitoes and others are rarely bothered. Mosquitoes have specific requirements to satisfy and process many different factors before they feed.

Many of the mosquito's physiological demands are poorly understood and many of the processes they use to evaluate potential blood meal hosts remain a mystery. Female mosquitoes use the CO_2we exhale as their primary cue to our location. A host seeking mosquito is guided to our skin by following the slip stream of CO_2 that exudes from our breath.

Short Range Attractants
Once they have landed, they rely on a number of short range attractants to determine if we are an acceptable blood meal host. Folic acid is one chemical that appears to be particularly important. Fragrances from hair sprays, perfumes, deodorants and soap can cover these chemical cues. They can also function to either enhance or repel the host seeking drive.

Dark colors capture heat and make most people more attractive to mosquitoes. Light colors refract heat and are generally less attractive.

Detergents, fabric softeners, perfumes and body odor can counteract the effects of color. In most cases, only the mosquito knows why one person is more attractive than another.

How Long do Mosquitoes Live?
Mosquitoes are relatively fragile insects with an adult life span that lasts about 2 weeks. The vast majority meet a violent end by serving as food for birds, dragonflies and spiders or are killed by the effects of wind, rain or drought.

The mosquito species that only have a single generation each year are longer lived and may persist in small numbers for as long as 2-3 months if environmental conditions are favorable.

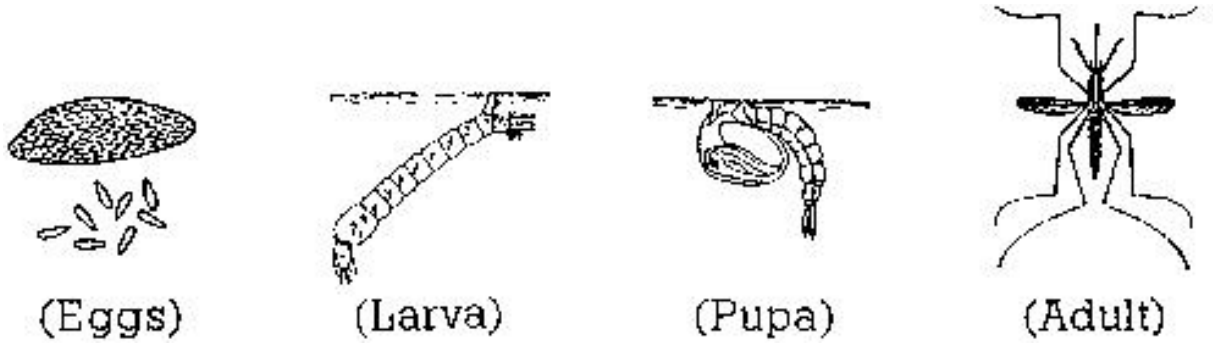
Mosquitoes that hibernate in the adult stage live for 6-8 months but spend most of that time in a state of torpor. Some of the mosquito species found in arctic regions enter hibernation twice and take more than a year to complete their life cycle.

Mosquito Bite
The saliva makes penetration easier and prevents the blood from clotting in the narrow channel of her food canal. The welts that appear after the mosquito leaves is not a reaction to the wound but an allergic reaction to the saliva injected to prevent clotting. In most cases, the itching sensation and swellings subside within several hours. Some people are highly sensitive and symptoms persist for several days. Scratching the bites can result in infection if bacteria from the fingernails are introduced to the wounds.

Where do mosquitoes go in the winter?
Mosquitoes, like most insects, are cold blooded creatures. As a result, they are incapable of regulating body heat and their temperature is essentially the same as their surroundings. Mosquitoes function best at 80° F, become lethargic at 60° F and cannot function below 50° F.

Mosquito Life Cycle

The type of standing water in which the mosquito chooses to lay her eggs depends upon the species. The presence of beneficial predators such as fish and dragonfly nymphs in permanent ponds, lakes and streams usually keep these bodies of water relatively free of mosquito larvae.



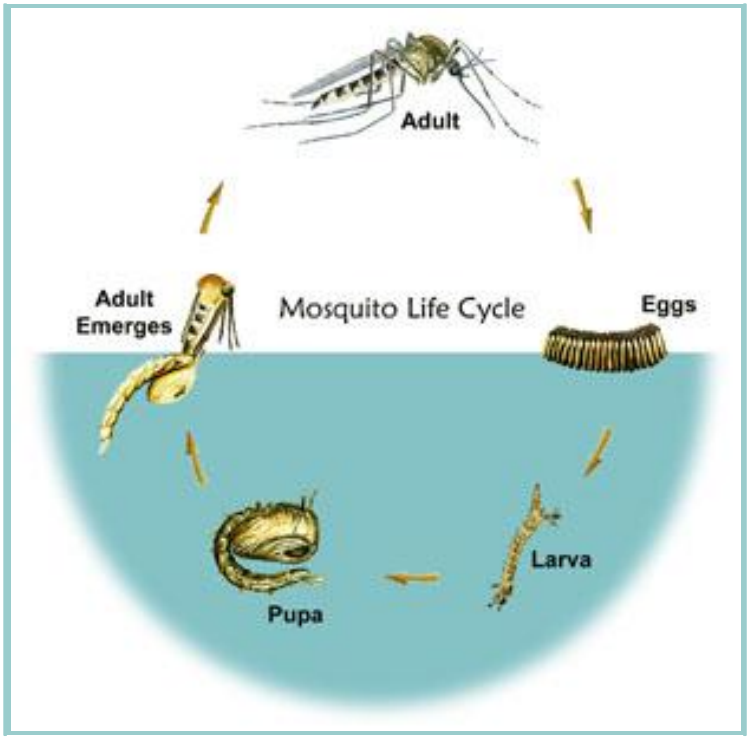
(about one hundred times actual size)

However, portions of marshes, swamps, clogged ditches and temporary pools and puddles are all prolific mosquito breeding sites. Other sites in which some species lay their eggs include tree holes and containers such as old tires, buckets, toys, potted plant trays and saucers and plastic covers or tarpaulins.

Some of the most annoying and potentially dangerous mosquito species, such as the Asian tiger mosquito, come from these sites.

The mosquito goes through four distinct stages during its life cycle:

- **egg** - hatches when exposed to water;
- **larva** - (plural. - larvae) lives in the water; molts several times; most species surface to breathe air;
- **pupa** - (plural - pupae) does not feed; stage just prior to emerging as adult;
- **adult** - flies short time after emerging and after its body parts have hardened.



Mosquitoes' Life Cycle

Wrigglers and Tumblers
The mosquitoes in the United States, all of which live in specific habitats, exhibit unique behaviors and bite different types of animals. Despite these differences, all mosquitoes share some common traits, such as a four-stage life cycle.

After the female mosquito obtains a blood meal (**male mosquitoes do not bite**), she lays her eggs directly on the surface of stagnant water, in a depression, or on the edge of a container where rainwater may collect and flood the eggs. The eggs hatch and a mosquito larva or "**wriggler**" emerges.

The larva lives in the water, feeds and develops into the third stage of the life cycle called a pupa or "**tumbler**". The pupa also lives in the water, but no longer feeds.

Finally, the mosquito emerges from the pupal case and the water as a fully developed adult, ready to bite.

Mosquitoes may overwinter as eggs, fertilized adult females or larvae. Eggs, larvae, and pupae must have water to develop. Some female mosquitoes lay their eggs directly on the water surface.

Others lay their eggs on substrates above the water line (flood pool mosquitoes); the eggs hatch upon flooding. In some cases, the eggs will remain viable for several years until further flooding occurs.

Mosquitoes belonging to the genus Culex lay their eggs in bunches or "*rafts*."

Each raft may contain up to 400 individual eggs. Larvae feed on bits of organic matter dispersed in the water, becoming full grown in about one week. The pupal stage lasts two to three days.

Female mosquitoes are ready to bite one to two days after adult emergence.

Male mosquitoes do not bite but feed on flower nectar or plant juices. Some mosquitoes have only one generation per year, whereas others may have four or more.

Raft, these are easy to find

Adults may fly 5 to 10 miles, but usually rest in grass, shrubbery or other foliage close to the water breeding area.

Mosquito Habitats

Running Water - Few mosquito species in the U.S. breed in running waters, such as streams. Larvae can be flushed out when stream volume increases, and to remain in the stream requires a large amount of energy. The tropical genus *Chagasia* and some *Anopheles* species are stream breeders. In addition, *Anopheles quadrimaculatus, Culex territans, and Uranotaenia sapphirina* have all been found in streams, although they prefer other habitats. Stream breeders will find vegetation along banks with which to anchor themselves or attempt to remain away from the main flow of the stream by seeking isolated eddies.

Transient Water - Transient water sources, such as flooded areas, snowpools, and ditches are used as breeding grounds for mosquito species whose eggs can withstand desiccation, such as *Aedes* and *Psorophora*. Their life cycles require alternating periods of wet and dry. Other species, like an opportunistic *Culex*, might be able to pull off a single generation during an extended flooded period. Transient water generally shows water quality changes which result in various mosquito species using the same pool over a period of time. Transient waters include:

Woodland Pools – Snowpool (*Aedes communis*)

Woodland Pools - Spring Rains *(Aedes stimulans*)

Fresh Floodwater –
(*Aedes canadensis)*

Tidal Floodwater –
(*Aedes sollicitans*)

Permanent water - These waters (also known as Semi-permanent) are present for extended periods of time and support characteristic aquatic vegetation. Cattail, rushes and sedges are typical freshwater swamp vegetation.

Genera associated with permanent water are *Anopheles, Culex, Culiseta, Coquillettidia,* and *Uranotaenia*. Eggs of these species are not desiccant-resistant and must be laid directly on the water. *Aedes* adults will oviposit near the edge of the swamp, or within tussocks of vegetation, requiring later flooding to inundate the eggs for hatching. As with transient waters, there is a seasonal change in the vegetation, water quality and mosquito species present. Permanent waters include:

Freshwater Swamp Tussocks
(*Aedes abserratus*)
A view of an early season tussocks swamp.

A close-up of a tussock reveal the vegetation under which larvae will live.

Another freshwater swamp are the cattail swamps, where *Coquillettidia perturbans* can be found.

Acid Water Swamp (White Cedar) Swamp – (*Culiseta melanura*) This mosquito has a subterranean life style.

Culiseta are found in *"crypts"* formed by pockets of water surrounding tree roots.

Brackish Water Swamps (Salt Marsh) – (*Culex salinarius*)

Polluted Water - (*Culex pipiens*)

Containers

Container water habitat can be found in both natural settings, such as water held by plants (bromeliads), to artificial settings, such as water found in tires. The habitat inside containers are based on the containers themselves.

Treehole sites generally have tannin-enriched water which is characteristically clear, with rotting wood at the bottom. Many treehole species now also use artificial sites, such as tires, since they provide insulation against the weather and are more numerous. Artificial containers are a convenient mode of transporting a species of mosquito outside of its natural range.

Small Plants - Bromeliads (tropical), pitcher plants (*Wyeomia smithii)*

Treeholes (*Aedes triseriatus)*

Bamboo

Crab Holes Decaying Fruit

Artificial - e.g., tires (*Aedes albopictus*, *Aedes aegypti*)

Pupa of Anopheles farauti

Mosquito traps recreate warm moist CO_2 (human breath), primary dry ice but other traps use propane and some traps add the irresistible attraction of octenol to trap mosquitoes. Some traps will contain a suction fan, and a light bulb to trap and attract the female mosquito. Several mosquito traps will operate quietly and will eliminate 100s of mosquitoes in a few hours at dusk and dawn.

Several government agencies will place the daily quarry of mosquitoes into plastic bags for counting and determine the mosquito species. The captured mosquitoes are often sent to a laboratory for further analysis.

Mosquito Control Section

Mission of the Environmental Protection Agency
The mission of the Environmental Protection Agency (**EPA**) is to protect human health and the environment. The EPA reviews and approves pesticides and their labeling to ensure that the pesticides used to protect public health are applied by methods which minimize the risk of human exposure and adverse health and environmental effects.

In relation to mosquito control, the Agency also serves as a source of information about pesticide and non-pesticide controls to address the concerns of the general public, news media, and the state and local agencies dealing with outbreaks of infectious diseases or heavy infestations of mosquitoes. The following documents provide some basic information on mosquito control, safety precautions, and information on insecticides used for mosquito control programs.

How Are Mosquitoes Controlled with Pesticides and Other Methods?
The first step in mosquito control is surveillance. Mosquito specialists conduct surveillance for diseases harbored by domestic and nonnative birds, including sentinel chickens (used as virus transmission indicators), and mosquitoes. Surveillance for larval habitats is conducted by using maps and aerial photographs, and by evaluating larval populations.

Other techniques include various light traps, biting counts, and analysis of reports from the public. Mosquito control programs also put high priority on trying to prevent a large population of adult mosquitoes from developing so that additional controls may not be necessary.

Since mosquitoes must have water to breed, methods of prevention may include controlling water levels in lakes, marshes, ditches, or other mosquito breeding sites, eliminating small breeding sites if possible, and stocking bodies of water with fish species that feed on larvae.

Both chemical and biological measures may be employed to kill immature mosquitoes during larval stages. *Larvicides* target larvae in the breeding habitat before they can mature into adult mosquitoes and disperse.

Larvicides
Larvicides include the bacterial insecticides *Bacillus thuringiensis israelensi*s and *Bacillus sphaericus*, the insect growth inhibitor methoprene, and the organophosphate insecticide temephos. Mineral oils and other materials form a thin film on the surface of the water which cause larvae and pupae to drown.

Liquid larvicide products are applied directly to water using backpack sprayers and truck or aircraft-mounted sprayers. Tablet, pellet, granular, and briquette formulations of larvicides are also applied by mosquito controllers to breeding areas.

Homeowners may apply Mosquito Dunks (made with Bacillus thuringiensis Berliner var. israelensis or B.t.i.) to kill mosquito larvae in the water. This natural ingredient is harmless to other living things and is biodegradable. (Summit Chemical Co. 800-227-8664).

Methoprene (Altosid XR)
Methoprene (Altosid XR) is another safe material for control of mosquito larvae. It is an insect hormone which retards the development of larvae (disrupts molting) and prevents mosquitoes from developing into adults (Clarke Mosquito Control Products, Inc. 800-323 -5727).

Altosid XR Briquettes
Altosid XR Briquettes can be placed even on ice for season-long control. Treat swamps, ponds, and marsh areas in early spring before thawing. These extended-release briquettes will provide up to 150 days of uninterrupted mosquito control once they hit the water. It can be applied by hand and the product is labeled for use in known fish habitats.

Microbial insecticides
The product known as **Bti** (*Bacillus thuringiensis israeliensis*) can be as effective as chemical insecticides. When the bacteria Bti encysts, it produces a protein crystal toxic to mosquito and midge larvae. Once the bacteria has been ingested, the toxin disrupts the lining of the larvae's intestine. It has no effect on a vast array of other aquatic organisms except midges in the same habitat. Bti strains are sold under the names Bactimos®, Teknar® and Vectobac®.

Mosquito

Dunks or Briquettes
Product Description: Small donut shaped and sized objects which release bacteria into water where mosquitoes are breeding. When the larva feed on the bacteria, they die.

Target Pests: Mosquito larva.

Areas of Use: *Anywhere*. This bacteria will not hurt pets, children, birds or wildlife. Great for use in bird baths, ponds, lakes, swamps, rain barrels, clogged gutters, sewers which hold water, retention ponds, drainage ditches, slow moving streams, bottoms of planters and anywhere water is able to accumulate and provide mosquitoes a place to reproduce.

Application: One dunk will cover about 100 sq/ft of surface area. You can break it up if treating small areas and tie it to a weight or anchor of some sort when applying it to moving water.

Juvenile Hormone
Methoprene (sold under the name Altosid®) is an insect growth regulator widely used by abatement districts to control mosquito larvae Methoprene mimics a natural juvenile hormone, and when present in the larval habitat, it keeps immature insects from maturing into adults. Unable to metamorphose, the mosquitoes die in the pupal stage.

Vector control technicians sometimes use methoprene to reach larval sources that would otherwise be difficult or dangerous to treat. Pellets can be flushed down toilets into underground septic tanks known to be breeding house mosquitoes. The methoprene kills the mosquitoes without upsetting the septic system's bacterial digestive processes.

Larvicidal Oils
Oils have been used for mosquito control for more than a century. The Marin / Sonoma District in California uses Golden Bear 1111®, a light viscosity oil that spreads quickly and evenly over the water surface, preventing larvae and pupae from obtaining oxygen through the surface film.

Oils have always been used as a product of last resort for the control of mosquito pupae, since this stage does not feed but does require oxygen. The only other option would be draining the source. Closer surveillance and timing of other agents and techniques can greatly reduce the need for larvicidal oils.

Chemical Larvicides
Costs and complexity of mosquito control have increased markedly since the passage of the Environmental Protection Act in 1969. The increasing number of governmental regulations and permitting bodies, rising costs of alternative chemicals and the spreading resistance of many vector species to existing pesticides have almost completely changed or eliminated the use of chemical control agents.

Chlorinated hydrocarbons like DDT and Chlordane are very much a thing of the past, as are the use of Organophosphate and Carbamate insecticides. Chlorinated hydrocarbons were removed from the US market in 1964, and in 1987.

Adulticides
Adult mosquito control may be undertaken to combat an outbreak of mosquito-borne disease or a very heavy nuisance infestation of mosquitoes in a community. Pesticides registered for this use are *adulticides* and are applied either by aircraft or on the ground employing truck-mounted sprayers. State and local agencies commonly use the organophosphate insecticides Malathion and Naled and the synthetic pyrethroid insecticides Permethrin, Resmethrin, and Sumithrin for adult mosquito control.

Mosquito adulticides are applied as ultra-low volume (**ULV**) sprays. ULV sprayers dispense very fine aerosol droplets that stay aloft and kill flying mosquitoes on contact. ULV applications involve small quantities of pesticide active ingredient in relation to the size of the area treated, typically less than 3 ounces per acre, which minimizes exposure and risks to people and the environment.

Chemical Control of Adult Mosquitoes
Because of environmental concerns and drift, chemical pesticides are not the most popular method. But if you do use chemical pesticides, the technique used for adult mosquito control is known as ultra-low volume (**ULV**) spray.

A small quantity of the pesticide is atomized into micron size particles and broadcast in a fog that drifts into sites where the adult mosquitoes hide. At best control is achieved up to 300 feet away, but it does help reduce the numbers of biting mosquitoes to tolerable levels. In recent years the use of vehicle-mounted units has decreased in favor of small, hand-carried dispersal units. This allows a more precise application of the pesticide.

The pesticide used for ULV spraying is pyrethrum (sold as Pyrocide®), a naturally occurring substance harvested from two species of Old World chrysanthemums, or pyrethrum flowers. This material is the least toxic available for mosquito control, and it degrades into non-toxic by-products within 4 to 6 hours after spraying.

Indoor Control

Space sprays or aerosol ***"bombs,"*** containing synergized pyrethrins 0.1%, are effective against adult mosquitoes. Frequent treatments may be needed during problem periods.

Outdoor Control

Adulticides

Space sprays or aerosol foggers containing pyrethrins result in rapid knockdown of adult mosquitoes. However, it is a temporary treatment with little residual effect. Residual sprays applied to tall grasses, weeds, trees, shrubs, and outbuildings, one to two days before use of the area, are effective. Use water solution or emulsions instead of oil-based formulations to prevent plant injury. Some insecticides registered for residual mosquito control include: carbaryl (**Sevin**), chlorpyrifos (**Dursban**) and malathion. There are a number of different formulations available. Follow specific label directions when applying.

Note: Malathion and carbaryl (**Sevin**) are extremely toxic to honey bees. Do not spray plants when in bloom. Mow weedy areas before treatment. Bee losses are minimized by spraying late in the afternoon when bees are gone or when temperatures are below 45°F. Malathion and methoxychlor are highly toxic to fish.

Mosquito fish (*Gambusia affinis*)

Mosquito fish can eat 100 to 500 larvae per day. They play an important role in mosquito control in ponds, canals, irrigated fields and some other freshwater sources. The fish live two to three years; they are live-bearing and produce 3 to 4 broods each year.

Release of mosquito fish in open freshwater situations should only be done by certified vector technicians. Upon request, Marin / Sonoma personnel will stock ponds for residents. Mosquito fish are not a feasible control alternative for saltwater marsh mosquitoes because they cannot tolerate the changes of salinity.

Repellents

Repellents applied to the skin and clothing will prevent mosquito bites for one to five hours depending on the person, type, number of mosquitoes and the type and percent of active ingredient in the repellent. Repellents are available as aerosol sprays, pump sprays, creamsticks, lotions, or foams.

N, N-Diethyl-m-toluamide (***Deet***) is very effective and widely used as a repellent but it should not be used indiscriminately as severe allergies can develop. Formulations containing high concentrations of Deet, 50% or more, should not be used on children. Formulations containing 5 to 10% Deet will work just as well as those containing 90% or more, however, they will not last as long.

Avon Skin-So-Soft has been widely used as a mosquito *"repellent"* for a number of years without being labeled. Avon Products, Inc. has recently obtained EPA approval and is now marketing some of its ***Skin-So-Soft*** products for use as a mosquito repellent.

Prevention

Since most of the mosquitoes that transmit encephalitis will not travel very far, the risk of contracting encephalitis can be minimized by controlling the mosquito breeding sites which are in close proximity to your home. Water management, to prevent mosquito breeding, is essential for control. Eggs do not hatch unless they are in water.

Remove old tires, buckets, tin cans, glass jars, broken toys and other water-catching devices. Change water in bird baths and wading pools once or twice a week; clean out roof gutters holding stagnant water; and place tight covers over cisterns, cesspools, septic tanks, barrels, and tubs where water is stored.

Never over-apply lawn and garden irrigation; fill, drain or treat tree holes; and drain or fill stagnant water pools, puddles, ditches, or swampy areas. Inspect water in plant containers, and water-holding stumps; keep grass mowed around bodies of water, stock ponds and reservoirs with fish.

Window Screens
Use adequate screens with 16 x 16 or 14 x 18 mesh on windows and doors. Screen doors should open outward and close automatically.

What Can I Do to Reduce the Number of Mosquitoes in and Around My Home?
The most important step is to eliminate potential breeding habitats for mosquitoes. Get rid of any standing water around the home, including water in potted plant dishes, garbage cans, old tires, gutters, ditches, wheelbarrows, bird baths, hollow trees, and wading pools. Any standing water should be drained, including abandoned or unused swimming pools.

Mosquitoes can breed in any puddle that lasts more than 4 days. Make sure windows and screen doors are "***bug tight***." Replace outdoor lights with yellow "***bug***" lights. Wear headnets, long-sleeved shirts, and long pants if venturing into areas with high mosquito populations, such as salt marshes or wooded areas. Use mosquito repellents when necessary, always following label instructions.

Should I Take Steps to Reduce Exposure to Pesticides During Mosquito Control Spraying?
Generally, there is no need to relocate during mosquito control spraying. The pesticides have been evaluated for this use and found to pose minimal risks to human health and the environment when used according to label directions.

For example, the EPA has estimated the exposure and risks to both adults and children posed by ULV aerial and ground applications of the insecticides malathion and naled. For all the exposure scenarios considered, exposures ranged from 100 to 10,000 times below an amount of pesticide that might pose a health concern. These estimates assumed several spraying events over a period of weeks, and also assumed that a toddler would ingest some soil and grass in addition to dermal exposure.

Other mosquito control pesticides pose similarly low risks. (For more details on health and environmental risk considerations, visit the EPA's website and download EPA fact sheets on the specific mosquito control pesticides.)

Although mosquito control pesticides pose low risks, some people may prefer to avoid or further minimize exposure. Some common sense steps to help reduce possible exposure to pesticides include:

- Pay attention to the local media for announcements about spraying and remain indoors during applications in the immediate area.
- People who suffer from chemical sensitivities or feel spraying may aggravate a preexisting health condition, may consult their physician or local health department and take special measures to avoid exposure.

- Close windows and turn off window-unit air conditioners when spraying is taking place in the immediate area.
- Do not let children play near or behind truck-mounted applicators when they are in use.

What Doesn't Work
There have been a number of natural and man-made mosquito repellents, attractants, and predators touted as effective against mosquitoes. In truth, they don't do much good and cannot be used to effectively control mosquitoes.

A company has been marketing a "*mosquito repellent plant*" that produces citronella and consequently repels mosquitoes. Citronella oil is produced by a number of different plants. At relatively high concentration, Citronella oil is repellent to mosquitoes. Thus far, there does not appear to be adequate scientific literature to substantiate the claim that enough Citronella is released by a stationary plant to repel mosquitoes. Most likely the plant would have to be physically damaged in order to release enough citronella to repel mosquitoes and the effect would be very short lived.

Purple Martin Diet
Dietary studies indicate that mosquitoes are insignificant in the purple martin diet. Studies of bat stomach contents show beetles as the dominant food. Ultraviolet or black lights and sonic devices indicate ineffective control.

Environmental Protection Agency
The Environmental Protection Agency (**EPA**) evaluates and registers (licenses) pesticides to ensure that they can be used safely. These pesticides include products used in the mosquito control programs that states and communities have established.

To evaluate any pesticide, the EPA assesses a wide variety of tests to determine whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish and plants, including endangered species and non-target organisms.

Pesticides and Mosquito Control Summary
Mosquito-borne diseases affect millions of people worldwide each year. In the United States, some species of mosquitoes can transmit diseases such as encephalitis, dengue fever, and malaria to humans, and a variety of diseases to wildlife and domestic animals. To combat mosquitoes and the public health hazards they present, many states and localities have established mosquito control programs.

These programs, which are based on surveillance, can include non-chemical forms of prevention and control as well as ground and aerial application of chemical and biological pesticides.

The mission of the Environmental Protection Agency (**EPA**) is to protect human health and the environment. The EPA reviews and approves pesticides and their labeling to ensure that the pesticides used to protect public health are applied by methods that minimize the risk of human exposure and adverse health and environmental effects. In relation to mosquito control, the Agency also serves as a source of information about pesticide and non-pesticide controls to address the concerns of the general public, news media, and the state and local agencies dealing with outbreaks of infectious diseases or heavy infestations of mosquitoes.

The following questions and answers provide some basic information on mosquito control, safety precautions, and information on insecticides used for mosquito control programs.

How Does EPA Ensure the Safest Possible Use of Pesticides?
The EPA must evaluate and register pesticides before they may be sold, distributed, or used in the United States. The Agency is also in the process of reassessing, and reregistering when appropriate, all older pesticides (those registered prior to 1984) to ensure that they meet current scientific standards. To evaluate a pesticide for either registration or re-registration, the EPA assesses a wide variety of potential human health and environmental effects associated with use of the product.

The producer of the pesticide must provide data from tests done according to the EPA guidelines. These tests determine whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish, and plants, including endangered species and non-target organisms.

Other tests help to assess the risks of contaminating surface water or ground water from leaching, runoff, or spray drift. If a pesticide meets the EPA requirements, the pesticide is approved for use in accordance with label directions.

However, no pesticide is 100 percent safe and care must be exercised in the use of any pesticide.

Always think of the consquences of overspraying

***Anopheles* spp.**

(Life; Kingdom: Metazoa (animals); Phylum Arthopoda; Class: Hexapoda; Order: Diptera; Suborder: Nematocera; Family: Culicidae; Subfamily: Anophelinae)

Malathion for Mosquito Control

Officials responsible for mosquito control programs make decisions to use pesticides based on an evaluation of the risks to the general public from diseases transmitted by mosquitoes or on an evaluation of the nuisance level that communities can tolerate from a mosquito infestation. Based on surveillance and monitoring, mosquito control officials select specific pesticides and other control measures that best suit local conditions in order to achieve effective control of mosquitoes with the least impact on human health and the environment. It is especially important to conduct effective mosquito prevention programs by eliminating breeding habitats or applying pesticides to control the early life stages of the mosquito.

Prevention programs, such as elimination of any standing water that could serve as a breeding site, help reduce the adult mosquito population and the need to apply other pesticides for adult mosquito control. Since no pesticide can be considered 100 percent safe, pesticide applicators and the general public should always exercise care and follow specified safety precautions during use to reduce risks.

What is Malathion?

Malathion is an organophosphate (**OP**) insecticide that has been registered for use in the United States since 1956. It is used in agriculture, residential gardens, public recreation areas, and in public health pest control programs.

When applied in accordance with the rate of application and safety precautions specified on the label, malathion can be used to kill mosquitoes without posing unreasonable risks to human health or the environment.

How is Malathion Used in Mosquito Control?

The mosquito goes through four distinct stages during its life cycle: egg, larva, pupa, and adult. Malathion is an ***adulticide***, used to kill adult mosquitoes. In mosquito control programs conducted by state or local authorities, malathion is applied by truck-mounted or aircraft-mounted sprayers.

Malathion is applied as an ultra-low volume (**ULV**) spray. ULV sprayers dispense very fine aerosol droplets that stay aloft and kill mosquitoes on contact. ULV applications involve small quantities of pesticide active ingredient in relation to the size of the area treated. For mosquito control, malathion is applied at a maximum rate of 0.23 pounds (or about 2.5 fluid ounces) of active ingredient per acre, which minimizes exposure and risks to people and the environment.

Malathion can be used for public health mosquito control programs without posing unreasonable risks to the general population when applied according to the label. The EPA has estimated the exposure and risks to both adults and children posed by ULV aerial and ground applications of malathion.

Because of the very small amount of active ingredient released per acre of ground, the estimates found that for all scenarios considered, exposures were hundreds or even thousands of times below an amount that might pose a health concern. These estimates assumed several spraying events over a period of weeks, and also assumed that a toddler would ingest some soil and grass in addition to skin and inhalation exposure.

However, at high doses, malathion, like other organophosphates, can over stimulate the nervous system causing nausea, dizziness, or confusion. Severe high-dose poisoning with any organophosphate can cause convulsions, respiratory paralysis, and death.

Does Malathion Pose Risks to Wildlife or the Environment?
Malathion used in mosquito control programs does not pose unreasonable risks to wildlife or the environment. Malathion degrades rapidly in the environment, especially in moist soil, and it displays low toxicity to birds and mammals. Malathion is highly toxic to insects, including beneficial insects such as honeybees. For that reason, the EPA has established specific precautions on the label to reduce such risks.

What is the Current Regulatory Status of Malathion?
As part of its responsibility to re-assess all older pesticides registered before 1984, the EPA is currently reviewing malathion as part of its reregistration process. The review of malathion was scheduled for completion in 2002. A risk assessment covering all uses of malathion is currently available to the public for review at http://www.epa.gov/oppsrrd1/op/malathion.htm.

Visit the EPA Web site for the most current information on malathion.

Larvicides For Mosquito Control

The Environmental Protection Agency (**EPA**) evaluates and registers (**licenses**) pesticides to ensure that they can be used safely. These pesticides include products used in the mosquito control programs that states and communities have established. To evaluate any pesticide, the EPA assesses a wide variety of tests to determine whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish and plants, including endangered species and non-target organisms.

Officials responsible for mosquito control programs make decisions to use pesticides based on an evaluation of the risks to the general public from diseases transmitted by mosquitoes or on an evaluation of the nuisance level that communities can tolerate from a mosquito infestation.

Based on surveillance and monitoring, mosquito control officials select specific pesticides and other control measures that best suit local conditions in order to achieve effective control of mosquitoes with the least impact on human health and the environment. It is especially important to conduct effective mosquito prevention programs by eliminating breeding habitats or applying pesticides to control the early life stages of the mosquito.

Prevention programs, such as the elimination of any standing water that could serve as a breeding site, help reduce the adult mosquito population and the need to apply other pesticides for adult mosquito control.

Since no pesticide can be considered 100 percent safe, pesticide applicators and the general public should always exercise care and follow specified safety precautions during use to reduce risks. The next section will provide basic information on larvicides, a type of pesticide used in mosquito control programs.

Larvicides

Larvicides kill mosquito larvae. Larvicides include biological insecticides, such as the microbial larvicides ***Bacillus sphaericus*** and ***Bacillus thuringiensis israelensis***. Larvicides include other pesticides, such as temephos, methoprene, oils, and monomolecular films. Larvicide treatment of breeding habitats help reduce the adult mosquito population in nearby areas.

How are Larvicides Used in Mosquito Control?
State and local agencies in charge of mosquito control typically employ a variety of techniques in an Integrated Pest Management (**IPM**) program. An IPM approach includes *surveillance, source reduction*, *larviciding* and *adulticiding* to control mosquito populations.

Since mosquitoes must have water to breed, source reduction can be as simple as turning over trapped water in a container to undertaking large-scale engineering and management of marsh water levels. Larviciding involves applying pesticides to breeding habitats to kill mosquito larvae. Larviciding can reduce overall pesticide usage in a control program.

Killing mosquito larvae before they emerge as adults can reduce or eliminate the need for ground or aerial application of pesticides to kill adult mosquitoes.

What are Microbial Larvicides?
Microbial larvicides are bacteria that are registered as pesticides for control of mosquito larvae in outdoor areas such as irrigation ditches, flood water, standing ponds, woodland pools, pastures, tidal water, fresh or saltwater marshes, and storm water retention areas.

Duration of effectiveness depends primarily on the mosquito species, the environmental conditions, the formulation of the product, and water quality.

Microbial larvicides may be used along with other mosquito control measures in an IPM program. The microbial larvicides used for mosquito control are *Bacillus thuringiensis israelensis (Bti)* and *Bacillus sphaericus (B. sphaericus)*.

Bacillus thuringiensis israelensis is a naturally occurring soil bacterium registered for control of mosquito larvae. *Bti* was first registered by the EPA as an insecticide in 1983. Mosquito larvae eat the *Bti* product that is made up of the dormant spore form of the bacterium and an associated pure toxin. The toxin disrupts the gut in the mosquito by binding to receptor cells present in insects, but not in mammals. There are 26 ***Bti*** products registered for use in the United States. Aquabac, Teknar, Vectobac, and LarvX are examples of common trade names for the mosquito control products.

Bacillus sphaericus is a naturally occurring bacterium that is found throughout the world. *B. sphaericus* was initially registered by the EPA in 1991 for use against various kinds of mosquito larvae. Mosquito larvae ingest the bacteria, and as with *Bti*, the toxin disrupts the gut in the mosquito by binding to receptor cells present in insects but not in mammals.

VectoLex CG and WDG are registered ***B. sphaericus*** products and are effective for approximately one to four weeks after application.

Do Microbial Larvicides Pose Risks to Human Health?
The microbial pesticides have undergone extensive testing prior to registration. They are essentially nontoxic to humans, so there are no concerns for human health effects with *Bti* or *B. sphaericus* when they are used according to label directions.

Do Microbial Larvicides Pose Risks to Wildlife or the Environment?
Extensive testing shows that microbial larvicides do not pose risks to wildlife, nontarget species, or the environment, when used according to label directions.

What is Methoprene?
Methoprene is a compound first registered by the EPA in 1975 that mimics the action of an insect growth-regulating hormone and prevents the normal maturation of insect larvae. It is applied to water to kill mosquito larvae, and it may be used along with other mosquito control measures in an IPM program. Altosid is the name of the methoprene product used in mosquito control and is applied as briquets (similar in form to charcoal briquets), pellets, sand granules, and liquids. The liquid and pelletized formulations can be applied by helicopter and fixed-wing aircraft.

Does Methoprene Pose Risks to Human Health?
Methoprene, used for mosquito control according to its label directions, does not pose unreasonable risks to human health. In addition to posing low toxicity to mammals, there is little opportunity for human exposure, since the material is applied directly to ditches, ponds, marshes, or flooded areas that are not drinking water sources.

Does Methoprene Pose Risks to Wildlife or the Environment?
Methoprene used in mosquito control programs does not pose unreasonable risks to wildlife or the environment. Toxicity of methoprene to birds and fish is low, and it is nontoxic to bees.

Methoprene breaks down quickly in water and soil and will not leach into ground water.

Methoprene mosquito control products present minimal acute and chronic risk to freshwater fish, freshwater invertebrates, and estuarine species.

What is Temephos?
Temephos is an organophosphate (**OP**) pesticide registered by the EPA in 1965 to control mosquito larvae, and it is the only organophosphate with larvicidal use. It is an important resistance management tool for mosquito control programs; its use helps prevent mosquitoes from developing resistance to the bacterial larvicides.

Temephos is used in areas of standing water, shallow ponds, swamps, marshes, and intertidal zones. It may be used along with other mosquito control measures in an IPM program.

Abate is the trade name of the temephos product used for mosquito control. Temephos is applied most commonly by helicopter but can be applied by backpack sprayers, fixed-wing aircraft, and right-of-way sprayers in either liquid or granular form.

Does Temephos Pose Risks to Human Health?
Temephos, applied according to the label for mosquito control, does not pose unreasonable risks to human health. It is applied to water, and the amount of temephos is very small in relation to the area covered, less than 1 ounce of active ingredient per acre for the liquid and

8 ounces per acre for the granular formulations. Temephos breaks down within a few days in water, and post-application exposure is minimal. However, at high dosages, temephos, like other OPs, can overstimulate the nervous system causing nausea, dizziness, and confusion.

Does Temephos Pose Risks to Wildlife or the Environment?
Because temephos is applied directly to water, it is not expected to have a direct impact on terrestrial animals or birds. Current mosquito larviciding techniques pose some risk to nontarget aquatic species and the aquatic ecosystem. Although temephos presents relatively low risk to birds and terrestrial species, available information suggests that it is more toxic to aquatic invertebrates than alternative larvicides.

For this reason, the EPA is limiting temephos use to areas where less-hazardous alternatives would not be effective, specifying intervals between applications, and limiting the use of high application rates.

What is the Current Regulatory Status of Temephos?
As part of its responsibility to reassess all older pesticides registered before 1984, the EPA completed its revised risk assessments for temephos in July 2001, and has issued risk management decisions in the final reregistration eligibility decision (**RED**). The RED document is available on the EPA Web site at:
www.epa.gov/oppsrrd1/REDs/temephos_red.htm.

What are Monomolecular Films?
Monomolecular films are low-toxicity pesticides that spread a thin film on the surface of the water that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown. Films may remain active typically for 10-14 days on standing water, and have been used in the United States in floodwaters, brackish waters, and ponds. They may be used along with other mosquito control measures in an IPM program. They are also known under the trade names Arosurf MSF and Agnique MMF.

Do Monomolecular Films Pose Risks to Human Health?
Monomolecular films, used according to label directions for larva and pupa control, do not pose a risk to human health. In addition to low toxicity, there is little opportunity for human exposure, since the material is applied directly to ditches, ponds, marshes, or flooded areas that are not drinking water sources.

Do Films Pose Risks to Wildlife or the Environment?
Monomolecular films, used according to label directions for larva and pupa control, pose minimal risks to the environment. They do not last very long in the environment, and are usually applied only to standing water, such as roadside ditches, woodland pools, or containers which contain few nontarget organisms.

What are Oils?
Oils, like films, are pesticides used to form a coating on top of water to drown larvae, pupae, and emerging adult mosquitoes. They are specially derived from petroleum distillates and have been used for many years in the United States to kill aphids on crops and orchard trees, and to control mosquitoes. They may be used along with other mosquito control measures in an IPM program.

Trade names for oils used in mosquito control are Bonide, BVA2, and Golden Bear-1111, (GB-1111).

Do Oils Pose Risks to Human Health?
Oils, used according to label directions for larva and pupa control, do not pose a risk to human health. In addition to low toxicity, there is little opportunity for human exposure, since the material is applied directly to ditches, ponds, marshes, or flooded areas that are not drinking water sources.

Do Oils Pose Risks to Wildlife or the Environment?
Oils, if misapplied, may be toxic to fish and other aquatic organisms. For that reason, the EPA has established specific precautions on the label to reduce such risks.

Naled For Mosquito Control

The Environmental Protection Agency (**EPA**) evaluates and registers (**licenses**) pesticides to ensure that they can be used safely. These pesticides include products used in the mosquito control programs that states and communities have established. To evaluate any pesticide, the EPA assesses a wide variety of tests to determine whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish and plants, including endangered species and non-target organisms.

Officials responsible for mosquito control programs make decisions to use pesticides based on an evaluation of the risks to the general public from diseases transmitted by mosquitoes or on an evaluation of the nuisance level that communities can tolerate from a mosquito infestation. Based on surveillance and monitoring, mosquito control officials select specific pesticides and other control measures that best suit local conditions in order to achieve effective control of mosquitoes with the least impact on human health and the environment.

It is especially important to conduct effective mosquito prevention programs by eliminating breeding habitats or applying pesticides to control the early life stages of the mosquito. Prevention programs, such as elimination of any standing water that could serve as a breeding site, help reduce the adult mosquito population and the need to apply other pesticides for adult mosquito control.

Since no pesticide can be considered 100 percent safe, pesticide applicators and the general public should always exercise care and follow specified safety precautions during use to reduce risks. This fact sheet provides basic information on larvicides, a type of pesticide used in mosquito control programs.

What is Naled?

Naled is an organophosphate (**OP**) insecticide that has been registered since 1959 for use in the United States. It is used primarily for controlling adult mosquitoes, but Naled is also used on food and feed crops, and in greenhouses. When applied in accordance with the rate of application and the safety precautions specified on the label, Naled can be used to kill mosquitoes without posing unreasonable risks to human health or the environment.

How is Naled Used in Mosquito Control?
Naled is an ***adulticide*** used to kill adult mosquitoes. In mosquito control programs conducted by state or local authorities, naled is applied by truck-mounted or aircraft-mounted sprayers.

Naled is applied as an ultra-low volume (**ULV**) spray. ULV sprayers dispense very fine aerosol droplets that stay aloft and kill mosquitoes on contact. ULV applications involve small quantities of pesticide active ingredient in relation to the size of the area treated.

For mosquito control, Naled is applied at a maximum rate of 0.05 pounds (0.8 ounce) of active ingredient per acre for aerial application and 0.1 pounds (0.33 ounce) per acre for ground application, which minimizes exposure and risks to people and the environment.

Does Naled Pose Risks to Human Health?
Naled can be used for public health mosquito control programs without posing unreasonable risks to the general population when applied according to the label. The EPA has estimated the exposure and risks to both adults and children posed by ULV aerial and ground applications of naled. Because of the very small amount of active ingredient released per acre of ground, the estimates found that for all scenarios considered, exposures were hundreds or even thousands of times below an amount that might pose a health concern.

These estimates assumed several spraying events over a period of weeks, and also assumed that a toddler would ingest some soil and grass in addition to skin and inhalation exposure. However, at high doses, naled like other organophosphates, can over stimulate the nervous system causing nausea, dizziness, or confusion. Severe high-dose poisoning with any organophosphate can cause convulsions, respiratory paralysis, and death.

Does Naled Pose Risks to Wildlife or the Environment?
Naled used in mosquito control programs does not pose unreasonable risks to wildlife or the environment.

Naled degrades rapidly in the environment, and it displays low toxicity to birds and mammals. Acute and chronic risk to fish is not expected, but there is potential for risks to invertebrates from the repeated use of Naled. Naled is highly toxic to insects, including beneficial insects such as honeybees. For that reason, the EPA has established specific precautions on the label to reduce such risk.

What is the Current Regulatory Status of Naled?
As part of its responsibility to reassess all older pesticides registered before 1984, the EPA is currently reviewing naled as part of its reregistration process. The review of Naled was completed in 2002. A risk assessment covering all uses of Naled is available to the public on the EPA Web site at http://www.epa.gov/oppsrrd1/op/naled.htm

Synthetic Pyrethroids For Mosquito Control

The Environmental Protection Agency (**EPA**) evaluates and registers (**licenses**) pesticides to ensure that they can be used safely. These pesticides include products used in the mosquito control programs that states and communities have established. To evaluate any pesticide, EPA assesses a wide variety of tests to determine whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish and plants, including endangered species and non-target organisms.

Officials responsible for mosquito control programs make decisions to use pesticides based on an evaluation of the risks to the general public from diseases transmitted by mosquitoes or on an evaluation of the nuisance level that communities can tolerate from a mosquito infestation.

Based on surveillance and monitoring, mosquito control officials select specific pesticides and other control measures that best suit local conditions in order to achieve effective control of mosquitoes with the least impact on human health and the environment. It is especially important to conduct effective mosquito prevention programs by eliminating breeding habitats or applying pesticides to control the early life stages of the mosquito.

Prevention programs, such as elimination of any standing water that could serve as a breeding site, help reduce the adult mosquito population and the need to apply other pesticides for adult mosquito control. Since no pesticide can be considered 100 percent safe, pesticide applicators and the general public should always exercise care and follow specified safety precautions during use to reduce risks. This fact sheet provides basic information on larvicides, a type of pesticide used in mosquito control programs.

What are Synthetic Pyrethroids?

Pyrethroids are synthetic chemical insecticides that act in a similar manner to pyrethrins, which are derived from chrysanthemum flowers. Pyrethroids are widely used for controlling various insects. **Permethrin, resmethrin,** and **sumithrin** are synthetic pyrethroids commonly used in mosquito control programs to kill **adult mosquitoes**.

- **Permethrin** has been registered by the EPA since 1977. It is currently registered and sold in a number of products such as household insect foggers and sprays, tick and flea sprays for yards, flea dips and sprays for cats and dogs, termite treatments, agricultural and livestock products, and mosquito abatement products.
- **Resmethrin** has been registered by the EPA since 1971 and is used to control flying and crawling insects in the home, lawn, garden, and industrial sites. It can also be used to control insects on ornamental plants (outdoor and greenhouse use), on pets and horses, and as a mosquitocide. Because of its toxicity to fish, resmethrin is a Restricted Use Pesticide (**RUP**) that is available for use only by certified pesticide applicators or persons under their direct supervision.
- **Sumithrin** has been registered by the EPA since 1975 and is used to control adult mosquitoes and as an insecticide in transport vehicles such as aircraft, ships, railroad cars, and truck trailers. It is also used as an insecticide and miticide in commercial, industrial, and institutional nonfood areas, in homes and gardens, in greenhouses, and in pet quarters and on pets.

How are Synthetic Pyrethroids Used in Adult Mosquito Control?

Most pyrethroid mosquito control products can be applied only by public health officials and trained personnel of mosquito control districts. Mosquito control professionals apply pyrethroids as an ultra low volume (**ULV**) spray. ULV sprayers dispense very fine aerosol droplets that stay aloft and kill adult mosquitoes on contact.

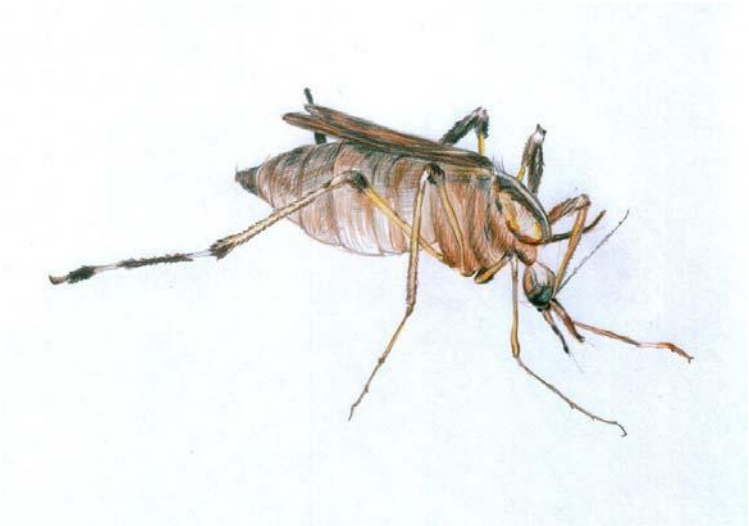
Pyrethroids used in mosquito control are typically mixed with a synergist compound, such as piperonyl butoxide, which enhances the effectiveness of the active ingredient. The product is often diluted in water or oil and applied at rates less than 1/100th of a pound of active ingredient or less than 4 fluid ounces of mixed formulation per acre.

Do Pyrethroids Pose Risks to Human Health?
Pyrethroids can be used for public health mosquito control programs without posing unreasonable risks to human health when applied according to the label. Pyrethroids are considered to pose slight risks of acute toxicity to humans, but at high doses, pyrethroids can affect the nervous system.

Do Pyrethroids Pose Risks to Wildlife or the Environment?
Pyrethroids used in mosquito control programs do not pose unreasonable risks to wildlife or the environment. Pyrethroids, when applied at mosquito control rates, are low in toxicity to mammals, and are practically nontoxic to birds.

Mosquito control formulations of permethrin break down in the environment, and high temperatures and sunlight accelerate this process. However, pyrethroids are toxic to fish and to bees. For this reason, the EPA has established specific precautions on the label to reduce such risks, including restrictions that prohibit the direct application of products to open water or within 100 feet of lakes, streams, rivers or bays.

What is The Current Regulatory Status of Pyrethroids?
As part of its responsibility to reassess all pesticides registered before 1984, the EPA has given highest priority to reviewing more acutely toxic pesticides such as organophosphates and carbamates. Organophosphates are currently under review.



Homemade Mosquito Repellent

I was at a deck party awhile back, and the bugs were having a ball biting everyone. A man at the party sprayed the lawn and deck floor with Listerine, and the little demons disappeared. The next year I filled a 4-ounce spray bottle and used it around my seat whenever I saw mosquitoes. And voila! That worked as well. It worked at a picnic where we sprayed the area around the food table, the children's swing area, and the standing water nearby. During the summer, I don't leave home without it.....Pass it on.

One Person's Comment

I tried this on my deck and around all of my doors. It works - in fact, it killed them instantly. I bought my bottle from Target and it cost me $1.89. It really doesn't take much, and it is a big bottle, too; so it is not as expensive to use as the can of spray you buy that doesn't last 30 minutes. So, try this, please. It will last a couple of days. Don't spray directly on a wood door (like your front door), but spray around the frame. Spray around the window frames, and even inside the dog house

Mosquito Identification Section

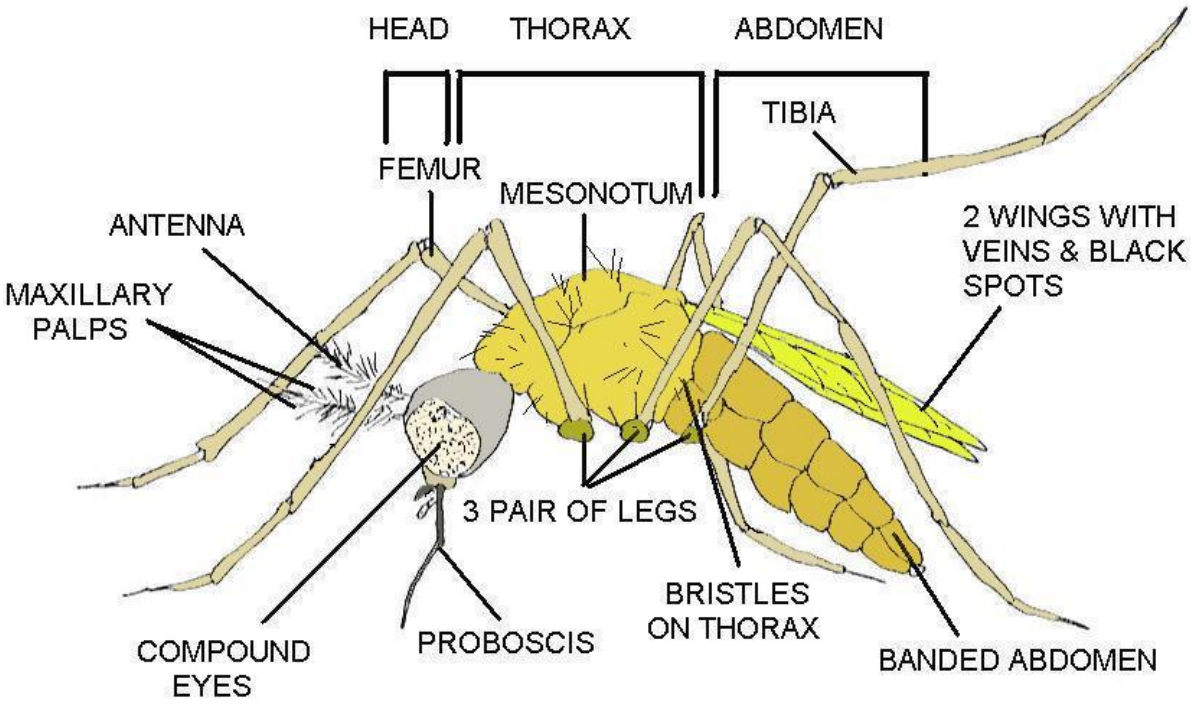
Anopheles spp.

(Life; Kingdom: Metazoa (animals); Phylum Arthopoda; Class: Hexapoda; Order: Diptera; Suborder: Nematocera; Family: Culicidae; Subfamily: Anophelinae)

Of the insects that serve as vectors for parasitic diseases, this genus is arguably the most important. Of the approximately 400 species of *Anopheles*, about two dozen serve as vectors for malaria (*Plasmodium* spp.) in humans. Mosquitoes also serve as the vector for canine heart worm (*Dirofilaria immitis*). There are about 422 species of *Anopheles* worldwide, many of them sibling species that can only be identified using genetic techniques. Of these, about 70 are vectors of the protozoan *Plasmodium* that causes malaria, but only about 40 are important. Malaria infects 300-500 million and kills 1.5-2.7 million people each year, making it by far the most serious of the diseases spread by insects.

Anopheles sp.

Another example of *Anopheles* sp.



ADULT FEMALE MOSQUITO
(Anopheles Mosquito)

The Northern House Mosquito or House Mosquito *Culex pipiens*

Common Associate Species: *Cx. restuans, Cs. inornata, An. punctipennis*

Culex pipiens, the Northern House Mosquito has a distribution that roughly includes the northern half of the United States. This species' range begins just north of Maine, along the Atlantic seaboard, and extends to the state of Washington in the west with some extension into southern British Columbia. The range along the Pacific coast extends into northern California and then east on a relatively straight line to North Carolina. The species is replaced by *Culex quinquefasciatus*, the Southern House Mosquito, in the southern United States with limited overlap in portions of the mid-west.

Culex pipiens provides the life cycle model for most of the domestic *Culex* in temperate areas. Inseminated adult females from the last generation of the season build body fat by feeding on carbohydrates and enter hibernation in fall. The females pass the winter in diapause and do not become active during periods of warm winter weather. Hibernating females are common in basements, outbuildings and subterranean enclosures. Like *Culex restuans*, the females congregate near moisture and move their resting location during the winter to remain in a humid atmosphere.

Mortality can be extensive during periods of winter drought. Females emerge from hibernation during May and begin depositing egg rafts in suitable habitat. Populations of this mosquito usually peak during August but breeding continues well into September. The adults from the last generation of the season lose all interest in blood meal hosts but will move in and out of overwintering sites during periods of mild fall weather. Larvae rarely persist in breeding habitats after females have entered hibernation.

Culex pipiens can be found in a fairly wide range of larval habitats but are generally associated with water that has a high organic content. The species utilizes temporary ground water that ranges from mildly to grossly polluted. The species also deposits its eggs in artificial containers including tin cans, tires and any refuse that allows stagnant water to puddle. The species is decidedly urban and reaches greatest numbers in large urban centers. Catch basins and storm drains provide ideal habitat for *Cx. pipiens*. The species becomes particularly abundant in areas where raw sewage leaks into subterranean drainage systems. Meat packing plants and slaughter house drainage ponds support high populations of this species. *Culex pipiens* can always be collected in the effluent from sewage treatment plants.

Collection

No special techniques are required to collect *Cx. pipiens* larvae. This species is common in urban settings and can usually be found in significant numbers in a variety of habitats where stagnant water collects. *Culex pipiens* will oviposit readily in buckets containing prepared straw infusions. Most piles of discarded tires contain a mixture of *Cx. pipiens* and *Cx. restuans* in addition to the tire breeding *Aedes*.

Culex pipiens occurs on every continent except Antarctica and is the most widely distributed mosquito in the world. In North America two races range north (*Cx. pipiens pipiens*) and south (*Cx. pipiens quinquefasciatus*) of 39ºN latitude, about the level of Sacramento. *Cx. p. pipiens* lives in the milder coastal climate areas, while *Cx. p. quinquefasciatus* is found in the warmer inland valleys.

Culex pipiens' main host is wild birds, but it also feeds freely on a wide variety of warm-blooded vertebrates, including man. In northern California, it currently plays only a lesser role as a carrier of human disease, while in southern California and the Gulf Coast region it is a major carrier of Saint Louis encephalitis. It is also the best known carrier of West Nile Virus, a severe encephalitis virus newly arrived in the Americas that is spreading along the eastern seaboard.

Culex pipiens is a serious pest, called the "*house mosquito*" because it commonly develops in small containers around the home. It shows great skill in finding ways to get into the house where it feeds on the occupants at night. It also occurs in containers and sumps on farms and industrial plants, in polluted waters, and will feed out-of-doors at night.

Culex pipiens larvae typically develop best in dirty, stagnant water containing abundant organic matter, in ground pools and natural and man-made containers. Vector technicians often find improperly installed or maintained underground septic tanks producing huge numbers of this species. The mosquitoes gain entrance thorough cracks in the ground, through poorly fitting or unsealed covers, or by the vent pipes made for removal of gases. We recommend that all vents be covered with window screening, preferably aluminum screen, to exclude adults.

A house mosquito feeds on a Hawaiian 'i'iwi bird. Mosquito-borne malaria infections caused the extinction of many Hawaiian native bird species within a few years after *Culex pipiens* was introduced to the islands. [Photos: NATIONAL GEOGRAPHIC, September 1995]

Polluted habitats do not generally support a very wide variety of species. Most larval samples from polluted water sources consist mainly of *Cx. pipiens* and *Cx restuans*. *Culex pipiens* larvae are easily distinguished from *Cx. restuans* by the length and shape of the antennae.

Where does this Mosquito normally lay its Eggs?
In tin cans, buckets, discarded tires and other artificial containers that hold stagnant water.

In untended bird baths, clogged rain gutters and plastic wading pools that hold stagnant water.

In storm drains and catch basins in urban areas.

In septic seepage and other foul water sources above or below ground level.

How does this Mosquito Overwinter?
The last generation of adult females mate and build body fat by feeding on carbohydrates.

Mated females find refuge in culverts, basements and protected areas that stay above freezing.

The body metabolism slows considerably and winter is spent in a state of torpor.

Females that survive the winter, blood feed in spring and lay eggs that produce the summer populations.

Antennal Shape
The characteristic antennal shape is difficult to see in the dipper but the slightly longer, constricted antennae and prominent antennal tufts can be discerned with practice. The multiple hair tufts on the siphon can be used as a diagnostic character under the microscope. *Culex salinarius* is a closely related species that is easily distinguished by the longer, more slender siphon.

St. Louis Encephalitis
SLE is a natural infection found in a variety of wild birds. Culex pipiens can function as a vector and pass the virus from one bird to the next. If virus is introduced to an urban setting, Culex pipiens can amplify the infection in urban birds. House Sparrows, an introduced species, circulate exceptionally high levels of SLE when they become infected. Culex pipiens that bite infected birds acquire the virus and are capable of passing it on to humans.

Summary
Culex pipiens is usually the most common pest mosquito in urban and suburban settings.

Culex pipiens is an indicator of polluted water in the immediate vicinity.

Culex pipiens is recognized as the primary vector of St. Louis encephalitis (SLE).

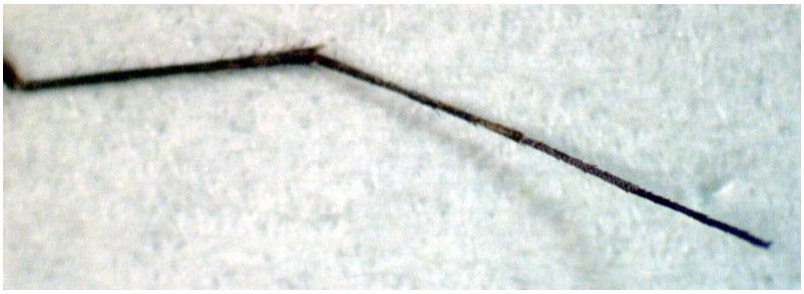
Culex pipiens is normally considered to be a bird feeder.

Some urban strains have a predilection for mammalian hosts and feed readily on humans.

Most populations probably contain individuals that accept blood from mammals as well as birds.

Culex pipiens Identification

***Culex pipiens* is identified by the basal bands of its abdominal terga which are rounded posteriorly and narrowly joined to the lateral patches.**



The hindtarsi of *Culex pipiens* are also unbanded.

With 11 species, Culex is one of the largest genus of mosquitoes. Females of this group have short palpi and a blunt, rather than pointed abdomen. Unlike most Ochlerotatus, they tend to have numerous generations in a year. Several hundred eggs are laid packed together in rafts. A female can lay six or seven times in her forty to fifty day life span.

Pale Marsh Mosquito *Ochlerotatus dorsalis*

Ochlerotatus dorsalis' common name comes from its whitish-grey appearance: the abdomen and wings have intermixed narrow light and dark scales. Sometimes the light scales predominate. The hind legs have pale white bands overlapping the individual joints. This mosquito is found in Asia, Europe and North America.

In California it occurs along the Pacific coast and in the eastern regions of the state. It breeds along the edges of bays, marshes and lakes. It is especially frequent in the seasonally flooded marshes along the edges of the San Francisco and San Pablo bays.

A strong flyer, *Ochlerotatus dorsalis* often disperses 20 miles or more from its breeding sources. Unlike most other local *Ochlerotatus*, the pale marsh mosquito is active almost year-around. Females produce continuous broods throughout the spring and summer, with 8 to 12 hatches each year, and the last adults emerging in October.

Pre-adult stages can be as short as 1 to 2 weeks in the warm summer weather. Populations sometimes build up to huge numbers in brackish marshes subject to prolonged spring flooding.

Ochlerotatus dorsalis is a serious pest mosquito and a secondary vector of the encephalitis virus. Females prefer to feed on large mammals like cattle and horses (and man) when these are available.

They are vicious biters, and so aggressive and persistent that livestock tend to move away from areas where they are numerous.

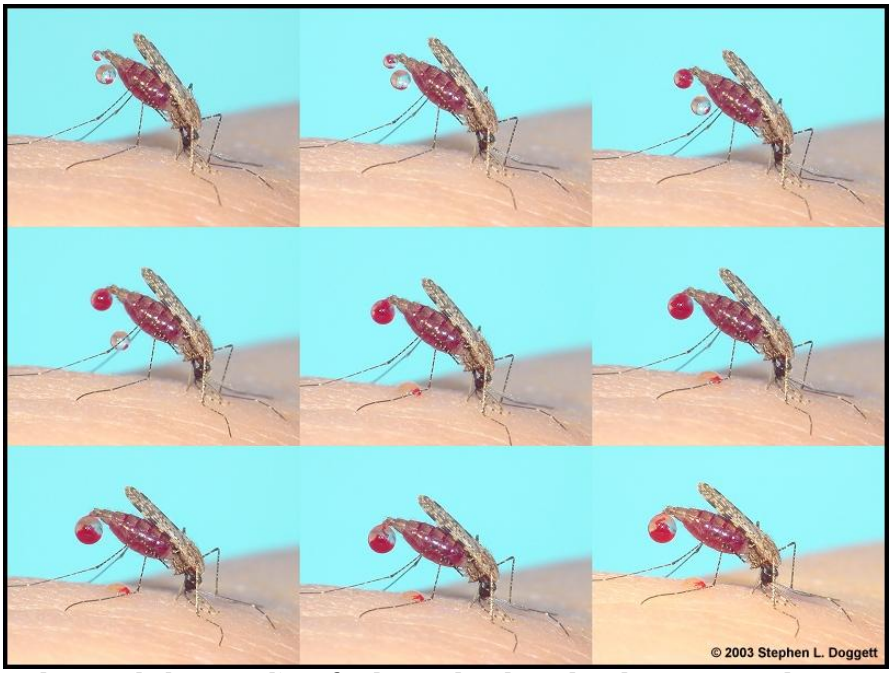
Ochlerotatus dorsalis

Western Malaria Mosquito *Anopheles freeborni*

Anopheles freeborni is the most important malaria vector in California. In our lifetime, endemic malaria has been eradicated from the U.S. But in our grandparents' time, it was so serious that education guidelines called for it to be included in the instructional program in every primary school. Today, carrier mosquitoes still occur throughout the state, and hundreds of active infections are discovered every year in tourists and immigrants from other countries.

Anopheles are easily distinguished from other mosquitoes: their eggs are laid individually and have small floats on each side; the larvae lack the long breathing tube found in other mosquitoes; adults have hairs, but no scales on the abdomen and both sexes have palpi as long as the proboscis. Feeding females assume a distinctive pose with their abdomen pointed high in the air.

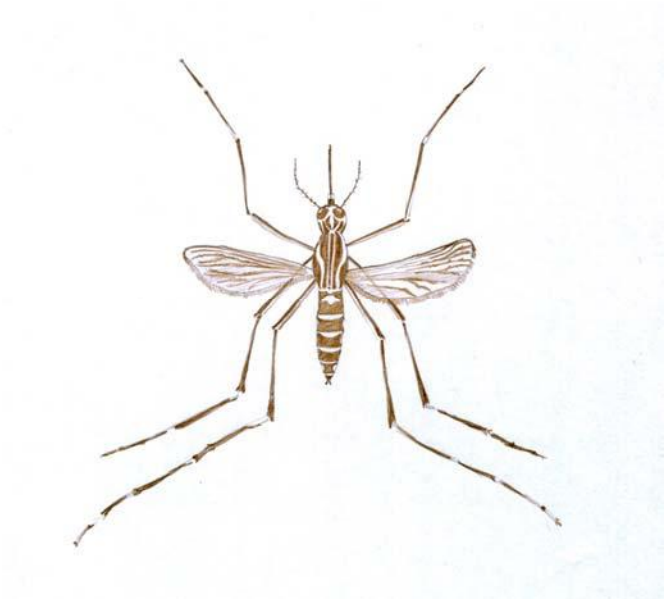
Western malaria mosquitoes occur west of the Rocky Mountains, between southern Canada and northern Mexico, and from sea level to about 6,000 ft. elevation. The larvae prefer clear, clean water, in sunlit or partially shaded streams or ponds. They occur in both Marin and Sonoma counties, but their highest density is found in the irrigated and seasonally flooded rice fields of the great central valley, historically the region of California's highest malaria infection rates. Adults migrate in the spring and fall, but most stay within five miles of their larval sites. Like most *Anopheles*, they are active during the hours of darkness, and find shelter in hidden places during the day. Females feed mainly on medium to large mammals like rabbits, deer, cattle or horses, and they pursue and bite man aggressively.



The above female *Anopheles annulipes* feeding. The clear droplet is excreted soon after the initiation of blood feeding, to maximize blood intake.

Aedes aegypti *by Roland Mortimer, Rio de Janeiro*

There are many types of mosquitoes living in the tropical and sub-tropical regions of the world. We can roughly divide them into two groups--Culex and Aedes--but perhaps one of the most important is ***Aedes aegypti***. According to the World Health Organization, the virus for Dengue fever is the most important arbovirus to man in the world, and since *Aedes* has been found to transmit this virus, it has been widely studied and blamed as the vector.

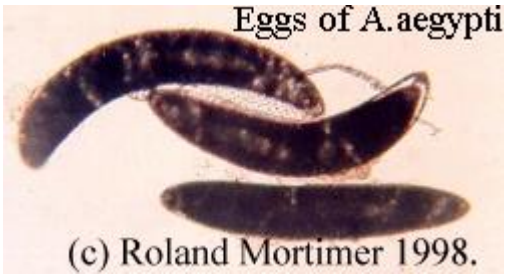


This mosquito is small in comparison to others, usually between three to four millimeters in length discounting leg length. It is totally black apart from white '*spots*' on the body and head regions and white rings on the legs. The thorax is decorated with a white '*Lyre*' shape of which the 'chords' are two dull yellow lines. Its wings are translucent and bordered with scales.

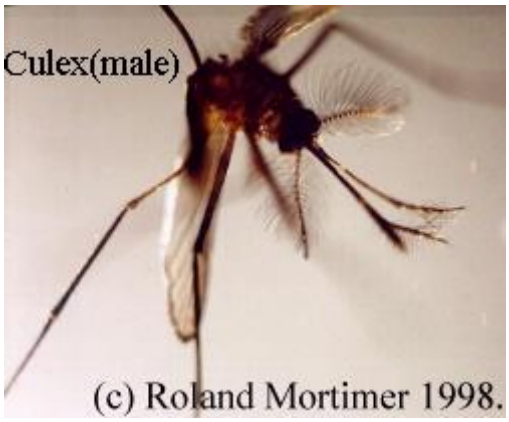
At rest, the insect turns up its hind legs in a curved fashion and usually cleans them by rubbing one against the other, or exercises them by crossing them and alternately raising and lowering them.

Many people believe mosquitoes only live two or three days, but in actual fact, left unmolested they can live for months. The males of all species of mosquitoes do not bite humans or animals of any species, they live on fruit.

Only the female bites for blood, which she needs to mature her eggs. The eggs of most species are laid together in a raft form, but *Aedes* lays her eggs separately, thus allowing them to spread over large surfaces of water if conditions permit. In this way, the eggs stand a better chance of survival.

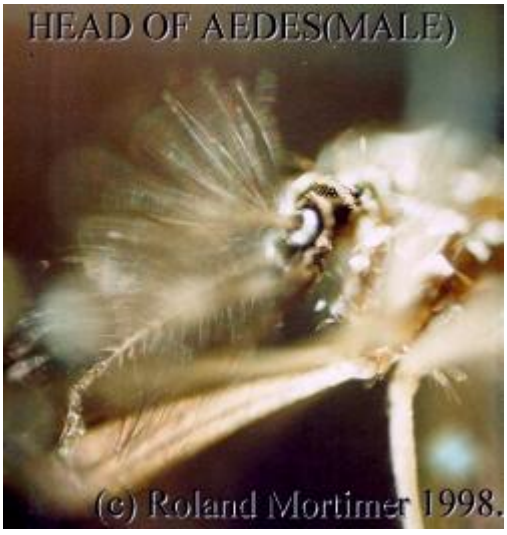


When freshly laid, the eggs are white but soon turn black in color. The young larvae feed on bacteria in the water and soon cast their skins as they rapidly grow.



Most types of mosquito species can lay their eggs in any type of water, mainly dirty or even polluted. Not *Aedes*, she only lays her eggs in clean water which contains no other living species.

Many people have died from Dengue fever and many more around the world suffer terribly because of this species. The male mosquito is much more beautiful, his antennae looking like large plumes and the palpi long and adorned with feathery hairs. After a few weeks, or even shorter in the summer, the larvae reach the pupa stage. This stage is usually very short and the pupae rise to the surface of the water where the top of the pupal case opens, like the lid on a can, and out emerges the new adult.



Aedes aegypti, unlike other species, is very intelligent, if one could say that mosquitoes are intelligent. They arrived in Brazil from Ethiopia with the slave trading ships. Living near man for so long she has become totally dependant on him and has learned a lot from him. For instance, she has greatly reduced the `humming' sound she makes with her wings so man cannot hear it, unlike other species whose humming is extremely irritating and awakens the deepest sleeper.

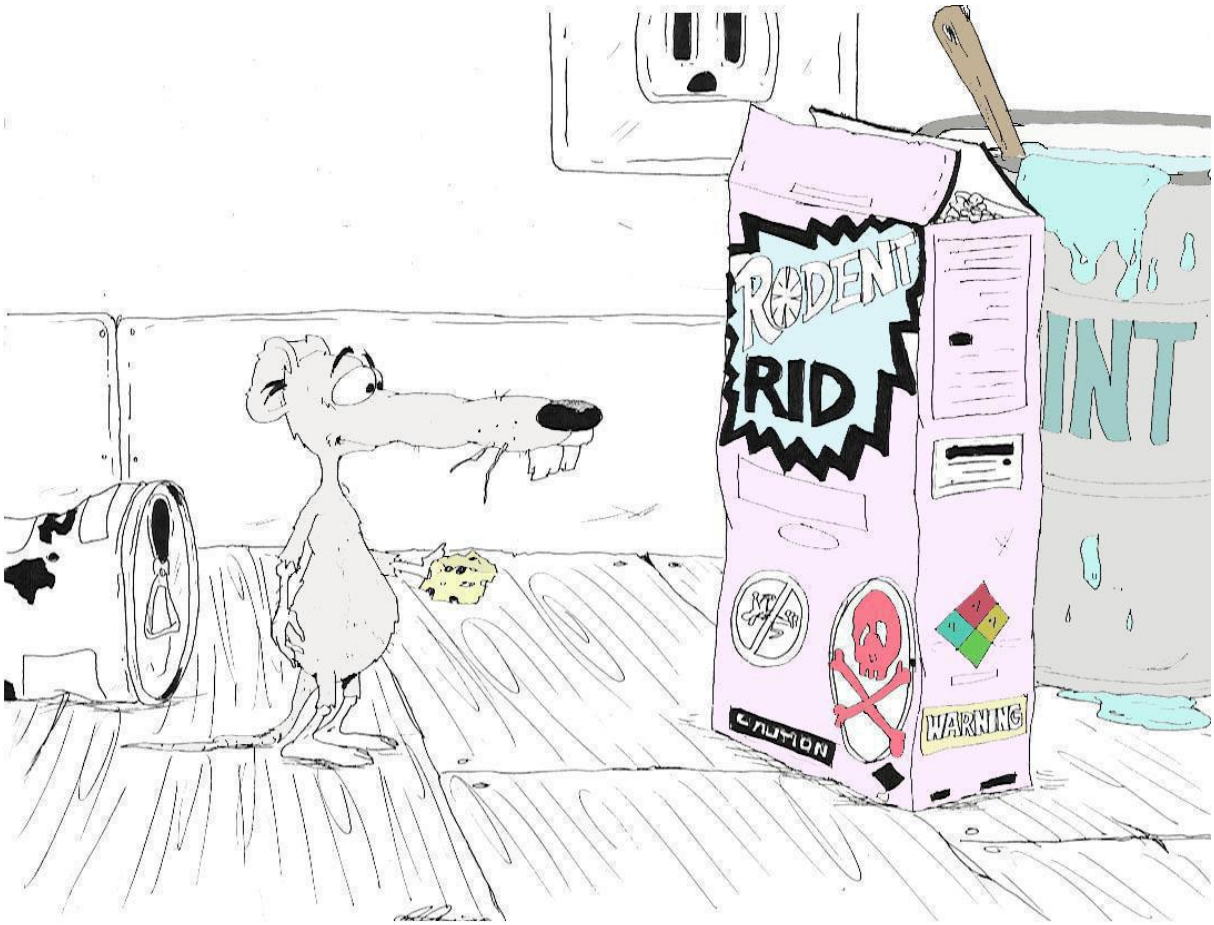
She never lives more than ninety meters from dwellings thus guaranteeing her meals. She attacks from below or behind, usually from underneath desks or chairs and mainly at the feet and ankles. The insect is very fast in flight unless gorged with blood. Other types of mosquito even fly into your face and can be easily caught or killed--not *Aedes*, she's too smart.

The eggs can survive for very long periods in a dry state, often for more than a year. Since the virus can be passed from adult to egg, the virus, too, is guaranteed survival until the next summer and heavy rains.

The virus remains in the salivary glands of the mosquito, and when she bites for food, she injects saliva into the wound where the anti-coagulants contained in her saliva facilitate feeding. Without knowing it, she also injects the virus into the host.

There are no intermediate animal vectors for the virus; it seems the system is contained in man/mosquito/man relationships. *Aedes* is very domesticated, as much as your pet dog or cat. Most mosquitoes can live in forested areas a long way from humans and live on animal blood--not *Aedes*, she relies on man and will only bite animals in his total absence, although the female does actually take juices from various types of fruit at times.

The water in Brazil is very well chlorinated, but, even so, *Aedes* does well. Another species of *Aedes*, *Aedes albopictus* is known to transmit Yellow fever; chances are she is also capable of transmitting Dengue fever. There is a vaccination available for Yellow fever but, to date there is no form of treatment against Dengue fever. There are actually four virus types.



Culex tarsalis

Culex tarsalis is widely distributed in North America west of the Mississippi River, between southern Canada and northern Mexico.

It occurs throughout California, from sea level up to nearly 10,000 in feet elevation, and is especially abundant in the Central Valley and coastal regions, including Marin and Sonoma Counties.

As its name suggests, *C. tarsalis* has bands of white scales around the joints of its tarsi (legs). There is also a pale band around the center of the proboscis, a line of white scales extending along the hind tibia and femur, and a series of V-shaped spots made of dark scales on the underside of each abdominal segment. This mosquito develops rapidly and produces multiple generations. In the hot summer season, egg to adult development occurs in as few as four to ten days. A female can lay six or seven times, with some 300 eggs in a batch. Without control efforts, local populations can reach huge numbers in a short time.

Culex tarsalis breeds in nearly every freshwater source except treeholes. Larvae are found in all but the most polluted ground pools. Summer agricultural irrigation produces an especially favorable environment, with highest population densities coinciding with the months of most intense irrigation.

During the daytime, adults rest in tree cavities, animal burrows, and artificial habitats like barns, chicken houses and culverts. In most areas, they feed equally on birds and mammals including man, depending on availability. After years of intense efforts to keep them under control, vast populations in the central valley have become resistant to nearly all the common chemical insecticides.

Culex tarsalis is the most important carrier of western equine and Saint Louis encephalitis in much of the western U.S. It occurs together with wild birds - the natural reservoir of infection, and the virus is often discovered in field-collected specimens. It is also readily infected after taking an infected blood meal, and easily transmits the virus during its later blood meals. The appearance of antibodies against encephalitis virus in the flocks of sentinel chickens kept in several parts of the state is a signal alarm to the districts to begin quickly and aggressively reducing *Culex tarsalis* numbers around populated areas.

Notice that the abdomen is blunt with no cerci present.

Mosquitoes of the *Culex tarsalis* species have a distinct ring around the proboscis.

Also, they have apical and basal tarsal bands.

Mosquito Disease Section

Female of the malaria vector mosquito, *Anopheles gambiae* taking a bloodmeal.

Mosquitoes were already feeding on blood during the days of the dinosaurs. Many viruses, bacteria, protozoans, worms and other parasitic organisms have spent millions of years adapting their own life cycles to the intimate relationships between biting arthropods and their hosts. In a kind of lottery-of-life, every successful agent has evolved and fine-tuned each detail of its existence to the ecology and natural history of its two very different kinds of hosts.

Mosquito believed to be more than 25 million years old preserved in amber.

Vector-borne diseases that affect agriculture, like equine encephalitis, canine heartworm, or bluetongue of sheep, have received a lot of attention by scientists. The vast majority affect only wildlife populations and still very little is known about these insects. Some bacterial and viral agents have only recently been discovered, when new diagnostic tools identified a previously unrecorded organism in a human patient.

The normal vertebrate hosts of most vector borne diseases of man (malaria is now almost an exception) are wild or domestic animals. Humans usually become infected only when they step into an already existing natural or "***enzootic***" cycle. Diseases caused by organisms currently exploring these newly opened transmission routes to man have been called "***emerging infectious diseases***".

Mosquito-borne Diseases

Mosquito-borne Diseases
Mosquito-borne diseases affect millions of people worldwide each year. In the United States, some species of mosquitoes can transmit diseases such as West Nile, Encephalitis, Dengue fever, and Malaria to humans, and a variety of diseases to wildlife and domestic animals. To combat mosquitoes and the public health hazards they present, many states and localities have established mosquito control programs. These programs, which are based on surveillance, can include non-chemical forms of prevention and control as well as ground and aerial application of chemical and biological pesticides.

Can mosquitoes carry diseases?
Any insect that feeds on blood has the potential of transmitting disease organisms from human to human. Mosquitoes are highly developed blood-sucking insects and are the most formidable transmitters of disease in the animal kingdom. Mosquito-borne diseases are caused by human parasites that have a stage in their life cycle that enters the blood stream.

The female mosquito picks up the blood stage of the parasite when she imbibes blood to develop her eggs. The parasites generally use the mosquito to complete a portion of their own life cycle and either multiply, change in form inside the mosquito or do both. After the mosquito lays her eggs, she seeks a second blood meal and transmits the fully developed parasites to the next unwitting host.

Malaria is a parasitic protozoan that infects the blood cells of humans and is transmitted from one human to the next by *Anopheles* mosquitoes.

There seven major diseases that mosquitoes carry. Five of these affect humans; one of them affects dogs and the other horses.

General Disease Information

Yellow Fever
Yellow fever is a viral disease carried by certain mosquitoes. The virus damages many body tissues, but especially the liver. The Aedes Aegypti mosquito carries the yellow fever virus from one person to another. When the mosquito bites an infected person or animal, the virus enters the insect's body, where it develops rapidly. Yellow fever is found in jungle areas, especially in South America. The disease can now be prevented by a vaccine.

Yellow fever is a virus infection of monkeys that can either be transmitted from monkey to human or from human to human in tropical areas of the world.

Encephalitis
Encephalitis is an untreatable, sometimes deadly and serious disease carried by mosquitoes. Its symptoms are severe headache, fever, vomiting, disorientation, chills, muscle aches and pains. It usually occurs in warm wet weather.

Encephalitis is a virus of the central nervous system that is passed from infected birds to humans by mosquitoes that accept birds as blood meal hosts in addition to humans.

Malaria
Malaria is a dangerous parasitic disease common on tropical and subtropical areas. It is transmitted by the female anopheles mosquito. Victims of malaria suffer chills and fever and millions of people die of the disease each year. There are four types of malaria. Most malaria can be healed by two different types of drugs.

Dengue Fever
Dengue Fever is also called Breakbone Fever. The disease causes fever, headaches, eye aches, pain in the muscles and joints. It may also cause a runny nose, sore throat, and skin rash. Dengue fever is caused by viruses that are carried by mosquitoes. Symptoms appear three to six days after the person is bit by a mosquito. Dengue fever is mostly found in the tropics.

Canine Heartworm
The heartworm may cause serious illness or even death. Adult heartworms live in a dog's heart, but young forms of the worm are found in their blood. Mosquitoes transmit the infection when they feed on the blood of an infected dog.

Dog heartworm is a large filarial worm that lives in the heart of dogs but produces a blood stage small enough to develop in a mosquito. The dog heartworm parasite does not develop properly in humans and is not regarded as a human health problem. A closely related parasite, however, produces human elephantiasis in some tropical areas of the world, a debilitating mosquito-borne affliction that results in grossly swollen arms, legs and genitals.

West Nile
West Nile virus is a mosquito-borne virus that can cause encephalitis (inflammation of the brain) or meningitis (inflammation of the lining of the brain and spinal cord). This virus is named after the West Nile region of Uganda, where the virus was first isolated in 1937. West Nile virus is most commonly found in Africa, West Asia and the Middle East.

West Nile virus is spread to humans by the bite of an infected mosquito. A mosquito becomes infected by biting a bird that carries the virus.

You cannot get West Nile virus from a person who has the disease. West Nile virus is not spread by person-to-person contact such as touching, kissing, or caring for someone who is infected.

West Nile virus is not spread directly from birds to persons. However, you should always avoid bare-handed contact when handling dead animals or birds. Use gloves or double plastic bags to place the carcass in a garbage can.

Symptoms of West Nile virus?
Most people who are infected with the West Nile virus have no symptoms or may experience mild illness such as a fever, headache and body aches before fully recovering. Some persons also develop a mild rash or swollen lymph glands. In some individuals, particularly the elderly, West Nile virus can cause serious disease that affects brain tissue. At its most serious, it can cause permanent neurological damage and can be fatal. Encephalitis (*inflammation of the brain)* symptoms include the rapid onset of severe headache, high fever, stiff neck, confusion, loss of consciousness (coma), muscle weakness, or possibly death.

How long does it take to get sick after being bitten by an infected mosquito?
West Nile virus symptoms generally occur 5 to 15 days after being bitten by an infected mosquito.

Who is at risk of contracting West Nile virus?
Anyone can become infected with the virus. However, the very old are more likely to become ill and develop serious symptoms (*such as encephalitis*) when infected.

If I live in an area where birds or mosquitoes with West Nile virus have been reported, and I am bitten by a mosquito, am I likely to get sick?
No. Even in areas where mosquitoes do carry the virus, very few mosquitoes -- less than 1% -- are infected. The chances that any one bite will be from an infected mosquito are very small.

I've gotten a mosquito bite. Should I be tested for West Nile virus?
No. Most mosquitoes are not infected with the West Nile virus. Illnesses related to mosquito bites are rare. However, you should see a doctor immediately if you develop symptoms such as high fever, confusion, muscle weakness, severe headaches, stiff neck, or if your eyes become sensitive to light. Patients with mild symptoms should recover completely, and do not require any specific medication or laboratory testing.

Is there treatment for West Nile virus?
Although there is no specific treatment, medication or cure, the symptoms and complications of the disease can be treated. Most people who get this illness recover from it.

Is there a vaccine for West Nile virus?
No. A vaccine for West Nile virus does not exist.

AIDS
The HIV virus that produces AIDS in humans does not develop in mosquitoes. If HIV infected blood is taken up by a mosquito the virus is treated like food and digested along with the blood meal. If the mosquito takes a partial blood meal from an HIV positive person and resumes feeding on a non-infected individual, insufficient particles are transferred to initiate a new infection.

If a fully engorged mosquito with HIV positive blood is squashed on the skin, there would be insufficient transfer of virus to produce infection. The virus diseases that use insects as agents of transfer produce tremendously high levels of parasites in the blood. The levels of HIV that circulate in human blood are so low that HIV antibody is used as the primary diagnosis for infection.

Two struck by West Nile Virus

More virus carrying mosquitoes have been found this year

Recent Newspaper Article

Health officials in New York say two more people have contracted the potentially deadly West Nile virus. The officials said both had been infected on Staten Island before spraying restarted in July and were now recovering. The victims are a 63-year-old man and a 63-year-old woman. A 78-year-old man also from Staten Island was infected earlier this year and made a full recovery. Last year, seven people died in New York and more than 60 were infected, which had never before been seen in the Western Hemisphere.

The virus is found in birds and can be transmitted by mosquitoes to other birds or to humans. Experts in 17 states are now on the lookout for the warning signs that the virus may be on the move into their area.

Precautions

Large areas of New York have already been sprayed with insecticide in an attempt to prevent an outbreak of illness. Dead birds have been found in several areas around the city, along with infected mosquitoes in other parts of the Eastern US such as Connecticut and New Jersey. The re-emergence of the virus this year has disappointed those who hoped that it might have been a freak visitor, unable to over-winter in the cold East Coast conditions.

It is not known whether extensive chemical spraying of New York City has had any impact on rates of other illnesses, such as skin conditions or respiratory problems. New Yorkers have being urged to cover up and dose themselves in DEET repellent, even in the sweltering heat of the city's summer.

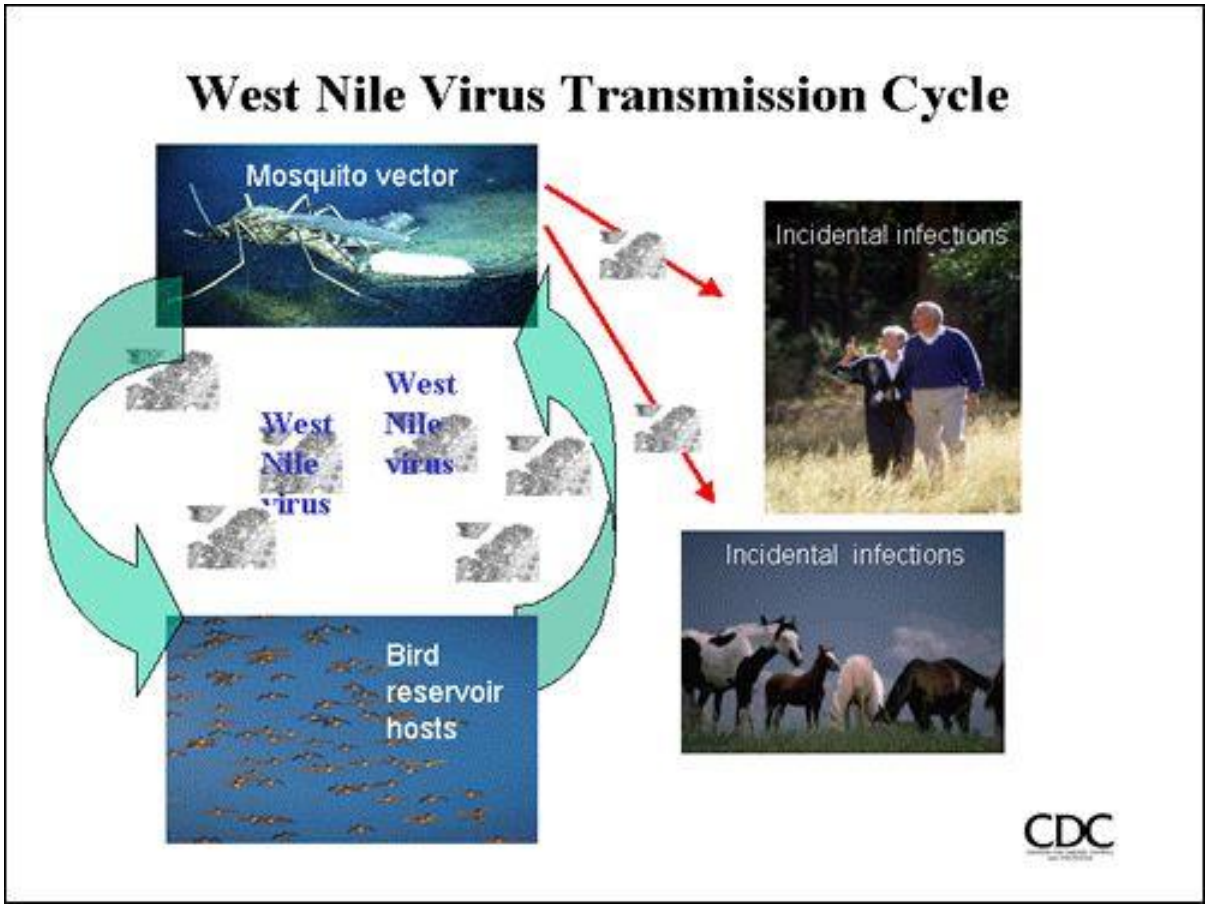
"It is critical that all New Yorkers, particularly the elderly and those who live on Staten Island, take precautions to reduce exposure to mosquitoes," said Health Commissioner Neal Cohen.

West Nile Virus Mosquito Information

The West Nile virus (**WNV**) is maintained in nature when an arthropod vector transmits the virus between vertebrate hosts. The primary vector for WNV in the United States is the ***Culex pipiens*** mosquito that commonly breeds in urban areas and prefers to feed on birds. To date, 11 mosquito species in the U.S., including other ***Culex, Aedes, Anopheles***, and ***Psorophora*** mosquito species, have tested positive for WNV. Mosquitoes acquire WNV when feeding on infected birds.

The virus is then stored in the mosquito's salivary glands and transmitted to humans and other incidental hosts when the mosquito takes a blood meal (view transmission cycle). The virus has been detected in many wild bird species, including the American crow.

Humans and other domestic animals are considered "***dead-end***" hosts, as they do not contribute to the transmission cycle but can develop an illness as a result of infection.



Viral Encephalitis

An arbovirus (**ar**thropod-**bo**rne **virus**) natural cycle includes periods in two hosts: a blood feeding arthropod and a population of wild vertebrates. The virus is picked up during a blood meal. It multiplies and eventually lodges in the arthropod's salivary glands, ready to be injected during any subsequent feeding. The arthropod can remain infective for life, without being harmed. There are no preventive vaccines for man, so adequate vector control is the only front-line defense against these viruses.

Public health workers in California keep watch for three especially dangerous arboviruses: Western Equine Encephalitis **(WEE)** and Saint Louis Encephalitis **(SLE),** and the rapidly spreading West Nile virus **(WNV).** Typical vertebrate hosts are wild birds, like sparrows, finches, jays, robins, doves and pigeons. Their seasonal north-south migrations mean that surveillance needs to be maintained throughout the state.

***Culex* Species**

The most important insect vector in California is the encephalitis mosquito, *Culex tarsalis*, common in both Marin and Sonoma Counties. Other *Culex* species can also serve as vectors. Encephalitis outbreaks in wild vertebrates occur during the months when mosquito density is highest, and sometimes they develop very quickly. Nevertheless, the environmental factors (like seasonal weather patterns, temperature and rainfall) that might help predict increased human exposure and risk of infection still need to be studied.

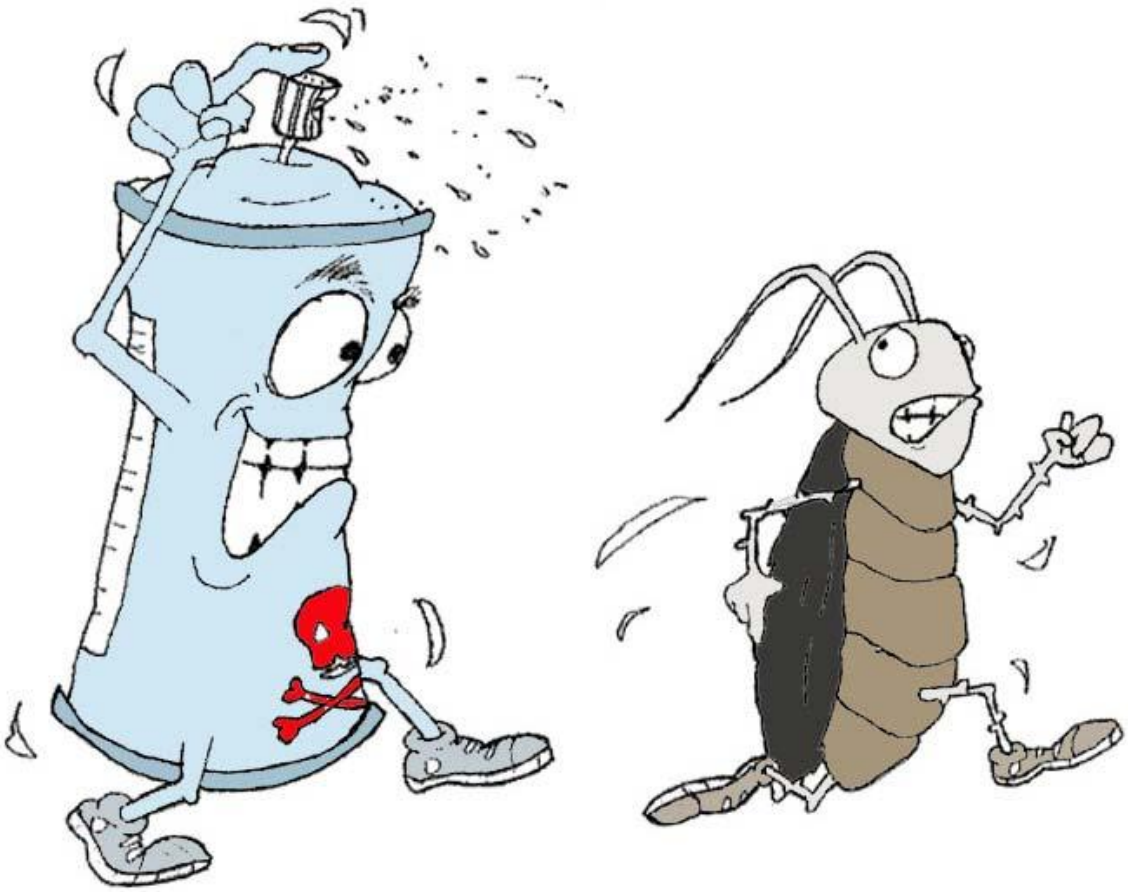
Occasional human infections with WEE have occurred in both Marin and Sonoma, and at least 13 cases have been found in horses in Sonoma County. Man and horses are accidental, dead end hosts for the virus. Transmission does not occur directly from person to person, and is unlikely from man or horses to mosquitoes because virus levels in circulating blood remain low.

From 1945 to 1987, there were 1,307 human deaths in California due to arbovirus infection. About 3 in every 100 such infections prove fatal, while others cause long-term disability. But for every recognized case, many more go undiscovered. Surveys in areas like Kern County, where high frequency of exposure would be expected, turned up many residents with antibodies against WEE and SLE arboviruses, but with no apparent symptoms of disease.

When symptoms do appear they can be severe, including fever, headache, and central nervous system disease with encephalitis (inflammation of the brain). Horses have a much greater exposure to migratory birds and mosquitoes. Equine cases tend to be severe, with between 25% and 30% fatalities. Recent experience in Sonoma county suggests that imported Australian emus may be extremely susceptible to the virus.

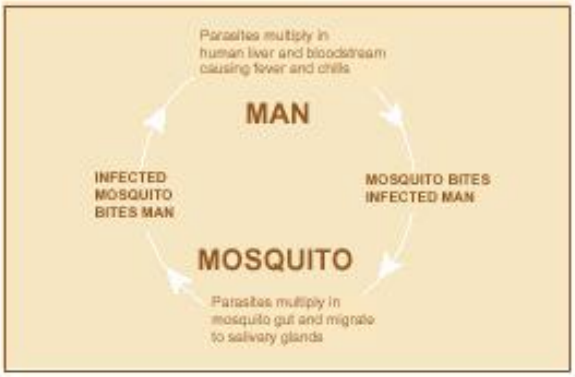
Sentinel Chicken Flocks

Several California vector control districts and the State Department of Health Services put out sentinel chicken flocks each spring to alert them of arbovirus presence in wild birds and transmission by local mosquitoes. This is how they discovered that WEE was active in Sonoma County during 1992, 1993, 1994 and 1997, and in neighboring Napa and Solano counties in 1996.



Malaria

Malaria is a life-threatening parasitic disease transmitted by mosquitoes. It was once thought that the disease came from fetid marshes, hence the name ***mal aria***, ((bad air). In 1880, scientists discovered the real cause of malaria a one-cell parasite called plasmodium. Later they discovered that the parasite is transmitted from person to person through the bite of a female Anopheles mosquito, which requires blood to nurture her eggs.



Man and mosquito play complementary roles in the malaria cycle.

Today approximately 40% of the world's population, mostly those living in the world's poorest countries, are at risk of malaria. The disease was once more widespread but it was successfully eliminated from many countries with temperate climates during the mid 20th century. Today malaria is found throughout the tropical and sub-tropical regions of the world and causes more than 300 million acute illnesses and at least one million deaths annually.

Ninety percent of deaths due to malaria occur in Africa south of the Sahara mostly among young children. Malaria kills an African child every 30 seconds. Many children who survive an episode of severe malaria may suffer from learning impairments or brain damage. Pregnant women and their unborn children are also particularly vulnerable to malaria, which is a major cause of prenatal mortality, low birth weight and maternal anemia.

There are four types of human malaria Plasmodium vivax
P. malariae, P. ovale and *P. falciparum. P. vivax* and *P. falciparum* are the most common and falciparum the most deadly type of malaria infection. *Plasmodium falciparum* malaria is most common in Africa, south of the Sahara, accounting in large part for the extremely high mortality in this region. There are also worrying indications of the spread of *P. falciparum* malaria into new regions of the world and its reappearance in areas where it had been eliminated.

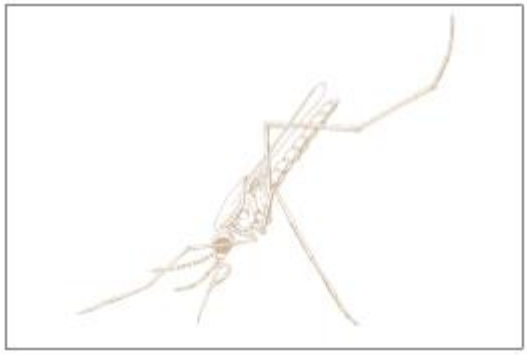
The malaria parasite enters the human host when an infected Anopheles mosquito takes a blood meal. Inside the human host, the parasite undergoes a series of changes as part of its complex life-cycle. Its various stages allow plasmodia to evade the immune system, infect the liver and red blood cells, and finally develop into a form that is able to infect a mosquito again when it bites an infected person. Inside the mosquito, the parasite matures until it reaches the sexual stage where it can again infect a human host when the mosquito takes her next blood meal, 10 to 14 days later.

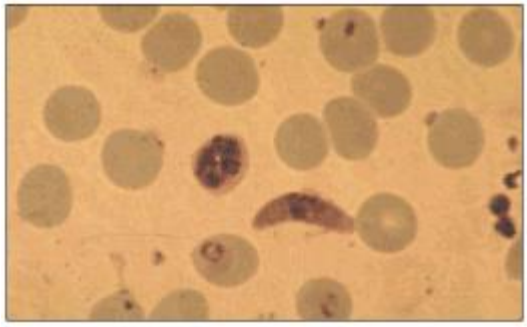
Malaria Symptoms
Malaria symptoms appear about 9 to 14 days after the infectious mosquito bite, although this varies with different plasmodium species. Typically, malaria produces fever, headache, vomiting and other flu-like symptoms. If drugs are not available for treatment or the parasites are resistant to them, the infection can progress rapidly to become life-threatening. Malaria can kill by infecting and destroying red blood cells (anemia) and by clogging the capillaries that carry blood to the brain (cerebral malaria) or other vital organs.

Malaria, together with HIV/AIDS and TB, is one of the major public health challenges undermining development in the poorest countries in the world.

Malaria Parasites

Malaria parasites are developing unacceptable levels of resistance to one drug after another and many insecticides are no longer useful against mosquitoes transmitting the disease. Years of vaccine research have produced few hopeful candidates and although scientists are redoubling the search, an effective vaccine is at best years away.





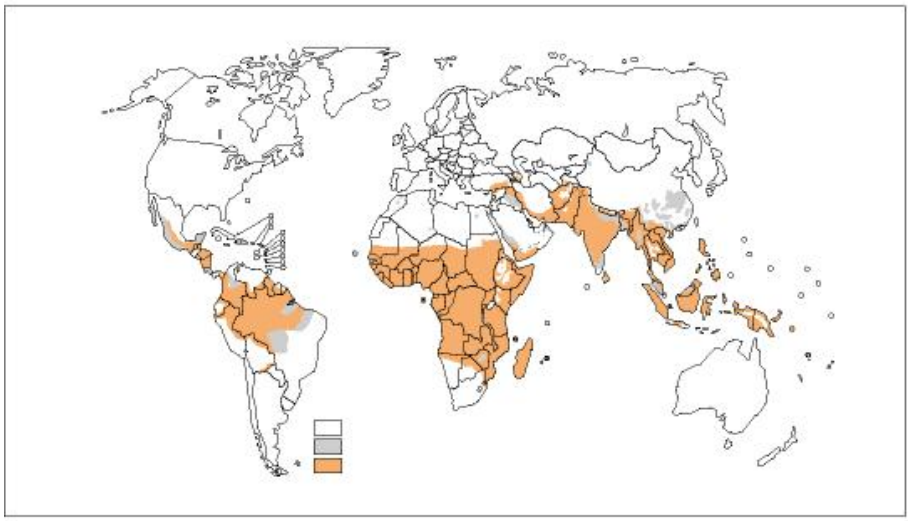
Above: Anopheles mosquito in characteristic biting and resting position. Below: Microscopist's view of Plasmodium Falciparum.

Pictures: WHO/TDR, WHO/PVivax

Science still has no magic bullet for malaria and many doubt that such a single solution will ever exist. Nevertheless, effective low-cost strategies are available for its treatment, prevention and control and the Roll Back Malaria global partnership is vigorously promoting them in Africa and other malaria-endemic regions of the world. Mosquito nets treated with insecticide reduce malaria transmission and child deaths.

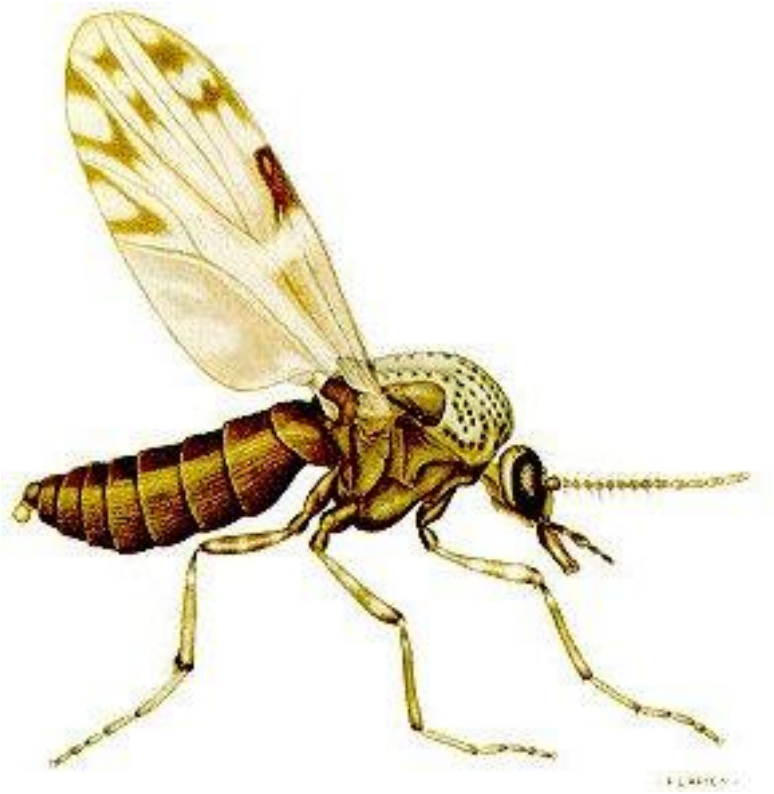
Prevention

Prevention of malaria in pregnant women, through measures such as Intermittent Preventive Treatment and the use of insecticide-treated nets (ITNs), results in improvement in maternal health, infant health and survival. Prompt access to treatment with effective up-to-date medicines, such as artemisinin-based combination therapies (ACTs), saves lives. If countries can apply these and other measures on a wide scale and monitor them, then the burden of malaria will be significantly reduced.



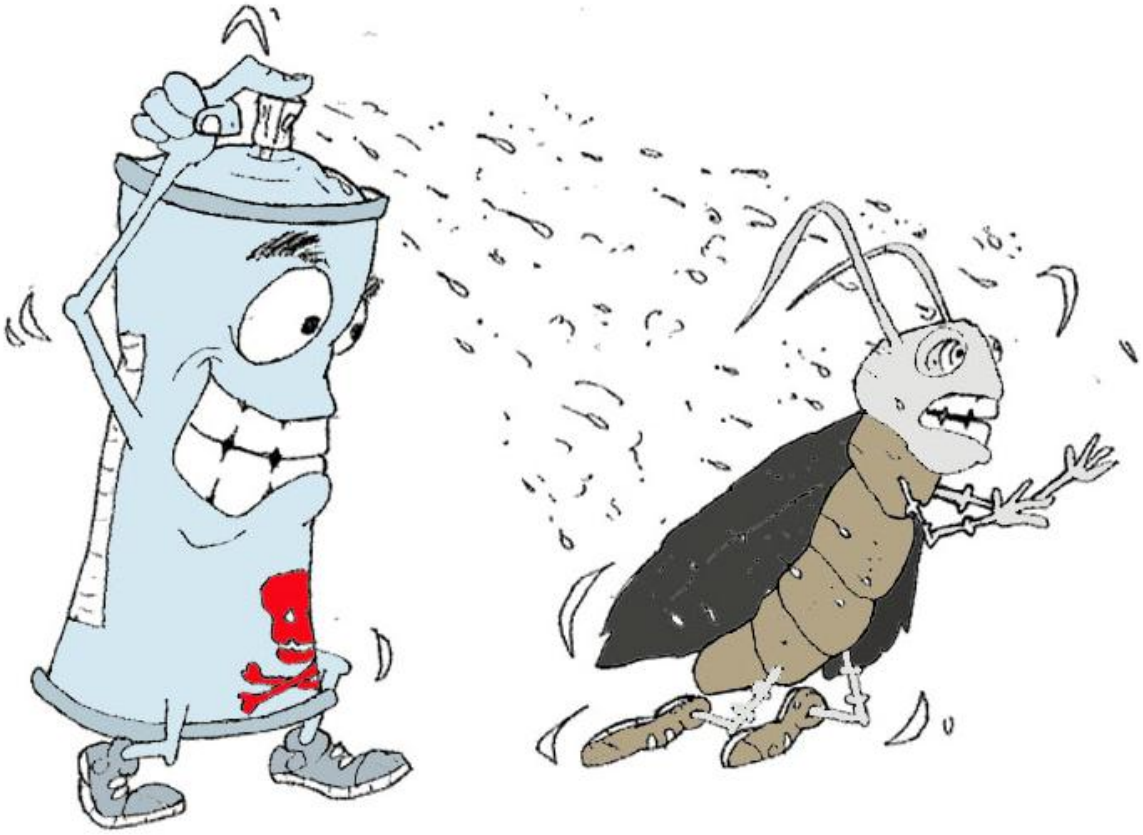
Above: World malaria situation. Malaria is endemic to tropical and subtropical regions.

Midge Section



Midges

SIZE: From 3/16 to 1/2 inch (5-12.7mm)
COLOR: Pale
DESCRIPTION: Name applies to mosquito-like flies in the family Chironomidae. They are different from mosquitoes in that female midges don't bite; males have large, bushy antennae. Adults produce a high-pitched humming sound when they swarm.
HABITAT: Adults frequently collect in large swarms in late afternoon or evening near streams, ponds, and lakes. They are often attracted to outdoor lights of houses close to these swarming sites.
LIFE CYCLE: Midges breed chiefly in water, but some develop in decaying vegetation, manure, or under the bark of trees. Because larvae occur in huge numbers in water, they are an important source of food for many species of fish. Adults emerge in the spring, frequently in large numbers.
TYPE OF DAMAGE: Although they do not bite, the adults can be a severe nuisance simply by their numbers.
CONTROL: Nearly impossible since streams, ponds and lakes cannot (and should not) be treated with insecticides to control these flies. Fogging for adults is not practical.
INTERESTING FACTS: Often mistaken for mosquitoes. The difference is that female mosquitoes do bite; female midges do not.



Midge Introduction

Midges are found almost everywhere and often occur in huge swarms. It is the large numbers that suddenly appear around the house or landscape that attract attention. Midges range from 1/8 to 1/2 inch and have a long, slender, delicate, mosquito-like body and feathery antennae.

Midges of the type shown are harmless. (There are other species of midges, called the biting midges or no-see-ums that are annoying blood suckers.) The non-biting midges cannot bite or sting and they do not feed on field crops, landscape plants, livestock, pets, people or structures.

Biology and Identification
Most midge larvae live in water. A few occur in decaying organic matter or in very wet soil. The source of the immature stage means midges will be most numerous near lakes and streams, though swarms considerable distances from the nearest water are possible. Midge larvae are an important food item for fish.

This fly belongs to a family of small to moderately large flies. People are often alarmed by midges since they resemble mosquitoes. However, they differ from mosquitoes in that the wings are not scaled and the mouthparts are short and not adapted for biting. Adult midges are slender, usually less than 5 mm long with long, slender legs and wings. Midges lay their eggs on water. The larvae are usually aquatic, are found in quiet water such as lakes, ponds, reservoirs and tanks, and are bottom feeders. Polluted water apparently favors their growth and development. In the summer, eggs will hatch in about 3 days and larvae will reach adulthood in about 4 weeks.

During peak emergence, large numbers of midges fly into residential and industrial areas causing annoyance and damage. They are attracted to lights at night and thousands will rest on the outside of buildings and will enter homes through the slightest crack. They fly into people's eyes, ears and mouths and are sometimes inhaled. Everything is contaminated by midges!

Common Name	**Scientific Name**
Non-biting midge	*Chironomus plumosus* (Linnaeus)
	Chironomus attenuatus Walker
Biting midges, punkies or no-see-ums	*Culicoides furens* (Poey)
Crane flies	*Tipula* spp.

Occasionally during April, May, and June, homeowners become alarmed by large swarms of gnat-like insects sometimes confused with mosquitoes. These non-biting midges are found near lakes, ponds or streams and may "dance" in swarms over the water, inciting fish to jump.

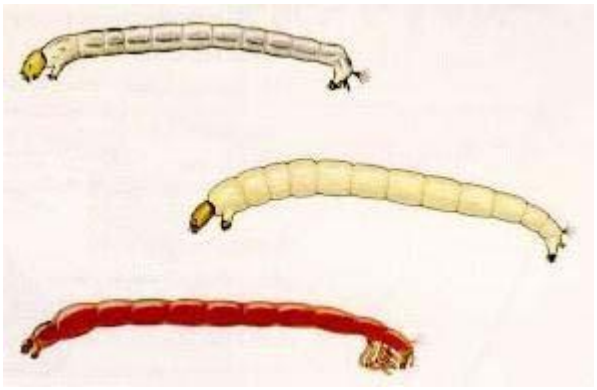
Most occur in huge swarms or small compact mating swarms, and a *"humming"* can be heard over a considerable distance. After sunset, adults become active and fly to night-lights, entering structures through the slightest of openings. Piles of eight to twelve inches of dead midges may accumulate in unwanted places. A stench similar to dead fish may be observed.

Biting Midges

There are also biting midges, which are very tiny insects (sometimes called "*no-see-ums*"), that suck blood from humans, mammals, reptiles, and other insects. Bites can cause itching and, in sensitive individuals, welts and lesions that can persist for several days. Other species transmit diseases. Crane flies (some resembling overgrown or *"giant"* mosquitoes) are small to large size with extremely long legs (similar to *"daddy-long-legs"*) that break off easily. Many have patterned wings. They are non-biting or stinging, but may cause alarm by their presence on sides of homes and elsewhere.

Identification

Non-biting midges are small (1/8-inch to 1/2-inch long), delicate, mosquito-like, but lack scales on their wings. Adults are humpbacked, brown, black, orange, or gray, lack a long beak (proboscis), and males have very feathery antennae. Larvae are often whitish, cylindrical-like, elongate or wormlike (up to 1/2-inch to 3/4-inch long) usually with paired prolegs, respiratory tubes absent on the prothorax, and have a dark head. Some are known as *"bloodworms"* or *"red worms"* due to the presence of hemoglobin in the blood.

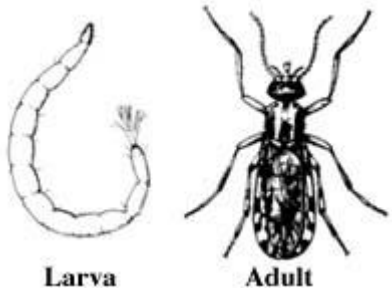


Others have a greenish color. Most live in fresh water while others are found in very moist soil, in wet moss, and under damp bark. Most larvae feed on algae or small aquatic plants.

Bloodworms

Biting Midges

Biting midges, punkies or no-see-ums are very tiny (less than 1/4-inch long), slender gnat-like flies. Some have narrow spotted or clear wings. Larvae are tiny, whitish, elongate, or wormlike, and are found in sand, mud, decaying vegetation, and water in tree holes.

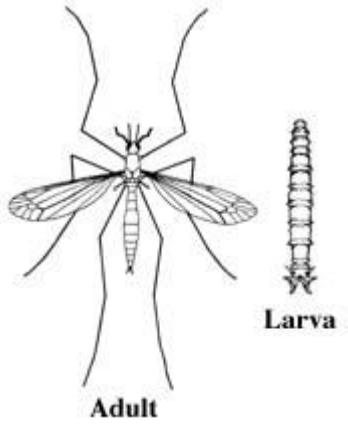


Biting Midges, punkies, or no-see-ums

Crane Flies

Crane flies are small to large (3/16-inch to just under an inch long) long-legged, slender-bodied with a V-shaped suture across the thorax. Legs of all species break off easily so that perfect specimens are difficult to maintain in an insect collection. Many have patterned wings and resemble mosquitoes. The larvae, called ***"leatherjackets,"*** develop a tough skin and can usually be found in damp soil feeding on decaying vegetable matter.

Maggots are legless, have poorly developed heads, and are about one inch long when mature. They are usually associated with poorly-drained soils and sometimes occur in large, concentrated numbers. They are sometimes mistaken as cutworms.



Crane Fly

Life Cycle and Habits

During peak emergence, extremely large populations of non-biting midges may create much annoyance simply by accumulating in freshly applied paints, hanging onto outdoor laundry, clustering on screens, etc. Summer resorts along lakes and other water frontage may have houses and buildings covered with these midges that enter around vent openings, air conditioning units, windows, doors, etc.

The following day, these midges are found dead on window sills throughout the building. Their presence causes concern to homeowners and others. Sometimes, midges invade factories and contaminate fabrics, plastics, packed materials, etc.

Other times, thick swarms can cause allergic reactions in susceptible individuals and even cause traffic hazards. Even economic losses occur when customers go elsewhere from certain motels and restaurants to avoid nuisance midges that are attracted to night-lights on their premises.

Eggs
Female midges lay eggs in masses over open water or attach to vegetation. Eggs hatch in about 72 hours and the young larvae drop to the bottom of the lake, stream, etc., feeding as scavengers on organic debris (silty ooze, algae and plankton). The larval stage takes about four weeks followed by pupation lasting usually 48 hours. Pupa emerge from their pupal skin, rising to the water surface like a mosquito. Adults do not eat and have a short life span of five to ten days. Males swarm at dusk with mating occurring after females enter the swarm.

Midges overwinter in the larval stage. They are beneficial as an important item of food for many freshwater fish and other aquatic animals.

Biting midges, punkies or no-see-ums are found especially along the seashore and the shores of rivers or lakes. Their small size is responsible for the name "***no-see-ums***" and their bite is far out of proportion to their size. Larvae are aquatic or semi-aquatic, found in moist sand, mud, decaying vegetation of salt and freshwater marshes, ponds and streams. They are believed to be scavengers.

Crane flies occur chiefly in damp situations with abundant vegetation. Larvae are aquatic or semi-aquatic, feeding on decaying vegetative matter. Others feed on living plants and may cause damage especially to turf and pasture. Some feed on flowers, certain vegetables and small fruits. Others are predaceous. Little is known of the adult feeding habits, but some possess a long slender proboscis and feed on plant nectar. Crane flies do not bite or sting humans.

Control Measures
No control measures for midges are entirely satisfactory when large bodies of water are nearby. Locating the source of breeding is best. If possible and practical, locate standing water on your premises and eliminate it. Midges may fly as far as a quarter of a mile from the breeding site such as a lagoon, drainage ditch, standing water, lake or pond. They can also develop in and around buildings in well-watered soils and occasionally in standing water from air-conditioning units on building roofs.

Check stagnant, polluted water accumulating in bird baths, clogged rain gutters, water-holding tree stumps, flower pots, old tires, etc. Sometimes, it is often best to wait out the one- to two-week emergence period for a particular species, hoping that additional emergence periods will not occur.

However, several species emerging at different times may occur in the same locality, lasting six to eight weeks or longer at 75°F to 80°F during hot, muggy weather.

Midge Prevention

Houses and buildings with outside lighting will attract large numbers of non-biting midges. Move light away from sensitive areas such as doorways, windows, patios, etc. Avoid the use of unnecessary lights until 45 minutes after sundown since 90 percent or more of flight activity takes place before that time.

Sometimes, eggs are laid on surfaces around lights and on buildings. These egg masses can become unsightly and smear when wet.

By replacing a 100-Watt mercury vapor light (ultraviolet energy) with a 50-Watt high-pressure sodium vapor light, midge concentrations are significantly reduced. (Lights least attractive to insects are sodium vapor or halogen with pink, yellow or orange tints and dichrom yellow bulbs.) Blacklight traps (bug zappers) will kill midges, but unfortunately often attract more midges into the area than are killed. Larvae have been controlled in small bodies of water by stocking with carp and goldfish at the rate of 150 to 500 pounds of fish per acre.

Biting midges apparently do not travel far from the place where larvae develop, and one may often avoid punkie attacks by simply moving a few yards away.

Insecticides
Small bodies of landlocked water may be treated with insecticides, but these bodies of water may or may not be the source of nuisance midges. Several of the commercial insecticides labeled for midge control are for application only by Public Health Officials, trained personnel of Mosquito Abatement Districts, and licensed pesticide applicators.

For control of midge larvae, one can apply temephos (***Skeeter Abate***) two percent or five percent, in standing water, shallow ponds, lakes, woodland pools, tidal water, marshes, swamps and waters high in organic content (highly polluted water). For adult control, one can apply permethrin (***Biomist***) ULV, using any standard ULV ground applicator capable of producing a non-thermal, aerosol spray with droplets ranging in size from 5 to 30 microns.

Also, labeled for adult control is chlorpyrifos + permethrin (***ULV Mosquito Master***). Permethrin 6.92 to 10 percent EC is a broad spectrum multiuse insecticide, providing quick knockdown.

Certain formulations of pyrethrins are labeled for outdoor adult midge control. Some licensed pest control operators use total release of aerosols and fog (**ULV**) for adult control. Granular pesticides have been used in barrier treatments around structures.

Eliminating Midges
Midge invasions may be abated by avoiding the use of outdoor lighting to the greatest possible extent, especially during early evening hours. For those midges that are still able to find their way indoors, the residual and space treatments described for the house fly will provide some degree of relief.

Midges are rarely a problem in a well-balanced aquatic community. Pollution of water, where algae growth provides food for midge larvae to feed, results in excessive midge populations.

Certain insecticides can be applied to the water to kill midge larvae, but if the food supply which will support future midge outbreaks is not removed, the source of the problem remains.

Midges have been controlled in small bodies of water by stocking them with carp and goldfish at the rate of 150 to 500 pounds per acre of water surface.

When water management techniques are not practical and the treatment of larval breeding waters is not feasible, fogging for adult flies may provide temporary relief. Malathion and synergized pyrethrins are examples of insecticides that have been used to control adult midges. Fogging provides limited results unless the entire residential area is treated.

Federal Pesticide Recordkeeping Requirements

Questions and Answers
Final regulations to implement requirements in section 1491 of the Food, Agriculture, Conservation, and Trade (**FACT**) Act of 1990, commonly referred to as the 1990 Farm Bill, went into effect **May 10, 1993.** On February 10, 1995 amendments to the regulations were published, which become effective on May 11, 1995. The regulations are administered by the U.S. Department of Agriculture's Agricultural Marketing Service (**AMS**).

Why are there regulations for restricted use pesticide recordkeeping for certified private applicators? The FACT Act of 1990, subtitle H, section 1491, states that the Secretary of Agriculture, in consultation with the Administrator of the Environmental Protection Agency (**EPA**), ***"shall require certified applicators of restricted use pesticides..... to maintain records comparable to records maintained by commercial applicators of pesticides in each State."*** Certified applicators include both commercial and private applicators.

The EPA currently requires certified commercial applicators to keep records under regulations implementing the Federal Insecticide, Fungicide, and Rodenticide Act (**FIFRA**). The EPA is prohibited from requiring certified private applicators to maintain records. However, some individual States require certified private applicators to maintain records.

Do the regulations apply to all pesticide applications? No. The regulations only require recordkeeping for applications of federally-restricted use pesticides. Pesticides are classified as restricted use, general use, or for both uses.

Is a Federal form required for maintaining the record(s)? No. The regulations do not require the use of a standardized form. This allows applicators the flexibility to fit the recordkeeping requirements into their current recordkeeping scheme.

What information is a certified private applicator required to maintain on a restricted use pesticide application? The recordkeeping requirements are:

1. The brand or product name, and the EPA registration number of the restricted use pesticide that was applied;
2. The total amount of the restricted use pesticide applied;
3. The location of the application, the size of area treated, and the crop, commodity, stored product, or site to which a restricted use pesticide was applied;
4. The month, day, and year when the restricted use pesticide application occurred; and
5. The name and certification number (if applicable) of the certified applicator who applied or who supervised the application of the restricted use pesticide.

When does the pesticide application information have to be recorded? The information required shall be recorded within 14 days following the pesticide application.

How long are records required to be kept? Restricted use pesticide records must be retained by the applicator for 2 years from the date of application and made available to individuals who are authorized to have access to the record information.

Certified applicators have no reporting requirements under the regulations.

Who has authorization to obtain record information from the certified applicator?
Individuals representing the Secretary of Agriculture or the State designated agency, which is most commonly the State Department of Agriculture. Also the attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, is authorized access to record information when it is determined the information is needed to provide medical treatment or first aid to an individual who may have been exposed to the restricted use pesticide for which the record is maintained.

Are there any penalties for violation of the Federal pesticide recordkeeping requirements? Yes. Any certified applicator who violates the requirements shall be subject to a civil penalty of not more than $500 in the case of the first offense, and shall be subject to a civil penalty of not less than $1000 for each violation for subsequent offenses, except that the civil penalty shall be less than $1000 if the Administrator determines that the certified applicator made a good faith effort to comply.

AMENDMENTS TO THE REGULATIONS - EFFECTIVE MAY 11, 1995

1. **Change in the way the location of a "spot application" is recorded.**
   A" spot application" is an application(s) of a restricted use pesticide made on the same day in a total area of less than one-tenth of an acre. This provision still does not apply to records maintained for greenhouse and nursery applications.

   The regulations were amended to require a more detailed description of the location of a *"spot application."* Spot applications must be recorded with the following information: Brand or product name and EPA registration number; total amount applied; location must be designated as *"spot application,"* followed by a concise description of the location (**Examples:** Spot application, noxious weeds were spot sprayed throughout field number 5 and 6. Spot application, sprayed for weeds next to the silo); and month, day, and year of application.

2. **Shortened the time period to make a record of the restricted use pesticide application.**
   The time period was reduced from 30 days to 14 days for the required information to be legibly recorded following the restricted use pesticide application.

   However, whether or not the written record has been completed, the certified applicator shall provide the record information for medical treatment or first aid.

3. **Change in the definition of a medical emergency.**
   A medical emergency is defined as a situation that requires immediate medical treatment or first aid to treat possible symptoms of pesticide poisoning or exposure.

4. **Change in the definition of a licensed health care professional.**
   A licensed health care professional is defined as a physician, nurse, emergency medical technician, or other qualified individual, licensed or certified by a State to provide medical treatment.

5. **Change in accessing records to facilitate medical treatment.**
   When the attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, determines that any record of the application of any restricted use pesticide required to be maintained is necessary to provide medical treatment or first aid to an individual who may have been exposed to the restricted use pesticide for which the record is or will be maintained, the certified applicator required to maintain the record shall promptly provide the record information and any available label information. If it is determined by the attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, to be a medical emergency, the record information of the restricted use pesticide, relating to the medical emergency, shall be provided immediately.

6. **Change in provisions for the release of record information obtained for purposes of medical treatment.**
   (1) The attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, may utilize and release the record or record information when necessary to provide medical treatment or first aid to an individual who may have been exposed to the ' restricted use pesticide for which the record is or will be maintained;
   (2) the attending licensed health care professional may release the record or record information to appropriate Federal or State agencies that deal with pesticide use or any health issue related to the use of pesticides when necessary to prevent further injury or illness; and
   (3) a licensed health care professional may release the record or record information to submit pesticide poisoning incident reports to the appropriate State or Federal agencies.

7. **Clarification that the Administrator of AMS, has flexibility in assessing civil penalties.**
   The amended regulations provide the Administrator of AMS, or the Administrator's designee, with flexibility in assessing civil penalties.

PPE is necessary when washing pesticide equipment.


U.R. GONE
BUG SPRAY

Personal Protective Equipment Section

Pesticides are necessary for agricultural production but potential hazards to users are not adequately emphasized. Accidents involving pesticides are usually due to improper handling, mixing, application of pesticides, or failure to use proper personal protective equipment and clothing.

General Guidelines
The minimum protection when working with pesticides is long sleeves, long pants, shoes and socks, rubber gloves, and splash-proof eye protection, regardless of the toxicity level of the pesticide. Rubber boots and a respirator are necessary when working with moderately or highly toxic pesticides. EPA recommendations include wearing a double layer of clothing. This can be accomplished by wearing coveralls over the long pants and long-sleeved shirt, and rubber boots over the shoes and socks.

Gloves
The use of gloves is mandatory when working with highly toxic pesticides. It is recommended that only unlined rubber or neoprene (nitrile, etc.) gloves be used when handling or using all pesticides. Unlined gloves should be thoroughly washed (inside and outside) after each use.

Gloves should be at least 12 inches long to provide adequate protection for wrists and the cuffs should be inside sleeves for most work. This will keep runoff pesticide from getting into the gloves. However, when working overhead, put the cuffs of gloves outside sleeves. Check rubber type gloves for leaks each time they are washed. Do this by filling gloves with water; fold the cuff over to put pressure on the water in the glove. If there are holes water will leak out. Discard gloves with leaks. **NEVER USE CLOTH OR LEATHER GLOVES WHEN WORKING WITH PESTICIDES** unless specified on the label.

Goggles and Face Shields
It is necessary to wear splash-proof goggles when working with pesticides. Not only can the pesticide be absorbed through the eyes but the acidity of a pesticide can cause permanent eye injuries also. Use goggles meeting or exceeding ANSI standard Z87.1, 1968 estimate. When pouring or mixing concentrates it is preferable to use a full-face shield to protect the face from splashes. Always wash the goggles or face shield with soap and water after use.

Boots
Unlined rubber or neoprene (nitrile, etc.) boots should be worn over work shoes or in place of work shoes when mixing or applying pesticides. Pull the legs of trousers over the tops of boots to help prevent spilled pesticide from getting inside boots. Wash boots with soap and water after each use.

NEVER WEAR CLOTH OR LEATHER BOOTS WHEN MIXING, OR APPLYING PESTICIDES.

Cloth or leather boots will absorb pesticides and allow the pesticide to contact the skin of the leg or foot and will be a source of residues causing chronic exposure.

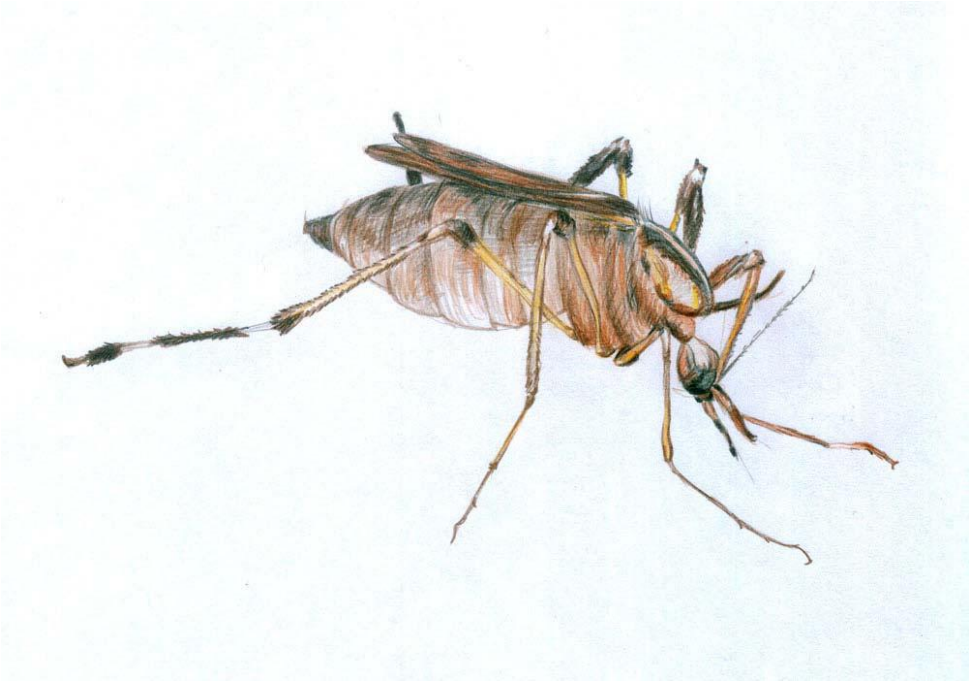
Headwear
A waterproof hat should be worn when mixing or applying pesticides because pesticides can be readily absorbed through the scalp. The hat should have a brim to keep drift or splashes off ears and neck. Plastic safety hats are ideal for use with pesticides and should be washed in soap and water after each use. Cloth hats may absorb pesticides and contaminate the wearer. **DO NOT USE CLOTH HATS.**

Respirators
Respirators are designed to prevent inhalation of toxic fumes and mists. They should be used when mixing or applying pesticides if the label specifies the need. Choose the correct cartridge for the type of pesticide being used. The manufacturer or supplier can provide guidance on selecting correct cartridges.

Replace cartridges when the odor of the pesticide becomes noticeable or when breathing becomes difficult during use. The life of cartridges will vary with the concentration of pesticide in the air around the respirator, breathing rate of the user, temperature, humidity and composition of the cartridge.

Respirators **SHOULD NOT** be used in low oxygen atmospheres (below 19.5 percent oxygen). Respirators **WILL NOT** provide adequate protection for a person having a beard. Choose the model and make of respirator that provides a good seal between the face piece and the face to prevent pesticides leaking into the respirator and being inhaled.

Always wash the face piece and straps in soap and water after each use. After drying, place the respirator and cartridges in a clean plastic bag until it is needed again. Select respirators having the approval of NIOSH or MESA.



Personal Protective Equipment Policy *Example*

Scope
This section applies to all supervisors and pesticide applicators.

Purpose
To assure employees are protected from chemical, physical and biological hazards by the use of personal protective equipment (**PPE**). PPE is designed and selected to protect the body from absorption, inhalation, physical contact and extreme temperature hazards.

Personal protective equipment includes, but is not limited to safety glasses, goggles, face shields, hard hats, gloves, safety-toe boots, respirators and earplugs/muffs.

Supervisor's Responsibilities
Supervisors assess workplaces to identify hazards that their employees are potentially exposed to during the course of their work. Hazard assessments are performed by observing work practices, interviewing employees and reviewing chemical material safety data sheets and tool/equipment manufacturer's instructions.

Supervisors select PPE based on the types of hazards identified during the assessments, level of protection needed, fit and comfort.

Supervisors are to ensure employees are provided with, and wear, PPE.

Hazard assessments are to be conducted whenever new equipment, processes or chemicals are introduced or an injury or illness indicates the need for PPE.

NOTE: Supervisors or Safety Officers should conduct noise and respiratory protection hazard assessments.

Training
Supervisors ensure employees are trained in the proper use of PPE. Employees are to receive information and training about why and when PPE is needed; how to put on, remove and adjust PPE; the use and limits of PPE, and how to care for and inspect PPE.

NOTE: Supervisors or Safety Officers should conduct noise and respiratory protection training.

Recordkeeping Requirements
Supervisors document that hazard assessments have been conducted using copies of the certification form found following this section.

Supervisors document training using copies of the certification form following this section.

NOTE: Supervisors or Safety Officers document noise and respiratory protection hazard assessments and training.

Personal Protective Equipment Training Certification		
_____ Employee's name	has been assigned and trained to use the following personal protective equipment when working in areas and/or tasks identified below:	
Area/Task	***PPE Required - X Applicable Lines***	***PPE Selected (Make and Model)***
	__ Eye/Face Protection __ Head Protection __ Hand Protection __ Hearing Protection __ Respiratory Protection __ Other:_____	
Area/Task	***PPE Required — X Applicable Lines***	***PPE Selected (Make and Model)***
	__ Eye/Face Protection __ Head Protection __ Hand Protection __ Hearing Protection __ Respiratory Protection __ Other:_____	
I, _____,	have received and understood the training on the PPE listed above. This training included the areas, tasks and hazards requiring PPE; how to properly put on, wear, and take off the PPE; PPE selection criteria, and the proper care, inspection, maintenance, useful life and disposal of the PPE.	
Supervisor:		Date(s) of Training:

Requirements for Workers

Unless specifically stated in the WPS as an exception or an exemption, the standard covers all pesticide use on a farm or in a greenhouse, nursery, or forest that produces agricultural plants. The exceptions are related to specific types of application and the exemption, which is not a total exemption, applies to owners, operators, and their immediate family (see Appendix for more detail).

Restrictions Associated with Pesticide Applications

An agricultural employer must not allow or direct any person other than one who is an appropriately trained and equipped handler to enter or remain in an area during pesticide application. The standard is more detailed for operators of nurseries and greenhouses. The standard specifically states that there are no exemptions to this restriction.

Entry Restrictions

After any pesticide has been applied on an agricultural establishment, the agricultural employer must not allow or direct any worker to enter or remain in the treated area before the REI specified on the pesticide labeling has expired. Some exceptions apply to these entry restrictions:

If an employer can assure that the worker will have no contact (not-touch or be touched) with pesticide residues on treated surfaces of plants or in soil, water, or air.

A worker may enter for short-term activities if the agricultural employer ensures that:

1. No hand labor is performed (moving or repairing irrigation or watering equipment not used to apply pesticides is not considered a hand operation).

2. The worker is in the treated area for no more than 1 hour in any 24-hour period.

3. No entry is allowed during the first 4 hours following pesticide application.

4. The worker must read or be informed of, in language the worker understands, all of the labeling requirements related to human hazards or precautions, first aid, symptoms of poisoning, personal protective equipment (**PPE**) specified for early entry, and any other safety requirements.

5. Required PPE is provided to the worker and conforms to the requirements of the standard for type of equipment, proper maintenance, and proper use by the worker.

6. Measures to prevent heat-related illness must be instituted, when necessary, if personal protective clothing is required.

7. A decontamination site is provided.

8. No worker is allowed or directed to wear or take home PPE contaminated with pesticides.

Notice of Application

Agricultural employers are required to notify workers of any pesticide application in greenhouses, on farms, or in nurseries unless the employer can assure that, from the start of application until the end of the REI, the worker will not enter, work in, remain in, and walk through or within one-quarter mile of the treated farm, forest, or nursery area, or pass through the treated greenhouse.

If the above assurances cannot be given to workers in greenhouses, all pesticide applications must be posted. If the above assurances cannot be given to workers on farms and in nurseries and forests, posted and oral warnings must be given to workers when the pesticide labeling requires them, and either posted or oral warnings must be given to workers when the pesticide labeling does not contain the posted and oral warning requirement.

The standard is very specific about the content, design, and size of the posting sign; when an oral warning is to be given and the information to be given to workers; and the type of information that employers must provide about specific pesticide applications.

Requirements
Employers are required to provide information on the location and description of the treated area and the time during which entry is restricted, as well as provide warnings not to enter the treated area until the REI has expired (EPA, 1993b).

Pesticide Safety Training

An agricultural employer must assure that any worker entering a treated area during the REI or within 30 days of the expiration of the REI has been properly trained in accordance with the standard. The exception to this requirement is an employee who is a certified applicator or who has received handler training specified in the standard.

Pesticide Safety Poster
An agricultural employer must display a safety poster where it can be readily seen and read by the workers. The poster must remain legible and contain basic pesticide safety concepts (specified in the standard), list emergency medical care information (address and telephone number), and be updated promptly when there is any change in the emergency care information.

Decontamination
An agricultural employer must provide a decontamination site for washing off pesticide residue whenever workers are required to enter a treated area during the REI and the 30-day period after expiration.

The decontamination site must have enough water for washing; water must be of a quality and temperature that will not cause illness or injury when it contacts the skin or eyes or if it is swallowed. Also, soap, single-use towels, and an eye-flush dispenser (unless worker carries one) should be on site.

The site cannot be located in an area being treated or under an REI and cannot be more than one-quarter mile from the workers (the standard contains some exceptions to the one-quarter mile limit).

These regulations contained four basic requirements:
(1) workers are not to be sprayed with pesticides;
(2) there are specific restricted entry intervals (**REI**) for 12 pesticides, interim restrictive entry levels for certain pesticides, and a general re-entry interval for all other agricultural pesticides prohibiting re-entry into treated areas until sprays have dried, dusts have settled, and vapors have dispersed;
(3) protective clothing is required for any worker entering a treated area before the specific re-entry period has expired; and
(4) ***"appropriate and timely"*** warnings are required for re-entry. These warnings may be given orally in appropriate language, placed on the pesticide notice board, or posted in the field.

Emergency Assistance
If there is reason to believe that a worker has been poisoned or injured by pesticides, the employer must make prompt transportation to a medical facility available to the worker.

On request the employer must provide, to either the worker or medical personnel providing treatment, information about the product including the EPA registration number, active ingredients in any product the worker might have been exposed to in the past 30 days, antidote and other first aid information from the product labeling, and information about the application and the exposure of workers to the pesticide.

Requirements for Handlers
The general applicability and exceptions and exemptions in the requirements for handlers and workers are the same. However, the requirements for handlers have specific differences.

Restrictions During Application

The handler employer must assure that:

No pesticide is applied so as to contact any worker (directly or through drift) other than an appropriately trained and equipped handler.

Workers handling highly toxic pesticides are monitored visually or by voice communication at least every 2 hours.

Any worker who handles a fumigant in a greenhouse, including a handler entering before acceptable safe entry criteria have been met, maintains continuous visual or voice contact with another handler who has immediate access to the required PPE if rescuing the handler in the greenhouse becomes necessary.

Notice of Application to Agricultural Employers
Prior to applying any pesticide on an agricultural establishment, a handler employer must provide the following information to an agricultural employer or be assured that the agricultural employer is aware of the specific time, date, location, and description of the pesticide-treated area, labeling requirements relating to protection of workers during or after application, product name, EPA registration number, active ingredients, REI, and notification requirements.

Pesticide Safety Training
A handler employer must assure that each handler is properly trained in pesticide safety by a qualified trainer. The minimum pesticide training required, as well as the criteria for qualified trainers, is specified in the standard. Certified handlers and handlers who have been trained under 40 Code of Federal Regulations, Part 171 are exempt from this requirement.

Knowledge of Labeling Information

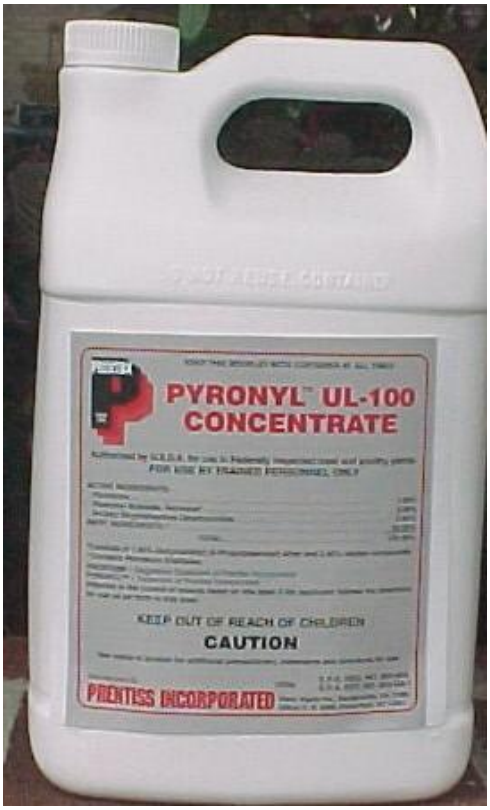
A handler employer must assure that handlers understand all of the labeling requirements related to safe use of pesticides before any handling activity takes place. The handler must also have access to the product labeling information during handling activities.

Safe Operation of Equipment
A handler employer must assure that handlers are instructed in the safe operation of all equipment they will be using. It is the handler-employer's responsibility to assure that the equipment is working properly and to inform employees, when appropriate, that the equipment may be contaminated with pesticides and to explain the correct way to handle such equipment.

Personal Protective Equipment
Any person handling a pesticide must use the clothing and PPE specified on the label for product use. Characteristics of protective clothing and PPE are specified in the standard, as are exceptions to PPE specified on product labeling. The handler employer must take appropriate measures to prevent heat-related illnesses.

Decontamination
A handler employer must provide a decontamination site (as specified in the standard) for washing off pesticides and pesticide residues during any handling activity.

Emergency Assistance
A handler employer must provide the same emergency assistance to handlers as discussed for workers.




UG-B-GONE

Professor Durbin's Pesticide Applicator Observations

Here are some of my following little observations that I've noticed during my years of teaching. I do not endorse any of the pesticide products. Don't be surprised if I drop in on you and check out your work.

Right photograph, here is a hand compress spray applicator. Know in the industry as a B&G sprayer. This sprayer will apply most liquid products. A necessary tool for any applicator.

Top photograph, old fashion hose reel spray set-up.

Yes, old fashioned. Most applicators have gone to a backpack style product applicator; this is your primary moneymaking tool if properly utilized. I said product and not chemical or pesticide. For some reason, customers prefer the word product especially when you are applying pesticides.

Here is my commentary, for some unknown reason, a majority of the younger applicators are doing a horrible job at applying product and conducting customer service. The larger firms are going through several new hires and only keeping a few of their trainees. This process is costing companies thousands of dollars and losing customers and I can't figure it out. My only answer is that this generation is has an unfavorable disease called "Lazy". Yes, just plain lazy from watching MTV, watching cartoons and playing video games. It seems that they do not respect any profession or the opportunity that some companies have given them on a silver platter.

The item on the right is often referred to as a "Centrobulb" or duster. This is a brand name and many variations are found. It is a simple tool to apply powder, dust or granular baits. An insecticide duster delivers a fine application of your favorite insecticidal dust. Get one that is non-conductive to electrical lines and switches. I have noticed that applicators will utilize this tool and proper product in areas that are wet or receive rain. This is a good use of product and good idea to boot.

The photograph above is a Crusader Duster or dust applicator and is great for voids in walls or cracks and crevices. Just pour your product in the top and squeeze the product into the cracks or inside switchplates. You got to get in the pest's home to kill them! Notice the plastic tip so that you don't get an electric shock. This moneymaking tool is great to kill cockroaches, bees or termites. I've heard enough complaints from applicators that they are unable to kill the pests. If you can't kill spiders or know someone that complains about not being able to kill spiders, then you know who I am talking about. Know your pest, its habitat and know your product!

Right photograph, I like to call this my coffee pot type of dispenser. It is a hand held compressed air spot applicator for indoor use. I like to use Phantom products in it and it works like dynamite on ants and termites alike. Notice the two red backpacks on this truck. Always have a backup backpack. Now go out there and pour a little coffee for the pest of the week.

Bottom photograph, Drax Gel (i.e. - Orthoboric acid 5%): Indoor ant bait in gel form. The "double barrel" syringe delivers both sugar and protein baits in one easy application. Bait can be placed in small amounts to cracks, crevices and other areas where conventional bait stations cannot be used. We have found excellent control of household ants by combining Drax Gel with FluorGuard bait stations. This ant bait combo gives you quick control of indoor ant populations.

Utilizing the same application gun, I hate to endorse any product, but here is an example of an ant bait which is the ideal means of targeted elimination of ant infestations. Baits are used to kill the entire colony, not just foraging workers. If the ants bite such as fire ants or if they are carpenter ants this is the product you need. The granules are unobtrusive, ready-to-use, and take less time to apply than conventional insecticides.

Termidor (Great on Ants too)

Termidor is applied at very low rates. Typically, the active ingredient (fipronil) is just 0.06% of the solution, a concentration much lower than that of older liquids and less than most insecticides. For an average home treatment, only about 8 ounces of the active ingredient is actually used. Keep in mind, too, that since 1995, fipronil has been used around the world for flea and tick control on household pets and on agricultural crops to protect food supplies. And Termidor has virtually no odor, which means you and your family won't notice a thing. Termidor is made from a revolutionary new nonrepellent or "undetectable" chemical technology treatment. That means termites cannot see, smell, taste or avoid Termidor. Instead they contact, ingest, and share it with their nestmates. This is in sharp contrast to older liquid termite controls, which rely on repellent barriers that termites can finds breaks in or avoid completely. Mix this in your backpack and never mix with a contact killer.

Cockroaches have been here since Adam and Eve. Yes, they did not come from another creature that evolved in to today's cockroaches as many of my contemporaries will tell you. As an applicator, you will see things that will set you right. Because of your route, you may never eat again at a certain restaurant. I know, I hate seeing German cockroaches because I've seen such large infestations in homes and restaurants. But this product has shown success in killing those little critters. Place Avert cockroach bait into cracks and crevices; holes; pipe chases; undersides of furniture; under drain plates; in or under trash containers; hidden surfaces around sinks and storage areas; behind baseboards; around doors and windows; inside, behind and under cabinets, drawers and shelving; under and behind appliances such as stoves and refrigerators; and in attics and crawl spaces. Also apply in points between different elements of construction, between equipment and floors, openings leading to voids and hollow spaces in walls, equipment legs and bases and crawl spaces where roaches hide. During follow-up applications, inspect bait placements and re-apply when necessary. Care should be taken to avoid depositing cockroach bait onto exposed surfaces. If gel contacts an exposed surface, remove gel and wash exposed surface. This product may also be used in food/ feed areas of food/ feed handling establishments. Believe it or not, this little tube is good for several applications. Let's get it right and make some money.

Roach baits are formulations that are attractive to roaches and (when eaten by the insect) are lethal to roaches. There are different types of baits that can be used, depending on roach species and area to be baited. The basic baits covered in this article are bait stations, bait gels and granular baits. Roach bait stations can be used indoors or outdoors; indoor use is usually recommended. Roach bait gels can be used indoors and can also be use on the exterior surfaces of buildings. Granular baits are usually used outdoors (in mulched areas where larger roaches breed or hide) but can also be used in attics or wall voids.

For best results, do not combine contact insecticides with baits. (A contact insecticide is a granule, liquid spray or aerosol that is used to directly kill targeted pests.)

Two bad things happen when you use a contact insecticide in the same area where baiting programs are implemented: your bait is contaminated and any domino effect will be neutralized. If you contaminate your roach bait with another insecticide, the bait will no longer be attractive to the targeted roach population. If you kill a roach with an insecticide spray, it will die before it passes the bait on to the rest of the roach population, thus killing your domino effect. The same is true when baiting for ants. You want the foraging worker ants to carry your bait back to the nest where all ants will consume the bait.

Many people are concerned when they see the amount of active ingredients in an insect bait. These people think that they are not getting their money's worth because the amount of active ingredients (insecticide or killing agent) seems to be very low. When baiting roaches, ants, silverfish or crickets, you do not want to see large amounts of active ingredients in the formulation. If insecticide levels are too high (in an insect bait), the targeted pest will be repelled instead of being attracted to the bait. The low amount of active ingredients in a roach bait (or other insect baits) is an attractive property to many people who wish to use as little insecticides as possible.

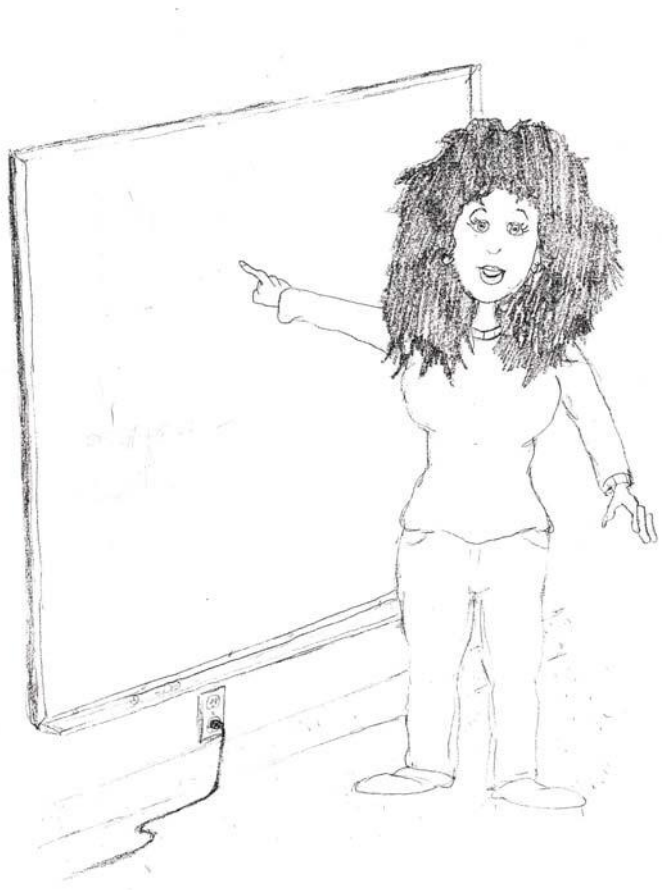
While I am on the subject, here is a super insect growth regulator. An insect growth regulator is by definition a juvenile hormone mimic, a material that inhibits the growth or maturity of certain insect pests. An insect growth regulator (IGR) is an important pest management tool because it helps to reduce, eliminate or prevent infestations of targeted pests without the use of conventional contact insecticides, thus reducing or eliminating the need for pesticides in homes, hospitals, restaurants, warehouse or any area where certain pests are not welcome.

Hydroprene is an IGR that was first introduced to the pest control industry under the brand name Gencor IGR. Gencor was used to help prevent or control populations of indoor roaches, most commonly used against German cockroaches.

Although the name has changed from Gencor to Gentrol, the active ingredient is still Hydroprene. The label for this product has been broadened to include not only roaches (cockroaches) but also many pantry pests, also known as stored product pests. The only stored product pest that does not react well to Hydroprene is the Cigarette Beetle.

This particular beetle is affected by Methoprene, another IGR that is widely used in indoor flea control programs. The Methoprene products used by professional pest control operators are sold under the brand name of Precor.

When cockroaches are exposed to Gentrol (any form or type) people usually report seeing crippled, deformed or otherwise odd looking roaches. These deformities are to be expected. Young roaches (also called cockroach nymphs) have an exoskeleton or outer shell. (Mammals have an internal skeleton or bone structure.) As roaches in their nymphal stage grow, their exoskeleton or outer shell becomes too small to contain the insect. As they reach the limits of their exoskeleton a new, flexible exoskeleton forms beneath the old one and the old "shell" splits open to allow the nymphs to molt. This transition denotes what is called a different instar or stage of development.



I always welcome your comments, suggestions on both pesticides and insects.

Delta Dust

Delta Dust (i.e. Deltamethrin .05%) I am not here to endorse this product, but I have found great success inside wall voids. It will kill cockroaches and ants and that is good enough for me.

This odorless, non-staining product is the world's only water-proof insecticide dust! Besides indoor and outdoor applications, it can also be used on ornamental plants. When left undisturbed, Delta Dust kills crawling insects up to eight months. Because it is water-proof, this insecticide dust will not absorb moisture (which destroys other dusts) and it will not clump. Provides quick control of ants, bees (especially carpenter bees), cockroaches, fleas, silverfish, ticks, and numerous stored product pests. Also an invaluable tool for controlling Boxelder Bugs, Ladybugs, White Footed Ants and Pavement Ants. Deltamethrin is a synthetic pyrethroid insecticide.

I hate to endorse any product but ExciteR is one of my cricket killers of all time. Once you spray this product, you'll see every type of critter run for its life.
This is a 6% concentrate of liquid pyrethrin used for fogging and spraying.

Using 1 to 4 ounces per gallon, Exciter can be used alone (in a fogger, mister or pump sprayer) and can also be used as an additive to other insecticides (Malathion, Permethrin, Cypermethrin) for the quick knock-down of insect pests. When used alone, Exciter does not have a long residual.

Prescription Treatment Brand Cy-Kick CS is a flowable concentrated controlled release Cyfluthrin. Simply mix 1-3 oz per gallon of water and spray liberally along baseboards, into cracks and crevices, etc. Cy-Kick is also used as an outdoor perimeter or lawn treatment. Virtually odorless and very long lasting. Cy-Kick is the choice of many professional pest companies it is good but not cheap. It will kill scorpions. I carry a can on my bike with along with my Colt 45. Between these two, I should be able to kill something.

NiBan - FG

Another commonly found pesticide product is NiBan - FG. Niban FG (e.g. Orthoboric acid 5.0 %): Weather resistant bait for the control of ants, carpenter ants, cockroaches, crickets, mole crickets, and silverfish for both interior and exterior use, for use in and around Homes, Apartments, Garages, Public and Private Institutions, Schools, Hotels, Hospitals, Warehouses, Supermarkets, Restaurants, and Food Processing Plants. Apply at a rate of 4 pounds per 1000 square feet (6 ounces per 100 square feet) of surface area. Spread evenly in crawl spaces, attics, drop ceilings, cellars with dirt or gravel floors. In warehouses, garages and basements, concentrate application along walls and baseboards. Apply in inaccessible areas such as cracks and crevices where insects may hide. Reapply as necessary.

When baiting for roaches, crickets or silverfish in cracks and crevices, Niban FG is easy to apply with a Crusader Duster. This professional duster enables you to penetrate deep into the hiding places of insect pests. When baiting outdoors only, Niban G is the best. Niban G is a larger granule, capable of withstanding outdoor conditions for longer periods. When treating for carpenter ants outdoors, consider using the larger granule size.

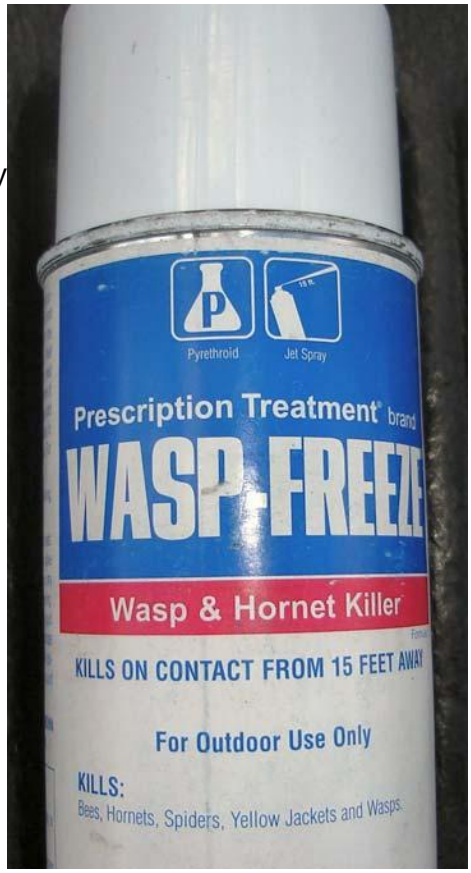
Talstar One

Talstar One is the new label name for Talstar concentrate. In the past there were several different labels for general categories of pest control in lawns, shrubs, ornamentals, indoor pest control in homes and other areas of pest management concerns. Talstar One has the label you need for controlling the many different pests that Fipronil is known to effectively eliminate or control.

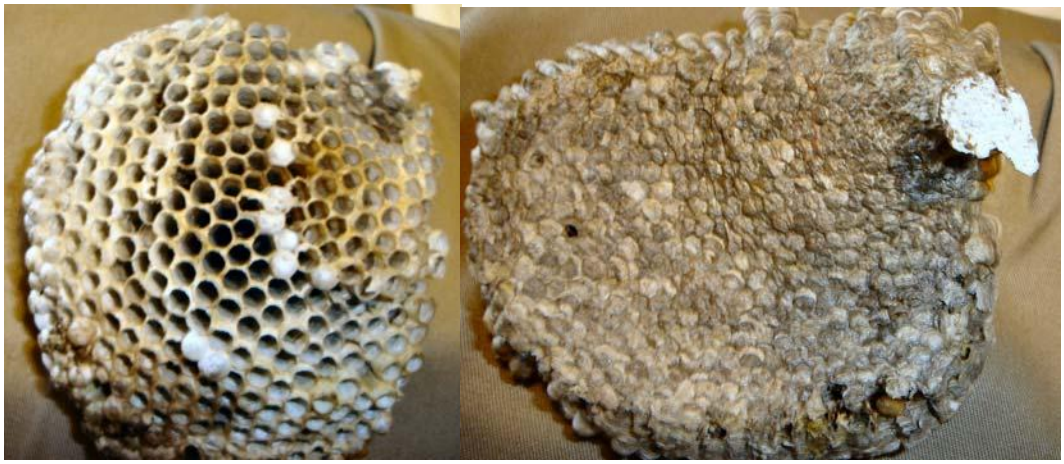
Lawn pests are listed with three different application rates allowed by the pesticide label: Low Rate (0.18 to 0.25 fluid ounces per 1,000 square feet), Medium Rate (0.25 to 0.50 fluid ounces per 1,000 square feet) and High Rate (0.50 to 1.00 fluid ounces per thousand square feet.) Special comments provided for Armyworms, Cutworms, Sod Webworms, adult Annual Bluegrass Weevil, Banks Grass Mite, adult Billbugs, adult Black Turfgrass Ataenius, Chinch Bugs, Mites, Flea larvae, Imported Fire Ants, adult mole cricket, mole cricket nymphs and ticks.

Wasp Freeze

Here is one of my favorite products and I am not trying to promote the brand name but any one that mixes a freezing agent with a pesticide is either crazy or a genius, either way the two are very close and this is a wonderful product. I wish I would have though of it. By the way, the 40 giant wasps can destroy a honey bee hive and kill the entire hive in less than four hours. Wasps are nasty by nature. They can bite or sting. They where designed by God as the prefect winged attach insect. Think about the wasp that will attach tarantulas. This professional outdoor aerosol projects a long stream of quick knock-down insecticide, for killing wasps or hornets. Use this product for a quick kill of visible stinging insects as they rest on their nests.



For best results, use Wasp Freeze at dusk when stinging insects are at rest. If necessary, re-apply your wasp spray the following day. The nests of Paper Wasps are usually located under eaves or other high places where wasp killing aerosols are needed. Wasp Freeze is designed for quick kill of stinging wasps and hornets but does not leave a long term residual. If longer residual is desired, use a double strength solution of Demon WP after using Wasp Freeze insecticide aerosols. If dealing with ground hornets, yellowjackets or other in-ground nests you will have poor results using any aerosol or wasp freeze.



Front and rear sides of a paper wasp's nest. It seems that the stinging insect customer related calls seem to make the most money for the applicator.

Now get to the Assignment and fax that Answer Key to me!

Glossary

Adulticide - A type of pesticide used to kill adult mosquitoes.
Aedes Solicitans - Species of mosquito that is not known to transmit West Nile Virus; breeds in salt marshes.
Altosid - Brand name of methoprene, a type of larvicide.
Arbovirus - A virus whose life cycle includes transmission by arthropods.
Arthropod - An invertebrate animal with jointed legs and a segmented body (includes flies, mosquitoes, ticks; also centipedes, scorpions, spiders etc.)
Aseptic Meningitis - Inflammation of the lining of the brain and spinal cord, not due to a bacterial infection.
Aspirator - A suction device used to remove liquid and other material from an area.
Autochthonous - Native to a place; not imported; used to describe a disease transmitted by vectors that became infected from a local source.
Avian Surveillance - Monitoring of the bird population for presence of a disease.
Bacillus Sphaericus - A bacterium; type of biological pesticide used to eradicate mosquito larvae in water. (mosquito larvae die after ingesting this bacteria).
Bacillus Thuringiensis var. Israelensis (BTI) – A bacterium; type of biological pesticide used to eradicate mosquito larvae in water(mosquito larvae die after ingesting this bacteria).
Case fatality rate-- the percentage of persons diagnosed as having a specified disease that die as a result of that illness (proportion of cases that die of the total infected).
Catch Basins - Grates seen at street corners for water runoff.
Communicable Diseases - Illnesses due to specific infectious agents or their toxic products that can be transmitted from an infected person or animal to a susceptible host; either directly or indirectly through an intermediate host.
Convalescent Blood Sera - Blood serum collected from patients recently recovered from a disease, often used to test whether a person has had a specific infection.
Culex Pipiens - Species of mosquito, the primary known vector for West Nile Virus, commonly found in urban areas; breeds in fresh but stagnant water.
DEET - DEET (chemical name, N,N-diethyl-meta-toluamide) is the active ingredient.
Encephalitis - Inflammation of the brain, which can be caused by numerous viruses, including West Nile Virus
Endemic - A disease naturally present in certain human or animal populations.
Enzootic - A disease naturally present in certain animal populations (sometimes used in contrast with "endemic").
Epidemic - A disease outbreak affecting certain human or animal populations.
Epizootic - A disease outbreak affecting certain animal populations (sometimes used in contrast with "epidemic").
Etiologic - Agents biologic organism or chemical material that cause disease.
Flavivirus - A subset of arboviruses (transmitted by arthropods); this family of viruses includes West Nile Virus, St. Louis Encephalitis and several others.
Gravid Traps - Type of mosquito traps designed to attract pregnant female mosquitoes.
Host - A living organism that serves as a blood source for blood-feeding arthropods, or on which a parasite lives.
IgM - Capture enzyme immunoassay (EIA) testing. A laboratory analysis for the presence of Immunoglobulin M antibodies (antibodies that rise during the acute phase of an illness and are a sign of recent infection).
Indirect IgG Enzyme Iimmunoassay (EIA) Testing - A laboratory analysis for the presence of Immunoglobulin G antibodies (long-lasting antibodies).
Intermediate Host - The arthropod carrier of a parasitic organism.

IPM - (**Integrated Pest Management**); A system for minimizing the impact of vectors and pests by using a variety of control procedures, and decreasing the chemical input to the environment.
Larvae - Immature mosquitoes; stage which hatches from the egg, prior to adult stage.
Larvicide - A type of pesticide used to eradicate immature mosquitoes (larvae).
Meningitis - Inflammation of the lining of the brain and spinal cord.
Methoprene - A type of larvicide; chemical that is used to prevent mosquito larvae from emerging and developing into adult mosquitoes.
Microbial insecticide - An insecticide made of bacteria whose infection kills insects; a substance produced by bacteria that is lethal to insects.
Migratory birds - Birds that fly south for the winter and return north in the spring.
Mosquito Breeding Site - A location where mosquitoes lay eggs, usually in stagnant water with organic material.
Mosquito Pools - A group of mosquitoes collected in one area and combined at the laboratory for testing for the presence of West Nile and related viruses.
N,N-diethyl-meta-toluamide - DEET (chemical name, N,N-diethyl-meta-toluamide) is the active ingredient in many insect repellent products.
Necropsy - Autopsy on an animal.
Neurology - The study of the nervous system and its disorders.
Outbreak - An unexpected increase in frequency or distribution of a disease
Overwintering - A period of rest or hibernation by which insects survive the winter
Palpi - The jointed feelers on each side of the mouth of some arthropods.
Pesticide - Substance used to kill pests such as insects, mice and rats; insecticide is a form of pesticide.
Phlebotomy - Blood Drawing.
Probosis - The straw-like sucking mouthparts of some blood feeding arthropods.
Reservoir - An animal population that normally harbors a disease-causing organism capable of being transmitted to man or other animal populations.
Resmethrin - A synthetic pyrethroid pesticide used to eradicate adult mosquitoes in the home, lawn, garden and at industrial sites; active ingredient in the product ***Scourge***.
Rickettsia - A group of small bacteria that live inside tissue cells, and are carried by ticks, mites, fleas or lice.
Salt Marsh - Areas of vegetation in bodies of salt water that may support the breeding of certain types of mosquitoes such as Aedes solicitans.
Sentinel 'Guard'- Testing of birds and other animals as an early warning system for the presence of virus (e.g. sentinel chickens).
Serologic - Of, or relating to serum.
Seropositive - Positive laboratory result of a serum sample.
Serum - Liquid portion of the blood containing proteins, including antibodies.
Smudge pot - Container used to hold a substance producing dense smoke; used to drive away insects.
St. Louis Encephalitis (SLE) - Mosquito-borne viral disease that causes inflammation of the brain; very similar to West Nile Virus.
Sumithrin - A synthetic pyrethroid pesticide used to eradicate adult mosquitoes in swamps, marshes, and recreational areas; active ingredient in the product Anvil 10 + 10.
ULV - Ultra Low Volume; a method of insecticide distribution in which a small portion of the compound is fragmented into extremely fine particles for aerial dispersal.
Vectobac - Brand name for larvicide Bacillus thuringiensis var. israelensis (**BTI**).
Vectolex - Brand name for larvicide Bacillus sphaericus.
Vector - An arthropod carrier of a disease producing organism. Usually used when part of the organism's natural life cycle takes place in the arthropod (= intermediate host).
Vector Control - Management of organisms that carry disease.