MOSQUITO CONTROL

Edward D. Walker
Department of Entomology, M.S.U.

Modern mosquito control involves integration of a variety of methods to achieve the single end of preventing mosquito bites, and can be done in an environmentally-acceptable manner through the use of physical methods, biological controls, and appropriate and judicious application of insecticides. A knowledge of the different kinds of mosquitoes in Michigan is essential if they are to be controlled using the integrated pest management philosophy. The purpose of this presentation is to provide you with basic facts about biology and control of pest mosquitoes in Michigan. Because of limitations on time, I will forego a discussion of the role of mosquitoes in Michigan as carriers or "vectors" of disease agents. However, the reader should be aware that a variety of mosquito-borne diseases occur in Michigan, such as dog heartworm and eastern equine encephalitis.

Mosquitoes are annoying because the females bite in order to take a blood meal for development of her eggs. Male mosquitoes do not bite. Mosquito bites may simply cause a short-term itching sensation in the skin, or can lead to inflammation, allergic reactions and possibly to secondary infection with bacteria at the site of the bite. In large numbers, mosquitoes comprise a nuisance and can greatly reduce the quality of life for people and animals. Large populations of mosquitoes can also impact economic activity, including recreation and tourism industries and the golfing industry. Often, proprietors of recreation facilities such as golf courses may suffer economic loss if patrons decide to leave the facility because the mosquitoes are bad, or because they will not patronize the facility for the same reason. The relationship between the abundance or density of mosquitoes, and decisions by patrons regarding their recreational activities, has not been well quantified.

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Mosquitoes are true flies and like other insects have a developmental cycle involving metamorphosis from the egg to the adult stage. Mosquito eggs are laid singly or in clusters on or near water. Tiny larvae hatch from the eggs and develop in the water. The larvae feed on a variety of microorganisms and organic matter in the water, and develop through four larval stages to the pupal stage. Adult mosquitoes emerge from the pupal stage, and fly away. Male mosquitoes feed on nectar and do not bite for blood; female mosquitoes of most species require a blood meal to develop their eggs, and may bite several times during their lives. Female mosquitoes not only bite people, but also other animals including birds, mammals, frogs, and snakes.

Michigan has four major classes of pest mosquitoes based upon larval habitat and life history: the spring flood-water mosquitoes, the summer flood-water mosquitoes, the container mosquitoes, and the marsh mosquitoes. Overall, there are about 60 different species of mosquitoes in Michigan. From a pest piont of view, the most important groups of mosquitoes are the spring flood-water mosquitoes and the summer flood-water mosquitoes, thus my discussion will be confined to them.

Larvae of spring flood-water mosquitoes hatch from the eggs in March, in pools of water formed by melted snow in the woods. The eggs occur in the leaf litter at the bottom of the pools. These larvae develop slowly because of low water temperatures, an demerge as adults in May, before the pools dry up. The female spring flood-water mosquitoes can be very long-lived, and may bite several times and lay eggs in the woods where they will be flooded the following year. Spring flood-water mosquitoes have only one generation per year, so even if these eggs are flooded by summer rains, they will not hatch until the following spring. The species names of some of the spring flood-water mosquitoes are : Aedes Stimulans, Aedes excrucians, Aedes provocans, and Aedes canadensis. There are several more species as well, but they all have the same type of lif history pattern.

Summer flood water mosquitoes include several of our common pest mosquitoes in Michigan, such as Aedes vexans, Aedes trivittatus, and aedes sticticua. Larvae of this mosquito hatch from eggs after rainfall in the summer (usually 0.5 inch or greater) in shallow flooded areas such as meadows, roadside ditches, highway right=of-ways, tire tracks cow hoof prints, an dother habitats. The larvae develop very quickly (7-10 days) and several generations may occur each sumer depending upon the number of heavy rainfalls which occur.

Mosquito control should involve careful consideration of the biology of the mosquitoes that are forming the nuisance problem or disease threat. In all cases, larval mosquito control should be considered as the first option for abatement. This involves location of larval habitats followed by their modification of treatment in such a way that the integrity of the habitat is preserved but the mosquito larvae are reduced in numbers. By dealing with larval mosquitoes, the adults may never become a problem. Adult mosquito control invariably involves the use of insecticides.

The larval habitats of spring and summer flood-water mosquitoes can be permanently eliminated through environmental sanitation and civil engineering, and should be the first thing to consider for mosquito control. Because of the temporary nature and small size of mosquito flood-water habitats, they often can be altered to prevent mosquito production. However, there are laws and policies regulating alterations of wetlands, and the Michigan Department of Natural Resources must be consulted before these activities take place. Indeed, professionals responsible for mosquito control are in the unique position of finding a balance between preservation of our wetlands and elimination of mosquito sources, but this balance can often be achieved with careful planning and consultation with authorities. Landscape planners should consider carefully the kinds of mosquito habitats they may be creating when wetlands are integrated into landscape or neighborhood designs. However, it is entirely possible to reduce larval mosquito sources and at the same time preserve wetlands and other desirable habitats.

Source reduction of larval mosquitoes may involve: (1) installation of a catchment; (2) installation of tile leading to a catchment or drain; (3) modification of grade to permit drainage; or (4) conversion of a mosquito-producing area to a non-mosquito-;producing body of water such as an ornamental pond, water hazard, or permanent wetland. For tiling purposes, "sock" tile which allows water entry but prevents roots and debris from clogging the tile is very useful when dealing with woodland mosquito habitats.

Often, larval mosquitoes must be controlled through the use of insecticides which are applied directly into the water where larvae occur. In such instances, presence of larvae should be confirmed with use of a mosquito dipper and visible inspection. There are many registered larval mosquito insecticides. A bacterial insecticide, Bacillus thuringiensis israelensis H-14, is available in both liquid and granular formulations from commercial sources under trade names such as Vectobac and Teknar. Granular formulations are particularly effective against spring mosquitoes when applied during April when the larvae are in the second and third stage. Larvae eat the bacteria which then disrupt the gut cells of the larvae. Abate (temephos) as a plaster pellet and Altoside (methoprene) as a charcoal pellet are also effective insecticides. Abate is an organophosphate with relatively low toxicity. Altosid is an insect growth regulator. Both are effective against the spring and summer flood-water mosquitoes.

Application equipment for granular or pelletized formulations of these larvicides includes hand-cranking equipment or motorized backpack sprayers.

Adult mosquito control can also be accomplished through the use of registered insecticides. Essentially, there are three ways to accomplish this. First, adult mosquitoes can be killed on the wing during their normal flight time (dusk) using ultra-low volume (or ULV) equipment (a type of sprayer that is hand-held, mounted on a vehicle, or fixed to aircraft) and an insecticide. This method is sometimes called "cold fogging," although the droplet size of ULV applications comprises a cloud that is technically not a fog. This is an excellent method for controlling mosquitoes, because it allows for use of a small amount of material (generally about 3-5 fl. Oz. Per acre) in tiny droplets in a narrow band of time and space. In Michigan, malathion (as Fyfanon, an organophosphate), resmethrin (as Scourge, a synthetic pyrethroid), and permethrin (Biomist, also a synthetic pyrethroid) work well as adulticides applied as ULV. None of these insecticides are very toxic when used at the labeled dosages, and each offers very good activity against mosquitoes within the area where they are applied. In general, malathion in a ULV formulation is more effective at warmer evening temperatures.

A second approach to adulticiding is using thermal fogs. In this technology, an insecticide is heated along with another combustible material such as kerosene or oil, thus creating a fog which moves through the air, around vegetation, and among flying insects. For mosquito control, the best time to make a thermal fog application is in the evening when thermal inversion conditions exist. A thermal inversion occurs when the warm air (heated by the earth during the day) has not yet mixed with cooler air above it. The insecticidal fog remains most stable and near the ground under conditions of thermal inversion. Thermal foggers can be purchased commercially in sizes small enough for backyard use to sizes large enough for widescale application. Currently, formulations of malathion, resmethrin or permethrin are recommended, following the label directions. Thermal fogging has generally be discarded now that ULV technology is available.

Another way to control mosquitoes is to use "harborage" or "barrier" techniques. This involves spraying a dilution of malathion (3% concentration prepared from a 57% emulsifiable concentrate) or permethrin (3% concentration of a 12% concentrate) onto vegetation surrounding the area to be protected. This area could be a backyard, a cemetery, a park, fairway, etc. The insecticide provides a residual of active ingredient on plant leaf surfaces, and when mosquitoes fly from the harborage areas (the woods) through this zone, they die or are repelled and do not move into the open to bite. Equipment

for a harborage application varies with the size of the area to be protected, but can range from a small hand pump sprayer to a motorized backpack sprayer to a large Buffalo turbine rig.

Aerial predators are often cited in the popular press as a means for controlling mosquitoes by predation. However, scientific studies do not support the contentions that bats, swallows, purple martins, dragonflies, or other aerial predators are effective, even though these methods might sound appealing and the animals themselves have aesthetic and intrinsic value. One has to bear in mind that predation is a natural process that is ongoing, yet we have mosquitoes anyway, often in large numbers. Actually, birds and bats do not include many mosquitoes in their diets, despite some claims to the contrary. The idea that they eat thousands of mosquitoes per night comes from statement sin the natural history literature indicating that these predators would have to eat this many to maintain their existence. Outdoor, electronic bug zappers with ultraviolet lights do not control mosquitoes. So-called "mosquito plants" do not effectively repel mosquitoes, and are not recommended for this purpose despite advertisements to this effect. Other devices such as those advertised to repel mosquitoes by high frequency sound do not actually repel mosquitoes.

There are several sources of information on mosquitoes and their management that are appropriate for Michigan conditions. The Michigan Department of Public Health has produced a manual, the "Michigan Mosquito Manual: Fight the Bite?", which contains material on mosquito control activities, mosquito biology, mosquito-borne diseases such as encephalitis and dog heartworm, and organizational tips. The Michigan Mosquito Control Association is an organization f professionals who conduct mosquito control. This association has an annual meeting, a board of directors, educational materials, and training programs. The address of this association is P.O. Box 366, Bay City, Michigan 48707.

The Michigan Department of Agriculture certifies persons who apply insecticides for mosquito control. The certification process requires taking two examinations, one being a core exam and the other a specialty exam for mosquito control (category 7F). You can call your local Michigan Department of Agriculture office to schedule an examination or for further information. Study booklets for both of these exams are available from the Michigan State University Extension, Office of the Pesticide Education Coordinator (517-355-0117). These organizations also have general information on pesticide use and safety, integrated pest management, and other topics directly relevant to mosquito control. Or, you can call the medical entomologist (Ned Walker) at the Department of Entomology at Michigan State University (517-355-4662) for more information as well.