Mosquitoes

How Mosquitoes Find You

Studies indicate that mosquitoes find suitable prey using multiple senses. They detect carbon dioxide (CO_2) exhaled by prey species, they can see high-contrast objects, and, once they get close, they can sense the warmth, moisture, and volatile compounds being emitted by prey. As they travel through the environment, mosquitoes integrate these factors to successfully locate prey.

CO_2 plumes emanate from living prey, but are made discontinuous in the breezy outdoors, breaking them into scattered floating puffs. A lag in the insect's nervous system can cause it to fly through the puff before it can finish turning toward the source. When tests were performed in wind tunnels, researchers noted that mosquitoes flew out of perfectly good plumes of CO_2 to investigate other sensory clues. Tracking equipment allowed the researchers to record the "flight waverings" and swoops of individual insects in the tunnel. These experiments were designed to look at how mosquito preferences interact.

The researchers found that CO_2 triggers female mosquitoes (*Aedes aegypti*) to start exploring visual contrast. When there was no extra CO_2 in the tunnel air, females flew here and there but didn't pay special attention to contrasting objects on the floor. Adding an extra whiff of CO_2 to tunnel air inspired the mosquitoes' interest in features that stood out — plastic filters, glass squares or even spots of projected light that contrasted with the light or dark tunnel floors. They also found that heat, human volatile compounds (like "sweaty socks" odor), and moisture increased mosquito attraction when combined with visual contrast and CO_2 plumes. These results are increasing our understanding of mosquito behavior and could help us reduce incidences of mosquito-borne diseases.

Mosquito Repellents

Once you've attracted some mosquitoes, you may be wondering how best to repel them. Deet (N, N-Diethyl-meta-toluamide) is still the most effective active ingredient in personal mosquito repellents. If you are sensitive or otherwise concerned, consider applying it to a specific hat or shirt rather than directly to your skin. When absorbed in cotton, it can effectively repel mosquitoes for several weeks. Some species of mosquitoes prefer to feed on lower body parts, so treating socks or anklets can also be an effective use of deet. These strategies can significantly reduce the user's exposure to deet.

Botanical compounds (extracts from plant materials) have also been used as personal mosquito repellents. Citronella oil has been used as a mosquito repellent for over 50 years and is not expected to pose health risks to people, including children and other sensitive populations. Other active ingredients in mosquito repellents include geraniol, eucalyptus oil, garlic, basil, neem, catnip, birch, bluestem grass, rosemary, spearmint, peppermint, cinnamon, and others. Few of these work as effectively as deet.

Avon Skin-So-Soft, a skin cream product, is also an effective repellent for certain mosquito species. Though less effective than deet, its active ingredients are dimethyl phthalate (DMP), vanillin, coumarin, and piperonal. DMP was patented as a mosquito repellent in 1929 and was used in various formulations prior to the introduction of deet in 1955.

Reduce mosquito breeding areas by eliminating standing water. Use floating "donuts" or "dunks" in drinkers and water features where mosquitoes breed. These contain Bacillus thuringiensis v. israeliensis (Bti) which control mosquito larvae in standing water. Replace or repair screens on doors and windows or use mosquito netting in sleeping areas. When outdoors, wear long sleeved shirts and long pants and apply mosquito repellents when mosquitoes are abundant. Reduce standing water in your garden by removing empty beverage containers, discarded tires, or any other item that will pool water to create a mosquito breeding area. Buckets, barrels, birdbaths, and other water vessels should be either emptied twice per week or have one of the above-mentioned floating "dunks" placed in it.

Lastly, we come to the battery-powered, personal mosquito repellers. Some of these purport to use sound to repel mosquitoes. These devices are ineffective. The other type has a fan, a replaceable repellent strip, and some also have a heating element to help volatilize the repellent. These devices seem to work where mosquito pressure is low to moderate, but not so well when you are in serious mosquito country.

Some of these products are available for purchase, but use caution. They may not have undergone the extensive testing required for EPA Registration required to be labeled as a pesticide. Just because a compound comes from a "natural" source, it does mean that it is safe for human use. Many plants are highly toxic (e.g. oleander, hemlock, etc.).

Mosquitoe Traps

Source reduction and larval control can be very effective, but some mosquitoes will survive and many people are not comfortable using pesticides. So, lets take a look at some mosquito traps and how they work.

Most mosquitoes have a preferred host (birds, mammals, humans, etc.). However, if the preferred host is not present, they can and will feed on other less preferred hosts. Most mosquitoes feed on sugary plant nectar or insect honeydew for energy, but the females of many species require bloodmeals to produce eggs. They spend most of the time resting in discreet places, but are activated when they receive host recognition cues. These cues include long-range, midrange, and close-range attractants.

When mosquitoes sense CO_2, they follow the plume upwind to its source. As mosquitoes get closer to their host, other cues become more important than CO_2. As the mosquito nears its host, it relies more on vision to locate the host. For this reason, light is a midrange cue. Here wavelength of light can also become important as some mosquito species show a preference for various colors and/or ultraviolet light.

Human and animal skin odors act as close-range cues for certain species of mosquitoes. In fact, sweat, especially armpit sweat, is a strong attractant for some species of mosquitoes. Research is actually being done to recreate these compounds in the laboratory.

Mosquito traps utilize CO_2, light, moisture, heat, sound, and/or volatile compounds (octenol) to attract mosquitoes. CO_2 is either generated by the catalytic burning of propane or the slow release of compressed CO_2 gas. Once they are attracted, fans pull them either into a net, sticky trap, catch basin, or electric grid.

Another attractant used is octanol, a fatty alcohol. These traps are effective in closed environments, but are less effective at reducing mosquito biting rates outdoors. Other trap designs use ultraviolet and other light sources light to attract flying insects. These are not effective on mosquitoes and attract and kill many harmless and beneficial insects

The bottom line is that traps do reduce the number of mosquitoes in an area, but you are still at risk of receiving bites. CO_2 generating traps generally work better than those that do not use CO_2. Traps are most effective when used in an integrated pest management (IPM) approach - a combination of strategies that include source reduction, larval control, and careful use of repellents. The information for this article was excerpted from *Mosquito Traps and Attractants* by William Quarles published in Common Sense Pest Control Quarterly, Vol. XIX, Number 2, Spring 2003.

Naming of companies or products is neither meant to imply endorsement by the author nor criticism of similar companies or products not mentioned.

Additional Resource: University of Arizona - AZ 1221, Mosquitoes

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Adapted from original Backyard Gardener publications by Jeff Schalau, Agent, Agriculture & Natural Resources, University of Arizona Cooperative Extension, Yavapai County