Mosquito Insight and Personal Repellents

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Importance of preventing mosquito bites

Mosquitoes can transmit disease-causing microorganisms to humans. For example, both the yellow fever mosquito (*Aedes aegypti*) **[Fig. 1]** and the Asian tiger mosquito (*Aedes albopictus*) **[Fig. 2]** can transmit or vector the Zika virus from humans to humans (USCDC, 2016). These two mosquito species can also vector dengue, chikungunya and yellow fever viruses. The encephalitis mosquito (*Culex tarsalis*) **[Fig. 3]** can carry and transmit the West Nile virus from birds to humans. Because a single bite from an infective mosquito can cause a mosquito-borne disease in humans, it is best to avoid all mosquito bites altogether by wearing personal mosquito repellents whenever and wherever there is a risk of being bitten by a mosquito during the entire mosquito season. Farm workers and humans in close proximity to animal production facilities may experience more mosquito bites than the general public because of the presence of ready sources of blood meals for mosquitoes in the livestock animals.

Mosquito biology

Female mosquitoes need to take blood meals in order to produce eggs. The egg of the yellow fever mosquito is very small but still visible with the naked eye. **Figure 4** shows its color, shape and size relative to the tip of a pencil. The eggs and immature stages of the yellow fever mosquito and Asian tiger mosquito develop in standing water, found mostly in artificial containers around the house, that can hold water for several days (e.g., cans, bottles, jars, buckets, tires, toys, furniture, flower vases, cisterns, bird baths and animal water troughs) **[Fig. 5]**. The yellow fever mosquito can also breed indoors (e.g., in flower vases), while the Asian tiger mosquito mainly breeds in natural and artificial water receptacles outdoors. The encephalitis mosquito breeds in standing water outdoors in pastures, ditches **[Fig. 6]**, and irrigated croplands. Mosquitoes can complete their development from eggs to larvae or wrigglers **[Fig. 7]**, pupae or tumblers, then adult mosquitoes within two weeks during the summer months.

Fig. 1. Female yellow fever mosquito (*Aedes aegypti*). (Photo: USCDC)

Fig. 2. Female Asian tiger mosquito (*Aedes albopictus*). (Photo: USCDC)

Fig. 3. Female encephalitis mosquito (*Culex tarsalis*). (Photo: Mike Catangui)

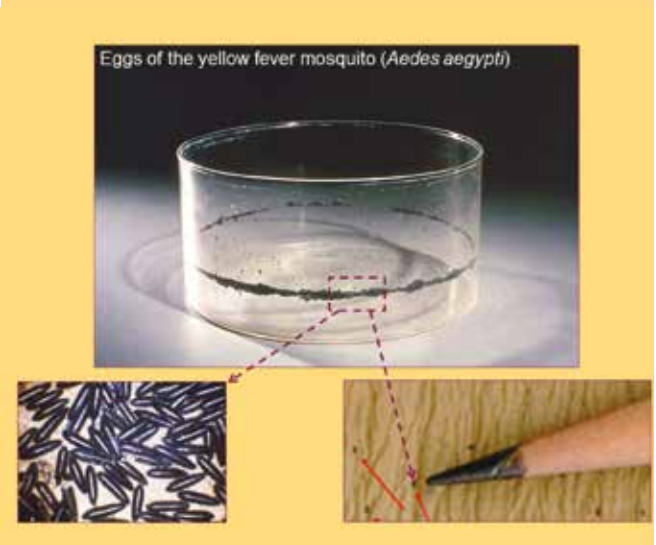

Fig. 4. Eggs of the yellow fever mosquito (*Aedes aegypti*). (Photos: USCDC)

Fig. 5. Potential breeding sites of the yellow fever mosquito (*Aedes aegypti*). (Photo: USCDC)

Fig. 6. Potential breeding site of the encephalitis mosquito (*Culex tarsalis*). (Photo: Mike Catangui)

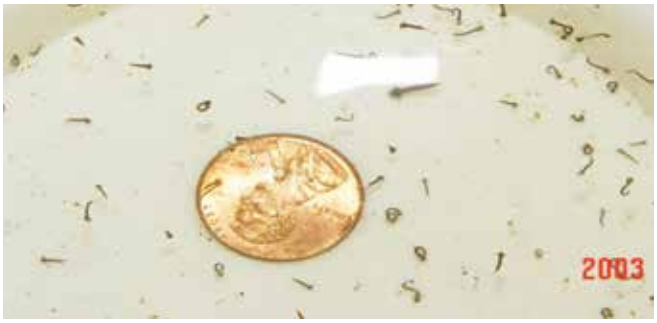

Fig. 7. Mosquito larvae or wrigglers of the inland floodwater mosquito (*Aedes vexans*). (Photo: Mike Catangui)

Fig. 8. Distribution of mosquito vectors of the Zika virus disease in the U.S. (Source: USCDC)

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Mosquitoes can bite at any time of the day

The potential mosquito vectors of the Zika virus (*Aedes aegypti* and *Aedes albopictus*) can bite humans in broad daylight. They can also bite to a lesser extent at night, dawn and dusk. Mosquito vectors of the West Nile virus (*Culex tarsalis* and related species) bite mainly at night when it is dark. In general, the bites of mosquitoes that bite in broad daylight are relatively painless or less noticeable than mosquitoes that bite at night under the cover of darkness. The inland floodwater mosquito (*Aedes vexans*) which is, perhaps, the main nuisance mosquito species in the Midwest, bites mainly at dusk and dawn.

In terms of geographic distribution in the U.S., each state will have a mosquito species that can transmit a certain vector-borne disease. The encephalitis mosquito is likely present in every single state; the geographic distribution of the mosquito species that can vector the Zika virus extend as far north as Minnesota and Iowa, then eastward to Maine **[Fig. 8, see page 63]** (USCDC, 2016).

Effective personal mosquito repellents are available to everyone

Personal mosquito repellents are, perhaps, the first line of defense against mosquito-borne illnesses like the Zika virus disease, West Nile encephalitis, Western equine encephalitis and Saint Louis encephalitis. A single bite from an infected mosquito may be enough to cause disease in humans. And, even though mosquito numbers can be reduced by eliminating or treating their breeding sites or resting areas, there will always be mosquitoes that can bite humans during outdoor activities. Personal mosquito repellents **[Table 1 on next page]** are products that can be applied directly onto the human skin or clothing for the purpose of repelling or killing adult mosquitoes (Catangui and Wilson, 2003). While repellents containing the chemical DEET can be applied directly on human skin and clothing, products containing the insecticide, permethrin, cannot. Permethrin must be applied only on clothing or related apparels such as hats, shoes and overalls several hours before being worn. Organic alternatives to DEET or permethrin, such as geraniol-based products **[Table 1]**, are also available for chemically-sensitive individuals.

Mosquito light traps can be used as an adjunct to repellents

Mosquito light traps that run continuously in outdoor areas can divert large numbers of blood-seeking mosquitoes away from human hosts. Mosquito light traps use "BL" bulbs that emit both ultraviolet and visible lights that are highly attractive to mosquitoes and other insects. Light traps and personal mosquito repellents may be more effective when used together as "push-pull" control tactics than when used on their own. That is, mosquitoes repelled by personal repellents worn by humans during outdoor activities may be diverted or attracted more to the light trap. An example of an effective mosquito light trap is shown in **[Fig. 9]**.

Fig. 9. Example of a mosquito light trap (Paraclipse Mosquito Eliminator) [Photo: http://paraclipse.com]

References:

Catangui, M. A. and J. A. Wilson. 2003. Personal mosquito repellents. FS 920. South Dakota State University (http://openprairie.sdstate.edu/extension_fact/99).

United States Centers for Disease Control and Prevention [USCDC]. 2016. Zika virus.

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TABLE 1. PERSONAL MOSQUITO REPELLENTS					
MFR.	BRAND NAME	ACTIVE INGREDIENT	FORMULATION TYPE	CLAIMED EFFECTIVE DURATION	DIRECTIONS FOR USE (SEE LABEL FOR COMPLETE DIRECTIONS AND PRECAUTIONS)
3M HEALTH CARE	Ultrathon™ Insect Repellent	DEET (34.34%)	skin lotion	12 hours	Apply only on exposed human skin; do not use under clothing. Apply to palm of hand for application to face and neck and rub on. Do not apply near eyes and mouth, and apply sparingly near ears. Do not allow children to handle this product, and do not apply on children's hands. When using on children, apply to your own hands, and then put on the child. This product may damage certain plastic materials.
	Ultrathon™ Insect Repellent 8	DEET (25.00%)	skin and clothing spray	8 hours	Can be applied on human skin and clothing; do not use under clothing. Hold container 6 to 8 inches from skin or clothing and spray with a slow sweeping motion. To apply to face, spray into palm of hand and spread evenly on face and neck. Spray shirts, pants, cuffs, socks and around other openings in outer clothing. Do not apply near eyes and mouth. Apply sparingly around ears. Do not allow children to handle this product, and do not apply on children's hands. When using on children, apply to your own hands, and then put on the child. This product may damage certain plastic materials.
	Ultrathon™ Clothing and Gear Insect Repellent	permethrin (0.50%)	clothing spray	6 weeks (on treated clothing and gear)	Apply on clothing and gear only. Let treated clothing and gear dry for 2-4 hours before wearing. Do not apply on human skin. See label for detailed directions.
FARNAM	Centaura™ Insect Repellent for Horse and Rider	picaridin (20.00%)	skin spray	12 hours (horse and human)	Apply on exposed skin and clothing of humans, or exposed skin of horses. Do not apply on human skin under clothing, or on horse skin under the saddle. See label for detailed directions.
TYRATECH	Guardian™ Backyard Mosquito & Tick Repellent	geraniol (0.25%)	skin spray	4 hours	Spray evenly on all exposed, dry human skin. For best results, spread evenly with hand to moisten skin. Do not spray directly on or near face of adults. Instead, spray in palm of hand and spread on face and neck of adults. Do not apply to face or hands of young children. Do not allow children to apply this product to themselves.
	Guardian™ Wilderness Mosquito & Tick Repellent	geraniol (5.00%)	skin spray	8 hours	Spray evenly on all exposed, dry human skin. For best results, spread evenly with hand to moisten skin. Do not spray directly on or near face of adults. Instead, spray in palm of hand and spread on face and neck of adults. Do not apply to face or hands of young children. Do not allow children to apply this product to themselves.

Prior to using any product mentioned in this article, carefully read and follow all available instructions, warnings and safety information made available by the product's manufacturer.

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