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## Personal Mosquito Repellents

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# Personal MOSQUITO REPELLENTS

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**P**ersonal mosquito repellents are perhaps the first line of defense against mosquito-borne illnesses like 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 are products that can be applied directly onto the human skin or clothing for the purpose of repelling or killing adult mosquitoes. 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 are also available for chemically-sensitive individuals.

## South Dakota mosquitoes

### How many kinds of mosquitoes are in South Dakota?

South Dakota has at least 44 different kinds or species of mosquitoes. The two most common mosquitoes are the encephalitis mosquito (*Culex tarsalis*) and the inland floodwater mosquito (*Aedes vexans*). These two species are found in every county in the state.



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Encephalitis mosquitoes were found positive for the West Nile virus in South Dakota in 2002. The encephalitis mosquito is perhaps the most important carrier of the West Nile virus and other mosquito-borne viral diseases in the state.

The inland floodwater mosquito and 19 other species known to occur in South Dakota have been found to carry the West Nile virus in other states. Although a mosquito species found positive of the virus in nature may potentially be a carrier, further tests are usually needed to determine if the species is efficient in transmitting the virus to humans.

#### **How do mosquitoes survive South Dakota winters?**

Female encephalitis mosquitoes overwinter as adults. They can be collected during the winter months in food storage cellars, barns, hollow logs, tree stumps, caves, street manholes, buildings, and many other sheltered areas. In contrast, inland floodwater mosquitoes overwinter as eggs on the soil surface in locations that flood periodically during the spring and summer months.

#### **What time of day do mosquitoes bite?**

In South Dakota, mosquitoes can bite at any time, day or night. The encephalitis mosquito is most active just after sunset. The inland floodwater mosquito will bite during the day and is also active just after sunset.

#### **Why do mosquitoes bite?**

Adult female mosquitoes need blood to produce eggs and perpetuate their species. Although they can survive by feeding on sugary liquids, it is only after a blood meal that they start producing eggs. Only female mosquitoes bite. Male mosquitoes feed on sugars found in fruits and flowers.

#### **What attracts mosquitoes to humans?**

Mosquitoes looking for a blood meal are mainly attracted to carbon dioxide in the breath, body heat, and sweat of humans. Lactic acid and numerous other scents emitted by the human skin have also been found attractive to mosquitoes. Individuals who produce more body heat, sweat, carbon dioxide, and lactic acid will be more attractive to mosquitoes.

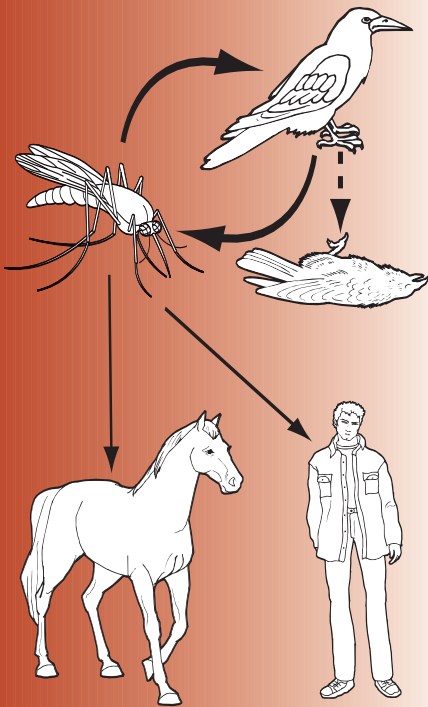
#### **What other hosts do mosquitoes feed upon besides humans?**

Birds, horses, cattle, dogs, cats, rabbits, squirrels, and other animals are fed upon by mosquitoes. It is when mosquitoes bite different hosts that disease-causing microorganisms may be spread.

#### **What disease-causing microorganisms can mosquitoes transmit?**

Arboviruses (short for arthropod-borne viruses) such as the West Nile virus, western equine encephalitis virus, and Saint Louis encephalitis virus are perhaps the most important microorganisms that mosquitoes transmit in South Dakota. In other parts of the world, mosquitoes are carriers of parasites that cause human malaria, filariasis, dengue fever, Japanese encephalitis, yellow fever, and others.

The West Nile virus is a disease that primarily affects birds. It may be transmitted by mosquitoes from infected birds to other hosts such as humans or horses. The West Nile virus has not been shown to be transmitted from human to human, horses to humans, or horses to horses. Thus, the West Nile virus in South Dakota is carried by various species of birds and spread by mosquitoes.



## U.S. EPA required statements on the label of all DEET products

- Read and follow all directions and precautions on this product label.
- Do not apply over cuts, wounds, or irritated skin.
- Do not apply to hands or near eyes and mouth of young children.
- Do not allow young children to apply this product.
- Use just enough repellent to cover exposed skin and/or clothing.
- Do not use under clothing.
- Avoid over-application of this product.
- After returning indoors, wash treated skin with soap and water.
- Wash treated clothing before wearing it again.
- Use of this product may cause skin reactions in rare cases.

## THE FOLLOWING ADDITIONAL STATEMENTS will appear on the labels of all aerosol and pump spray formulation labels:

- Do not spray in enclosed areas.
- Do not spray directly onto face. To apply to face, spray on hands first and then rub on face.

## Mosquito repellents

### What is the most effective way to prevent mosquito bites?

Use a combination of DEET applied on the skin and permethrin applied on the clothing. DEET repels mosquitoes while permethrin actually kills mosquitoes on contact.

Using DEET alone or permethrin alone will not be as effective as using the two in combination. However, using DEET alone may be sufficient for most outdoor activities such as going to the park, mowing the lawn, gardening, or relaxing in the backyard. Individuals who will be outdoors for an extended period of time, like hunters and campers, are encouraged to use the combination of DEET and permethrin.

## DEET

### What is DEET?

DEET is the common name of the chemical called N, N-diethyl-meta-toluamide. It is also known as N, N-diethyl-3-methylbenamide. It is a man-made chemical first developed by the U.S. Army in 1946 for the purpose of preventing bites from insects, ticks, and mites when troops are outdoors. DEET has been available for over-the-counter use by the general public since 1957. There are currently many different brands of repellents containing varying percentages of DEET as their active ingredient. See Extension Extra 8147 for a list of products containing DEET available in South Dakota.

### How does DEET work?

DEET appears to disorient mosquitoes by interfering with the function of their antennae. In effect, DEET prevents the mosquitoes from finding you. DEET does not kill mosquitoes, it only repels them.

### What precautions should be taken when using DEET products?

After being on the market for over 45 years, DEET has been generally perceived as safe for use by the general public, and DEET products have unrestricted availability to the public. However, the U.S. Environmental Protection Agency (EPA) has required all products containing DEET to carry specific directions.

### What concentration of DEET should be used on children?

The use of insect repellents containing DEET is the best way to reduce the risk of getting West Nile Virus. Products containing DEET are the most effective mosquito repellents available. The maximum concentration currently recommended for infants (greater than two months of age) and children is 30%. The concentration of DEET in products may range from less than 10% to over 30%. Higher concentrations of DEET will protect children for longer periods of time. One should select the lowest concentration effective for the amount of time spent outdoors. It is generally recommended DEET should not be applied more than once a day. For most children going outdoors, the once per day application of DEET will be most appropriate at dusk, one of the two times per day mosquitoes are most active, the other time being dawn.

## Sample precautionary statements on the label of permethrin repellent products:

- Clothing treatment only.
- Do not apply to skin.
- Harmful if absorbed through skin.
- Avoid contact with face, eyes, or skin.
- Avoid breathing vapors or spray mist.
- Do not allow contact with treated surfaces until spray has dried.
- Wash thoroughly after handling and before eating or smoking.
- Do not allow spray to contact food or water supply.

## Sample label directions for use on permethrin repellent products:

### Initial treatment instructions

- Select a well-ventilated outdoor area protected from wind and lay out the clothing to be treated (as a complete outfit: shirt, trousers, and socks).
- Hold can upright about 6 to 8 inches from surface of the clothing and spray with a slow sweeping motion to lightly moisten the surface of the fabric.
- Continue spraying over entire outfit until a total treatment time of 60 seconds has elapsed and the outer surface of the fabric is moist enough to cause a slight color change or darkening.
- Pay special attention to socks, trouser cuffs, and shirt cuffs.
- Turn the clothing over and treat the other side as described above.
- Hang the treated clothing and allow to dry for at least 2 hours (4 hours under humid conditions) before wearing.
- One can will treat two complete outfits.
- Do not exceed recommended spraying time.

### Retreatment Instructions:

- This product contains an active ingredient which actually binds to the fabric being treated, providing residual protection which lasts a minimum of two weeks, and holds on through several machine washings.
- Do not retreat clothing more than every two weeks.
- Launder clothing at least once before retreating.
- For retreatment, follow instructions for initial treatment.

## What concentration of DEET should adults use?

The choice will depend on how long the individual will potentially be exposed to biting mosquitoes. Although there are no absolute recommendations, results of controlled laboratory studies (Fradin and Day, 2002) do indicate the following expected performances:

- Under moderate mosquito biting pressures, a single thorough skin application of a product containing 4.75% DEET may provide up to 1 hour and 30 minutes of protection.
- Under moderate mosquito biting pressures, a single thorough skin application of a product containing 6.65% DEET may provide up to 2 hours of protection.
- Under moderate mosquito biting pressures, a single thorough skin application of a product containing 20% DEET may provide up to 4 hours of protection.
- Under moderate mosquito biting pressures, a single thorough skin application of a product containing 23.8% DEET may provide up to 5 hours of protection.

There appears to be a limit in the duration of protection time that increasing DEET concentrations may provide. For example, a product containing 100% DEET may provide no more than 10 hours of protection from mosquito bites; the duration of protection time provided by products containing 35% and 100% DEET may not be significantly different. If a longer time of protection is needed, the DEET product may simply be reapplied immediately after or just before the expected time of protection elapses. The U.S. military uses a product containing **33.3% DEET** in extended release formulation, and always in combination with **permethrin-treated clothing**. This DEET and permethrin combination is expected to provide at least **8 hours** of protection under severe mosquito biting pressures in the field.

## permethrin

### What is permethrin?

Permethrin is a synthetic pyrethroid insecticide. This means that although it is a man-made chemical, its molecular structure was patterned after pyrethrum, a naturally occurring insecticide from the flowers of a chrysanthemum plant. It has been on the market since 1974.

### How does permethrin work?

Permethrin kills mosquitoes on contact by disrupting their nerve cells.

### Is permethrin safe?

Permethrin cannot be applied directly on the skin. It should be applied on clothing 2-4 hours before being worn.

Permethrin products for use on clothing contain 0.5% permethrin. This concentration should be safe if used as specified on the label. See Extension Extra 8147 for a list of products containing permethrin available in South Dakota.

Permethrin at a lower concentration (0.25%) is also used in insecticidal shampoos for children infested with head lice, indicating that permethrin may indeed be a relatively safe chemical. Nevertheless, the directions on the product label must be followed carefully.

## alternative repellents

A few natural-ingredient-only repellents may provide up to 2 hours of protection. Results of controlled laboratory studies (Fradin and Day, 2002) do indicate the following expected performances:

- Under moderate mosquito biting pressures, a single thorough skin application of a product containing a combination of soybean oil, geranium oil, and coconut oil (Bite Blocker for Kids) may provide up to 1 hour and 30 minutes of protection.
- Under moderate mosquito biting pressures, a single thorough skin application of a product containing oil of lemon eucalyptus (Repel Lemon Eucalyptus, Fite Bite Plant-Based Insect Repellent) may provide up to 2 hours of protection.
- Under moderate mosquito biting pressures, a single thorough skin application of a product containing citronella oil may only provide less than 20 minutes of protection.
- There are currently no clothing-applied natural products that will actually kill mosquitoes on contact.

## Summary

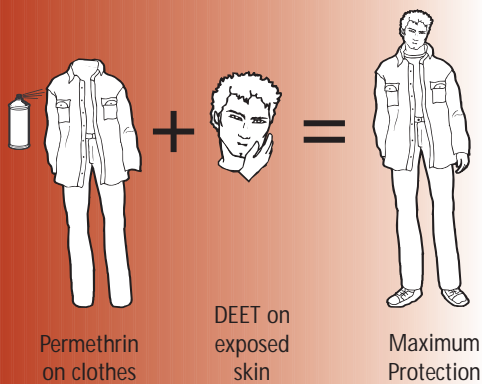
South Dakota has 44 different kinds of mosquitoes and about half of them may be capable of spreading microorganisms that may cause diseases in humans. Fortunately, there are now effective personal mosquito repellents that can be used by the general public as a first line of defense against mosquito bites and mosquito-borne diseases.

Choosing a personal mosquito repellent will depend on the individual. Those who are regularly exposed to severe mosquito bites, such as hunters and campers, may need to use a combination of a DEET product applied on the skin and a permethrin product applied on the clothing for maximum protection. DEET repels mosquitoes while permethrin kills mosquitoes on contact.

For most common activities such as going to the park, playing sports, relaxing in the yard, or taking a walk, applying products containing various concentrations of DEET on the skin and clothing may be sufficient. DEET products are very safe if used as specified on the product label.

Individuals who, for various reasons, cannot or do not want to use DEET or permethrin may choose plant-based products containing a soybean oil-geranium oil-coconut oil combination, or products containing lemon eucalyptus oil. However, individuals choosing natural products must remember that the protection time provided by natural products may be significantly shorter than products containing DEET and permethrin.

Because of their availability, ease of use, low cost, and proven efficacy, personal mosquito repellents may indeed be the first line of defense in our effort to combat mosquito-borne diseases in South Dakota.





See Extension Extra 8147, Personal Mosquito Repellents Available in South Dakota for information on specific repellents containing DEET and permethrin that are registered for sale in South Dakota.

Always read and follow product label directions and precautions.

In case of accidental poisoning call:  
1-800-222-1222  
Sioux Valley Poison Control Center

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This publication is intended for use by the citizens of South Dakota. Listing of brand names is for informational purposes only and does not imply endorsement of one product over another or discrimination against a similar unmentioned product.



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