

Tick Repellent Research Information

**Apply each repellent according to directions on the label.*

Note: This is not a full list of all research done around repellents.

DEET

What is DEET?

DEET is the chemical N,N-diethyl-meta-toluamide. DEET is the active ingredient in many repellents used against ticks. DEET is the most widely used and studied insect repellent. Repellents with DEET may come in sprays or mists, lotions and wipes; these are meant to be used on skin. It may damage plastic and some synthetic fabric clothing.

What should I know about how to use DEET safely?

- Make sure to read and follow the directions on the label.
- Avoid applying repellent on wounds or broken skin.
- Avoid breathing in, swallowing, or getting repellent into your eyes (DEET is toxic if swallowed).
 - Swallowing DEET may cause:
 - Nausea
 - Vomiting
 - Low blood pressure
 - Encephalopathy (disease that causes damage to brain)
 - Seizure
 - Coma
 - Ataxia (lack of muscle control during tasks such as walking, talking, and swallowing)

DEET and Children

- An adult should help children less than 10 years old apply repellent. Avoid applying around eyes and mouth of young children. The recommended %DEET for children is 10% to 30%.
 - Research has shown that children absorb more DEET than adults (because of the higher skin to body weight ratio).
 - With excessive exposure of several days to weeks, adults and especially children experienced:
 - Seizures
 - Slow heart rate
 - Nausea
 - Vomiting
 - Blistering
 - Lethargy (lack of energy/enthusiasm)
 - Ataxia (lack of muscle control during tasks such as walking, talking, and swallowing)
 - Encephalopathy (disease that causes damage to brain)
 - Anaphylaxis (extreme allergic reaction)

Can DEET cause problems to my health?

- Negative health effects from limited exposure to a DEET product applied to the skin is rare.
 - Only 10 cases were reported in the 50 years that DEET has been available to the public.
 - None have been reported since 1992.
- One study was done using data from the American Association of Poison Control Centers, they looked 20,764 cases of DEET exposure and the side effects related to each.
 - They found that overall, children experienced more of the less severe outcomes and adults experienced more of the worst outcomes associated with an exposure.

How does DEET effect the environment?

The effect DEET has on the environment and the possible harm it may have is not completely known. Very few studies have been done on this topic, especially the long-term effects. The initial effects DEET has on the environment is better understood. One study found that over 65% of surface water contained a concentration of DEET. In that same study they found that DEET is slightly toxic to birds, fish and is practically nontoxic to small mammals. They found that the concentration in DEET would have to be 75,000 times the highest concentration reported in surface waters to have a significant impact of aquatic life. It is very unlikely that the levels of DEET would reach this naturally.

What should I know about the different concentration percentages (%) in DEET repellents?

- Products meant for the skin can range from 4-100% concentration
- The Centers for Disease Control and Prevention (CDC) recommend a concentration of 20% or higher. Concentrations above 50% give no added protection.

Where can I find more information on DEET?

Centers for Disease Control and Prevention: Agency for Toxic Substances & Disease Registry
<https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=201>

The insect repellents: A silent environmental chemical toxicant to the health

<https://www.sciencedirect.com/science/article/pii/S1382668917300285>

By: Roy, DN; Goswami, R; Pal, A. From: The Journal of Environmental Toxicology and Pharmacology; Volume 50; Pages 91-102, Published: March 2017

Insect Precautions - Permethrin, Deet, and Picaridin-Is DEET safe? ([Indiana University Bloomington-Health Center, Insect Precautions.](#))

DEET-based insect repellents: safety implications for children and pregnant and lactating women.
Koren et al. <http://www.cmaj.ca/content/169/3/209.full>

Is there a risk associated with the insect repellent DEET (N,N-diethyl-m-toluamide) commonly found in aquatic environments? https://ac-els-cdn-com.proxy.uwec.edu/S0048969707006316/1-s2.0-S0048969707006316-main.pdf?_tid=87af01af-ebb0-4527-a5b9-2b578b125750&acdnat=1533133580_2f1e63a5b31deb809eb75db67c3a9fc3

The insect repellents: A silent environmental chemical toxicant to the health <https://www-sciencedirect-com.proxy.uwec.edu/science/article/pii/S1382668917300285>

Permethrin

What is permethrin?

Permethrin repels and kills ticks. It is the only repellent that kills them. Permethrin can be found in pretreated clothing or in a spray that can be used on clothing. Could also be used to spray insect nets, sleeping bags, tents, or boots. It should not be applied directly on the skin.

How well does permethrin work?

- [The Journal of Medical Entomology, 2011, Vol. 48\(2\), pp.327-333](#) research study found the following:
 - People who wore clothes that were treated with permethrin had 3.36 less tick bites than the people who wore clothing not treated with permethrin
 - People wearing permethrin-treated shoes and socks were 73.6% less likely to have tick bites than people who wore shoes and socks not treated by permethrin.
- The number of washes permethrin lasts depends on the product, read the label and follow directions given.

I have never heard of permethrin, is it safe?

- Permethrin is over 2,250 times more harmful to ticks than humans.
- When put directly on skin, usually less than 1% is absorbed into the body.
 - DEET is absorbed at over 20 times that rate.
- Permethrin-treated clothing for toddlers is not a concern of the Environmental Protection Agency (EPA).
- A person who weighs 140 pounds could be exposed to 32 grams of permethrin a day and not experience health effects.
 - An entire permethrin bottle of clothing treatment has less than 1 gram.

Can permethrin cause problems to my health?

- There are possible side effects if permethrin is breathed in, touches skin, or touches eyes. When in contact with skin, it may cause: skin tingling or numbness and mild reddening of skin.
- Possible side effects include:
 - Skin irritation, tingling, burning, or itching
 - Eye redness, pain, or burning
 - Irritation in nose and lungs
 - Difficulty breathing
 - Headaches
 - Dizziness
 - Vomiting

*Do not use if allergic to Chrysanthemums (a popular plant in the daisy family).

Permethrin and the Environment

Permethrin is highly toxic to aquatic life and cats. Exercise caution and follow label warnings when using permethrin products if you have cats. Avoid using it on dogs who play with or are groomed by family cats. Don't use it around fish tanks or ponds either as it is toxic to fish. Permethrin-treated clothing poses no threat to cats once the product has dried.

Would permethrin be safe for my kids?

No current data was found related to an increased risk of side effects specifically to permethrin.

If I am pregnant or nursing, is it safe for me to wear permethrin treated clothing?

The Environmental Protection Agency (EPA) has found no evidence suggesting this would be a concern.

Where can I find more information on permethrin?

National Pesticide Information Center

<http://npic.orst.edu/factsheets/PermGen.html#wildlife>

Repellent Treated Clothing

<https://www.epa.gov/insect-repellents/repellent-treated-clothing>

Permethrin Fact Sheet: Did you know?

<http://www.tickencounter.org/prevention/permethrin>

BioUD

What is BioUD?

The active ingredient in BioUD is 2-undecanone, which comes from wild tomato plants. In 2007, BioUD was registered by the Environmental Protection Agency (EPA) as a mosquito and tick repellent.

How well does BioUD work?

- BioUD was tested and found to work well against three different groups of ticks in the Ixodes species (deer tick)
- Undiluted and 50% dilutions of BioUD were found to be more repellent against all three tick species when compared to 98.11% DEET.
- BioUD was found to work better than DEET against Lone Star ticks and Black-legged (deer) ticks.
- BioUD was found to work just as well as DEET against American Dog (wood) ticks.
- Further research is needed to see how BioUD and DEET compare in their effectiveness to repel ticks/mosquitos. BioUD needs to be further tested in the field environment. (Experimental and Applied Acarology, 2009, Vol. 48(3), pp. 239-250)

Can BioUD cause problems to my health?

- May be harmful if swallowed
- May cause mild eye irritation

Where can I find more information on BioUD?

Experimental and Applied Acarology, 2009, Vol. 48(3), pp. 239-250

<https://link.springer.com/article/10.1007/s10493-008-9235-x>

*Currently BioUD can only be purchased online.

<http://www.homs.com/bioud%C2%AE.html>

Picaridin

What is picaridin?

Picaridin is an insect repellent that can be used against biting flies, mosquitoes, chiggers, ticks, and fleas. It is a synthetic (man-made) chemical first made in the 1980's. It is available as a lotion, pump spray and wipes. The spray has been found to be more effective than the lotion or wipes. It is odorless and doesn't damage plastics or clothing.

Does Picaridin work well?

Concentrations of 10% and 20% of Picaridin provide very high levels of protection for up to 12 hours against lone star ticks. Picaridin has been found to have better protection against ticks than DEET.

Can Picaridin cause problems to my health?

May cause irritation to the skin and eyes. It is practically non-toxic if inhaled. Less than 6% is absorbed into the skin.

Where can I find more information on picaridin?

Bissinger, B., Roe, R. (2010). Tick repellents: Past, present, and future. *Pesticide Biochemistry and Physiology*, 96(2), 63-79. https://ac-els-cdn-com.proxy.uwec.edu/S0048357509001412/1-s2.0-S0048357509001412-main.pdf?tid=65cb0fc7-de59-43d2-8918-9b68b52d9f88&acdnat=1532533077_d151b1a8ba91b9954cd0132ece7674c1

Diaz, J. (2016). Chemical and Plant-Based Insect Repellents: Efficacy, Safety, and Toxicity. *Wilderness & Environmental Medicine*, 27(1), 153-163. <https://www-clinicalkey-com.proxy.uwec.edu/#!/content/playContent/1-s2.0-S1080603215004342?returnurl=null&referrer=null&scrollTo=%23t0005>

Gervais, J. A., Wegner, P., Luukinen, B., Buhl, K., Stone, D. (2009). Picaridin General Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. Retrieved from npic.orst.edu/factsheets/PicaridinGen.html

IR3535

What is IR3535?

IR3535 is a biopesticide that has been used in Europe since the 1970s and became available in the United States in 1999. It is an odorless repellent that is gentle on the skin. Available as an aerosol, lotion, pump spray or wipes. It may damage plastic and clothing.

Does IR3535 work well?

- One study showed IR3535 was more repellent than similar concentrations of DEET against deer tick nymphs.

Can IR3535 cause problems to my health?

- The Environmental Protection Agency (EPA) has no record of adverse effects, including since Europe started using IR3535 in the 1970s.
- IR3535 could cause eye irritation if it enters the eyes.

Where can I find more information about IR3535?

Bissinger, B., Roe, R. (2010). Tick repellents: Past, present, and future. *Pesticide Biochemistry and Physiology*, 96(2), 63-79. https://ac-els-cdn-com.proxy.uwec.edu/S0048357509001412/1-s2.0-S0048357509001412-main.pdf?_tid=65cb0fc7-de59-43d2-8918-9b68b52d9f88&acdnat=1532533077_d151b1a8ba91b9954cd0132ece7674c1

Diaz, J. (2016). Chemical and Plant-Based Insect Repellents: Efficacy, Safety, and Toxicity. *Wilderness & Environmental Medicine*, 27(1), 153-163. <https://www-clinicalkey-com.proxy.uwec.edu/#!/content/playContent/1-s2.0-S1080603215004342?returnurl=null&referrer=null&scrollTo=%23t0005>

IR3535 Fact Sheet - https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_PC-113509_01-Jan-00.pdf

Oil of Lemon Eucalyptus

What is Oil of Lemon Eucalyptus (OLE)?

Oil of Lemon Eucalyptus is made from an essential oil mixed with a chemical called PMD (p-Menthane-3,diol). The repellent comes in the form of a spray or a lotion. It should not be used with children under the age of 3.

Is Oil of Lemon Eucalyptus oil the same of Lemon Eucalyptus essential oil?

- No. They are different. The lemon eucalyptus essential oil has a trace of PMD (the long acting repellent). This makes the essential oil not as effective because there is such a small amount of PMD in it.
 - In comparison, oil of lemon eucalyptus has between 64-100% PMD (the long acting repellent). Therefore, oil of lemon eucalyptus is much more effective than the lemon eucalyptus essential oil.
 - Oil of lemon eucalyptus is a more natural repellent, however PMD can be synthetic (man-made).

Does Oil of Lemon Eucalyptus work well?

It may offer better protection against ticks than DEET. However you have to reapply more often. Oil of lemon eucalyptus offers about 2 hours of full protection. Doesn't usually have the same lasting power as 20-50% concentrations of DEET, which offers about 5 hours of full protection.

Can Oil of Lemon Eucalyptus cause problems to my health?

Studies show the only adverse effect is eye irritation when the product gets into someone's eyes. When used according to label, an Oil of Lemon Eucalyptus product is not expected to cause health problems, including children (3+ years) and sensitive populations.

Where can I find more information about Oil of Lemon Eucalyptus?

Bissinger, B., Roe, R. (2010). Tick repellents: Past, present, and future. *Pesticide Biochemistry and Physiology*, 96(2), 63-79. https://ac-els-cdn-com.proxy.uwec.edu/S0048357509001412/1-s2.0-S0048357509001412-main.pdf?_tid=65cb0fc7-de59-43d2-8918-

9b68b52d9f88&acdnat=1532533077_d151b1a8ba91b9954cd0132ece7674c1

Diaz, J. (2016). Chemical and Plant-Based Insect Repellents: Efficacy, Safety, and Toxicity. *Wilderness & Environmental Medicine*, 27(1), 153-163. <https://www-clinicalkey-com.proxy.uwec.edu/#!/content/playContent/1-s2.0-S1080603215004342?returnurl=null&referrer=null&scrollTo=%23t0005>

Heid, M. (2013, June 18). Is Oil of Lemon Eucalyptus as effective as DEET or Picaridin? Retrieved from <https://www.outdoors.org/articles/amc-outdoors/is-oil-of-lemon-eucalyptus-as-effective-as-deet-or-picaridin>

Humphries, S. (n,d). Mosquito repellents: 'Lemon Eucalyptus Oil' is not 'Oil of Lemon Eucalyptus'! Retrieved from <http://www.hebebotanicals.co.nz/mosquito-repellents/>

p-Menthane-3,8-diol (Oil of Lemon Eucalyptus) Fact Sheet
https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_PC-011550_01-Apr-00.pdf

Essential Oils

Do essential oils work well as a tick repellent?

Many natural products and essential oils have the potential to work well and be safe for use, however more research needs to be done. Researched oils include: rosemary, geraniol, peppermint, thyme, lemongrass, and cedar. Effectiveness varies based on type, application and concentration.

Where can I find more information on this research?

Ability of Two Natural Products, Nootkatone and Carvacrol, to Suppress *Ixodes scapularis* and *Amblyomma americanum* (Acari: Ixodidae) in a Lyme Disease Endemic Area of New Jersey
<http://www.bioone.org/doi/pdf/10.1603/029.102.0638>

Repellent Activity of Fractioned Compounds from *Chamaecyparis nootkatensis* Essential Oil Against Nymphal *Ixodes scapularis* (Acari: Ixodidae)
<https://academic.oup.com/jme/article-abstract/43/5/957/873494?redirectedFrom=fulltext>

Biocidal Activity of Three Wood Essential Oils Against *Ixodes scapularis* (Acari: Ixodidae), *Xenopsylla cheopis* (Siphonaptera: Pulicidae), and *Aedes aegypti* (Diptera: Culicidae)
<http://www.bioone.org/doi/pdf/10.1603/0022-0493%282007%29100%5B622%3ABAOTWE%5D2.0.CO%3B2>

What would I learn if I read these studies?

These studies show us that many natural products and essential oils have the potential to work well and be safe for use. However, more research must be done. Most of these studies were performed in a lab and not out in the "real world". Research is needed to know if essential oils will work well and be safe when used out in the "real world".

Additional Information

- **Information on Lyme Disease from Centers for Disease Prevention and Control (CDC)**
<https://www.cdc.gov/features/lymedisease/index.html>
- Information on Ticks, Research by Dr. Paskewitz from UW-Madison
 - <http://mcevbd.wisc.edu/partners/university-of-wisconsin-madison/dr-susan-paskewitz>
- **Best repellent for you?**
 - <https://www.epa.gov/insect-repellents/find-repellent-right-you>
- **At this link you can search to see if your specific repellent is EPA approved:**
 - <https://www.epa.gov/insect-repellents/find-repellent-right-you#search> tool