



## Insect Repellents

Dr. Alan T. Eaton, Extension Specialist, Entomology

The term “insect repellent” doesn’t accurately reflect how these materials work. They don’t actually repel insects, but rather block the receptors that mosquitoes, gnats, punkies, no-see-ums and other insects use to detect appropriate hosts for them to bite.

Blocking those receptors stops the insects from biting, so a more accurate term might be “bite-preventing substances.” By the way, they can also repel some insect relatives such as ticks.

The effectiveness of repellents varies with the active ingredient(s), the concentration, and the target species. Products come as lotions, pump sprays, pressurized cans, and wipes. Which one is best? That’s for you to decide. Look at the list of active ingredients and their concentrations to help decide which one to buy. ***Always follow label directions when using repellents.***



Read the label to see the active ingredients, their percentages, and what pests the product should repel. Photo: Alan T. Eaton.

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## *Did You Know?*

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**DEET was developed in 1946. DEET is an acronym for the N-diethyl-metatoluamide.**

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DEET is an acronym for the long technical name: N, N-diethyl-metatoluamide. Developed in 1946, DEET has been used extensively since then and serves as the standard mosquito repellent against which new candidate materials are tested.

In addition to working on mosquitoes, it works well on fleas, biting midges (punkies, no-see-ums) and black flies. It doesn't work well on snipe flies, deer flies, greenheads or horse flies. (By the way, no repellents really work on those groups.) Ticks and chiggers are closely related to insects, and DEET works on them, too.

Repellents that have higher concentrations of DEET generally last longer and are more effective (to a point) than those with low concentrations. DEET should never be allowed into mucous membranes (nose, mouth, eyes), and should never be used on infants less than two months old. Officials don't recommend using products containing more than 30 percent DEET. A few people are allergic to it. DEET is greasy and also dissolves some plastics and finishes.

**Picaridin** is a relatively new repellent. It first became available in U.S. products in 2005. For most species, it's as effective as DEET, but appears to lack some of DEET's shortcomings. It doesn't dissolve plastics or finishes, and no allergic reactions have been noted. Perhaps as products containing picaridin become more widely used, some shortcomings might appear. Picaridin works well on mosquitoes, and also biting midges (punkies/no-see-ums) and chiggers. It works almost as well as DEET on ticks. N.H.-registered repellents with low picaridin concentration are labeled for mosquitoes, biting flies and chiggers. Those with higher concentrations include ticks on the label. Avon, Cutter, Go Ready, Natrapel, OFF, Repel, Sawyer and Walgreens are brand names that include picaridin repellents registered in New Hampshire.

**Oil of Lemon Eucalyptus** is one of many "natural" products. Research has shown that repellents based on natural oils or herbs are less effective on mosquitoes than products based on picaridin or DEET. According to the Centers for Disease Control and Prevention, oil of lemon eucalyptus (active ingredient: p-menthane 3, 8-diol [PMD]), tested against U.S. mosquitoes "provided protection similar to repellents with low concentrations of DEET." The data showed that this was effective only for the first few minutes of the testing. After that, it was much less effective.

Oil of lemon eucalyptus should not be used on children younger than three years old. S.C. Johnson (OFF) produces two products containing PMD that are registered in New Hampshire. One (towelettes) has 8 percent PMD, and lists black flies, gnats, mosquitoes, no see-ums on the label. The other (liquid) has 10 percent PMD, and lists those pests plus "ticks, chiggers and bugs."



For those who prefer natural ingredients, there are many choices, but tests reveal they must be reapplied more frequently than DEET, and often cannot match its performance. Photo: Alan T. Eaton.

**Citronella** is a natural product with limited repellence to mosquitoes. It is incorporated in some candles and torches, in addition to repellents. The material is derived from two grasses native to tropical Asia: *Cymbopogon nardus* (L.) Rendle (“mana grass”) and *C. winterianus* Jowitt.

**2-Undecanone** is a chemical derived from wild tomato plants. Some chemical registries refer to the same compound as methyl nonyl ketone. In preliminary tests on American dog ticks and some mosquitoes, it worked as well as or better than DEET. EPA registered the material as an insect repellent in 2007. The material became registered for use in New Hampshire in 2010, under the trade name “Bite Blocker BioUD”. BioUD is a trade name for products with this active ingredient. A search of the N.H. pesticide registry uncovered a surprise: we have many products with this chemical, registered to repel or train dogs & cats, but not formulated for use as insect repellents.

**IR3535** (ethyl butyl acetyl aminopropionate) has several chemical names. The chemical was designed in the early 1970s and has been available in Europe since the mid-1970s. Tests show that it works moderately well on mosquitoes and fairly well on blacklegged tick. At least three manufacturers (Sawyer, Chattem, and Avon) make products that combine sunblock and insect repellent, contain this chemical, and are registered for use in NH. The Chattem (“Bullfrog Mosquito Coast”) and Sawyer products typically have 20 percent IR3535 and are registered for mosquitoes. The Avon products have lower percentage of active ingredients and are registered for “biting midges, black flies, deer ticks, gnats, mosquitoes, no-see-ums, and sandflies.”

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## ***Did You Know?***

**Some permethrin products are registered to be applied to clothing to “repel” ticks. These should never be applied directly to the skin.**

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### **Other repellents**

Research continues to turn up new candidates for registration as repellents. Recent examples include A13-37220 and tansy essential oil. Perhaps these will eventually appear in commercial mosquito or tick repellents.

Amitraz and permethrin are two artificial chemical pesticides for ticks that show what is sometimes called repellency. Rather than being true repellents, they seem to create irritation and toxicity symptoms in ticks, which cause ticks to drop off and prevent them from attaching. Tick control products containing fipronil can also prevent tick attachment, which some people interpret as “repellency.” Some permethrin products are registered to be applied to clothing to “repel” ticks. These should never be applied directly to the skin. Apply them to clothing, then let it dry before wearing.

Dimethyl phthalate, R-11 and ethyl hexane diol were fairly effective against mosquitoes and black flies, but they are no longer available in repellents. They were discontinued in the early 1990s, based on health concerns.

### **Labels and the registration process**

Repellents are classified as pesticides by the U.S. Environmental Protection Agency. As such, in order to be sold in this country, they must first be registered with the EPA. Companies submit product information (contents, testing results, targets, proposed label, etc) and EPA looks to see if the products are “safe” for use as directed. For most chemicals, they also look to see if they work.

For one group of chemicals, effectiveness testing is much reduced or not required by EPA. This is for “natural” products composed of chemicals on the federal “generally regarded as safe” (GRAS) list. The GRAS list includes materials in food, such as black pepper, many essential oils, caffeine, ethyl alcohol, spices, etc. Insect repellants that contain only GRAS-list ingredients don’t have the same rigorous testing requirement to prove their effectiveness, which is why a “natural” repellent might not work as well as one tested against the standard (DEET).

When a product is accepted by EPA, the label becomes a legal document that we are all required to follow for use. We aren’t allowed to use (or recommend) products in a manner that is “inconsistent with their labeling.” Please read and follow label directions. They are there to ensure your safety and maximize effectiveness of the product.

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### **About the Author**

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