How to Win the Battle of the Bugs
You don’t need harsh chemicals to keep the biters at bay. We reveal new, safer options.

Would you rather be eaten alive by mosquitoes and ticks that can carry debilitating—and even deadly—diseases or douse yourself in harmful repellents full of potentially dangerous chemicals? Almost three-quarters of Americans say they worry more about insect-carried diseases, such as Lyme and West Nile, as well as newer threats like chikungunya and Powassan, according to a recent Consumer Reports survey of 2,011 U.S. adults.

Here’s the real dilemma, though: Most people also say that safety is key when they choose a repellent, but only about a third think the products now on the market are safe for adults. Even fewer—23 percent—think the repellents are safe for kids.

If you’re conflicted about what to do, we have good news: For the first time ever in Consumer Reports’ tests of insect repellents, new, safer products—made with milder, plantlike chemicals—were the most effective. (See Ratings on page 36.) The top scorers outperformed products that contained deet, a chemical that did best in our previous Ratings but can cause serious side effects (see the facing page). The active ingredients in the top repellents are picaridin and oil of lemon eucalyptus, both chemically synthesized compounds that are similar to or come from natural ingredients. The secret sauce in best-scoring Sawyer Fisherman’s Formula is picaridin; in Repel Lemon Eucalyptus, it’s oil of lemon eucalyptus. They are not side-effect-free, but “those problems are much less severe than deet,” says Urvashi Rangan, Ph.D., executive director of Consumer Reports’ Food Safety and Sustainability Center. “Still, all repellents should be used sparingly and only for the time you need them—especially on children and older people.”

That’s why an effective bug-avoidance strategy requires a full arsenal. Our new tests provide clarity on that, too, identifying non-chemical approaches that offer some relief (setting up a fan on your back patio, for example) and those that don’t help much if at all (think citronella candles, wristbands, and “all-natural” products with geraniol, lemongrass, and rosemary oils).

The Swat Team Bares Arms
To find effective spray-on repellents, we went to an outside lab and tested 15 pump sprays and aerosols. The products contained
deet, oil of lemon eucalyptus, picaridin, a chemical called IR3535, and products made with natural plant oils.

Our brave testers had a different repellent applied to each of their forearms and, 30 minutes later, reached into an 8-cubic-foot cage containing 200 disease-free, female mosquitoes in need of a blood meal to lay their eggs. We used culex mosquitoes (the kind that transmit West Nile and are most active between dusk and dawn) and aedes (a variety that likes to feed on humans, is active all day long, and carries chikungunya). Our experts watched and recorded bites every hour.

A repellent failed if a tester was bitten two or more times in one 5-minute session, or once in two consecutive sessions. For ticks, we marked each tester’s bare arms with three lines, then released, one at a time, five disease-free deer ticks to crawl on them. The repellent failed if two ticks crossed into the treated area.

What Bugs a Bug Most?
The top-performing products contained 20 percent picaridin (Sawyer Fisherman’s Formula) and 30 percent oil of lemon eucalyptus (Repel Lemon Eucalyptus). They kept mosquitoes and ticks away for at least 7 hours. Two deet products also earned at least Very Good scores, and the repellent that was 15 percent deet (Repel Scented Family) outperformed the 25 percent deet product (Off! Deep Woods VIII), possibly because of its inactive ingredients. The IR3535 products, Coleman SkinSmart and BullFrog Mosquito Coast, didn’t make our list of top sprays. Some of the plant-oil products couldn’t ward off the aedes mosquitoes for even half an hour. To see the bugs in action on our testers’ arms, go to ConsumerReports.org/cro/insects0715.

Repellents: The Bottom Line
GO PLANTLIKE Look first for products with 20 percent picaridin or 30 percent oil of lemon eucalyptus; we think they’re safer than those with deet.
LIMIT DEET If you do opt for deet, avoid concentrations of more than 30 percent (which are potentially dangerous) or below 8 percent (which may not work as well).
SKIP THESE Don’t bother with “all-natural” plant-oil repellents. Skip wristbands, too. Neither worked well in our tests.

Get a Pest-Free Backyard

We tried a candle, a diffuser, and a fan. Here’s what worked.

TO FIND OUT HOW WELL area repellents worked, we simulated a backyard barbecue in a 25x30-foot room and unleashed 250 aedes mosquitoes, known to be aggressive biters. We suited up four testers in protective suits and sat them at a “picnic” table, where we lit an Off! Citronella Bucket, $8.50, containing a candle with 0.5 percent oil of citronella. Then we counted how often mosquitoes landed on them. We tested again with the Bug Band Portable Diffuser, $20, which uses a battery-operated blower to propel the scent of 20 percent geraniol, another plant oil. Last, we cranked up an oscillating pedestal fan to its highest speed to see whether it could literally blow mosquitoes away.

What we found. Neither the citronella bucket nor the geraniol diffuser kept the mosquitoes at bay. But the fan showed some promise: It cut mosquito landings by 45 to 65 percent, at least among people sitting close to the fan. Our survey found similar results: 45 percent of people who used fans said they were especially helpful, compared with 31 percent of those who tried candles. What else can you do? Clean out gutters and empty old tires and bird-baths (where mosquitoes breed) and clear away ivy and decaying leaves (where they hide). For ticks, keep your lawn mowed, remove leaves, and let in as much sun as you can. Consider fencing, to keep out deer and other animals that carry ticks.

The Scoop on Deet and Its Alternatives

DEET (N, N-diethyl-meta-toluamide) has been the go-to insect repellent since it was introduced in the 1950s. But consumers are still confused by it: 64 percent of people we surveyed admit that they don’t know how much deet a repellent should contain for it to be considered safe. And balancing safety and effectiveness is tricky. Products with 15 percent or more deet do work, though concentrations above 10 percent are no better, pest tests have found. And deet, especially in high concentrations, can cause rashes, disorientation, and seizures. That’s why we say you should avoid repellents with more than 30 percent deet and not use it at all on babies younger than 2 months. But go too low—such as 7 percent deet—and it won’t stop bites for long.

PICARIDIN AND OIL OF LEMON EUCALYPTUS—two repellents introduced in the last decade—make good alternatives to deet. Here’s why.

They work. The repellents we tested that contain 20 percent picaridin and 30 percent oil of lemon eucalyptus (p-Menthan-3,8-dio) warded off mosquitoes for at least 7 hours and kept deer ticks away for at least 6 hours. But the concentration is important: A spray that contained just 5 percent picaridin performed worse than the 7 percent deet product we tested.

They’re safer. Picaridin is made to resemble the compound pipermine, which occurs naturally in black pepper plants. Oil of lemon eucalyptus comes from the gum eucalyptus tree. Both have less serious side effects than deet has.

Oil of lemon eucalyptus can cause temporary eye injury. The Food and Drug Administration says it should not be used on children under age 3. Of the two, picaridin is a better choice for kids, although it can cause some irritation of skin, eyes, and lungs.
NATURAL REPELLENTS DON'T DO THE JOB

Products with natural plant oils, such as citronella, lemon-grass, and rosemary, often have labels that talk a good game, with claims such as "proven effective" or "reps mosquitoes for hours." But don't believe it. Unlike repellents with chemically synthesized ingredients (including picaridin and oil of lemon eucalyptus), plant-oil products are exempt from scrutiny by the Environmental Protection Agency. That's because the EPA considers them "minimum risk." But none of those products we tested lasted more than 1 hour against oxites mosquitoes, and some failed almost immediately. In addition, the names of two products—Babyganics Natural and EcoSmart Organic—imply that they're organic. But neither contains certified organic ingredients or bears the Department of Agriculture organic seal.

WRISTBANDS ARE A BUST

They're marketed as being safer, because you don't have to rub anything into your skin. But when our testers stuck their arms into a cave of mosquitoes while wearing one of two wristbands—the Coleman Naturals Insect Repellent Snap Band (containing citronella oil) or the Super Band Wristband (containing geraniol oil)—the bugs started biting immediately. Given those results, we've rated them as poor performers and recommend that you skip them.

In February the Federal Trade Commission charged another maker of repellent wristbands, Viesnek, with deceptive marketing of its Mosquito Shield Bands, which the FTC says contain mint oil. The FTC says the company's claim that the bands protect against mosquitoes wasn't backed up with scientific evidence. The case will be decided by a U.S. District Court; the FTC is seeking penalties and consumer refunds.

TRY THESE

A1 Sawyer  A2 Repel  A3 Repel  A4 Natrapel  A5 Off!

AVOID THESE

A14 Off!  A15 EcoSmart

Ratings: Insect Repellents

Scores in context: Of the 15 insect repellents we tested, the highest scored 96; the lowest, 7. All products are listed in order of performance.

| CR Best Buy | Recommended |  | Excellent | Very Good | Good | Fair | Poor |

INSECT REPELLENTS

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<th>Rank</th>
<th>BRAND &amp; PRODUCT</th>
<th>PRICE</th>
<th>Score</th>
<th>Active Ingredient</th>
<th>Type</th>
<th>Effectiveness Against Mosquitoes</th>
<th>Effectiveness Against Deer Ticks</th>
<th>Effectiveness Against Culex Quinquefasciatus</th>
<th>Effectiveness Against Chikungunya</th>
<th>Effectiveness Against Anopheles and Aedes</th>
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*Does not contain certified organic ingredients.

Find the Best Insect Repellent for You

BEST ALL-AROUND

• 1 Sawyer Fisherman's Formula Picaridin $8.25

This pump spray stood out in several ways. It protected for 8 hours against mosquitoes, including the aggressive ones that spread chikungunya. And it protected for more than 8 hours against ticks. It also has less serious side effects, especially for kids. The only negatives: It's a little pricey, and it discolored leather and vinyl and removed nail polish.

LESS LIKELY TO STAIN

• 2 Repel Lemon Eucalyptus $7

Of the top repellents, the Repel Lemon Eucalyptus pump was least likely to damage or discolor materials. But it did take off nail polish.

PLEASANT SCENT AND FEEL

• 2 Repel Lemon Eucalyptus $7

When it comes to scent and feel, these stood out. The Repel had a mostly eucalyptus scent with a hint of lemon, and it was slightly oily. The Natrapel had a floral perfumey aroma, and it was oily. The Off! had a mild aroma that was mostly floral and a little fruity. It left a thin, dry coating.
Don’t Spray It on Your Face, and Other Tips

Proper use is essential, even with safer repellents. That means:

• Apply repellents only to exposed skin or clothing (as directed on the product label).
• Never put it on under clothing. Use just enough to cover and only for as long as needed; heavy doses don’t work better.
• Don’t apply repellents over cuts, wounds, or irritated skin.
• When applying to your face, spray first on your hands, then rub in, avoiding your eyes and mouth, and using sparingly around ears.
• Don’t let young children apply. Instead, put it on your own hands, then rub it on. Limit use on children’s hands, because they often put their hands in their eyes and mouths.
• Don’t use near food, and wash hands after application and before eating or drinking.
• At the end of the day, wash treated skin with soap and water, and wash treated clothing in a separate wash before wearing again.

The Danger in the Bite

MOSQUITO-BORNE DISEASES
West Nile was reported in 47 states last year and killed 85 people in the U.S. Chikungunya isn’t as widespread—yet—or as deadly. Of the almost 2,500 cases reported in the continental U.S. since January 2014, there were no deaths, and only 11 cases were from bites received in the continental U.S. (all in Florida). The rest were brought back from the Caribbean, Asia, or Africa. But experts worry that chikungunya may be prone to large outbreaks in urban settings. The mosquitoes that carry it bite day and night. Plus, roughly 70 to 80 percent of infected people develop symptoms, compared with 20 percent of those infected with West Nile.
WHAT TO DO See a doctor if you develop signs of either disease: fever, headache, and body aches for West Nile; and fever and joint pain for chikungunya. Both are viral, so antibiotics won’t help. But over-the-counter pain relievers can ease symptoms.

TICK-BORNE DISEASES
Lyme disease affects about 300,000 people each year, mostly in the Northeast and Upper Midwest. But that geographic reach is expanding, and doctors in new areas may be less familiar with the disease. Other tick-related diseases include Rocky Mountain spotted fever, most often in North Carolina, Oklahoma, Arkansas, Tennessee, and Missouri; babesiosis, in the Northeast and Upper Midwest; ehrlichiosis, in the Midwest and South; and an emerging virus, Powassan, mainly in the Northeast and Great Lakes region.
WHAT TO DO See a doctor if you develop a bull’s-eye rash accompanied by flu-like symptoms, which indicates Lyme. Prompt treatment can stop the infection and prevent more serious complications, such as joint pain and facial paralysis (Lyme disease); heart, joint, or kidney failure (Rocky Mountain spotted fever); blood clots and bleeding (babesiosis); difficulty breathing or bleeding disorders (ehrlichiosis); and neurological problems (Powassan).

The Deal With Skin So Soft

How did a bath oil develop a reputation as an insect repellent? Avon’s Skin So Soft makes no repellent claims, and its ingredients—mineral oil and emollients—are purely cosmetic. But because it had so many fans, we tested the pump spray—available in 1993—and found that it did fend off mosquitoes at all. Other Skin So Soft products are now marketed as repellents. One, Skin So Soft Bug Guard Plus IR3535 Expedition, combines a repellent with sunscreen. But we think such products are a bad idea: Sunscreens should be applied liberally and often, so the combo could lead to unnecessarily high doses of the repellent. We haven’t yet tested Avon’s stand-alone repellent, Skin So Soft Bug Guard Plus Picardin, but we plan to include it in our next round of testing. That product contains just 10 percent picardin. In our tests of similar products, the two with 20 percent picardin performed very well, and the one with 5 percent didn’t.