Fact Sheet:
Characteristics and Regulatory Status of Spatial Insect Repellents

Spatial insect repellents work by releasing a repellent material into a protected area in the form of a smoke or vapor. Two general types of spatial repellents—coils and candles or torches—have been available for many years all over the world. More recent developments in the U.S. market include systems relying on the heat of a lamp to vaporize the repellent, others relying on a fan to disperse a repellent material that volatilizes at ambient temperatures, and an impregnated paper device with a very high surface area from which the repellent volatilizes.

Each of these types of spatial repellent products is available to U.S. consumers. While examples of each type are currently registered by EPA as pesticides, some coils and candles contain ingredients which EPA has determined to be eligible for exemption from regulation under FIFRA.

The types of spatial insect repellents currently available on the U.S. consumer market are described below.

1. **Heat-Based Vaporization.** Both old and newer technologies rely on heat to vaporize the repellent material.

   A. Coils. Mosquito coils have been widely used for many years, all over the world. They are inexpensive to make and to purchase, and effective in repelling mosquitoes, although they are not effective against other flying insects. A combustible matrix is formed into a coil and coated with a pesticide. In use the coil is placed on a stand and ignited. The pesticide is released behind the smoldering tip of the coil, as the temperature for volatilization is achieved.

   Registered Products

   - EPA-registered coils contain low percentages of allethrins (synthetic pyrethroids)

   Permitted Efficacy Claims

   - Repels mosquitoes

   Efficacy Testing of Mosquito Coils

   - A common method of testing the efficacy of coils is to compare the number of mosquito landings or bites on the exposed skin of human subjects located in the vicinity of the coil to the numbers of landings or bites on subjects in an untreated area

- Very limited efficacy data has been required for registered mosquito coils
- New repellent coil products have been registered without new efficacy data, on the rationale that they are essentially identical to those already on the market
- In its reregistration review of these allethrin coils EPA decided to require new efficacy data, a requirement still awaiting approval from the Office of Management and Budget

B. Candles/Torches. Candles or torches containing citronella, linalool, or geraniol are available to consumers to repel mosquitoes. The repellent material is incorporated into the candle wax or torch fuel, and is volatilized by the heat of combustion. Three citronella candle products, one citronella torch, and one linalool candle are currently registered by EPA. Other *unregistered* mosquito-repellent candles and torches containing citronella or geraniol are also available. Both citronella and geraniol are classified as minimum risk pesticides under FIFRA §25(b), and products containing these active ingredients (and meeting all other applicable requirements)[1] are eligible for exemption from the registration requirement of FIFRA.

Permitted Efficacy Claims

- Repels mosquitoes

Efficacy Testing of Candles and Torches

- A common method of testing the efficacy of candles is to compare the number of mosquito landings or bites on the exposed skin of human subjects located in the vicinity of the repellent candle to the number of landings or bites on subjects in an untreated area.
- Very limited efficacy data has been required for registered repellent candles or torches. As these products are subject to registration review, new efficacy testing is likely to be required.

C. Lamp with Butane-Powered Heater and Mat Insert. EPA has registered several repellent products that consist of a lamp with a heat-generating butane cartridge and a repellent mat insert. Combustion of the butane generates heat, which liberates vapor from the repellent mat. The lamp-and-cartridge/mat products currently registered by EPA all contain 21.97% allethrin as the active ingredient. An advantage of these

[1] To be eligible from exemption a product must contain only ingredients—whether pesticidally active or inert—on lists of potentially exempt ingredients maintained by EPA; it must list on the label all active ingredients by name and percentage by weight, and must list all other ingredients by name; it must bear no false or misleading label statements, or claims to repel specific vectors of public health concern.

products over coils and candles is that they do not smoke; a disadvantage is that they are far more expensive.

Permitted Efficacy Claims and Related Label Statements

- Repels mosquitoes and black flies for a maximum of [xxx] hours
- Provides repellency over area of [xxx square feet] for [xxx] hours
- For best results, allow 10 to 30 minutes for product to take effect
- This product works well in outdoor areas where there is minimal air movement, such as decks, unenclosed porches, patios, and yards
- Do not use in windy conditions

Efficacy Data Supporting Lamp-and-Cartridge/Mat Products

- Three field studies were conducted in 2000 in which human subjects stood in circular arrays (three subjects per array, each placed either upwind, downwind, or perpendicular to the wind direction) at various distances from the repellent emitter. Testing was repeated over several nights.
- Relative protection was calculated as the ratio of the number of landings on subjects located in areas with and without the repellent emitter.

2. **Fan-Dispersed Vaporization.** Another technology for spatial repellent delivery uses a fan to disperse vapors from a material that volatilizes under ambient conditions.

   A. **Stationary Insect Repellent.** EPA has registered a spatial repellent product that consists of a cartridge containing linalool, a naturally occurring terpene alcohol found in over 200 species of plants, inserted into a stationary fan device that disperses the repellent vapors

Permitted Efficacy Claims

- Provides repellency over [xxx area] for [xxx] hours
- Reduces mosquito landings
- Repels mosquitoes

Efficacy Data Supporting This Product

- A 1998 field study compared mosquito landing rates on a single human subject who moved at 15-minute intervals between two 8' x 8' areas, 80 feet apart, one untreated and the other treated with a single repellent device placed in one corner of the area. Testing was repeated over two evenings and one morning.

B. **Belt-worn Personal Insect Repellent**. EPA registered in 2007 a wearable personal repellent device that consists of a small battery-powered fan and a repellent mat insert. The device is worn on a user's belt. The mat is treated with metofluthrin, a pyrethroid that volatilizes at ambient temperatures. The device creates a cloud of mosquito-repellent vapor around its wearer.

Permitted Efficacy Claims

- Repels mosquitoes
- Provides protection from mosquitoes for up to [xxx] hours
- As you move from place to place, [product] rebuilds its protection in a few minutes

Efficacy Data Supporting This Product

- A field study was conducted in 2004 in which bite counts were compared between human subjects wearing and not wearing the product.

3. Passive Vaporization. A repellent material sufficiently volatile under ambient conditions of use may not require heat or a fan to generate and disperse a repellent vapor.

A. **DeckMate.** First registered by EPA in 2007, this product consists of an accordion-folded paper strip impregnated with metofluthrin, a volatile pyrethroid. The product is activated by removing the folded paper strip from its packaging, stretching it out, and hanging it at least 5 feet above the ground. The metofluthrin volatilizes at ambient temperatures to repel mosquitoes.

Permitted Efficacy Claims and Efficacy-Related Label Statements

- Repels mosquitoes over an area of [xxx] square feet
- Up to 36 hours of repellency from mosquitoes
- For best results, use when air is still or in gentle breezes
- Do not use in wet weather

Efficacy Data Supporting This Product

- Two field studies were conducted in 2004 in which a single human subject wearing a Tyvek suit stood half-way between two DeckMate devices placed 8 feet apart

- The research was repeated three times with five subjects standing between two treated DeckMate devices, and three times with one subject standing between placebo DeckMate devices

- Mosquito landings on subjects who stood between treated DeckMate devices were compared to landings on subjects who stood between placebo devices