

Snake Repellents

Wildlife Services (WS), a program within the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS), uses several methods to manage brown tree snake populations on Guam and the Northern Marianas Islands. The purpose of these management efforts is to reduce the number of brown tree snakes, particularly around military bases, airports, and shipping ports, in order to minimize the risk of accidentally exporting this invasive species to Hawaii or the continental United States. Brown tree snakes were first introduced to Guam in the late 1940s or early 1950s hidden away in cargo shipments.

Effective Snake Repellents

Snake management methods used by WS include trapping and the use of snake-sniffing detector dogs. To improve these management methods, research is underway to develop toxicants, reproductive sterilants, improved trap lures, and chemical repellents.

Research has shown that cinnamon oil, clove oil, and eugenol are effective snake repellents. Snakes will retreat when sprayed directly with these oils and will exit cargo or other confined spaces when these oils are introduced to the area.

On March 6, 1996, the U.S. Environmental Protection Agency (EPA) published in the *Federal Register* a notice exempting certain minimum risk pesticides from regulation under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The exemption, issued by EPA under the authority of FIFRA Section 25(b) and codified at 40 Code of Federal Regulations (CFR) 152.25, applies to cinnamon oil, clove oil, and eugenol. These materials are exempt from the requirements of FIFRA when used as pesticide active ingredients provided that:

1. They are used alone or in combination with other active ingredients exempted under FIFRA 25(b);
2. They contain only EPA List 4(A) inert ingredients.

The list of acceptable inert ingredients may be obtained from the following Web site:
<http://www.epa.gov/opprd001/inerts/lists.html>.

While cinnamon oil, clove oil, and eugenol are exempted from Federal regulation under FIFRA Section 25(b), they are not automatically exempt from regulation by the State or Territory in which they are used. Before using any of these materials as a snake repellent, contact the territory or State agency responsible for pesticide regulation to determine whether additional regulatory requirements apply.

Endangered Species Considerations

Before using any of these materials as a snake repellent, consult with appropriate wildlife authorities to ensure that the use does not present a hazard to any threatened or endangered species. It may be necessary to obtain a permit from the U.S. Department of the Interior's Fish and Wildlife Service and/or the applicable State or local wildlife agency before repellents may be used. Obtaining all required permits and licenses is the responsibility of the applicator.

General Information

Any use of cinnamon oil, clove oil, and eugenol to manage snakes must comply with information in this tech note. A copy of this tech note must be in the possession of any individual applying these oils to manage snakes.

Obtaining Repellent Oils

Applicators may obtain oils from any retail or wholesale chemical supplier. Any commercially available brand with 95 percent or greater food-grade oil is acceptable. When ordering these products, use the information below:

- Cinnamon oil: CAS No. 8015-91-6
- Clove oil: CAS No. 8000-34-8
- Eugenol: CAS No. 97-53-0.

Aerosol Spray Application

Cinnamon oil, clove oil, and eugenol aerosol sprays are effective for moving snakes. Spray mixtures should be formulated to contain:

- One percent active ingredient (either cinnamon, clove, or eugenol oil)
- One percent sodium lauryl sulfate
- Ninety-eight percent water.

To use, spray the mixture directly on the snake, aiming for its head. Direct contact with the snake will trigger escape behavior. To be effective, the spray must come in direct contact with the snake. Application to hard surfaces will not prevent snakes from entering areas.

Vapor Fumigant Application

Cinnamon oil, clove oil, and eugenol may also be used to fumigate enclosed spaces. To prepare, saturate a piece of absorbent material with one of the oils. Use only unadulterated oils. Pass hot air directly over the saturated absorptive material to volatilize the oils. DO NOT USE OPEN FLAMES TO HEAT THE OILS. The heated air should be no hotter than 200 degrees Fahrenheit, or no hotter than 10

degrees Fahrenheit below the flash point of the oil being used. The flash point for eugenol is 230 degrees Fahrenheit, and the flash points for cinnamon oil and clove oil are 200 degrees Fahrenheit.

Direct the heated air into containers, cargo spaces, house crawl spaces, or other enclosed spaces where snakes may be located. Snakes will emerge and vacate the treated space. This application method is only effective for driving snakes out of enclosed spaces. These oils will not prevent snakes from entering enclosed spaces.

Storage and Disposal

Store oils in the original container. Recycle containers or dispose of them in an appropriate landfill.

Potential Hazards

Applicator hazards are not expected, unless the applicator is allergic to the oil being used. If eye irritation occurs, flush with water for 15 minutes. If breathing difficulty occurs, remove person to fresh air and call a physician. Clove oil and eugenol are known fish anesthetics, and therefore should not be applied directly to water.

Additional Information

Additional information on these repellents may be obtained by calling WS' National Wildlife Research Center (NWRC) at (970) 266-6000 or by visiting NWRC's Web site at:
<http://www.aphis.usda.gov/ws/nwrc>.

Additional information is also available in the following publication: Clark, L. and J. Shivik. 2002. Aerosolized essential oils and individual natural product compounds in brown tree snake repellants. *Pest Management Science* 58:775-783.

For further information about the availability of these products, contact your WS State Director at 1-866-4USDAWS (1-866-487-3297) or WS' Pocatello Supply Depot at (208) 236-6920. In Guam call (671) 635-4400.

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