

Public Health Pesticides for Flea Control

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While mosquitoes are probably the most notorious disease-vector insects, other blood-sucking arthropods such as ticks, bed bugs, and fleas are major and growing threats to people and domestic animals, and have spurred the recent development of novel public health pesticides and veterinary medicines. Fleas, in particular, are a group of insects that cause major irritation to domestic animals and people, in addition to their infamous role in spreading the Black Death (plague) and other infectious diseases. After a long period of declining impact, fleas have



rebounded extraordinarily in recent years, possibly due to reductions in the chemical control toolbox or to development of resistance to the remaining pesticide treatments. Regardless of the cause, this resurgence has led to many new and generally effective products coming onto the market, as well as a rekindling of interest in a range of traditional remedies.

Fleas are small (1/16" – 1/8"), laterally flat, dark, wingless insects with tube-like mouthparts adapted for piercing the skin of animals. Flea larvae have a varied diet, including flakes of dead skin and the feces of mature fleas, so they can live for long periods in animal bedding or burrows, but adult fleas, both male and female, are obligate ectoparasites, obtaining all their nourishment from blood taken from host animals. Fleas inject saliva when they bite, which causes irritation; if they also inject parasites, the bites can cause infection. In addition to plague, infectious disease spread by fleas include murine (endemic) typhus and other bacterial diseases, myxomatosis and other viral diseases, and infection by some tapeworms and trypanosome protozoans. Even without direct infection, flea bite saliva can cause strong allergic reactions, and scratching can open the skin to secondary infections.

There are many types of fleas, and their common names refer to their typical hosts, but this can be quite misleading, as many fleas are quite willing and able to blood-feed on a range of hosts. Thus, oriental rat fleas (*Xenopsylla cheopis*), which generally live on rats and mice, spread bubonic plague during the Black Death when fleas infected with the bacteria *Yersinia pestis* sought out other prey after their rodent hosts died. Ongoing *Yersinia pestis* activity in California, in contrast, is associated primarily with other fleas that infest ground squirrels and other rodents, but also move to domestic cats that can then bring the fleas and pathogen into houses. The human flea, *Pulex irritans*, despite its common name, has a very wide host spectrum, and probably spread to people from guinea pigs or peccaries in South America. It is not a major disease vector, and has become an increasingly uncommon pest species with modern hygiene.

While the dog flea *Ctenocephalides canis* is, not surprisingly, most often found on dogs, it is a relatively uncommon species, and the major cause of flea problems today for humans, dogs, and cats throughout the world is the cat flea *Ctenocephalides felis*. While this species is most often found on domestic cats, it can also maintain its life cycle on dogs and several other mammals. It bites people, and can cause substantial discomfort, but cannot maintain a population without pets or other animals. Cat fleas mate and lay eggs on cats or dogs, but most eggs fall off into the pet's bedding, where the larvae can feed on dead skin or flea feces before reinfesting the host. Therefore, effective control of cat fleas requires treatment both of the adult insects on the host animals, and control of the eggs and immatures in the bedding and elsewhere in the local environment.


Effective control of adult fleas inevitably requires treatment of the host animals with chemical insect toxicants known as ectoparasiticides (see Table 1), although these are sometimes sold as insecticides (regulated by EPA), and sometimes as veterinary drugs (regulated by FDA). Some botanical products, including garlic and pennyroyal, are promoted as alternative "natural" flea killers, but their safety and effectiveness have not been shown (pennyroyal, in particular, can be highly toxic to mammals). Most of flea control products have been formulated for topical ("spot-on") application, generally for monthly use, but others are orally administered and a few are injected. Some require prescriptions, and others do not, but some flea treatments have been associated with serious side-effects, and precisely following product labels is mandatory in all cases. As well, it may be wise to consult a veterinarian before starting a new product.

Treated animals will become rapidly reinfested by fleas in the bedding or elsewhere in the house unless effective measures are taken to control immature fleas and eggs as well as adults. In addition to

Active Ingredient	Applied	Vet Uses	Regulation	Typical Products & Application (Alphabetical)
Toxicants = Flea Killers				
Amitraz	Topical	Dogs	Pesticide	Certifect, Promeris for Dogs
Dinotefuran	Topical	Cats & Dogs	Pesticide	FirstShield, SimpleGuard, Vectra
Fipronil	Topical	Cats & Dogs	Pesticide	EasySpot, Fiproguard, Frontline, Parastar, PetArmor
Imidacoprid	Topical	Cats & Dogs	Pesticide	Advantage, Advocate, K9Advantix II
Metaflumizone	Topical	Cats & Dogs	Pesticide	Promeris ¹
Nitempyram	Oral	Cats & Dogs	OTC Drug	Capstar
Permethrin	Topical	Dogs	Pesticide	FirstShield Trio, K9Advantix II, SimpleGuard 3, Vectra 3D
Selamectin	Topical	Cats & Dogs	Prescription Drug	Revolution
Spinetoram	Topical	Cats	Pesticide	Assurity
Spinosad	Oral	Dogs	Prescription Drug	Acuguard, Comfortis, Trifexis
Insect Growth Regulators or Insect Development Inhibitors				
Lufenuron	Oral, Injectable	Cats & Dogs	OTC Drug; Prescription Drug	Program, Sentinel
Methoprene	Topical	Cats & Dogs	Pesticide	Fiproguard Plus, Frontline Plus, PetArmor Plus
Pyriproxyfen	Topical	Cats & Dogs	Pesticide	Advantage II, FirstShield, K9Advantix II, SimpleGuard, Vectra
Ingredients added to control other ectoparasites				
Milbemycin	Oral	Dogs	Prescription Drug	Trifexis, Sentinel
Moxidectin	Topical	Cats & Dogs	Prescription Drug	Advantage Multi = Advocate

1 (from Table 1) Sales of Promeris for Dogs were voluntarily discontinued by Pfizer in 2011, but products may still be available.

2. For example, diatomaceous earth can cause severe problems for lungs, eyes, and mucous membranes if not used carefully.



ectoparasitocides, most modern flea control products also include insect growth regulators (IGR's) or insect development inhibitors (IDI's), which prevent the hatching of eggs or the development of adults from juvenile fleas. While IGR's and IDI's work well, they can take several months to fully eradicate a flea infestation. During this time, the cat or dog treated with an ectoparasitocide will act as a "roving flea trap", mopping up and killing newly hatched fleas. Some veterinary flea treatments also include materials active against other ectoparasites.

In addition to IGR's and IDI's in veterinary flea treatments, there are a wide range of alternative methods for killing juvenile fleas in the home, including both chemical and non-chemical approaches. Over 2500 insecticide products are registered in the U.S. vs. fleas, including many household insecticide foggers and sprays; as with spot-on treatments, strict adherence to the label instructions is critical for safe and effective control. Diatomaceous earth and many household chemicals, including baking soda, salt, and borax, as well as "25(b)" exempt botanical pesticides, have been recommended for flea control, but there is little evidence of their effectiveness and some risks associated with their use.²

Non-chemical treatment of juvenile fleas, including frequent vacuuming and high-temperature laundry of bedding, can be quite helpful and pose essentially no risk, although diligent care is required for complete control. Temperature and humidity affect flea survival, but the extraordinarily cool and dry conditions required for effective environmental control mean that it is generally not a practicable option.

For More Information:

FDA (2009): "Safe Use of Flea and Tick Products in Pets"

(www.fda.gov/ForConsumers/ConsumerUpdates/ucm169831.htm)

National Pesticide Information Center (2012): "Flea Control" (npic.orst.edu/pest/flea.html)