

IPM for Fleas in Schools

INTRODUCTION

Fleas can be a problem in all parts of the country except in very dry areas. The most common species in school buildings is the cat flea (*Ctenocephalides felis*). This flea feeds on cats, dogs, and humans, as well as rodents, chickens, opossums, raccoons, and other animals. The dog flea (*C. canis*) and the human flea (*Pulex irritans*) are less commonly encountered.

IDENTIFICATION AND BIOLOGY

Adult cat fleas are small ($\frac{1}{8}$ inch long), wingless insects with powerful hind legs that are adapted for jumping and running through hair. The adult body is reddish-brown to black, oval, and laterally flattened. Unlike many other flea species, adult cat fleas remain on their host. After mating and feeding, adult female fleas lay oval, white eggs. These smooth eggs easily fall from the host into cracks, crevices, carpet, bedding, or lawn covering. A mature female flea can lay up to 25 eggs per day for three weeks.

Small, worm-like larvae ($\frac{1}{16}$ to $\frac{3}{16}$ inches long) hatch from the eggs in 2 to 12 days. They have a distinct brown head and are eyeless, legless, and sparsely covered with hairs. The larval body is translucent white and a dark-colored gut can be seen through the flea's skin. Flea larvae feed on dried blood excreted by adults. They will also eat dandruff, skin flakes, and grain particles. Larvae live in cracks and crevices or on the ground where eggs have fallen. Under favorable conditions, they take 8 to 21 days to develop, but they can take up to 200 days under unfavorable conditions.

Larval fleas eventually spin silken cocoons in which they metamorphose into adults. The cocoons are sticky and attract dirt and debris, which camouflages them. Under optimal conditions, new adults are ready to emerge from their pupal cocoons within two weeks. They can, however, remain in their cocoons up to 12 months in the absence of a host or under unfavorable climatic conditions. Vibrations and/or elevated temperature stimulate adults to emerge from their cocoon. This ability to wait until a host arrives can result in a sudden increase of adult fleas when they emerge simultaneously from many cocoons.

As soon as the adult fleas emerge from the pupal case, they seek a host from which to take their first blood meal.

Adults can live 1 to 2 months without a meal and can survive 7 or 8 months with one. They are the only stage that lives on the host and feeds on fresh blood.

The flea population builds up all year long in the form of eggs, larvae, and pupae, but rapid development into biting adults cannot be completed until temperature and humidity are optimal and host cues signal for adult emergence from the pupal cocoon.

ASSOCIATED PROBLEMS

Flea bites cause irritation, and sometimes serious allergic responses in animals and humans. Other, more serious, yet far less common problems are associated with the cat flea. Cat fleas can carry or transmit various organisms, such as *Yersinia pestis*, which causes bubonic plague; *Rickettsia typhi*, which causes murine typhus; and *Dipylidium caninum*, the double-pored dog tapeworm, which can live in dogs, cats, or humans.

DETECTION AND MONITORING

Fleas can be a problem in schools even when no pets are kept in the buildings. Adult fleas can be brought in on the clothing of staff, students, or visitors. Other possible sources include urban wildlife such as rats, feral cats, raccoons, opossums, chipmunks, squirrels, or birds that may live in unused parts of buildings. Detection is as simple as seeing fleas or noticing bites around the ankles of people in the building. Flea dirt—adult flea feces that dries and falls off a host—also may be visible.

Areas to Monitor

- In and around the cages of pets kept in classrooms (also check the pets themselves for signs of fleas).
- Places where animals might find harborage, such as basements, crawlspaces, attics, eaves, rooftop structures, and secluded shrubbery near buildings.

Monitoring Traps

Flea Sock Traps

These are homemade, knee-high, white flannel booties that fit over the shoes and lower pant legs. When you walk through a flea-infested area, fleas will jump onto the flannel and become temporarily entangled in the nap where you can easily see and count them. Long, white athletic

Most of the information for this chapter was modified from:

IPM for Schools: A How-to Manual. United States Environmental Protection Agency. EPA 909-B-97-001. March 1997.

Richman, D. L. *IPM for Fleas in Schools*. University of Florida School IPM Web site at schoolipm.ifas.ufl.edu/tp5.htm. March 1998.

socks worn over the shoes and trouser legs will also work, as will wide strips of sticky-backed paper wrapped around the lower legs (sticky side out). Socks can also provide protection from bites if a person must enter a severely flea-infested area for a short period of time.

Light Traps

These compact traps, roughly 4 by 6 inches in size, consist of a small electric light and a sheet of sticky paper. Adult cat fleas seeking a host appear to be attracted to both the warmth of the trap and the light emanating from it. Research has shown that fleas are most attracted to green light and are more attracted to light traps if the light is turned off for 10 seconds every 5 to 10 minutes; therefore, it is important to use a trap with a green light that can flicker on and off.

Light traps are especially useful for monitoring in offices or classrooms where no animals are present and

the flea population is likely to be small. Check the traps once a week. If no fleas are caught by the second week, move the trap to another location or remove it. If the traps catch only a few fleas, the infestation is very small and can probably be managed with the traps alone. In this case, leave the traps in place until no fleas have been caught for at least a week. If more fleas are caught per trap in a week, this indicates a more serious infestation, and time must be devoted to finding its source (such as an animal living in or under the building).

Persistent Flea Problems

Persistent flea problems in buildings where there are no pets may indicate the presence of rodents or other wildlife. In this case, it may be helpful to have a professional identify the fleas. A flea's identity can be used to determine the host animal and where to search for the host or its nest.

Sample IPM Plan for an Indoor Flea Situation

If monitoring has confirmed a high indoor flea population that requires an immediate response, the following IPM program can be used to manage the situation. A significant reduction of flea numbers should occur within 1 or 2 days.

- 1. Protect Yourself.** Wear long pants tucked into boots or socks. For added protection, you may want to apply an insect repellent to pantlegs and footwear.
- 2. Vacuum and/or Steam-Clean Infested Areas.** Since most fleas reside in carpeting, it should be thoroughly cleaned. In uncarpeted areas, or where carpeting cannot be steam-cleaned, concentrate vacuuming along baseboards, under furniture, behind doors, or in other areas where dust collects and flea eggs are protected from foot traffic. See Physical Controls on page 56 for more details.
- 3. Apply an Insect Growth Regulator (IGR).** After completing steps 1 and 2 above, spray carpets and floor with an appropriately labeled IGR (see Chemical Controls on page 57). The IGR will prevent pre-adult fleas that survive vacuuming or steam-cleaning from maturing into biting adults. **(Pennsylvania law allows pesticide applications in schools only by certified applicators, registered technicians, or by non-certified applicators or non-registered technicians under the direct supervision of a certified applicator. Notification must be given**

to all staff and parents or guardians of students who request it 72 hours prior to pesticide use. Warning signs must also be posted in the vicinity 72 hours prior to and for 48 hours after the application. The law also mandates a 7-hour reentry period for common access areas whenever pesticides are applied.)

- 4. Apply an Insecticide If Needed.** The first three steps described above should reduce the flea population to a low level and keep it there while long-term measures (such as locating and removing wild animal flea hosts from the building) are undertaken. If sufficient management has not been achieved, apply a borate insecticide to carpeting or spot-treat infested areas with insecticidal soap or pyrethrin (see Chemical Controls on page 57). If adequate management has still not been achieved, a pest management professional should be contacted to apply a stronger insecticide, such as a synthetic pyrethroid. A combination of both an IGR and an appropriately labeled pesticide may be needed in some cases. All label directions should be followed to the letter and the applicant should wear appropriate protective clothing.
- 5. Remove Any Wildlife Nesting In or Under Building.** If flea problems persist but no pet is present, check for wildlife in the vicinity of the building and remove any animals that are found. A residual insecticide may be needed under buildings to prevent flea migration indoors.

MANAGEMENT OPTIONS

An integrated management program for fleas can be designed by selecting from the following strategies and tactics. See the sample emergency flea management plan below.

Physical Controls

Wild Animal Removal

Wild animals can be trapped by trained animal management technicians. Consult your Yellow Pages or obtain recommendations from your Penn State Cooperative Extension county agent. Make appropriate repairs to exclude animals.

Vacuuming

- Vacuuming on a regular basis throughout the year will keep developing flea populations low by eliminating adult fleas and their eggs.
- Vibrations caused by vacuum cleaners will stimulate new adult fleas to emerge from their pupal sacs. These new adults will be either exposed to any residual insecticide on the floor or captured in the next vacuuming.
- Vacuuming is not very effective at capturing flea larvae in carpeting because the larvae coil themselves around the fibers. Vacuuming does, however, remove the dried blood on which the larvae feed.
- Use vacuum attachments to clean cracks and crevices. Caulk or seal these openings.
- Most fleas will be killed when dust in the vacuum bag suffocates them. To be sure they are killed, you can vacuum up a tablespoon of cornstarch.
- Vacuum badly infested areas thoroughly every day until the infestation is managed.
- When infestations are severe, you may need to supplement vacuuming with steam-cleaning or other management tactics.

Steam-Cleaning

The services of a steam-cleaning firm may be warranted when flea populations are severe. This process kills adult and larval fleas and probably some eggs as well; however, since the warmth and humidity from the steam also stimulates the remaining flea eggs to hatch a day or two after the cleaning, some fleas may reappear. If the other steps recommended in this section are followed, the few fleas that hatch after steam-cleaning should represent the last of the flea population.

Flea Combs

Classroom pets in a flea-infested room should be combed regularly with a special flea comb that can be purchased at a pet store. Fleas and eggs removed from the animal should be dropped into soapy water.

Laundry

Wash removable floor coverings, such as rugs, located in areas where there are known infestations. Any bedding for classroom pets should be washed regularly.

Ultrasonic Devices

It has been suggested that ultrasonic flea collars keep fleas off pets, but recent investigations have shown these devices to be ineffective.

Heat

Tests have indicated that cat flea larvae die after exposure to 103°F for one hour, and techniques to raise the temperature in a room to provide this exposure have been developed. The heating process uses a common heating unit modified to include special blowers and flexible ducts. Companies have been using heat to kill termites and wood-boring beetles for a number of years, and now some companies are experimenting with heat to manage fleas. One potential problem with this technique is that fleas can burrow into carpets and upholstery, and perhaps escape lethal temperatures.

Drying or Flooding Infested Areas Outdoors

Outdoors, organic matter can temporarily harbor flea larvae. Either drying out these areas or saturating them with water will kill eggs and larvae. You can also treat these areas with insect-attacking nematodes (see Biological Controls below) or with an insecticide labeled for outdoor use (see Chemical Controls on page 57).

Biological Controls

Beneficial Nematodes

Insect-destroying nematodes (*Steinernema carpocapsae*) can be applied to the lawn as a spray. These microscopic, worm-like organisms live in the soil and kill insects by entering their bodies, feeding on their tissue, and releasing harmful bacteria. They do not affect people, pets, or plants. When the nematodes mature and reproduce, the nematode larvae leave to search for other hosts. They cannot move far (only 1 or 2 inches) and die if they fail to contact other insects. The nematodes sold for flea management are native to the United States and are found naturally in the soil nationwide. They will not adversely affect earthworms, but may attack insects other than fleas.

Nematodes may not be effective in some situations, and may also require monthly applications (Mallis, 1992).

Tips for Using Nematodes

- Use the number of nematodes recommended by the manufacturer.
- Treat outdoor areas where you have found evidence of sleeping animals or areas that you know are regularly traveled by animals.
- Moisture is critical to the effective use of nematodes, so water the area before and after the application.

Chemical Controls

If nonchemical methods alone are ineffective, or only partially effective, then integrating a pesticide into your management program may be warranted.

Pesticides must be used in accordance with their EPA-approved label directions. **Pennsylvania law allows pesticide applications in schools only by certified applicators, registered technicians, or by non-certified applicators or non-registered technicians under the direct supervision of a certified applicator. Notification must be given to all staff and parents or guardians of students who request it 72 hours prior to pesticide use. Warning signs must also be posted in the vicinity 72 hours prior to and for 48 hours after the application. The law also mandates a 7-hour reentry period for common access areas whenever pesticides are applied.** Applicators should always wear protective gear during applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in the IPM program should be maintained on file. These materials should not be applied in common access areas when occupied, and never where they might wash into a drain or sewer unless otherwise labeled.

Insecticidal Soap

Insecticidal soap products can be found in pet stores and sometimes hardware stores. Some of these products contain pyrethrins.

Insecticidal soap can be used on pets, rugs, floors, and other places where flea eggs or young fleas may have collected. Outdoor areas also can be treated with insecticidal soap to reduce adult populations. Because this soap can kill a wide variety of insects, mites, and other arthropods (many of which are beneficial), it should be used outdoors only in spot treatments where wild animals nest, and only when flea infestations are large.

Diatomaceous Earth and Silica Aerogel

These dusts can be used for flea management. Diatomaceous earth is made from fossilized diatoms, and silica gel is produced from sand. Both of these products kill insects through desiccation: they abrade the wax and oil on the insect's outer covering, leading to dehydration and death. Although these materials are not poisonous to humans, the fine dust travels freely through the air and can be irritating to the eyes and lungs; therefore, use a dust mask and goggles during application. Silica gel and diatomaceous earth are sometimes formulated with pyrethrins, which are discussed below.

How to Use Diatomaceous Earth and Silica Aerogel

- Lightly dust upholstered furniture that is suspected to harbor fleas. Be sure to work the material into cracks and crevices.
- Lightly dust rugs or pet bedding.
- Apply to infested carpeting, leave for a couple of days, and then vacuum up.
- Dust crawl spaces, wall voids, attics, and other similar spaces where you suspect animals of nesting or resting.
- Do not use in moist environments; neither material works well when wet.

Citrus Oil Extracts (D-Limonene/Linalool)

D-limonene and linalool are citrus-peel extracts that have been used for years as food additives. Products that contain d-limonene kill larval and adult fleas, while those containing both ingredients kill all flea stages. EPA-registered citrus shampoos are mild enough to use on young animals, but veterinarians caution that some cats may react negatively if the material is applied in excessive concentrations. Citrus sprays also can be applied to animal bedding, but they should not be used outdoors or to spray entire rooms.

Borates

Borate products worked into the nap of the carpet can be used to manage fleas. This treatment is an intestinal poison which acts on flea larvae that have ingested it. These products may be effective for up to a year. This product is sold through veterinarians, but application of borates by a pest management professional is recommended in schools.

Imidacloprid and Fipronil

Both imidacloprid and fipronil are available through veterinarians as spot-on oils that are applied to the shoulder area of a cat or dog. These materials become

distributed over the body within a few hours. (Consult a veterinarian before using either of these products on a pet other than a cat or dog). These insecticides are relatively nontoxic to mammals and kill almost all the fleas on the pet within 24 hours of treatment. Both products continue to kill fleas for at least 30 days after treatment. However, fleas may feed, mate, and lay eggs before they die.

Pyrethrins and Synthetic Pyrethroids

There are a number of flea management products containing pyrethrins and synthetic pyrethroids which are used as spray treatments to reduce the number of fleas. These products should be applied by a pest management professional.

Insect Growth Regulators

Insect growth regulators (IGRs) inhibit the development of immature fleas, but do not kill adult fleas. Use of an IGR product (or a borate product) in conjunction with an adulticide (imidacloprid, fipronil, pyrethrins, or pyrethroids) prevents development of immature fleas and kills adult fleas. Methoprene and pyriproxyfen are available in pet sprays, pet collars, and spot treatments. Fenoxycarb is available through professional pest management companies and is for outdoor use only. Lufenuron, a medicine for dogs and cats, is available only from veterinarians. It manages fleas by preventing eggs from hatching.