CHAPTER 8
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

Fleas are small, wingless insects. They pass through four developmental stages: egg, larva, pupa, and adult (Figure 8-1). The adult body is oval and compressed on the sides, allowing the insect to glide through the narrow spaces between the hairs of its host. Young adults that haven't had their first blood meal are quite small and black in color; after feeding they expand and appear lighter brown. The hairy, worm-like, white larvae, which are 1/16 to 3/16 inches long, have a distinct brown head.

Under the best conditions, a female flea can lay about 25 eggs a day for at least three weeks. She lays eggs either on the host or in its bed or nest. Eggs laid on the host fall off and accumulate in floor cracks, rugs and carpets, dust, and damp soil.

Eggs hatch in 2 to 12 days. Optimal conditions for egg hatching and flea development are temperatures between 65 and 80°F with a relative humidity of 70% or more. Dry conditions and temperatures over 95°F are fatal to larvae because they lose excessive moisture.

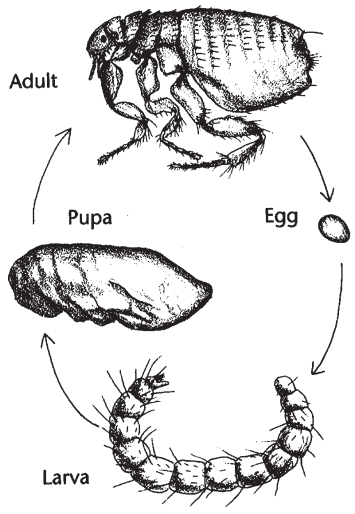
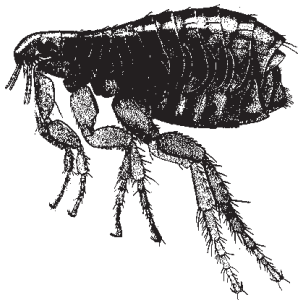


Figure 8-1. The Flea Life Cycle

The larvae develop over 8 to 21 days in the cracks and crevices where the eggs have fallen. In unfavorable conditions, they may develop more slowly, taking up to 200 days. The larvae feed on dried blood excreted by adult fleas.



When conditions are favorable, the pupal stage lasts 1 to 2 weeks, but when it is cool and moist and no host is present, this stage can last nearly a year. Adult fleas emerge from the pupal case in response to the warmth, vibrations, and carbon dioxide coming from an animal or human. This ability of flea pupae to wait until a host arrives can result in a sudden increase of adult fleas when they emerge simultaneously from many accumulated flea pupae.

As soon as the adult fleas emerge from the pupal case, they look for a host for their first blood meal. Adults can live 1 to 2 months without a meal and can survive 7 or 8 months with one.

These variations in flea development time account for the sudden appearance of large numbers of adult fleas in "flea season," usually in the late summer and early fall. The flea population has been building up all year long in the form of eggs, larvae, and pupae, but rapid development into biting adults cannot be completed until the temperature and humidity are right and a host appears.

DAMAGE

Flea bites cause irritation, but also serious allergies in animals and humans. Other more serious and 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,

raccoons, opossums, chipmunks, squirrels, feral cats, or birds that may live in unused parts of the buildings.

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, crawl spaces, attics, eaves, roof top 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 socks worn over the shoes and trouser legs will also work, as well as 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 (roughly 4x6-inch) traps are composed of a small electric light and a sheet of sticky paper. Fleas attracted to the warmth and light get stuck to the paper. Research has shown that fleas are most sensitive to green light and are more attracted to light traps if the light is turned off for 10 seconds every 5 to 10 minutes (Pickens et al. 1987); therefore, it is important to choose a trap with a green light that can flicker on and off.

Light traps are especially useful for monitoring in office situations 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 controlled by the traps alone. In this case, leave the traps in place until no additional fleas have been caught for a week. If 20 or more fleas are caught per trap in a week, this probably indicates a more serious infestation, and time must be devoted to finding the source of the infestation (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 can be useful to have the fleas identified by a professional. When the flea species is not the cat flea, its identity can help determine the host animal and where to search to find the animal or its nest.

Management Options

An integrated management program for fleas can be designed by selecting from the following strategies and tactics. See Box 8-A for a sample emergency flea control plan.

Physical Controls

Wild Animal Removal

Wild animals can be removed with traps by trained animal control technicians. Consult your Yellow Pages or talk to your County Agricultural Extension agent for a recommendation. Make appropriate repairs to the building to exclude animals. For controlling rats and mice see Chapter 12.

Vacuuming

- Vacuuming on a regular basis throughout the year will keep developing flea populations low by picking up adult and egg-stage fleas.
- Vibrations caused by vacuum cleaners will stimulate pupal stage fleas to emerge, and the new adults can be captured in the next vacuuming.
- Vacuuming is not very effective at capturing flea larvae in carpeting because they coil themselves around the fibers. Vacuuming does, however, pick up the dried blood that larvae feed on.
- Use vacuum attachments to clean cracks and crevices. Caulk or seal these openings permanently.
- Most fleas will be killed when dust in the vacuum bag blocks their breathing apparatus, but to be sure, you can vacuum up a tablespoon of cornstarch.
- Vacuum badly infested areas thoroughly every day until the infestation is controlled.
- When infestations are severe, you may need to supplement vacuuming with steam-cleaning or other controls.

Steam-Cleaning

The services of a steam-cleaning firm may be warranted when flea populations are high. This process kills adult and larval fleas and probably some eggs as well; however, since the warmth and humidity from the steam

Box 8-A. Sample IPM Program for an Indoor Flea Emergency

If monitoring has confirmed a high indoor flea population that requires an immediate response, the following IPM program can be used to bring the emergency under control. A significant reduction of flea numbers should occur within one to two days.

1. Protect Yourself. Wear long plants tucked into boots or socks. For added protection, you may want to apply an insect repellent to pant legs 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 for more details.
3. Apply an Insect Growth Regulator (IGR). After completing steps 1 and 2 above, spray carpets and floor with an IGR such as methoprene or fenoxycarb (see Chemical Controls). The IGR will prevent pre-adult fleas that survive vacuuming or steam-cleaning from maturing to biting adults.
4. Apply an Insecticide if Needed. The first three steps described above should reduce the flea population to a very low level and keep it there while long-term measures (e.g., locating and removing wild animal flea hosts from the building) are undertaken. If sufficient control has not been achieved, apply a borate insecticide to carpeting or spot-treat infested areas with insecticidal soap or pyrethrin (see Chemical Controls). If adequate control has still not been achieved, apply a stronger insecticide, such as a synthetic pyrethroid. Follow all label directions to the letter and 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 the animal.

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 chapter are followed—regular vacuuming, washing, etc.—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.

Heat

Tests have indicated that cat flea larvae die after exposure to 103° F for one hour (Silverman et al. 1981), and researchers have developed techniques to raise the temperature in a room enough to provide this exposure (Forbes and Ebeling 1987). 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 woodboring beetles for a number of years, and now some companies are experimenting with heat to control fleas. One potential problem with this technique is that fleas can burrow down 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 the eggs and larvae (Silverman et al. 1981). You an also treat these areas with insect-attacking nematodes (see Biological Controls, below) or with an insecticidal soap (see Chemical Controls, below).

Biological Controls

Insect-Attacking Nematodes

These microscopic, worm-like organisms live in the soil and kill insects by entering their bodies, feeding on tissue, and releasing harmful bacteria. These bacteria do not affect humans or other vertebrates. When they have eaten all they can of the insect, the nematodes leave to search for other prey. They cannot move far (only an inch or two) and die if they find no other

insects. The nematodes sold for flea control are native to the United States and are found naturally in the soil all over the country; they will not adversely affect beneficial soil organisms, including earthworms.

Tips for Using Nematodes

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

Chemical Controls

If non-chemical methods alone prove insufficient to solve the problem, then integrating a pesticide into your management program may be warranted. For information on the hazards of various pesticides and on how to select an appropriate pesticide for your situation, consult Appendix G for a list of resources.

Pesticides must be used in accordance with their EPA-approved label directions. Applicators must be certified to apply pesticides and 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. Do not apply these materials when buildings are occupied, and never apply them where they might wash into the sanitary sewer or into outside storm drains.

Insecticidal Soap

The insecticidal properties of naturally occurring fatty acids used to make soaps have been refined into a number of useful flea-control products. These insecticidal soap products can be found in pet stores and sometimes hardware stores. Some of these products contain 0.01% pyrethrins (discussed below).

Insecticidal soap can be used on pets, rugs, floors, and other places where flea eggs or young fleas may have collected. Outdoor areas can also 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 during periods of large flea infestations. Routine or random outside treatment or cover spraying is not advised. To locate areas with adult fleas, wear the flea socks described above (under Detection and Monitoring) and walk around the areas suspected of harboring fleas. If adult fleas are present, they will hop onto the socks where you can easily see them and evaluate the degree of the infestation.

Diatomaceous Earth and Silica Aerogel

These are insecticidal dusts that can be used for flea control. Diatomaceous earth is made from fossilized diatoms, and silica gel is produced essentially from sand. Both these products kill insects by desiccation; they absorb the wax and oil from the insect's outer covering which causes dehydration and death. Although these materials are not poisonous to humans directly, 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 also formulated with pyrethrins (discussed below).

How to Use Diatomaceous Earth and Silica Aerogel

- Apply a light dusting to upholstered furniture that is suspected of harboring fleas. Be sure to get into the cracks and crevices.
- Apply a light dusting to rugs or pet bedding.
- Apply to infested carpeting, leave for a couple of days, and then vacuum up.
- Dust into 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 products can be used directly on pets, but veterinarians caution that some cats may suffer if the material is applied in excessive concentrations. These materials can also be applied to animal bedding but should not be used to spray entire rooms, nor should they be used outdoors.

Borates

Sodium polyborate can be used in carpets to control flea larvae. The powder is worked into the nap of the carpet and then thoroughly vacuumed. This treatment will continue to kill flea larvae for as long as a year. Veteri-

narians sell sodium polyborate formulations for carpet application and there are also companies that provide this service.

Insect Growth Regulators

Insect growth regulators (IGRs) arrest the growth of the flea at or before the pupal stage, but they do not kill fleas that have reached the adult stage before the material was applied. IGR products, such as methoprene and fenoxycarb, should be used before fleas reach the adult stage and only inside where severe infestations were previously located. Use liquid solutions and apply as spot treatments. Do not use aerosol foggers because much of the material falls on areas that will have no contact with fleas.

Pyrethrins and Synthetic Pyrethroids

There are a number of flea control products containing pyrethrins and synthetic pyrethroids. These products should be used as a last resort in areas where fleas problems are severe. Apply as a spot treatment—do not use aerosol foggers.

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