

Structural Pest Control

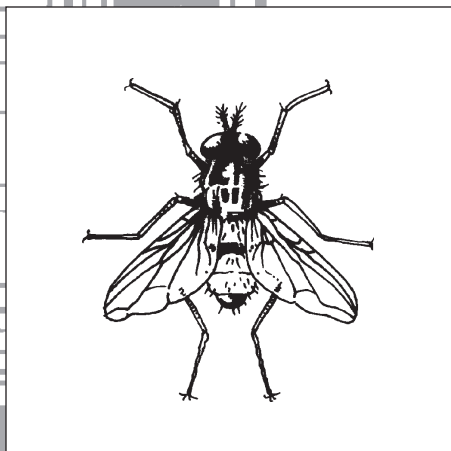
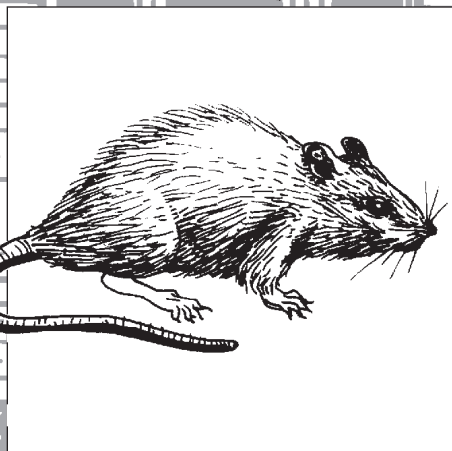
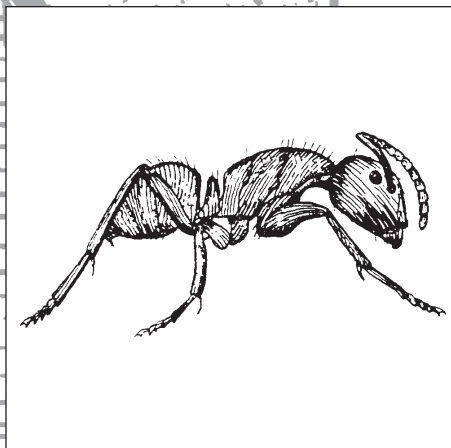
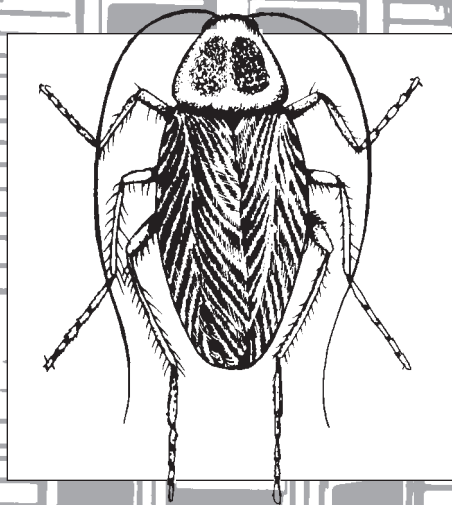


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Directions for using this manual

This is a self-teaching manual. At the end of each major section is a list of study questions to check your understanding of the subject matter. By each question in parenthesis is the page number on which the answer to that question can be found. This will help you in checking your answers.

These study questions are representative of the type that are on the certification examination. By reading this manual and answering the study questions, you should be able to gain sufficient knowledge to pass the Kansas Commercial Pesticide Applicators Certification examination.

Integrated Pest Management in Structures



Insect pest management in structures involves five basic steps:

1. Inspection
2. Diagnosis
3. Prescription
4. Application
5. Evaluation

Step 1. Inspection

Inspection includes asking questions of the customer and examining the building thoroughly to learn as much as possible about the problem. During the inspection, look for harbor-age areas and conditions of moisture, heat or darkness which favor infestations; food and water that can be used by pests; probable means of entry of the pests (such as incoming foods) and evidence of infestation (such as damage or droppings, as well as actual specimens or their cast skins).

The inspection also should give some idea of the control measures to use, safety precautions that may be necessary during the control effort, and when the work can best be done. Thoroughness during the inspection is of great importance in providing many of these answers.

Step 2. Diagnosis

Diagnosis includes identification of the pest and identification of any contributing factors (such as poor housekeeping or moisture). Once the pest is located it must be positively identified before proceeding. Many times an identification must be made from damage, droppings or cast skins.

After the pest has been identified, it is much easier to inspect for other evidence of infestation, harborage areas, and the means by which the pest gained entry. To do this, a knowledge of the biology and habits of the pest is necessary.

Step 3. Prescription

Prescription includes what, how, when and where to use the desired control to correct the problem. Make the prescription only after the inspection has been completed and all the facts surrounding the problem are known.

The prescription should include not only what can be done for the customer, but also what the customer can do in the way of habitat removal and sanitation to make the control effort a more successful and lasting one. Any limitations of the prescription should also be understood by the customer. The prescription can include one or more of these techniques: (a) good housekeeping;

(b) exclusion of pests (by means of mechanical repairs); or (c) pesticides, baits, and/or growth regulators.

Good housekeeping is an important factor in the control of many structural pests. Unless the habitat can be modified by removing the source of food and water, and eliminating hiding places, the pests will probably be able to survive and reproduce indefinitely. If housekeeping is not properly maintained, tactfully recommend corrective steps in management to help the situation.

Exclusion of pest insects should be the first step of the prescription. This includes caulking or filling cracks and crevices in buildings and foundations that may be points of entry, and screening all doors, windows, vents, etc., leading into buildings.

Pesticides, baits and growth regulators, can be applied both inside and outside structures. Often, growth regulators can be used as a preventive measure in an effort to avoid using greater amounts of pesticide. These products are most effective if applied to the areas most frequently inhabited by the pests.

Step 4. Application

Application is the safe implementation of the prescription. Remember, the success of the prescription is only as good as the application, and vice versa.

Step 5. Evaluations

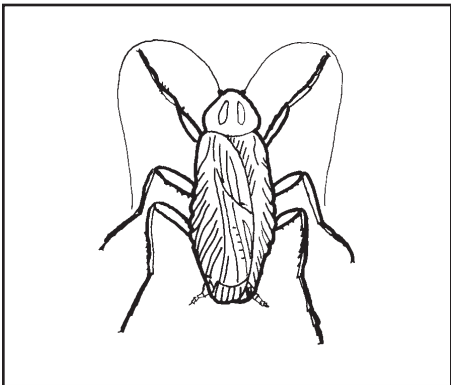
Conduct evaluations to determine if control methods are working. Periodic inspections are perhaps the best means of assessing success or failure. Be sure to use forms to document all data for future review.

Integrated Pest Management in Structures

Study Questions

1. (4) Identification of the pest and of other contributing factors in insect pest management is called:
 - a. diagnosis
 - b. evaluation
 - c. inspection
 - d. integration
2. (4) Prescription includes how, when and where:
 - a. to identify the pest
 - b. to use the desired control to correct the problem
 - c. to initiate an inspection plan
 - d. the pest management program will be operated within Kansas
3. (4) Caulking or filling in cracks in buildings and foundations:
 - a. will keep all pests out of the building
 - b. is for thermal insulation purposes only
 - c. should be the last step of the prescription
 - d. is a method of pest exclusion
4. (4) A good way to assess success or failure of a control program is:
 - a. periodic inspections
 - b. to check for dead bugs immediately after spraying
 - c. to ask the customer one day after pesticide application
 - d. conduct yearly surveys

Pests Usually Reproducing Indoors



German Cockroach



Cockroaches

Cockroaches are among the oldest of insects, as indicated by fossil remains dating to 300 million years ago. This ability to survive the many changing environments through time illustrates the capability of these insects to adapt to wide ranges of habitats and living conditions.

Cockroaches may mechanically transmit diseases. They also contaminate food and kitchen utensils with excrement and salivary secretions, leaving an unpleasant odor. Cockroaches sometimes produce allergic reactions in humans. The allergy is due to the insect’s body parts, not the odor. Therefore, it is important to make an effort to avoid having these body parts become airborne, e.g. by sweeping, the use of aerosol flushing agents, etc.

Biology and Behavior

Cockroaches develop by gradual metamorphosis through three life stages: egg, nymph and adult. Adult females produce small, bean-like capsules or oothecae that contain the eggs. Depending on the species, these capsules may be dropped at random near food, glued to some surface by the female soon after they are formed, or carried protruding from the abdomen until they are ready to hatch.

Nymphs which hatch from eggs and emerge from the ootheca resemble adult roaches, except that they are smaller and do not have wings. Their flattened bodies allow them to squeeze into crevices, and long, spiny legs enable them to run rapidly.

Nymphs molt several times before becoming sexually mature males and females. As indicated in Table 1, the time required to complete the life cycle varies from about two months to nearly three years, depending on the species and environmental conditions.

Most cockroaches are tropical or subtropical in origin and generally live outdoors. However, some species have become well-adapted to living with humans. They can be carried into homes in cartons, sacks and containers. Cockroaches have also been shown to travel along water pipes between apartments with common plumbing.

Most cockroaches are nocturnal and appear during daylight only when disturbed or where there is a large population. They prefer warm, dark, moist shelters and often are found around food handling areas; where pipes or electrical wiring pass along or through a wall; behind window or door frames, loose baseboards or molding strips; or undersides of tables, chairs and equipment.

Cockroaches feed on a variety of plant and animal products, including meat and grease, starchy foods, sweets, baked goods and other unprotected kitchen goods. They also feed on materials such as wallpaper paste, and book binding and sizing.

Common Species

There are about 55 species of cockroaches in the United States, but only 5 species are routine problems in buildings. Most of the other species live outdoors and, therefore, escape notice; if brought into the building they either leave or die. Unfortunately,

Table 1. Life History of Four Common Cockroaches in Kansas

	Average number of of eggs per capsule	Average number of capsules produced per female	Length of life cycle (days)	Average longevity of adults (days)	Approximate number offspring possible per year beginning with one female
German	37	7	60–250	140	35,300
American	15	58	320–1070	440	810
Brownbanded	16	10	140–380	110	680
Oriental	14	14	210–990	100	200

Pests Usually Reproducing Indoors

four species of cockroaches favor the buildings of people as a home.

German Cockroach (*Blattella germanica*)

The adult German cockroach is light brown and $\frac{1}{2}$ to $\frac{5}{8}$ inch long. The head shield is marked with two dark stripes that run lengthwise. Adults are fully winged but cannot fly. Immature German cockroaches are smaller and darker than adults, and are wingless.

The German cockroach is the most prevalent household roach in Kansas. As indicated in Table 1, the German cockroach produces more eggs per capsule than other species and has a developmental period as short as two months. Thus, troublesome infestations can develop rapidly after the introduction of a few individuals. The German cockroach is the only domestic species in which adult females carry the egg capsules protruding from their abdomens until the eggs are ready to hatch. In fact, few or no eggs will hatch if the capsules are detached from the female more than a day or two before hatching takes place.

These cockroaches thrive in all types of buildings, but are found more often in homes and commercial food establishments. They usually enter homes with bottled drinks, potatoes, onions, dried pet food, grocery sacks, corrugated cartons and even furniture. German cockroaches usually seek dark shelters near moisture and food. However, they may sometimes be found in the other parts of the building. They are adept at climbing walls and may hide behind pictures, book shelves, etc.

American Cockroach (*Periplaneta americana*)

The American cockroach is the largest of the common species, growing to a length of $1\frac{1}{2}$ to 2 inches. It is reddish-brown with a light yellow band around the edge of the head shield. Adults of both sexes have well developed wings, but seldom fly. However, they are capable of gliding flights.

The egg capsule is larger than $\frac{1}{3}$ inch in length and dark brown to

black in color. The capsule is dropped from the female, or she glues it to a protected surface, 24 hours after it is formed. Nymphs hatch in 50 to 55 days and are grayish brown, gradually becoming reddish brown as they mature.

Brownbanded Cockroach (*Supella longipalpa*)

The brownbanded cockroach is light gold to glossy brown, and $\frac{1}{2}$ to $\frac{5}{8}$ inch, with transverse yellow bands across the base of the wings and across the abdomen. The yellow bands across the back may be more pronounced on nymphs than on adults.

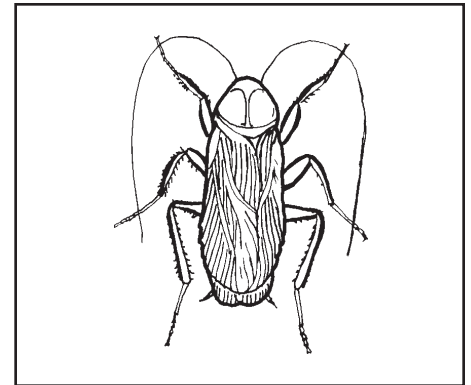
These cockroaches are quite active, and the adults fly readily when disturbed. The adult female carries her egg capsule for only a day or two before gluing it to protected surfaces such as the undersides of furniture and equipment and sometimes to ceilings in darkened rooms. The nymphs hatch in 50 to 75 days.

Brownbanded cockroaches prefer starchy foods and appear to have lower water requirements than other cockroaches. As a result, they can occupy many different locations within a building. Consequently, nymphs and adults frequently are found on ceilings in dark or dimly lighted rooms, behind picture frames, in light switches, in upper walls of cabinets and closets, on undersides of furniture and inside upholstered furniture.

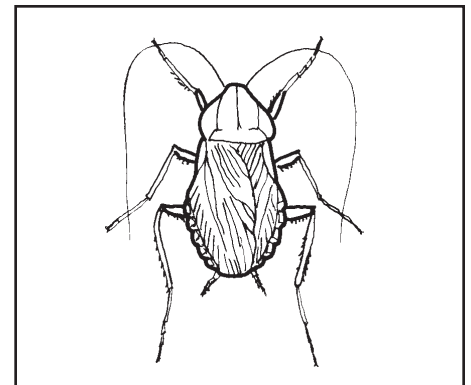
Because brownbanded cockroaches do not confine their activities to well-defined areas in the building, control may be more difficult.

Oriental Cockroach (*Blatta orientalis*)

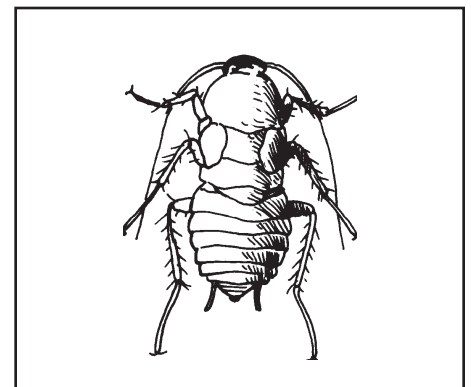
The adult oriental cockroach is glossy dark brown to black. Females are nearly $1\frac{1}{2}$ inches long and males are 1 inch long. The male has wings which cover three-fourths of the body, while the female has rudimentary wings which are reduced to mere lobes. Neither sex can fly. Nymphs are smaller than adults, dark brown to black, and wingless. The egg capsule is similar in appearance to that of



American Cockroach



Brownbanded Cockroach



Oriental Cockroach

Pests Usually

Reproducing

Indoors

the American cockroach. The female drops or glues the egg capsule to a protected surface 30 hours after it is formed. The nymphs hatch in about 60 days. Inside buildings, these cockroaches inhabit high moisture areas such as sewers, crawl spaces, drains, basements and hollow spaces under concrete slabs. Their activities are somewhat restricted to the ground or below-ground levels in buildings. With short or missing wings, this cockroach has a shiny appearance and is often mistaken for a black beetle. Occasionally, this species will migrate outside from building to building.

Pennsylvania Woods

Cockroach (*Parcoblatta* sp.)

The Pennsylvania woods cockroach may be up to 1 inch in length. It is dark brown with a distinctive pale border along each wing. This is a group of outdoor cockroaches that will not breed inside, and, therefore, not become established in the home. Egg capsules are dropped outside during the summer. The woods cockroach may wander into homes built in wooded areas, or be carried in on firewood.

Cockroach Control

It is difficult to remove all of the food, water, and hiding places that are available to cockroaches within a structure. To reduce indoor hiding and breeding areas, remove excess clutter and repair cracks and crevices. Good housekeeping can minimize food and water sources. By providing better access to cracks and crevices, sanitation can also maximize the results of a pesticide treatment.

Because various combinations of cockroaches can occur in the same building, it is essential to accurately identify the species present. This will permit use of control measures that take advantage of behavioral patterns and life requirements of the particular species. For instance, for chemical control of the widely dispersed brown-banded cockroach, chemicals must be applied over greater areas of a building than for control of the more restricted oriental or American roaches.

Non-chemical Control

1. Keeping tight-fitting windows and doors; caulking cracks in outside walls, sills and foundations.
2. Inspecting boxes and other containers, emptying them and immediately removing them from the building.
3. Repairing plumbing leaks and venting cabinets located under sinks or near dishwashers in an effort to avoid retention of moisture in these areas.
4. Keeping the premises clean by removing all food crumbs and placing garbage and trash into containers with tight-fitting lids. Clean refrigerator drain pans regularly, as well as spaces beneath refrigerators, ranges, and other appliances.
5. Using a high efficiency particulate air (HEPA) filter vacuum, try to remove as many roaches as possible. This physical removal of roaches reduces the population remaining for chemical control.

Chemical Control

To effectively control cockroaches with insecticides, it is necessary to inspect closely for their harborage sites and thoroughly treat these locations. Regardless of the insecticide or formulation chosen, chemicals placed in or near regular hiding places will provide much better control than those placed where cockroaches move only occasionally.

These methods of insecticide application generally provide temporary control within treated structures. To eliminate an established infestation from a building, first eliminate as many routes of reinfestation as you can. This should be followed by a thorough sanitation program before applying an approved pesticide to cracks, crevices and other harborage sites.

The type of chemical selected and the application method used will depend on the location and nature of the infestation. Pesticide selection should be based on the species of the insect,

Pests Usually Reproducing Indoors

application technique, surfaces to be treated and information on the label.

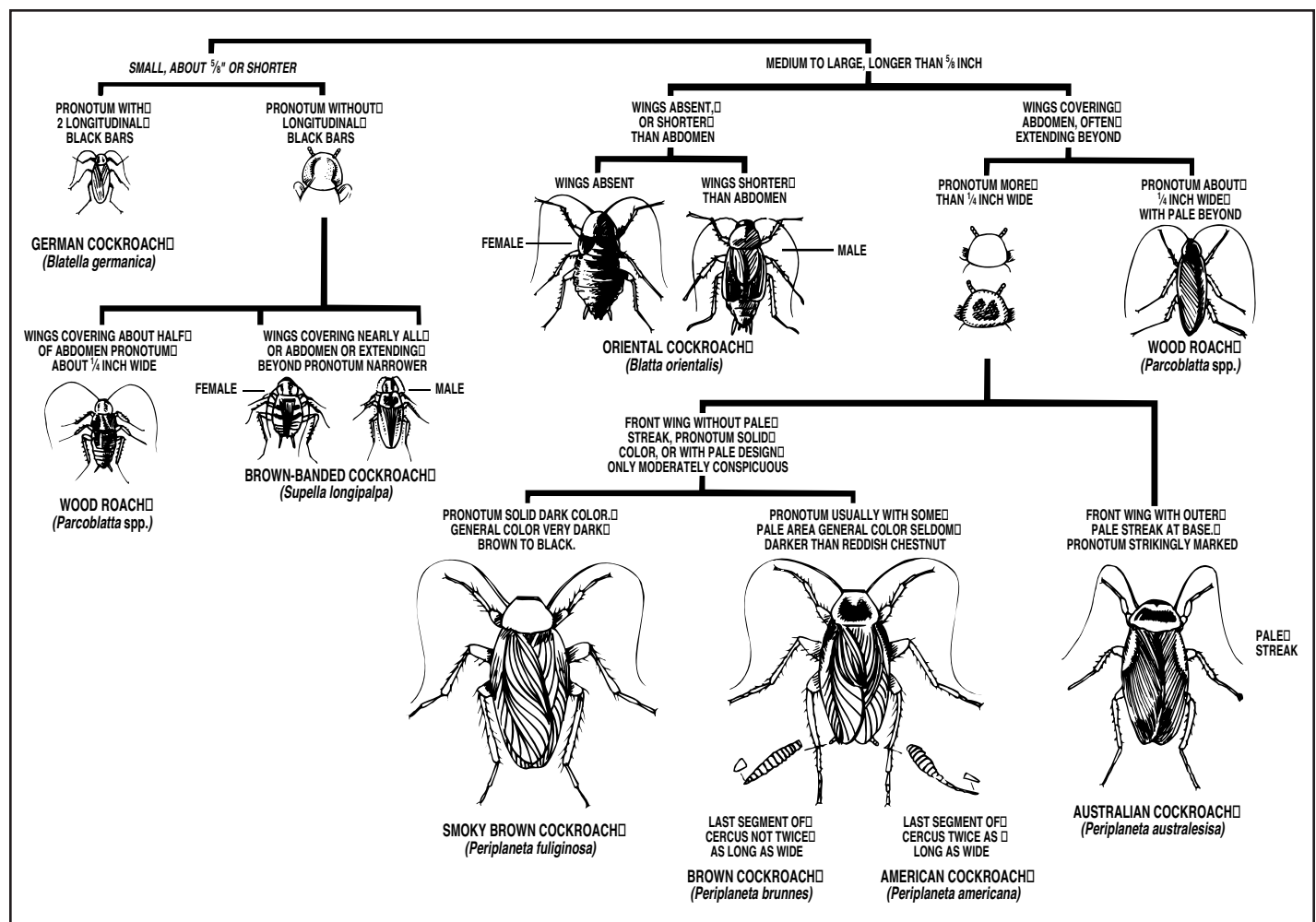
Study each cockroach problem, and use control measures in accordance with the location, extent and nature of the infestation. With a range of chemicals, formulations and application techniques available, it is important to select the appropriate combination to provide the desired control.

Residual insecticides are formulated in many ways, such as micro-encapsulation, soluble concentrate, oil-base solutions, water-base emulsions, or as water-base suspensions (wetttable powders) and other ways may be developed. Oil-base sprays may stain floor tiles and painted surfaces, deform carpet and other rubber pads and are fire hazards when used near open flames. Water-base emulsions are easy to mix, but may stain

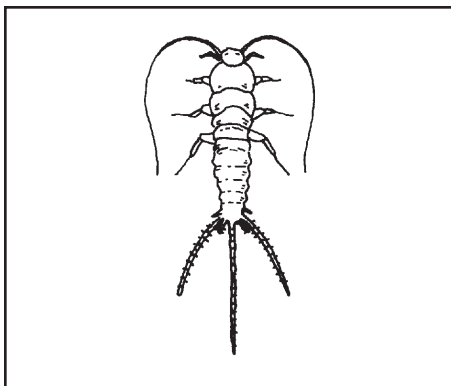
wallpaper, carpets and certain other surfaces. They can short out electrical circuits and are inferior to oil-base sprays on impervious surfaces such as glass and metal. Wetttable powders need constant agitation in the spray tank, but they leave active residues, especially on porous surfaces.

Residual sprays are easy and fast to apply, and should be used in cockroach harborage areas with attention to cracks and crevices. Usually, exposed surfaces are not treated with sprays, although it may be necessary to treat surfaces over which cockroaches crawl. Apply sprays just to the point of runoff to minimize chances of staining and reduce pesticide waste.

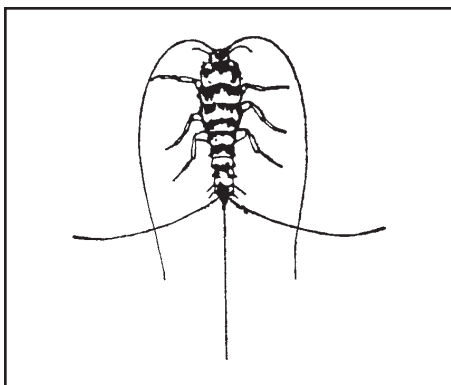
Insect growth regulators (IGR) are chemicals that interfere with the cockroach's (and certain other insects) life cycle to prevent their



Pests Usually Reproducing Indoors



Silverfish



Firebrat

development or reproduction. They are typically not acutely toxic to the cockroach and are best used in conjunction with baits or other residual insecticides.

Dusts sometimes can be used as the total treatment for cockroaches, but are most often used as a supplemental treatment. Dusts generally have longer residual action than sprays, but are ineffective if they become damp. Usually, dusts are less hazardous to people than sprays because they are not absorbed through the skin as easily.

Dusts are useful in cockroach control because they can be placed deep into cracks, crevices and wall voids; under refrigerators and furniture; around pipes, tunnels and conduits; on very smooth or very rough surfaces; and in some places not treatable with other formulations. Do not use dusts for treating large surfaces because they leave unsightly deposits. Also, heavy deposits are repellent to cockroaches. Use light pressure on the application device to minimize dust particles in living areas. Care must be taken to avoid food contamination by air currents blowing dust about.

Baits. Baits are presently more commonly used because of their low volatility and long term effectiveness. They can be precisely applied and present little exposure risk to the public or homeowner.

When using baits, it is important to remember that if cockroaches will not feed on the bait, the insecticide will have no effect. Thus, it is important not to contaminate stored bait with organic solvents, other insecticides, fungicides, fertilizers, etc. Baits are usually long lasting and often can be applied to areas that cannot be effectively sprayed or dusted. Baits are most useful when used in conjunction with a residual spray or dust. Baits provide best results in the building where there is no other food supply.

Space sprays (a suspension of liquid in air) with a flushing action are most useful for identifying the loca-

tion and extent of cockroach infestations. Contact or "flushing" sprays will kill only those insects directly hit with the insecticide. To obtain satisfactory control, these products should be used in combination with a residual insecticide.

Silverfish and Firebrats

Silverfish and firebrats prefer dark places. About the only time they are seen in lighted areas is after having been disturbed. If these insects are found on ceilings, it may be an indication that the infestation is located in the attic of the structure. When the temperature increases in the attic, there seems to be more activity and sightings of these insects. Such sightings would indicate that some form of treatment should be performed in the attic area.

Both have characteristic quick movements, stopping at short intervals then rapidly moving on. They are not able to climb on smooth, vertical surfaces. As a result, silverfish or firebrats may get trapped in the bathtub, wash basin, or in glass trays. The full-grown insect may be from $\frac{1}{4}$ to $\frac{1}{2}$ inch long; the young are considerably smaller.

Both silverfish and firebrats have a silver or gray colored body. But, upon close inspection, the firebrat shows a distinct mottled appearance. The bodies are thick at the front and taper to a somewhat pointed appearance at the tail.

Both of these pests have two long antennae or feelers on the head and three tail-like appendages. The center one of these tail-end feelers is directed straight back from the tip of the body. This characteristic has resulted in the common name of bristle-tail for these insects.

The firebrat thrives on hot conditions with temperatures between 32° and 43°C (90° and 110°F). At 37°C (98°F) they may pass from egg stage through their entire life cycle in about three months. The silverfish lives and multiplies readily at temperatures in the 24° to 29°C (75° to 85°F) range when the relative humid-

Pests Usually Reproducing Indoors

ity is rather high. Boiler rooms and engine rooms of institutions are ideal habitats.

When the temperature is in the right range these species will lay eggs in cracks or small openings, particularly along the baseboards and quarter rounds of rooms. If the pests are abundant in warm basements, the insects will breed and lay eggs along covered steam pipes or near hot air ducts where the eggs may be pushed into tiny cracks. The eggs will hatch in approximately two weeks in warm rooms. The immatures which hatch are identical to the adult except for the size difference.

These pests feed on a large variety of materials although they seem to prefer vegetable food. They may feed on starchy materials, on glue, or occasionally on leather and fur. They

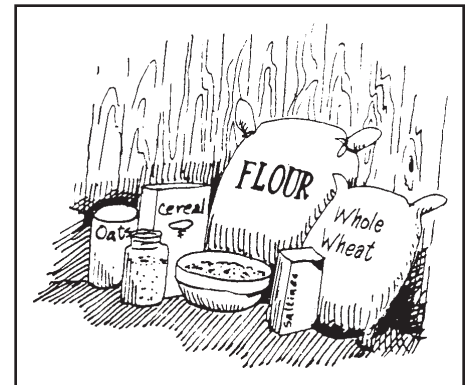
can also cause damage to paper or light clothing such as rayons or silks. Under rather warm conditions, book bindings, labels, and paper sizing may be readily attacked by these pests.

Control

Chemical control of silver fish and firebrats is similar to that employed for cockroaches. Control measures involve thorough treatment of cracks and crevices.

In warm basements, coarse sprays may be used on covered pipes or on areas which are warm or on surfaces where the insects are present.

Application of sprays or dusts should be repeated as often as necessary to maintain effective control. Generally, sprays applied either with a hand or pressure sprayer or brushed on are more effective than dry powder



Foods Attacked

BEETLES PICTORIAL KEY TO SOME SPECIES COMMONLY ASSOCIATED WITH STORED FOODS

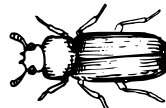
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PRONOTUM WITH 6 TEETH ON EACH SIDE □
BEAK ABSENT, SPECIES ABOUT 1/8 INCH LONG



SAWTOOTHED GRAIN BEETLE □
Oryzophilus surinamensis

PRONOTUM WITHOUT TEETH ON EACH SIDE □
BEAK ABSENT



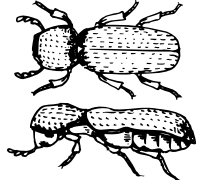
SMALL BROWNISH SPECIES □
LESS THAN 1/8 INCH LONG

HEAD VISIBLE FROM ABOVE □
1/8 INCH LONG OR MORE



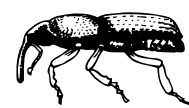
CONFUSED AND RED FLOUR BEETLES □
Tribolium confusum and *castaneum*

HEAD HIDDEN UNDER PRONOTUM □
LESS THAN 1/8 INCH LONG



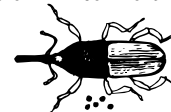
LARGER BLACKISH SPECIES □
1/8 TO 1/4 INCH LONG

PRONOTUM WITHOUT TEETH ON EACH SIDE □
BEAK PRESENT, SPECIES ABOUT 1/8 INCH LONG



RICE WEEVIL □
Sitophilus oryza

EACH FORE WING WITH 2 PALE SPOTS □
PRONOTUM WITH ROUND PUNCTURES



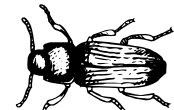
GRANARY WEEVIL □
Sitophilus granarius

FLATTENED BEETLES □
1/8 TO 1/4 INCH LONG □
PRONOTUM SEPARATED BY STRONG □
CONstriction FROM BASES OF WINGS



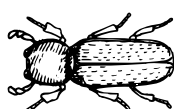
CADELLE □
Tenebroides mauritanicus

CONVEX BEETLES □
1/8 INCH LONG OR MORE □
PRONOTUM NOT SO STRONGLY □
SEPARATED FROM BASES OF WINGS



YELLOW MEAL WORM □
Tenebrio molitor

FORE WING WITH ROUGHENED SURFACE



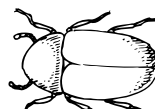
LESSER GRAIN BORER □
Rhyzopertha dominica

FORE WING SMOOTH



DRUG STORE BEETLE □
Stegobium paniceum

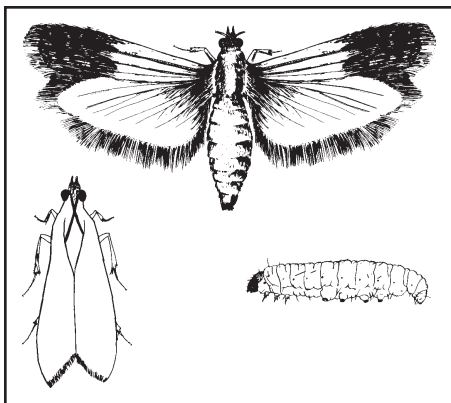
FORE WING WITH LINES



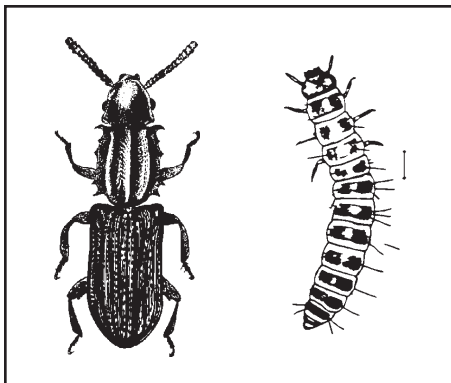
CIGARETTE BEETLE □
Lasioderma serricorne

Beetles: Pictorial Key to Some Species Commonly Associated with Stored Foods

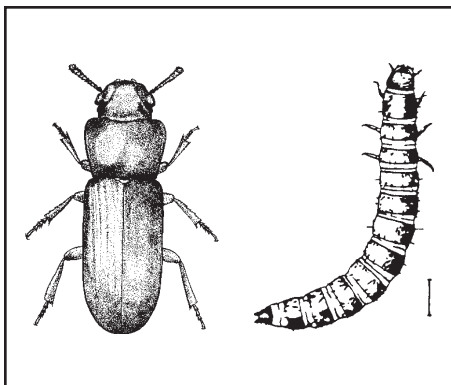
Pests Usually Reproducing Indoors



Indian-meal Moth



Sawtoothed Grain Beetle



Confused Flour Beetle

formulations except when powders are used on concrete. The sprays tend to soak in more rapidly on concrete and, thus, lose their effectiveness sooner. Attics and wall voids are important areas to apply chemical treatments for controlling silverfish and firebrats.

Prevention

It may be possible to change the temperature or the lighting in certain areas, which will cause the silverfish to die or to move into another area where they may be scattered or reached more easily by chemical treatment. A piece of furniture against a warmer wall of a room may provide a very suitable, dark hiding area for the silverfish. It might be feasible to move this furniture to another part of the room or to a cooler wall where the firebrats could not survive as well.

In other areas it might be possible to use a metal shield to modify the temperature around steam pipes so that the firebrats would not have such a desirable, warm, rough surface. Or, it might be possible to alter the air circulation in a room so the temperature around certain pipes could be lowered 3 to 5°C (5 to 10°F). This would particularly affect the habits of the firebrats. Some of these modifications may be used more readily in industrial buildings; but wherever possible, modifying the environment should be considered even in the household. Such measures are much more permanent than any chemical control.

Pests of Stored Food

A number of insects, commonly referred to as pantry or kitchen pests, infest dry or stored food products in the home. Most are either beetles or moths. In the case of beetles, both the adult and larval stages may be damaging while only the caterpillars of moths are destructive.

Infestations may first be noted when these insects are found in some product, but more commonly when the adults are seen crawling or flying about the kitchen or pantry.

Since most of these insects are of tropical or semitropical origin, they live and breed best under warm, humid conditions—conditions often found in kitchen cupboards. Since most do not hibernate, reproduction is continuous throughout the year and populations can build up rapidly if they are left undisturbed.

Infestations may develop whenever stored foods are kept for long periods (60 days or more). Stored food insects, if given enough time, can penetrate any packaging except glass or metal. Infestations can start in the home, store, warehouse, mill, processing plant or in transit.

Foods Attacked

The pests feed on or breed in flour, cereals, cornmeal, cookies, crackers, macaroni, rice, grains, spices, beans, popcorn, dried fruit, cured meat, candy, nuts, dried milk and eggs, and other stored foods such as dry dog, cat and fish food, and bird and vegetable seeds. They can also infest decorative wheat and corn items.

Steps in Solving Problems

1. Identify the insect to know its biology and food habits.
2. Locate the source of infestation. Check seldom used packages of cereal, oatmeal, pancake flour, cornmeal and raisins. Dry dog food stored in the basement or pantry also may be a source, and bird seed often is infested with Indian-meal moths. Insect pheromone traps are available for many stored product insect pests and may be useful as an early detection tool or to locate existing infestation sources.
3. Follow the suggestions under *Control*.
4. Help prevent future problems by following the suggestions under *Prevention*.

Most Common Pests

The most common stored-food pests in Kansas are the Indian-meal moth, sawtoothed grain beetle, confused flour beetle and cigarette beetle, which are general feeders.

Pests Usually Reproducing Indoors

Indian-meal Moth (*Plodia interpunctella*)

All damage is done by the larval stage (caterpillar) which attack a wide range of products, including cereal and cereal products, dried fruits, dehydrated vegetables, nuts, chocolate, candies and other confections.

When infestations are heavy, mature caterpillars often can be found in parts of the house far from the original food source, since they migrate quite a distance to pupate.

The Indian-meal moth is rather handsome, with a wing expanse nearly $\frac{3}{4}$ inch wide. It is easily distinguished from other pantry pests by the marking of its forewings—reddish-brown with a coppery luster on the outer two-thirds and whitish-gray on the inner portion of the wing. The female moth lays its eggs, singly or in groups, on food material. The eggs hatch within a few days into small, whitish worms, or caterpillars.

The worm of the Indian-meal moth spins a web as it becomes full grown, and leaves behind a silken thread wherever it crawls. Webbing in food products is a tell-tale sign of infestation. When full grown, the worm is about $\frac{1}{2}$ inch long and dirty white, varying sometimes to greenish or pinkish. This worm spins a silken cocoon and transforms to a light-brown pupa, from which the adult moth later emerges. The Indian-meal moth may pass through the egg, worm, and pupal stages in from six to eight weeks during warm weather.

Sawtoothed Grain Beetle (*Oryzaephilus surinamensis*)

The sawtoothed grain beetle is a slender, flat, brown beetle about $\frac{1}{10}$ inch long. It gains its name from the peculiar structure of the pronotum (section between head and wing covers) which bears six saw-like tooth projections on each side. Both larval and adult stages attack grain and grain products like flours, meals, breakfast foods, stock and poultry feeds, nutmeats, candies, dried milk, and dried fruits.

Adults live an average of six to 10 months. Female beetles drop their eggs loosely among the foodstuffs or tuck them away in a crevice in a kernel of grain. When the small, slender white eggs hatch, the emerging larvae crawl about actively, feeding here and there. They become full grown in about two weeks during summer weather and then construct delicate cocoon-like coverings by joining together small grains or fragments of foodstuffs with a sticky secretion. Within this cell, the larva changes to the pupal stage. Development from egg to adult may take from three to four weeks in the summer.

Confused Flour Beetle (*Tribolium confusum*)

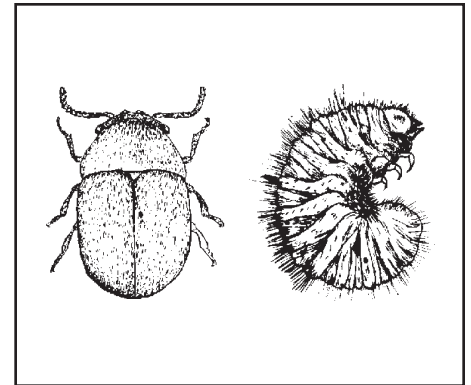
The confused flour beetle is a shiny, reddish-brown beetle about $\frac{1}{2}$ inch long, flattened and oval. The head and upper parts of the prothorax are densely covered with minute punctures. The wing covers are ridged lengthwise and sparsely punctured between the ridges. This beetle generally feeds on cereals and cereal products, but may infest other foodstuffs. They cannot feed on whole grains.

The average life-span of these beetles is about one year. Females lay their small, white eggs loosely in flour or other food material. Eggs, which are covered with sticky secretion, become covered with flour or meal and readily adhere to the sides of sacks, boxes and other containers. They hatch into small worm-like larvae, slender, cylindrical and wiry in appearance.

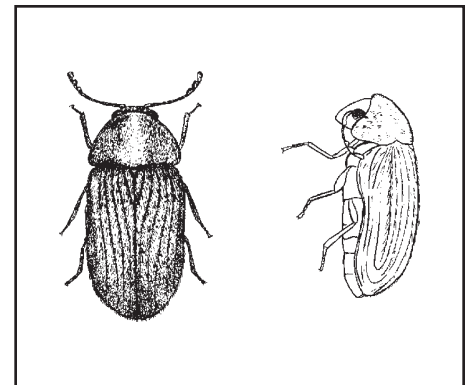
When fully grown, the larva is $\frac{3}{16}$ inch long and white, tinged with yellow. The pupal stage gradually changes to yellow and then brown, and shortly afterward transforms to a beetle. In summer, under favorable weather conditions, the period from egg to adult averages about six weeks.

Cigarette Beetle (*Lasioderma serricorne*)

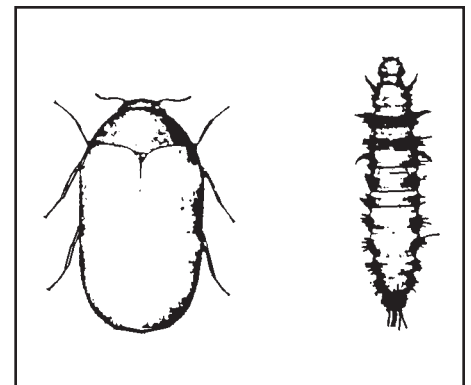
The cigarette beetle is about $\frac{1}{10}$ inch long, robust, reddish-brown,



Cigarette Beetle

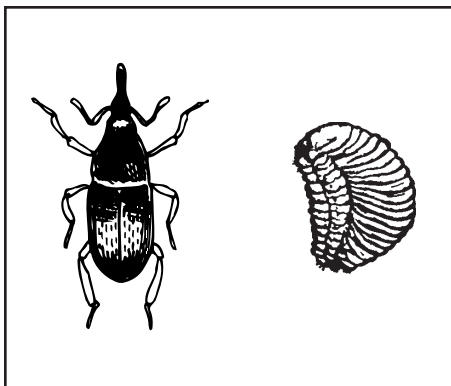


Drugstore Beetle

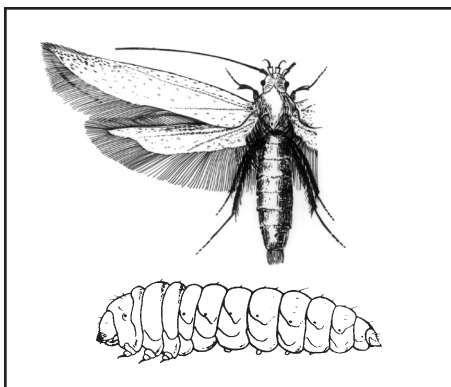


Cabinet Beetle

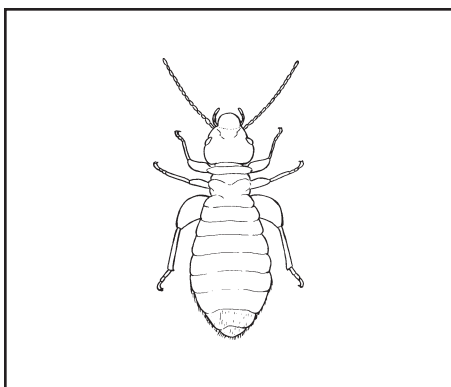
Pests Usually Reproducing Indoors



Granary Weevil



Angoumois Moth



Booklice

and clothed with short, fine hair. When viewed from the side, the beetle appears humped. It is known as the cigarette beetle from its feeding on cured tobacco, cigarettes and cigars. It also feeds on dried herbs, spices, cereals and cereal products, dried fruits, seeds, dried fish and meats, nuts, hair, wool, and other animal products.

The beetle lays eggs in the food substance. The small, yellowish-white grub is covered with long, silky, yellowish-brown hairs and is about $\frac{1}{16}$ inch long when fully grown. The pupae are within a closed cell composed of small particles of the food substance cemented together with a secretion of the larvae. The period from egg to adult is about six weeks. Adults will fly and are often found along window sills.

Drugstore Beetle (*Stegobium paniceum*)

The drugstore beetle is about $\frac{1}{10}$ inch long, cylindrical, and uniformly light brown. Its body is covered with a fine, silky down; it has fairly long antennae. This insect is known as the drugstore beetle because of its habit of feeding on drugs found in pharmacies. It is a very general feeder, attacking a great variety of stored foods, seeds, pet foods, spices, and pastry mixes, and has been said to "eat anything except cast iron."

This beetle lays eggs in almost any dry, organic substance. The small, white grubs emerging from the eggs tunnel through these substances and, when full grown, pupate in small cocoons. The entire life cycle takes seven months.

Cabinet Beetles (*Trogoderma ornatum*)

Cabinet beetles are dermestid beetles that prefer stored foods. The larval stage of these beetles does most of the damage. Full-grown larvae are about $\frac{3}{8}$ inch long and their body tapers at one end. Dark clumps of long hairs are common on the tapered end. Their shed skins are usually found in the food. Adults are thought to feed mainly on flower pollen outdoors, but

they may feed on stored food to some extent.

Internal Feeders

The granary weevil, rice weevil and angoumois grain moth, are internal feeders, living on whole grains or seeds. They lay eggs on the seeds; the larvae bore inside to feed and complete their development. Left unchecked, breeding will continue until all of the seeds are destroyed.

The granary weevil and the rice weevil are similar in form and habits, except that the rice weevil can fly, whereas the granary weevil cannot. Adults have a long, slender snout and are about $\frac{1}{10}$ inch long, brown to chestnut brown, cylindrical, and hard-shelled. The larvae are legless and pale with dark heads. These beetles only infest whole grain.

The angoumois grain moth is a tiny moth similar in size and color to clothes moths. They may be seen flying about in the house in the daytime, whereas clothes moths shun light. The larvae develop within whole kernels of grain such as popcorn, especially if it is home grown.

Booklice (*Psocoptera*)

Booklice or psocids are very small $\frac{1}{20}$ to $\frac{1}{10}$ inch, light-colored insects that may be found indoors and out. Indoors they frequent damp places around stored foods and books and in crawl spaces. They feed on molds and fungi.

Booklice do little damage and can be present in tremendous numbers. The young resemble the adults and the life cycle takes a little over a month. They may be carried into food manufacturing plants on infested pallets and cardboard slip-sheets. Products should not be stored flat on floors, but instead should be placed on dry, insect-free pallets so air can circulate around the products.

Booklice can be serious pests for manufacturers of food products and containers. They can be controlled by removing moisture and food sources. Control can often be accomplished through temperature and moisture control without pesticides. Directed

Pests Usually Reproducing Indoors

sprays and aerosols may be helpful in control.

Mites in Food Products

Several species of mites associated with stored grain products, cheese, nuts, and other foods cause quality deterioration and contamination. Although such mites do not bite, people may become sensitized to allergens on the mites or their waste products. Allergic responses range from skin rashes known as “grocers’ itch” to illness from ingesting mites to which one is allergic.

Control

Follow these steps when food is infested:

1. Dispose of any infested products.
2. Separate and store insect-free foods in tightly closed glass or metal containers. Glass jars with screw-on lids are best.
3. Clean pantry and cupboard shelves, particularly cracks, crevices and spaces under shelves. Remove all crumbs and spilled food with a vacuum cleaner.
4. Insecticide treatment is supplemental to good housekeeping since it will have no effect on insects breeding within food packages. Apply residual insecticides inside of food cabinets very lightly and only after shelves are empty and cleaned. Do not contaminate food or utensils with insecticide.
5. Allow the insecticide to dry thoroughly—three to four hours if oil based and one-half to one hour if water based is adequate. Cover shelves with shelving paper and replace properly packaged food items (see step 2).
6. If commodity storage is infested, fumigation may be necessary.

Prevention

Follow these steps to help prevent future infestations:

1. Avoid long storage periods by purchasing susceptible or seldom used foods in small quantities. Rotate stock on a first-in, first-out schedule that is a shorter term than the life cycle of the pest in-

volved. Store such products in tightly closed glass, metal containers, or in the refrigerator.

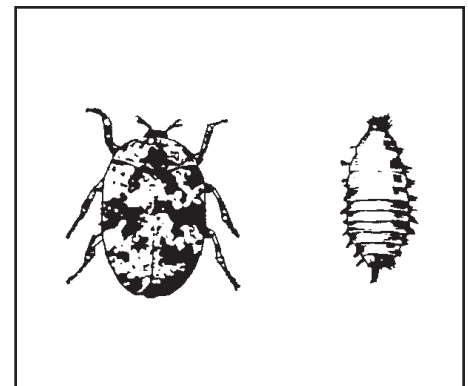
2. At time of purchase, carefully examine packages of cereal products such as cornmeal, macaroni and flours and dried fruits for evidence of insect infestation. Check packaging date to determine freshness. Look for holes in packages and avoid purchase of old or poorly packaged items.
3. Store susceptible foods in insect-proof containers or in the refrigerator. Insects cannot attack properly protected foods.
4. Keep storage areas clean. Do not allow cereals, flour, crumbs or food fragments to accumulate on shelves or in cracks and crevices since exposed food will attract the flying stage of pantry insects. Vacuuming is the best procedure. Cleaning with soap and water is less effective because the water washes some food particles into cracks and crevices. Infestations may begin in sofas and chairs where food is dropped between the cushions and not regularly cleaned. Occasionally, flour and carpet beetles can survive and reproduce in the vacuum cleaner. Always remove and dispose of sweepings.
5. Don’t forget to check dry dog, cat, fish, bird food and fertilizers for stored-product insects.

Fabric Pests

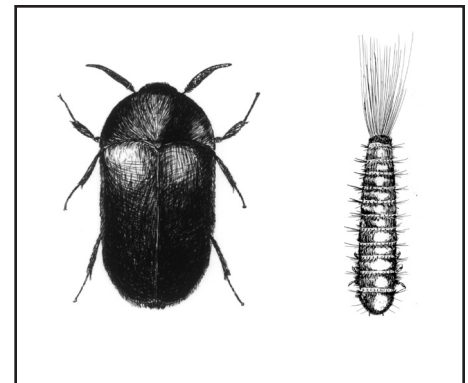
Carpet Beetles

There are several species of carpet beetles, but the most common is the black carpet beetle. You might find the brown, hairy larvae in stored woolens, carpeting, lint accumulations, cracks and corners of closets, dresser drawers and occasionally in stored food. The larvae are quite active.

The adults are small, oval, black beetles about ¼ inch long. The beetles do not cause damage, but the larvae are very destructive. The most serious damage results from the larvae feeding on animal fibers, fur, feathers, hair, bristles, mohair clothing, carpet-

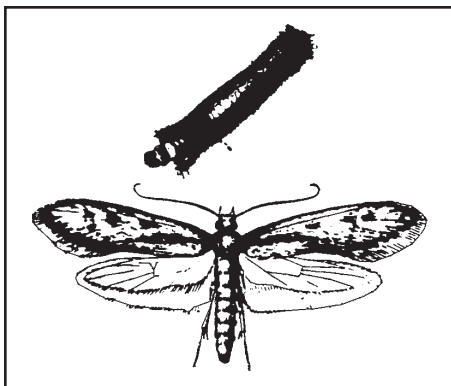


Carpet Beetle



Black Carpet Beetle

Pests Usually Reproducing Indoors



Clothes Moth

ing, upholstery and other household furnishings. People in heavily infested buildings may develop allergic reactions to hairs from the larvae that may float in the air.

If you find the larvae or their shed skins, inspect the area thoroughly. Start with a thorough search of:

- Stored woolens in chests, boxes and closets.
- Remnants of flannel, wool, fleece, or felt in closets, attics and basements.
- Under covers of upholstered furniture.
- In lint that accumulates in floor cracks, registers or cold air ducts.
- Under rugs, carpets and pads—especially around edges or under seldom moved furniture.
- Hunting coats containing remnants of game such as feathers and blood.
- Around baseboards, moldings and trim.
- In stored food with high protein content.

Control

If infestation is localized, remove infested material if possible. Then apply a suitable insecticide to area surfaces. If the infestation has spread throughout the building, do a thorough cleanup, then apply insecticides to infested areas. Use a coarse spray and concentrate on cracks and crevices and infested areas.

Treat baseboards, closet corners and carpeting edges. If the infestation is heavy, loosen and turn back the carpeting edges and spray both sides.

Prevention

Housekeeping is important. Regular, thorough cleaning of lint and spilled food removes insect breeding sites. Pay particular attention to rugs, carpets (especially areas next to walls), upholstered furniture, closets, shelves, radiators (and the space under and behind them), registers and ducts, baseboards, moldings, corners and floor cracks.

Dispose of or properly store wool, fur, fleece and other material. Store these in tight boxes, chests or plas-

tic bags treated with paradichlorobenzene or naphthalene. Dry clean or launder clothing before storing. Carpet beetles are more apt to infest soiled materials.

If large numbers of insects such as flies or small animals (or individual rodents in some situations) are killed in wall spaces, carpet beetles will be attracted and lay eggs on the animals. These beetles will then feed, develop and eventually move into rooms to become pests. The best method of controlling these beetles in this situation is to prevent the insects or animals they are feeding on from entering the building.

Clothes Moths

Clothes moths are well-known pests of fabrics in the home. Two species of clothes moths commonly infest woolens and other animal fibers—the webbing clothes moth and the case-making clothes moth.

Casemaking clothes moth adults are yellowish or buff in color and about ¼ inch long. Fully grown larvae are ½ inch long and are white with brownish-black heads. They spin a hard, portable protective case in the fabrics on which they feed.

The adult moth lays its soft white eggs in the fabric it attacks. The eggs hatch into the creamy white larvae. The larvae are the feeding stage in the life cycle. The adult moth has a fluttery flight and tends to avoid light.

About four generations per year occur under household conditions. Most moth infestations in homes are carried in on carpeting, woolen goods, furniture and other home furnishings. Used household items should be thoroughly sunned and perhaps sprayed before being taken into the home.

Control and Prevention

In general, the preventive and control measures for carpet beetles will also control clothes moths. Winter clothing should be dry cleaned, moth proofed and then stored in clothing cases or chests when not in use.

Pests Usually Reproducing Indoors

Study Questions

1. (6) Adult female cockroaches produce small, bean-like capsules:
 - a. or oothecae which contain the eggs
 - b. which are food for the nymphs
 - c. or cockroach nymphs which become adults in one week
 - d. and bury them underground for a winter food supply
2. (6) Cockroaches can feed on:
 - a. meat and grease
 - b. sweets and baked goods
 - c. wallpaper paste
 - d. all of the above
3. (7) The German cockroach:
 - a. produces fewer eggs per capsule than other species
 - b. has a very long developmental period
 - c. is less active than other domestic species
 - d. is the most prevalent household cockroach in Kansas
4. (7) The adult oriental cockroach is:
 - a. gold to light brown
 - b. very active and will fly from danger
 - c. glossy dark brown to black
 - d. a small, gold, flying insect
5. (8) The woods roach:
 - a. is not a normal home dwelling species
 - b. male will not be attracted to lights
 - c. usually nests inside homes
 - d. is a problem year round
6. (8) Chemicals will control cockroaches much better if:
 - a. there are openings in the building so the roaches will leave
 - b. chemicals are placed where roaches will occasionally inhabit
 - c. chemicals are sprayed outside of the building
 - d. chemicals are placed in or near regular hiding places
7. (9) Pesticide selection for cockroach control should be based on:
 - a. insect species and application technique
 - b. surfaces to be treated
 - c. information on the label
 - d. all of the above
8. (9) The pesticide formulation which requires constant agitation in the spray tank is:
 - a. a wettable powder
 - b. an oil base spray
 - c. water base emulsion
 - d. none of the above
9. (10) Dusts are usually less hazardous to people than sprays because:
 - a. of their quick vaporization
 - b. they have no residual action
 - c. they are much less toxic
 - d. they are not as easily absorbed through the skin
10. (10) Silverfish and firebrats prefer to inhabit:
 - a. dark places
 - b. lighted areas
 - c. smooth vertical surfaces
 - d. cool (60–70°F) temperature locations

Pests Usually Reproducing Indoors

Study Questions

11. (11) What materials do silverfish and firebrats usually damage?
 - a. glue or starchy materials
 - b. leather or fur
 - c. paper or light clothing
 - d. all the above
12. (12) Most kitchen or pantry insect pests are:
 - a. silverfish or firebrats
 - b. beetles or moths
 - c. crickets
 - d. springtails
13. (12) Stored foods attacked by pests are:
 - a. dried fruit
 - b. cured meat
 - c. grains
 - d. all of the above
14. (13) The Indian meal moth damages:
 - a. food in the adult stage of its life cycle
 - b. food in the larval stage of its life cycle
 - c. food in all stages of its life cycle
 - d. wool fabrics only
15. (13) The confused flour beetle generally feeds on:
 - a. cereal products
 - b. wool fabrics
 - c. dried meats
 - d. bird and vegetable seeds
16. (14) What is the life cycle length for the drugstore beetle?
 - a. 10 days only
 - b. 3 weeks only
 - c. 2 months or less
 - d. 6 months or longer
17. (14) Book lice can be serious pests for:
 - a. homeowners
 - b. restaurant owners
 - c. manufacturers of food products and containers
 - d. hotels, motels, and nursing homes
18. (15) The best procedure for cleaning cracks and crevices in cabinet shelves is:
 - a. by fumigating
 - b. with soap and water
 - c. with a vacuum cleaner
 - d. with a damp cloth
19. (15) The brown, hairy larvae of the carpet beetle can be found:
 - a. in stored woolens
 - b. in carpets
 - c. in stored food
 - d. all of the above
20. (16) To control a localized carpet beetle infestation:
 - a. remove infested material if possible and apply insecticide to the storage area surfaces
 - b. use a space spray on the infestation before cleaning
 - c. use an oil base spray on asphalt tile
 - d. remove and destroy the carpet
21. (16) Adult casemaking clothes moths are:
 - a. dark brown and 1 inch long
 - b. yellowish or buff and $\frac{1}{4}$ inch long
 - c. tan or light brown and $\frac{1}{2}$ inch long
 - d. gray with brown markings and $\frac{1}{2}$ inch long

Occasional Invaders

Occasional invaders have been defined as pests which occur in buildings at some stage of their life cycle while usually not completing their entire life cycle inside. This heading may suggest that their occurrence is by chance. In fact the presence of these pests may be predictable and even preventable if the biology of the insect is understood.

It is important to remember that this is a varied group of pests that are entering structures at different times and for different reasons. Some years the infestations may be heavy; other years there may be no problem at all. Therefore, there is no one general method of control for all of these pests. Each case must be individually diagnosed and treated.

There are many reasons these pests will move into structures. A major cause is seasonal changes. Pests often enter in large numbers to overwinter—for harborage, food and/or water. Other causes of an infestation include: environmental changes, natural dispersal, population pressure and by accident.

While you can obviously have no control over all of these factors (i.e., seasons), there are non-chemical measures that can be taken to reduce the attractiveness of a structure to many of the occasional invaders. These measures include: proper light management, exclusion, sanitation and water management.

Crickets

Crickets are common household invaders. These pests may enter homes through open doors and windows, as well as cracks in poorly fitted windows, foundations or sidings. Once inside, crickets can subsist on a wide variety of organic substances. In Kansas, the crickets commonly infesting houses are the house cricket, the field cricket, and the camel or cave cricket.

House Crickets

(*Acheta domesticus*)

House crickets are light to dark brown in color with three dark bands on the head. Adults are about $\frac{3}{4}$ to $\frac{7}{8}$ inch in length. These crickets can live and reproduce outside during the summer or inside year round. Indoors, the female will lay from 40 to 170 eggs in cracks and crevices. The eggs hatch in two to four months and the nymphs (immatures) develop into adults two months later.

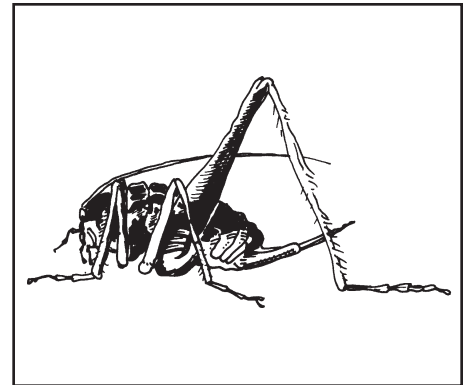
Field Crickets (*Gryllus* sp.)

There are many species of field crickets. These insects range in size from $\frac{1}{2}$ to 1 inch in length and they are dark brown to black in color. Field crickets prefer to live outdoors and are not adapted for living inside structures. Most field crickets overwinter as eggs in the soil. The eggs hatch from May to June and the nymphs become adults in the fall. These crickets have only one generation per year.

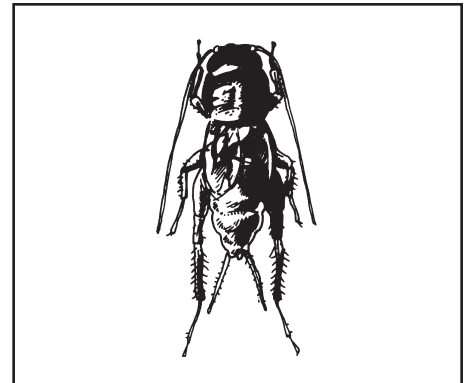
When found outdoors, house and field crickets feed mostly on plant debris and organic refuse. These crickets enter homes in late summer, as the vegetation becomes scarce or crops are harvested. Once inside, male crickets often reveal their presence by a chirping sound which is produced as they rub their outer pair of wings together. These sounds are used in courtship, fighting and to sound an alarm.

House and field crickets can cause damage to woolsens, furs, silks, cottons and other fabrics. Clothing soiled with perspiration is especially subject to attack. As with other insect pests, the amount of damage depends on the number feeding and the length of time they have been present. Large numbers of field and house crickets may cause fabric damage.

Tall grass around the house foundation or proximity to a dump area, field, or garden with plenty of plant debris make a structure susceptible to cricket infestations. At night, these species are also attracted to lights.



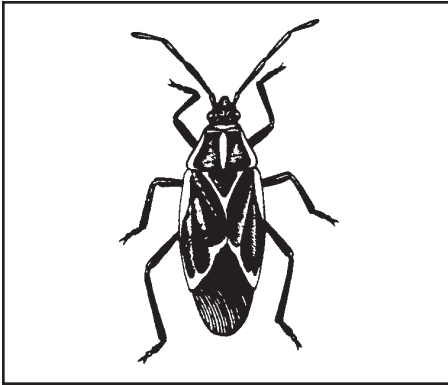
Female Cricket



Male Cricket

Occasional

Invaders



Boxelder Bug

Camel or Cave Cricket (*Ceuthophilus maculatus*)

These insects are not true crickets but resemble house and field crickets because they have long antennae and well developed jumping legs. They are often light tan with darker bands on some segments and, unlike true crickets, are wingless. Camel or cave crickets are found mainly in cool, damp and dark areas. Outdoors, they frequent the undersides of logs and flat stones. It is the search for this kind of environment that leads them to the basement and other dark areas of the house. Logs and flat stones with suitable organic matter for food near a house increase the likelihood of infestation. These insects are not attracted to lights.

Much less damage is done by cave or camel crickets than by field and house crickets. Their diet consists of plant debris and they may also chew paper products. However, these crickets seldom chew fabrics. Sanitation is the most important step in reducing cricket feeding and reproduction. Eliminate weeds and dense vegetation around the house foundation. Remove rotting wood, stones, bricks, tile, and other debris where crickets hide. Since crickets may enter at doorways and basement windows, make necessary repairs. Caulk or fill in cracks and crevices in the house foundation and other points of entry. Heavy cricket migrations are very difficult to control. Spraying foundation walls, window wells, sub-floor crawl spaces, under garbage cans, at door thresholds and other points of entry, or hiding places can help reduce troublesome populations. Baits may be applied around garbage cans or other outdoor areas where crickets hide but which are inaccessible to children. Baits may be used beneath concrete drain splash pans, around foundations, patios, driveways and sidewalks.

When infestations are very heavy, it may be necessary to treat a 5- to 20-foot wide band of the soil extending completely around the house. Indoors, residual insecticides should be applied to baseboards, in closets,

under stairways, around fireplaces, in basements, on ground level floors, and wherever crickets become a nuisance.

Boxelder Bug (*Leptocoris trivittatus*)

In the late summer and early fall, adult boxelder bugs move into sheltered areas to overwinter. These insects become household pests as they crowd into any cracks and crevices they can find. Eventually, some of them may make their way into wall voids. Although they will not bite man or damage buildings, furnishing, clothing or food, they can spot curtains and walls with fecal material and they will leave a stain if crushed. Boxelder bugs are mainly a nuisance pest because of their presence when crawling and flying around rooms and accumulating in light fixtures.

Adult boxelder bugs are about ½ inch long, and dark brown to black in color with red lines on their backs. The young, or nymphs, are wingless but generally similar in shape to the adults. The smaller nymphs are solid bright red, but the older nymphs have some black markings.

Adults come out of their winter shelters in early spring, mate and lay small rusty red eggs on trees, leaves, grasses, shrubs and stones. The eggs hatch in about two weeks into small, bright red nymphs. They feed by piercing the tissue of the plant and sucking out the juices. Studies on nymphs in cages show they will feed on a wide variety of plants, including maple, ash, oak, boxelder, golden rain-tree, tree-of-heaven, mulberry, honey locust, lilac, honeysuckle, iris, geranium, tulip, peony, asparagus, strawberry, pigweed, crabgrass and foxtail. They may do some damage when feeding on strawberries. Nymphs spend most of their lives in weeds, grasses and under accumulations of old leaves, tree seeds and other debris.

By mid-summer the nymphs develop into adults which produce a second generation that matures in the fall. Large numbers of nymphs can often be observed in late summer on

Occasional Invaders

host plants. After maturing, the second-generation adults begin to seek winter quarters. They often move toward structures, entering near the foundation and pushing into cracks. Many get into wall spaces and under shingles. During the coldest part of the winter the insects are inactive, but during warm winter days some will become active and move around the inside and outside of the house.

The first warm days of spring bring the bugs out of their protected wintering places in preparation for outdoor activity. Unless they are bothersome, particularly at doorways, there is little point in spraying at this time. Those trapped in houses die during the spring.

Boxelder bugs are more common during dry summers. During wet weather, small nymphs are easily drowned. To prevent large fall populations of these insects, young boxelder bugs should be treated in the summer. Sprays should be applied to thoroughly cover infested tree trunks, limbs and foliage.

For fall home treatment, spray the outside of foundation walls thoroughly up into the area where the siding overhangs the foundation. Window wells, subfloor crawl spaces, door thresholds, and other points of entry or hiding places should also be sprayed thoroughly. Direct spray on the bugs if possible because they are difficult to kill. Repeat applications may be necessary to reduce infestations.

Indoor control of the boxelder bug is difficult. For temporary control, use a space spray. Fill the entire room with mist and close it off for several hours. Use a vacuum cleaner to collect and destroy the bugs. Several residual insecticides are labeled for the treatment of cracks, crevices, wall voids and other overwintering sites.

Elm Leaf Beetle (*Pyrrhalta luteola*)

The elm leaf beetle was introduced into this country from Europe 150 years ago. This pest feeds almost exclusively on elm trees. Although

most elm species are subject to attack, Siberian elms (commonly called Chinese elms) and hybrid elms are preferred hosts.

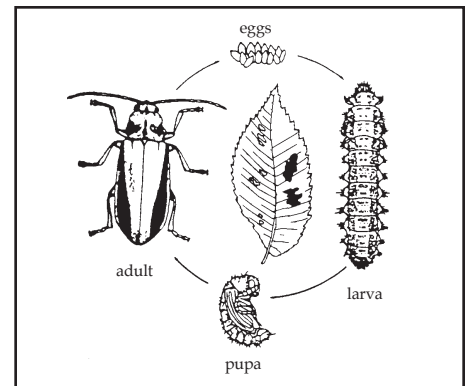
Both the adult and the larval stages of the elm leaf beetle feed on elm leaves. Adults eat small, rough, circular holes in expanding leaves. The majority of the damage is caused by the larvae feeding on the undersides of leaves leaving only the upper surfaces and veins.

Elm leaf beetle feeding damage may result in partial or complete defoliation of the tree. Severely infested leaves will turn brown, and often drop prematurely. In some cases, by mid-summer the entire tree may be defoliated. Trees which lose many of their leaves as a result of elm leaf beetle damage commonly put out a new flush of growth which may be consumed by other insects found on the host trees or by a second generation of the elm leaf beetle. Feeding damage by elm leaf beetles seldom kills an elm tree. However, severe feeding will weaken a tree making it more susceptible to attack by other insects and diseases.

Adults of the elm leaf beetle seek winter hibernating sites in attics, garages, wood piles and other protected places in late summer and fall. In the spring, the beetles migrate back to elm trees. These beetles are a nuisance in the home; especially in the spring when they become active and are attempting to find their way out. Inside, elm leaf beetles will cause no damage, but become a nuisance as a result of their presence in unwanted places.

Adults are about $\frac{1}{4}$ inch long, yellowish to olive green with a black stripe along the outer edge of each wing cover. In the spring, the beetles leave their overwintering quarters, fly to nearby elms, mate and begin laying eggs.

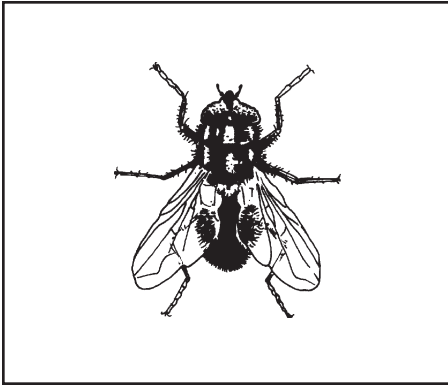
The lemon-yellow, spindle shaped eggs are laid on end in groups of five to 25 in two or three parallel rows on the undersides of elm leaves. A female may lay 600 to 800 eggs over her life span. Small, black larvae hatch



Elm Leaf Beetle

Occasional

Invaders



Face Fly

in about a week and feed on the under-surface of the leaves. The larvae feed for three weeks and when mature they are approximately ½ inch in length, dull yellow, with what appear to be two black stripes down the back.

Young larvae feed in groups and older larvae may feed singly. At the end of the larval stage, they migrate to lower parts of the elm tree. They pupate under debris on the soil, or in cracks, crevices or crotches of the tree trunk or larger limbs. Bright yellowish-orange pupae can be found around the base of the tree. Adults emerge seven to 14 days later in midsummer.

In Kansas, there are two complete generations of elm leaf beetle per year and in some areas, a partial third-generation. The specific timing of these generations varies with the season and with different areas of the state. Spraying infested trees should be timed to kill the young first-generation larvae and, later, the second generation larvae just after hatching from the egg. Specific time varies with the season and different areas of the state. Examine the undersides of the leaves for yellow eggs and emerging larvae. Insecticide application times are usually about mid-May for the first generation and early to mid-July for the second generation.

In the fall, some control of these beetles may be obtained by treating the foundation, window wells, sub-floor crawl spaces, door thresholds and other points of entry with a residual pesticide. For temporary control indoors, sweep them up or use a space spray. Whenever possible, spray the beetles directly. Collect and destroy beetles following the treatment. Several residual insecticides are labeled for the treatment of wall voids and other overwintering sites.

Non-chemical Treatments are effective in reducing elm leaf beetles inside houses:

1. Caulk around exterior window frames, doors and vents.
2. Make sure all lap siding is tightly nailed.

3. Inspect attic for openings that can be sealed.
4. Make sure that all vents and louvers are sealed and have small mesh screen covering them.
5. Caulk and seal coolant lines and wiring from air conditioner units, water pipes, and dryer vents which lead into or out of crawl-spaces/basements.
6. Inspect, repair, and seal, if necessary, the mortar between cinder-blocks.
7. Seal spaces between foundation and sill plate.

Attic Flies

In Kansas, the most common attic fly is the "face fly." Attic flies overwinter as adults in homes and other buildings. They enter the highest rooms of a structure during the autumn months through various small cracks and openings. They hibernate in wall voids, window casings, dark corners, closet clothing, beneath curtains and behind furniture.

Just as the flies are a nuisance in the fall, while seeking hibernating quarters, they are again troublesome on warm winter days and in the spring, trying to get outdoors. As the warm spring weather induces fly activity, many appear inside the home from wall voids. The attic flies make irritating buzzing noises, actively spin around in circles, move sluggishly, and make a greasy spot when crushed. They congregate in large numbers, especially at windows and in rooms not frequently used. These flies will do no damage to home furnishings, or humans, but are a nuisance by their presence. Even after the flies are removed from a room, within a few days the same room may need to be treated again. It is the continuous appearance of these pests in a room that is most frustrating.

The face fly is similar in appearance to the house fly, but is somewhat darker in color. The large eyes of the male face fly nearly touch on top of the head, while those of the housefly are far apart. Female face flies are difficult to separate from female house

Occasional Invaders

flies. However, the face fly female has a silvery stripe around the eyes, whereas the stripe around the eyes of the house fly is golden in color. The middle body section of the face fly is slate-gray. During the summer months, face flies are very annoying on livestock where they lap exudation from the eyes, nostrils and mouth. Face fly females deposit eggs in fresh cow manure during the spring and summer. The maggot stage lasts three to 10 days; egg to adult takes about 14 to 18 days.

Control of the attic flies cannot be permanent until the openings are closed through which these flies enter the home. Use caulking compound or other suitable material to fill all cracks and openings near windows, doors, vents, and other possible fly entry sites. Seal holes, cracks and splits in the siding. Maintaining the structure in good repair will greatly reduce infestations. Use tight-fitting screens, especially on the upstairs and attic windows. Screen ventilators, louvers and air conditioner openings.

Flies inside the home can be killed by using an aerosol space spray. Dead, dying, and sluggish flies can be picked up with a vacuum cleaner, or with a broom and a dust pan. Destroy the sweepings to prevent reinfestation. Accumulations of dead flies in attics and wall voids may attract carpet beetles which feed on the flies and then move into woolen carpets and other animal fiber products in the house. Applications of labeled residual pesticides can be directed into window pulley openings, wall voids, and known fly entry sites around windows and doors.

Any tightly enclosed room with little air movement, such as attics and storage rooms can be successfully treated by hanging impregnated resin strips. Use strips according to label directions.

Clover Mite (*Bryobia praetiosa*)

Clover mites feed on plant juices. There are at least 200 host plants for this pest. They are most numerous in newly established lawns or in old

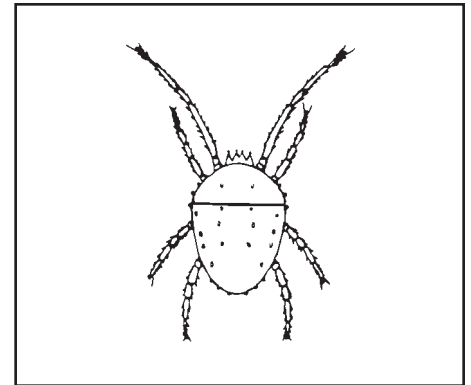
lawns where there is a healthy growth of succulent, well-fertilized grass. Heavy feeding results in lawns having a silvery appearance. Inside homes the clover mite will not harm pets, people or furnishings. However, they will leave red stains when crushed.

These pests are not insects. Adults are small and reddish-brown in color. Like other mites, adults have eight legs. They can be distinguished by their long front legs. These are about two times the length of the other legs.

The females are parthenogenetic and lay their eggs without fertilization from a male. In fact, male clover mites have never been found in the United States. The bright red eggs are laid in cracks and crevices, around the foundation, and on the bark and twigs of trees. Egg development depends on environmental conditions, particularly temperature and humidity. The eggs will lie dormant until temperatures fall below 85°F in the late summer and early fall.

After hatching, the mites pass through four stages of development. The larvae (six legs), protonymph (eight legs), deutonymph (eight legs) and adult (eight legs). For each of these stages they will feed, move to a protected site, molt and emerge. Each of these stages lasts from two to six days (one month total). There are two or more generations per year. This activity will continue until the temperature drops below 45°F. On warm sunny days during the winter, feeding and egg hatching may resume, especially on the southeast, south and southwest exposures of structures and trees. Feeding and egg-laying resumes in the spring until temperatures again reach 85°F. This is the reason that clover mites are seldom a problem during the hottest part of the summer.

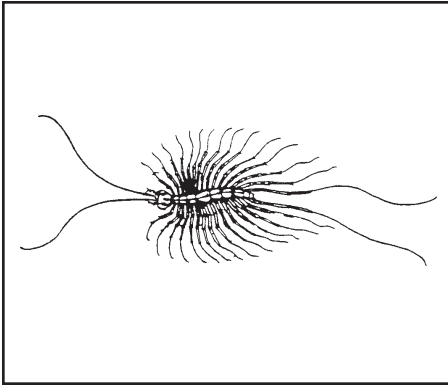
It is in search of protected sites for oviposition, molting, hibernation and feeding that they become a problem. They also are a problem when host plants are removed (mowing, dry weather) and under population pressure. High infestations will look like brick dust and are often concentrated



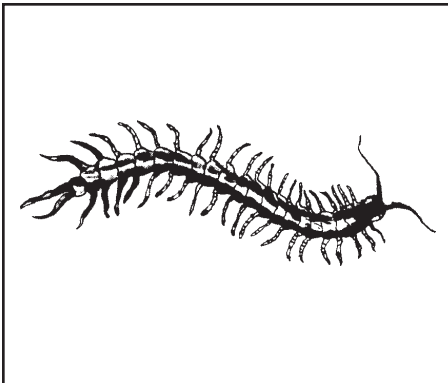
Clover Mite

Occasional

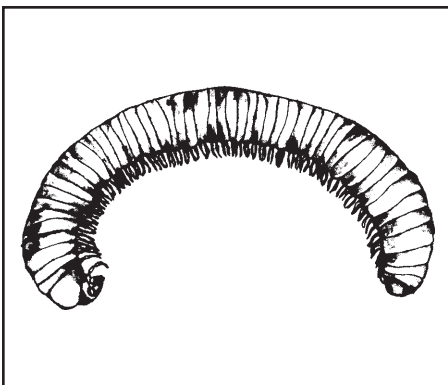
Invaders



House Centipede



Field Centipede



Millipede

on the sunny side of the structure. One serious infestation was estimated at 250,000 on the floor of one room.

There is no satisfactory control method once the mites are inside. They are difficult to remove without creating a stain. Therefore, prevention is better than cure. Space sprays will kill those mites directly hit by the pesticide. The use of a vacuum cleaner attachment to remove mites from indoor surfaces can be successful if care is taken not to crush them. Residual treatments can also be made to door and window frames where clover mites enter.

Mites will not readily cross loose, clean, cultivated soil. Therefore, a grass-free band 18 to 24 inches wide around the structure can reduce clover mite populations by as much as 90 percent. This grass-free barrier can be planted with a variety of plants that are less attractive to the clover mite. These plants include: zinnia, marigold, salvia, rose, chrysanthemum, petunia, barberry, juniper, spruce, arborvitae and yew.

Clover mites can be further prevented by a residual treatment of the outside foundation. For heavy infestations it may be necessary to treat a 10- to 20-foot barrier around the structure.

Bird Mites and Rodent Mites

Several other species of mites may be found in homes from time to time, but they usually go unnoticed. Not infrequently, however, people incur bites and, on searching for the cause, discover mites on walls, floors, or furniture. The most common of these are four related species: northern fowl mite (*Ornithonyssus sylviarum*) and the poultry red mite (*Dermanyssus gallinae*) associated with birds and birds' nests; and the tropical rat mite (*Ornithonyssus bacoti*) and the mouse mite (*Allodermanyssus sanguineus*) associated with rodents and their nests. Although each of these species has distinct host preferences, all show adaptability for survival and will bite people if their normal hosts are not available.

Invasion of these mites into room interiors usually occurs after birds nesting on the outside of the structure have abandoned the nest or shortly after rodents have been exterminated from the building. Preventing birds from nesting or frequently roosting on or in a structure will avert problems with bird mites, and proactive rodent proofing of buildings greatly reduces the likelihood of rat and/or mouse mite infestations. Crack and crevice treatments with a residual acaricide may be necessary to control mite infestations.

Centipedes

Centipedes appear somewhat similar to millipedes; however, they possess only one pair of legs per body segment. A typical centipede is about 1½ to 2 inches long and possesses 15 or more leg-bearing segments.

The first pair of legs are modified to look like jaws and contain poison glands. Larger species can pierce the skin, causing some pain and swelling.

Centipedes can be found in moist sites such as in leaf piles, compost heaps, under stones or under bark on felled trees. They are predaceous and feed on insects, spiders and other small animals. They occasionally enter homes from outdoors.

The house centipede is an unusual looking centipede. Its body is about 1¼ inches long and it has very long legs and antennae. The house centipede is an efficient predator, feeding on house flies, clothes moths, small cockroaches, brown recluse spiders and silverfish. They can endure dry situations and will reproduce in buildings.

Control measures include exclusion and outdoor sanitation of harborage sites. Residual treatments can also be made to both indoor and outdoor harborage sites.

Millipedes

During the spring and autumn months, millipedes can be troublesome to the homeowner. Millipedes crawl from outdoors into homes and other buildings. Infestations are usually limited to the basement or

Occasional Invaders

first-floor rooms. However, millipedes have been reported to crawl up walls and drop from the ceiling. These creatures normally live outdoors, feeding on damp and decaying wood and organic matter. Moisture favors the development of millipedes.

Heavy rains are believed to raise the water level in the soil causing millipedes to find shelter elsewhere. It is important for the homeowner to remember that these creatures do not feed upon the building structures or home furnishings. They do not bite or sting persons, but if crushed may stain fabrics and leave an unsightly mess.

Millipedes are cylindrical and slightly flattened with many segments, each bearing two pairs of legs. These gray or brownish-black, worm-like animals are active at night. They tend to hide during the daytime, usually beneath various objects located on damp soil. Millipedes normally range in size from ½ to 1½ inches. They tend to curl up when touched or disturbed.

Adults normally overwinter, and in the summer, lay eggs singly or in groups in the soil. A single female may lay 20 to 300 eggs which hatch within a few weeks. Then the young pass through seven to 10 instars before reaching adulthood in the autumn. Some may overwinter in the immature stage with maturity occurring the following summer.

Control measures are the same as those discussed for pillbugs and sowbugs.

Pillbugs (*Armadillidium vulgare*)
Sowbugs (*Porcellio laevis* and *Porcellio scaber*)

Pillbugs and sowbugs are not insects, they are members of the order Isopoda. Other members of this order are aquatic and breathe through gills. These household pests breathe through tube like invaginations much the same way that insects do. However, these tubes are single, open pores without spiracles. Therefore, they are subject to water loss and have very high moisture requirements. In addition, they do not have

a waxy layer on the epicuticle like insects do. To reduce water loss, they are often found grouped together under objects and they are only active at night.

Pillbugs are dark gray, ½ inch long and humpbacked. They can roll themselves into a ball when alarmed. Early immatures have six pairs of legs, later immatures and adults have seven pairs.

Sowbugs are also gray and ½ inch long. They have a flattened appearance and do not roll themselves into a ball. They have two, tail-like appendages and seven pairs of legs.

These pests feed on decaying vegetable material. They are found beneath objects on the damp ground. They often make their way into basements, crawl spaces or are carried in on potted plants. When decaying organic material and moisture are abundant, large populations of these pests may build up. Mulches are especially a source of problems.

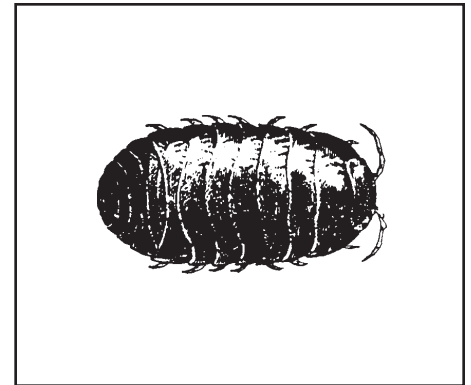
The female carries 20 to 90 eggs in a marsupium or brood pouch for four to eight weeks. The young are born live and there are one to three generations per year (usually two). They can live up to two years as adults, possibly longer. While they are mostly a nuisance, heavy populations may attack vegetation.

Removing debris and decaying organic material from around the structure will help reduce populations. Moisture and ventilation problems should be identified and corrected.

Residual pesticides can be applied to points of entry and dark, damp infested areas. Outdoors it may be necessary to treat a 5- to 20-foot band around the perimeter of the building.

Ground Beetles
(*Coleoptera; Carabidae*)

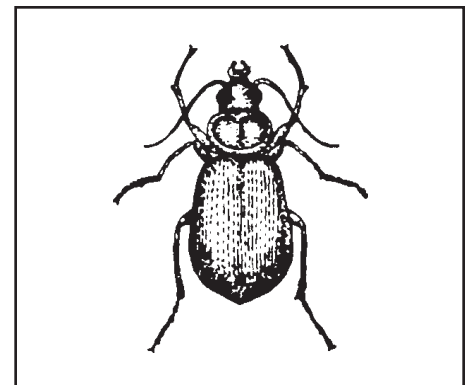
Ground beetles occasionally become a pest when they invade buildings. One's first reaction is to panic since the beetles are frequently thought to be cockroaches or some other undesirable creature. However, ground beetles do not damage household structure or fabrics and they are considered harmless to people.



Sowbug

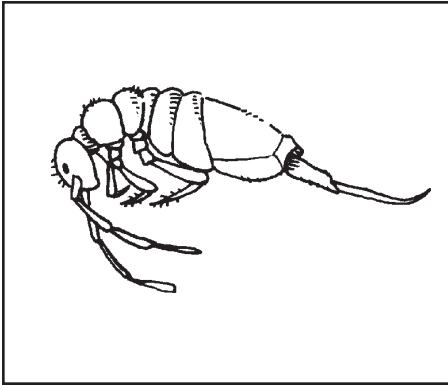


Pillbug

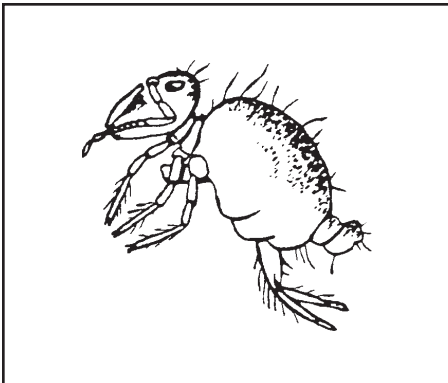


Ground Beetle

Occasional Invaders



Springtail (elongated)



Springtail (rounded)

The adult beetles range in size from $\frac{1}{16}$ to $1\frac{3}{8}$ inches long and most are shiny black in color. Some ground beetles are colored reddish-orange, metallic blue or green, or with other bright markings. Their legs are long and well adapted for running. They rarely fly.

Female ground beetles lay their eggs in the soil and adulthood is reached within a few months to a year, depending on the species. Larvae occur in the soil and are rarely seen, whereas the adults can be found under bark, in decomposing wood, under stones, and around lights. Both the larvae and adults are beneficial to people since they feed on other insect larvae.

Springtails (*Collembola*)

Springtails are minute, wingless, pale-colored insects about $\frac{1}{32}$ inch long. There are many species and they range in shape from elongate and narrow to spherical or rounded. The name "springtail" refers to a forked appendage attached to the undersurface of the body that functions as a spring, propelling the insect forward great distances.

During the spring months, these insects frequently build up in huge populations and can become a nuisance. They are found in moist soil, under bark, in decaying logs, in fungi, and in organic mulches and decaying vegetable matter.

Generally speaking, springtails cause no economic problems but may be a nuisance by their presence. For example, they can be a problem in and under potted house plants. This is especially true when these plants are put outside during the summer

months and then carried back inside in the fall. These pests are restricted to humid habitats, in many cases using a fan to lower the humidity may solve the problem.

Indoors, springtails may be found in or around windows and shower areas where humidity is high and wood, which has been frequently exposed to moisture, has begun to deteriorate. Ventilation of such areas and a new coat of paint may eliminate the problem.

General Control of Occasional Invaders

Special effort should be made to keep compost piles and other organic matter accumulations as far away from the house as possible. Eliminate wet, damp conditions around the house foundation, in basements, crawl spaces and attics. Maintain sanitary conditions by picking up old boards, rocks, leaves and other debris which could shelter these pests. In some cases such as boxelder bugs, host plant removal may be required. Successful control inside can be obtained only if control measures are taken outside the building in addition to work done indoors.

Repair of cracks in the foundation wall, around doors, basement windows and other points of entry with caulking compound will reduce the numbers of occasional invaders entering buildings. Indoor individual insects can be picked up with a vacuum cleaner and the sweeper bag contents destroyed, or they can be collected by means of a dust pan and broom, then crushed and discarded.

Study Questions

1. (19) Especially subject to attack by house and field crickets are:
 - a. woolens and furs
 - b. clothes soiled with perspiration
 - c. carpets and heavy drapes
 - d. silk fabrics
2. (20) Cave or camel crickets' diets consist of:
 - a. plant debris and paper products
 - b. starchy foods and fabrics
 - c. most fabrics
 - d. leather and paper products
3. (20) Boxelder bugs are more common:
 - a. in areas free of weeds and plant debris
 - b. during wet summers
 - c. during dry summers
 - d. a and b
4. (21) Where do the boxelder bug nymphs spend most of their lives?
 - a. on the bark of maple and boxelder trees
 - b. in weeds and under plant debris
 - c. inside buildings
 - d. underground
5. (21) The adult elm leaf beetle may overwinter in:
 - a. attics
 - b. garages
 - c. woodpiles
 - d. all of the above
6. (22) Attic flies are pests because:
 - a. they bite humans
 - b. their buzzing, noisy presence is irritating to people
 - c. they can damage home furnishings
 - d. they eat dry cat food
7. (23) Clover mites can be distinguished from other mites found in the home:
 - a. by their greenish color
 - b. by their clover shaped appearance
 - c. by their long front legs
 - d. because they attack humans and plants
8. (23) During high summertime temperatures, the clover mite
 - a. begins hiding in the soil
 - b. dies
 - c. eggs remain dormant until cooler temperatures (under 85°F)
 - d. turns bright green in color
9. (24) House centipedes occasionally enter homes and feed on:
 - a. brown recluse spiders and silverfish
 - b. house flies and clothes moths
 - c. small cockroaches
 - d. all of the above
10. (25) Millipedes are considered pests because they:
 - a. may stain fabrics if they are crushed
 - b. cause a painful sting to humans
 - c. secrete a staining saliva when eating
 - d. infest starchy foods and grains
11. (25) Ground beetles are frequently mistaken for:
 - a. carpet beetles
 - b. cockroaches
 - c. sowbugs
 - d. elm leaf beetles

Occasional Invaders

Study Questions

12. (26) Springtails are:
 - a. generally not an economic problem
 - b. found in dry, cool areas
 - c. winged, dark colored insects
 - d. between $\frac{1}{2}$ to $\frac{3}{4}$ inch long
13. (26) Successful control of occasional indoor pests can be obtained if:
 - a. favorable conditions for the pest indoors are eliminated
 - b. area is vacuumed only when pests are noticed
 - c. control measures are taken outside the building
 - d. a and c

Pests Annoying and Attacking People and Pets

Common Flies in Buildings

Several species of common flies annoy humans. Although they differ in appearance, all are in the order Diptera and have complete metamorphosis (egg, larval, pupal and adult stages).

House Fly (*Musca domestica*)

The house fly is known in all areas of the world and is the most widely distributed insect of importance to humans. In some areas, it may constitute 98 percent of all flies entering buildings. As a matter of necessity, a large part of any pest control program (as an example, screened windows and garbage collection) will be directed against house flies.

The house fly is gray in color. The gray thorax is marked with four equally broad dark stripes running longitudinally. The mouth parts are sponge like and are adapted for taking liquefied foods. They may be partly withdrawn into the head when not in use. Eggs are laid and larvae develop in animal and vegetable refuse. Garbage, contents of pit privies, animal manure, spilled animal feed, and soil contaminated with organic matter such as from washings of any of these items are favorite breeding places.

House flies are very prolific, each female laying several masses of many eggs. Under favorable conditions the eggs hatch in 24 hours or less. The maggots, pointed at the front end, creamy white and about $\frac{1}{2}$ inch long when mature, move about in the breeding medium to secure optimum temperature and moisture conditions. Larval stages last three to 24 days; the usual time in warm weather is four to seven days.

Full-grown larvae move to dry parts of the breeding medium or move out into the soil or sheltered areas under debris to pupate. The pupal case is reddish-brown. The pupal stage usually lasts four to five days. Under very warm conditions only three days may be required, and in cold weather

flies may remain in the pupal case for several weeks. When this stage is completed, the adult pushes open the end of the pupal case and, after drying and hardening, flies away to feed. Mating may take place a day or two following emergence from the pupal case.

Many of the intestinal diseases of man, such as the dysenteries, cholera and typhoid fever are transmitted by house flies. The fly simply transports the organisms causing these diseases. Frequently, they are regurgitated onto the food when the fly attempts to liquify it for ingestion.

The house fly has a wide flight range and varied food tastes. The female is naturally attracted to collections of filth in which to lay her eggs.

Non-Chemical Control

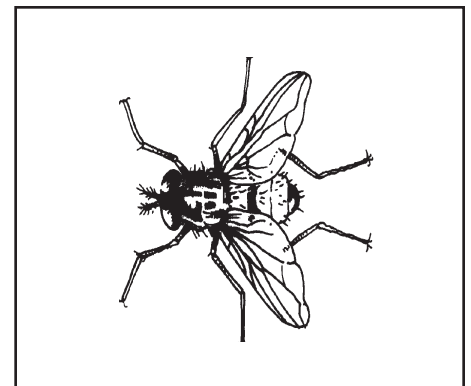
Sanitation. There is no substitute for sanitation in house fly control, i.e., destroying their breeding place. Because house flies have developed resistance to many insecticides, proper sanitation is even more essential. Place garbage in cans with tight-fitting lids. Keep cans on racks and wash them frequently. Exercise care when repeated washing of cans occurs. Rinsing and washing water should be disposed of properly.

Pick up garbage at frequent intervals and dispose of it in properly operated sanitary landfills. Chemical treatment of breeding areas hastens development of resistance to insecticides more than does chemical control measures for adults. Therefore, place your emphasis on sanitation.

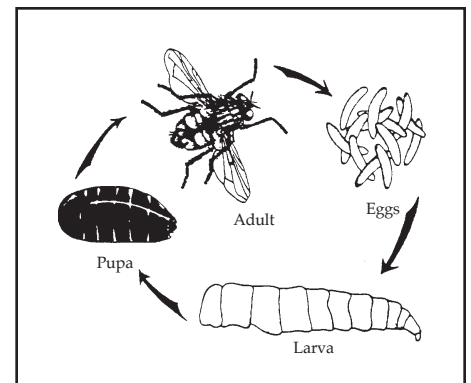
Screens and doors. To keep flies out of buildings, screen all doors and windows with 16- or 18-mesh screen. Use automatic closers on all outside doors and keep them properly adjusted.

Other non-chemical control methods that should be considered for house fly control include air doors, insect electrocuters and light traps.

Trapping. The most recently manufactured blacklight traps with replaceable sticky strips beneath the lights are helpful in removing the few flies that may gain entry despite screens

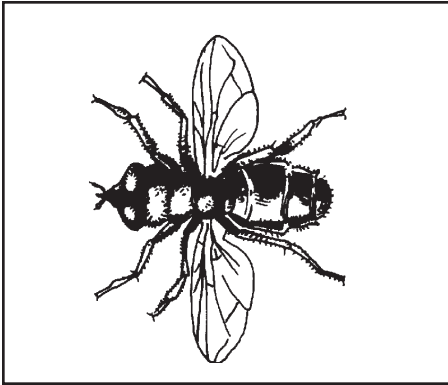


House Fly

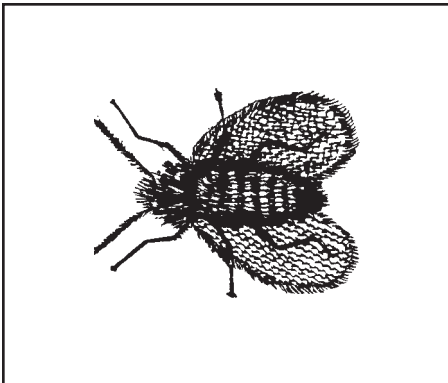


Life Cycle of a House Fly

Pests Annoying and Attacking People and Pets



Blow Fly



Drain Fly

and tight doors. In areas where flies are commonly found, wall-mounted lights will attract and trap the flies on the glueboards. These units should be inspected and cleaned on a regular basis.

Chemical Control

The application of insecticides for the control of adult flies indoors usually includes the use of aerosols. Application of insecticides with some residual action also may be effective if applied around windows or other areas visited by flies. Impregnated resin strips may offer some control of adult flies, but care must be taken not to place these strips in areas prohibited by the label.

For control of adult flies out-of-doors, aerosols applied by mist, fog or ultra-low volume equipment is of some value. Fly baits may offer some control in certain situations, particularly where no other food is in competition. Residual sprays may be used around areas of high fly concentration such as garbage cans. Resin strips impregnated with insecticide are effective if placed inside garbage cans or bulk solid waste containers. Chemical controls may need to be repeated frequently in order to be effective.

Blow Flies

There are many species of blow flies. They can be identified by their relatively large size and shiny blue, green, copper or black abdomens. They are also called blue bottle flies and green bottle flies, depending on the color. Blow flies are larger and more robust than house flies. Adults are strong fliers and are attracted to breeding sites from long distances. The life cycle is similar to that of the house fly.

Blow fly maggots (larvae) develop in materials such as cheese, eggs, meat, fish, dead animals and droppings of dogs and other animals. Different types of organic matter often encourage the presence of different species of flies. In certain neighborhoods it is not uncommon to find blow flies associated with dog manure.

While these flies have essentially the same potential for transmitting disease organisms as do house flies, they have fewer opportunities because they are less inclined to enter buildings. Occasionally, blow flies cause annoyance indoors in much the same ways as do house flies.

Normally, blow flies originate outdoors, but infestations can arise from dead rodents and birds inside attics, crawl spaces and wall voids. They may also come from birds' nests in eave troughs, above windows, or even in soiled carpets and rugs.

Control

Inspect and destroy all sources of maggot infestation. Remove pet feces each week. The control measures recommended for house flies are, in general, effective against blow flies.

Face Fly

See attic flies under *Occasional Invaders*.

Drain Flies (*Psychoda* sp. and *Telmatoctopus* sp.)

Occasionally, drain fly adults mysteriously appear in buildings. These flies cling to clothing, fall into food, mar fresh paint, darken lamps, congregate at windows and cause general annoyance. The infestation is initially observed mostly near sinks, bathtubs and floor drains.

Drain flies, also known as moth flies, filter flies and sewage flies, are about $\frac{1}{16}$ to $\frac{1}{8}$ inch long with a light gray or tan-colored body and light-colored wings. The body and wings are densely covered with hairs giving this fly a moth-like appearance and hence the name, moth fly.

These flies are identified by the 13-segmented antennae with each segment having a "bulbous swelling" with a whorl of long hairs. Also, the wings are folded over the body in a roof-like manner when at rest.

There are many generations of this fly each year. From egg to adult requires about eight to 24 days depending on the temperature. This pest is associated with decomposing organic matter.

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Non-Chemical Control

Sanitation is the basic step in controlling the drain fly. Cleaning the overflow drains, drain traps, cellar drains, and sump pumps will help to eliminate the problem. Drain pans in automatic defrost refrigerators are also a possible breeding place. Any commercial drain cleaner that cleans and disinfects the main drain and the over flow drain will suffice. A stiff brush should be used to clean all accessible surfaces within the drain.

Pouring boiling water into the overflow drain will also quickly eliminate the maggots. Clean out and remove any other decaying organic material in the area.

Chemical Control

Use insecticides only after identifying the source and solving the sanitation problem. Do not apply insecticides directly to drains or sewer systems unless specifically labeled for that purpose. Follow label directions for application of space sprays to control adults.

Spiders

Many people fear spiders because of myths that surround them or the publicity given to the very rare fatal poisonings by a few species. Others object to them because of their annoying habit of building webs in corners, on furniture, across doorways or in other places. Under some conditions, spiders are considered beneficial because they feed on insects.

Spiders have a characteristic appearance recognized by most people. Spiders lack wings and antennae. Their bodies have two regions: a cephalothorax (fused head and thorax) and an abdomen. Males are usually smaller than females of the same species. The eight legs of a spider are attached to the cephalothorax which also bears the eyes and mouth parts. Most spiders have eight eyes, but some species have only six and a few have less or none. All spiders have a pair of jaw-like structures, chelicerae, at the end of which is a hollow, claw-like fang. Each fang has a small open-

ing in the end through which venom can be ejected.

The abdomen of spiders contains their reproduction system, the largest part of their respiratory system and the spinnerets. The latter are the silk spinning glands located at the tip of the abdomen. Spiders are seldom aggressive towards humans and usually bite only when injured or trapped. Only large spiders are capable of breaking the tough skin of humans. Smaller spiders usually inflict only superficial scratches.

Nearly all spiders have venom glands. Almost all of the United States' species have a venom so feeble that their bites are insignificant.

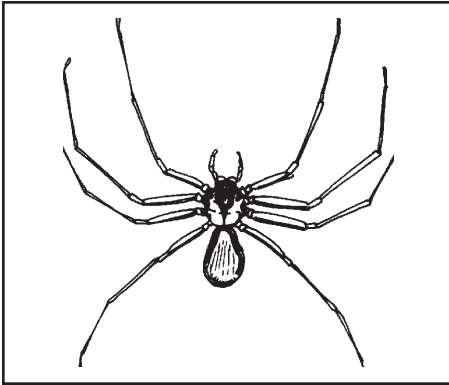
The severity of a person's reaction to the bite of a spider is influenced by a number of factors. The species of spider and the area of the body where the bite occurs are of great importance. The amount of venom injected and the depth of bite also play a role. The signs and symptoms are caused by the mechanical action of the bite, and/or by the venom. In some cases, there is no reaction.

After being impregnated by the male, the female spider begins to lay eggs. The eggs are laid in dark retreats or in silk cocoons called egg sacs. The females of some species guard the eggs; others carry the egg sac with them. Depending upon the species, a female may produce as few as two or as many as 3,000 eggs. They usually are laid over a period of time in several sacs.

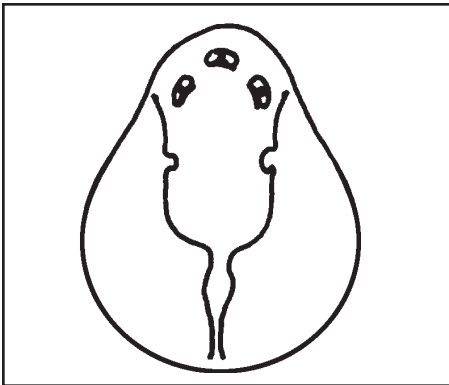
In warm weather, the young may hatch within three weeks. They tend to remain together for several days before scattering. Cannibalism often occurs during this period. Most of our common species mature within one year, going through a series of molts as do insects. Some species require up to 20 years to reach maturity.

Mating and egg-laying occur any time of the year, depending upon the species. Some species mature and lay eggs in the summer after overwintering as half-grown individuals. Others overwinter as eggs, hatch in the spring and mature and lay eggs in the fall.

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Brown Recluse (top view showing violin-shaped marking)



Enlarged cephalothorax of Brown Recluse showing violin-shaped marking and eye arrangement (six eyes in three pairs)

Spiders cannot fly. Therefore, spiders use other means of dispersing in addition to walking. Some, such as the brown recluse, find many objects transported by people suitable retreats and can be moved great distances in this manner. The most interesting method of travel is "ballooning," which is practiced primarily by the young of some species.

To accomplish ballooning, the spider climbs to the top of an object such as a plant or fence post and releases a strand of silk. If a wind is blowing, the spider sends out silk until enough of it is windborne to lift the spider from its perch. Spiders reach great heights by this method and have been carried 60 miles.

Some spiders build simple webs and others build very complex ones. Webs usually consist of strong, non-sticky strands of silk which form the framework. These strands are united with a series of silk strands having sticky globules on them. Spiders are just as susceptible as insects to being stuck in the sticky globules, but spiders are adept at avoiding them. Some types of spiders do not spin webs but use their silk only for building egg sacs or retreats.

Spiders can be separated into two groups based on the way they capture prey:

1. Web-spinning spiders which use their webs to catch insects and live all the time in the web or in a nest near it. Most species that commonly live indoors are web-spinning spiders. However, the brown recluse spider is a hunting spider and many species of outdoor hunting spiders are occasional invaders into homes.
2. Hunting and ambush spiders which run on the ground or on plants, catching insects wherever they find them or waiting among leaves and flowers until insects come within their reach.

Spiders eat live prey, consisting usually of insects and their relatives. Victims are killed by the venom the spider injects through its fangs. Spiders have food preferences but a hun-

gry spider will tackle most anything that is not too large. Some species can go for long periods without food. The brown recluse, for example, has survived for six months without food or water.

Although all spiders require water for survival, some species require very little and can live in dry environments. However, many species can live only in humid places and need a regular source of drinking water. Most species are attracted to water sources if they are available. For this reason, you should first look in areas around water pipes, floor drains and air-conditioners when trying to determine the location of an indoor infestation. Others live in warm, dry places and can be found in subfloor air vents, in upper corners of rooms and in attics. Most species found indoors hide either in cracks, in darkened areas or in retreats.

Outdoors, spiders live in a variety of places depending upon the species. Some hide in flowers waiting for prey; others live on tree trunks, under stones or leaves, or in and under eaves. Most of the outdoor living species do not adapt to indoor conditions.

There are two poisonous spiders with which every Kansas resident should be familiar. They are the black widow and the brown recluse. They are two of the most poisonous spiders in the United States and both occur in Kansas. You should know how to recognize them, how their bites affect humans, what to do when bitten, and how to control spiders in and about dwellings.

Brown Recluse Spider *(Loxosceles reclusa)*

The brown recluse spider can be found throughout Kansas. This spider constructs a loose, irregular web in undisturbed areas. Indoors they can be found under shelves or boxes, in storage areas or in clothing that has been stored undisturbed for a long period of time. Unlike the black widow, this spider is a hunter and leaves its web in search of prey.

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Males and females are similar in appearance and their bites are equally toxic. They range from $\frac{1}{4}$ to $\frac{1}{2}$ inch in length (excluding legs). The legs are quite long and somewhat darker than the off-white to yellow or tan body. The most distinguishing characteristic is a brown guitar or violin-shaped marking on the first body region. This characteristic has resulted in the common name of “fiddle-back” or “violin” spider.

Bite and Symptoms

The brown recluse is a shy but active spider which avoids danger in undisturbed places. Bites usually occur when a person is putting on clothes or shoes such as winter coats or hunting boots which have been stored in which the spider is hiding. This spider hunts at night and some bites occur when the spider has crawled onto a bed and is squeezed by a person rolling in his or her sleep.

The amount of venom injected by the spider and the victim's sensitivity are both factors in determining the seriousness of the bite. As with the black widow, children and the elderly are usually the most seriously affected. Victims may have no reaction at first, or may immediately feel a stinging and painful sensation. Intense pain may last from two to eight hours. A small blister forms at the bite and a large area around the bite becomes red and swollen. Some victims experience nausea, stomach cramps, stiffness of joints and fever. Tissue in the infected area will peel away, resulting in an ulcerous sore that gradually fills with scar tissue. Wounds are slow to heal, sometimes taking six to eight weeks.

If bitten by a brown recluse or a spider that you think may be one, apply an ice pack to reduce the enzymatic action of the venom and immediately see a doctor. Medical treatment may reduce severe reactions to the bite.

Black Widow Spider (*Latrodectus mactans*)

The black widow spider can be collected throughout the state. The black widow belongs to a family of spiders called cob web weavers or tangled

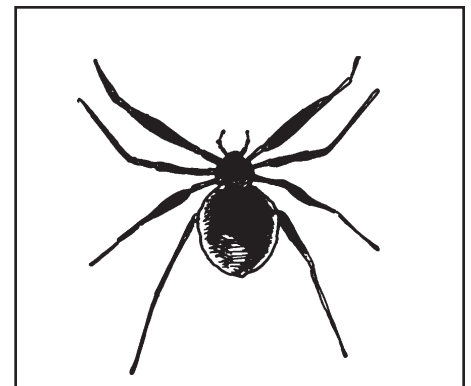
web weavers. Loose, unsightly webs made by members of this group are commonly found in cellars, crawl spaces, garages, and infrequently cleaned buildings. It will inhabit undisturbed areas, often hiding in old stumps and hollow logs, under fallen fence posts, in abandoned animal burrows or in piles of dead tree branches and other debris.

The poisonous female is about $\frac{1}{2}$ inch long (excluding legs) when mature and is shiny black or brownish black. Its round abdomen has an orange or red marking resembling an hourglass on the underside. Sometimes this hourglass is incomplete, consisting of two reddish triangles. The smaller, non-poisonous male is little more than $\frac{1}{4}$ inch in length (excluding legs). It has several whitish streaks on the sides of the abdomen, but usually lacks red markings underneath.

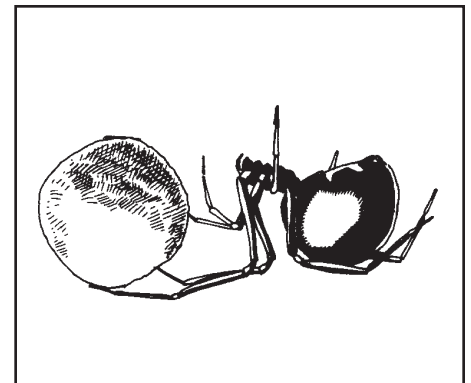
The female black widow is usually found hanging upside down in her loose, tangled web. She encloses 200 to 260 eggs in a round off-white silken egg sack which she will guard until the young hatch. She is normally shy and nocturnal, seldom leaving her web. The black widow is not at all aggressive and can be subjected to considerable provocation without attempting to bite. She may, however, rush out and attack when the web is disturbed or when she is accidentally trapped in clothing or shoes which have been stored unused for some time.

Bite and Symptoms

The bite of the female may not be felt at the time the venom is being injected. It is usually followed by a burning sensation, localized swelling and redness. Pain may become intense after one to three hours and last up to 48 hours. The person may experience cramps in the legs, arms and chest. The abdominal muscles may become rigid. Other symptoms may include headache, nausea, tremors, speech defects, and a slight rise in body temperature. The degree of symptom severity depends a great deal on the sensitivity, health and



Black Widow (adult female)

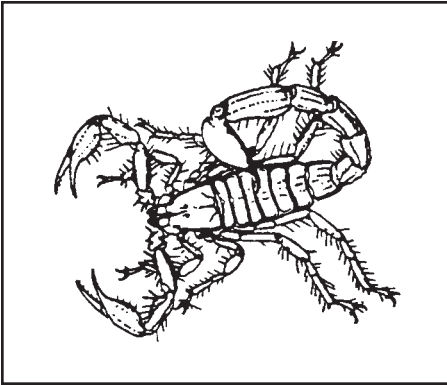


Black Widow With Egg Sack



Black Widow Underside Markings

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Scorpion

age of the victim. Small children and the elderly are usually the most severely affected.

The person should be kept calm and under observation. A mild antiseptic (such as iodine or hydrogen peroxide) can be applied to the bite. If the symptoms begin to appear, take the victim to a doctor or hospital at once. When spider bites occur, the spider should be captured, if possible, and taken to the doctor to verify the type of bite. Fatalities are rare and the healthy person usually recovers quickly and completely.

General Spider Control

Non-chemical control

Good sanitation is the best method of control. Use vacuum cleaner attachments with strong suction to collect spiders and webs, then destroy the bag and its contents. Frequent cleaning throughout the entire household will reduce spiders and insects serving as spider food. Sealing cracks in room interiors is important.

Brown recluse spiders often are found in homes where there is an abundance of insects. Rid premises of piles of rubbish and trash. Be careful when moving piles of lumber and machinery that have not been used for some time, or undisturbed boxes. Examine and shake out clothing that has hung in closets or other storage areas before wearing. As the spiders wander every night, even an item that has been hung only a day or two may harbor one. Sticky traps placed in corners or close to walls are helpful in reducing brown recluse populations.

Many spiders may be excluded from homes by caulking or otherwise eliminating cracks and crevices around the foundations and around windows and doors. Outside window shutters, step areas, crawl spaces, and related hard-to-reach places can be washed with a forceful stream of water from a hose.

Sticky traps can be effective in the control of some species of spiders.

Chemical Control

Residual insecticides can be effective in supplementing sanitation practices. Apply insecticides where the spiders normally hide. Dust formulations are suggested for wall voids and attics. Wettable powders and microencapsulated formulations are superior to emulsifiable products. Spiders are not insects and, therefore, pesticide selection should be based on label instructions.

Scorpions

(*Centruroides vittatus*)

Scorpions have a long body ending in a tail-like structure and a stinger. Their front pair of appendages are enlarged and equipped with pincers much like those of a crab or crayfish. The only species known to occur in Kansas is a relatively harmless kind, *C. vittatus*.

Scorpions feed at night, primarily on insects and spiders. They grasp their prey with their pincers, and larger victims are then paralyzed by their venom. When preparing to sting, their tail is curled upward over their back. The tail and stinger are then thrust downward and inserted into the victim. Scorpions will also sting in self defense.

The biology of the scorpion is not fully understood. The young are born alive and until their first molt they are carried on the back of the female scorpion. It takes three to four years for many species to reach maturity. During the day, scorpions inhabit cool, dark, undisturbed areas. They are often found under old boards, rocks and other debris around buildings. Inside they can be found near moisture, e.g., sinks, plumbing and washing machines. Occasionally, they may take shelter in clothing that is infrequently worn.

Bite and Symptoms

Scorpions rarely sting humans. The effect of the venom from *C. vittatus* resembles that of a bee or wasp sting, producing localized swelling. There may also be a burning sensation that

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extends beyond the sting site. Sensitivity to scorpion venom will depend upon the age and health of the victim as well as on the species of scorpion.

Symptoms of a reaction to the sting of a more potent species of scorpion may include restlessness, slurred speech, tightening of the throat, twitching and possibly a high temperature. If these symptoms appear, the victim should be taken to a doctor at once.

Control

Sanitation and tight construction are critical for scorpion control. Piles of lumber and debris should be removed from around the building. Residual pesticides can be applied as barrier treatment and to harborage sites.

Fleas

Cat flea (*Ctenocephalides felis*)

Fleas are small, brown, wingless insects $\frac{1}{8}$ to $\frac{3}{16}$ inch in length. Adult fleas are parasites (blood feeders) of mammals and birds. Their bodies are long and narrow with flattened sides. This body shape allows them to move rapidly between the hairs or feathers of their hosts. Their legs are well developed for rapid locomotion and they are capable of jumping considerable distances.

Only the cat flea, *C. felis*, is common on dogs and cats, and in households, in Kansas.

The adult female flea must have a blood meal before she can lay fertile eggs. The small, white, ovoid eggs are laid as she moves about on the host animal. The eggs drop from the host animal onto the ground, into bedding materials, in cracks and crevices, upholstered furniture and carpeting. The eggs usually hatch in one to 10 days depending on the temperature and humidity.

The tiny worm-like larvae feed on skin scales, and bits of dried blood and debris. In five to 11 days the larvae complete development and spin a silken cocoon. The flea pupates inside of the cocoon, emerging as an adult eight to nine days later.

Emergence of the adult is triggered by vibration, warmth and carbon dioxide from the host animal. The fleas can remain in the pupal stage for up to five months. Newly emerged adult fleas can survive for up to three weeks without feeding.

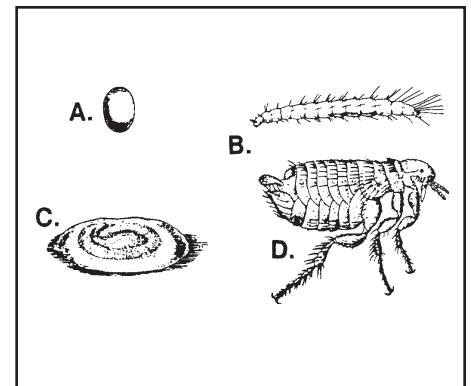
Flea problems are usually associated with infested cats and dogs. Occasionally, infestations will result from rats or squirrels nesting in the home. Every flea problem is associated with a warm-blooded host. There are no free-living, or non blood-feeding fleas, commonly referred to as "sand fleas."

Ordinarily, the adult flea will maintain an association with its preferred host, the dog or cat. Humans are not likely to be attacked unless the flea population is high. Flea outbreaks also are commonly observed if the pet is removed. With the normal host gone, fleas will feed on the most readily available food source, namely humans. This can also occur after a vacation when both pet and owner have been away for a considerable period of time.

During the summer, fleas can develop outside wherever flea-infested animals frequent. Pets often become infested at this time as they travel throughout the neighborhood.

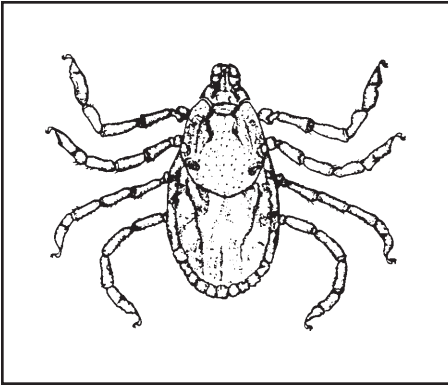
To be effective, control efforts must be directed against both the adult fleas on the host animal and the adult and immature stages located throughout areas frequented by the animal. Flea control requires a combination of strategies. The cooperation of the homeowner is critical for effective flea control.

The homeowner should be advised to thoroughly clean prior to the treatment. This should include the vacuuming of floors, carpets, rugs, upholstered furniture and baseboards. The sweepings should be disposed of immediately to prevent reinfestation. The vacuum bag contents should be burned or placed in an airtight plastic bag. All pet bedding should be replaced or thoroughly washed.

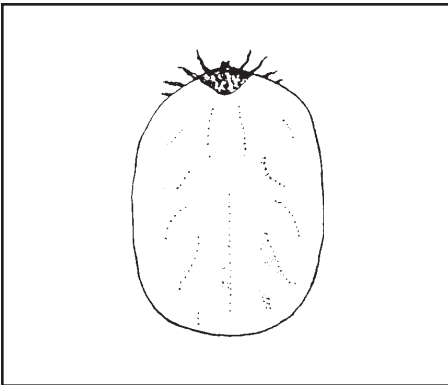


Flea Life Cycle: a. Egg; b. Larvae; c. Cocoon; d. Adult

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Brown Dog Tick (adult female)



Brown Dog Tick (engorged)

The pet should be treated on the same day as the home treatment. The homeowner should be advised to have a veterinarian perform this treatment. The commercial pesticide operator should never treat animals.

Treatment should include the application of residual pesticides and an insect growth regulator to all infested areas. During the warm summer months it may be necessary to treat outdoor areas. Formulations and concentrations of residual pesticides may differ for indoor and outdoor use. Residuals labeled for indoor use will be for either general or spot treatment. Be sure to check the label before making an application.

Methoprene and fenoxycarb are two insect growth regulators labeled for use on fleas. These products act only to interfere with or disrupt flea development. They are usually used as either a pre-season preventative treatment or in conjunction with a residual insecticide.

Ticks

Ticks are related to insects but differ from them by possessing eight legs in the adult stage and lacking antennae, compound eyes and wings. Their bodies are flattened from top to bottom, and their skin is tough and leathery. The mouth parts of ticks protrude from the small end of an unsegmented pear-shaped body. All ticks are external parasites of vertebrates, and feed only on blood and tissue fluids. Although they spend much time off the host, they do not feed during such times. Each tick feeds only three times—once as a larva, once as a nymph, and after becoming an adult—even though their progress through life may require one to three or four years. When not engorged with blood, adult ticks are less than a quarter of an inch long. Engorged females become so distended that they become egg-shaped and may be as big as a pea or even a small grape. Such engorged ticks are pale colored, tan or brown, with dark brown legs and mouth parts clustered closely together on the under side of the front end.

Any of the following species can cause tick paralysis in pets, livestock, wildlife and people, but it is most frequently caused by Dermacentor ticks. The condition is caused by a toxic property in the saliva of some ticks and is especially likely to occur under heavy infestation; but, a single tick can produce a paralytic response if it is attached along the spine or, especially, at the base of the skull. The toxin is only produced by a tick after the third day of engorgement, so there is no danger of paralysis from promptly removed ticks. The paralysis begins in the limbs and may appear as lack of coordination of central nervous system dysfunction. It can progress to involve the involuntary nerves and affect breathing and cardiac function. Removal of the tick or ticks before the paralysis reaches this stage allows the host to rapidly recover.

Brown Dog Tick (*Rhipicephalus sanguineus*)

The brown dog tick is an important parasite of dogs. Cats are sometimes fed on by these ticks and humans may be unwilling hosts if living in close contact with infested dogs or if they move into an infested home but have no dog. This tick cannot survive the winter outdoors in most of Kansas but will breed in homes and kennels. Therefore, high populations may be found indoors year round.

Ticks go through three developmental stages after hatching from the egg. These are the six-legged larva (seed tick), the eight-legged nymph (yearling), and the adult tick. The larvae are small and difficult to see, but nymphs and adults are easily recognized and commonly observed. Ticks usually mate on the host animal. The females then drop to the ground and deposit 3,000 to 4,000 eggs, which hatch into the larvae or seed ticks. The eggs hatch in eight to 67 days depending on environmental conditions. All three stages require a blood meal. Each unfed stage is capable of living for long periods without food but must have a

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blood meal before developing to the next stage.

Dogs become infested when they frequent areas in which ticks have dropped off of other dogs.

The larvae and nymphs are often found in the hair along the back while the adults commonly attach to the dog's ears and between the toes. While the developmental stages are often found in these regions, they are not restricted to them and may be found on practically any part of the dog's body.

When individuals of each stage are fully engorged, they drop from the host and seek a nearby hiding place. They have a tendency to climb, and for this reason all stages of ticks can be found in cracks and crevices near ceilings. They will also be in cracks of floors and in furniture, under the edges of carpets and rugs, behind baseboards, curtains, pictures, under window and door moldings, in radios, clocks and electric outlets.

The brown dog tick can complete its entire life cycle in about two months. If ticks are allowed to continue their feeding and egg laying without control measures, large populations can rapidly build up.

Control

The control of household infestations may be very difficult and require thoroughness and perseverance. Treatment should start with the dog. The pest control operator should never treat animals. It is preferable to have the pet treated by a veterinarian.

The next step is to eliminate ticks from the home. Regularly use a vacuum cleaner on cracks in the floor and under the edges of rugs and carpets, on rugs and carpets, draperies, furniture and baseboards to pick up as many ticks as possible. The sweepings should be disposed of immediately to prevent reinfestation. All infested bedding should be washed or disposed of.

Apply residual insecticides into cracks in the floor, along baseboards, window casings, the floor under the edge of rugs and other areas where

the ticks may be hiding. It is important to remember that ticks climb upward. Ceiling cracks and items hanging on walls should be carefully inspected. Do not allow children or pets in treated areas until surfaces are dry. It may be necessary to repeat the treatment if the first application is not successful.

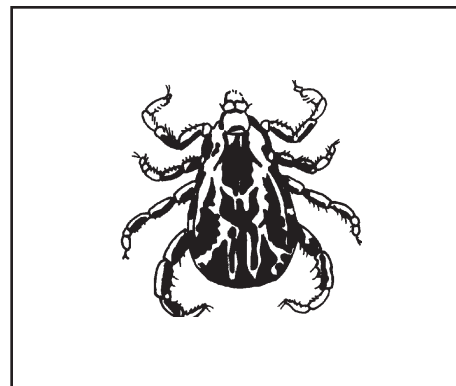
American Dog Tick (*Dermacentor variabilis*)

The American dog tick, also known as the wood tick, is one of the most common ticks in Kansas. It is not normally found indoors in great numbers, but can be picked up outdoors by people and pets and, thus, carried into the home. It will not, however, establish itself indoors. It is most commonly encountered in spring through mid-summer.

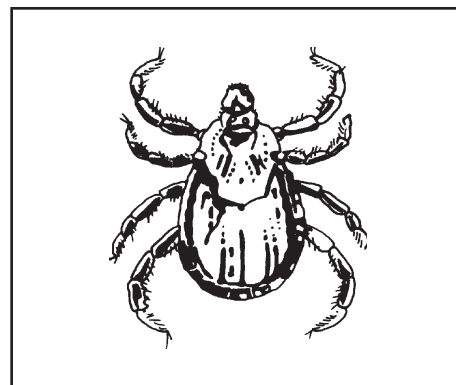
The American dog tick is capable of transmitting Rocky Mountain spotted fever and tularemia (rabbit fever). Larval and nymphal forms are usually found on mice, rabbits, muskrats, skunks, raccoons, foxes and other small animals. The adults prefer larger animals such as dogs, coyotes, humans, cattle, hogs and sheep.

Female ticks lay from 4,000 to 6,500 eggs. They hatch into larvae in 26 to 40 days, depending upon the temperature. The larvae move about actively searching for a host, such as a mouse or a rabbit. After completing a blood meal, the larvae drop to the ground and soon molt to the eight-legged nymphal stage. The nymphs seek out hosts, and after engorging themselves for several days, drop to the ground and molt to the adult stage.

Adult ticks attack larger hosts on which they may feed for one or two weeks. Mating occurs on the host. After mating, the female drops from the host and seeks a protective spot to lay eggs. She dies soon thereafter. The life cycle can take from one to two years, depending upon the availability of food and the temperature. The adult wood tick can live as long as three years without food.



American Dog Tick (male)



American Dog Tick (female)

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Blacklegged Tick (*Ixodes scapularis*)

This species includes the so-called “deer tick” that was thought to be a separate species (*Ixodes dammini*) from 1979 through 1992. There are no white markings on this species, and the legs are mahogany-colored rather than black. Blacklegged ticks are present in the eastern three tiers of counties in Kansas but are absent or rare further west. They require high humidity and, in Kansas, are usually found only in or near wooded areas near streams, ponds and lakes.

Blacklegged ticks are capable of transmitting Lyme disease, but only a low percentage of the population in Kansas seems to harbor the Lyme disease spirochete. They can also transmit the causative agents of tularemia, ehrlichiosis, and possibly Rocky Mountain spotted fever.

Larvae and nymphs are indiscriminate in host selection and may feed on any mammal (including humans), birds, and even on lizards. They are most common on mice, other rodents, and medium-sized animals such as raccoons and foxes. The adult females also may feed on the same array of hosts but are more abundant on deer, cattle, horses and dogs. The females usually attach to the head or neck of the host. Adult male blacklegged ticks do not feed.

In the north central states and New England, the blacklegged ticks have a two-year life cycle, but in Kansas and southern states most of the population attains adulthood in one year.

Adult females find hosts on warm days from October through January, and feed slowly through much of the winter. In late winter or early spring, engorged females detach from the host, mate, and, 10 to 20 days later, lay about 3,000 eggs each. Eggs hatch in seven to 20 weeks, assuring warm weather for the larvae. The rest of the life cycle is similar to that of American dog ticks.

Lone Star Tick (*Amblyomma americanum*)

Lone star ticks are common

throughout the eastern one-third of Kansas and are very abundant within a mile or two of streams and water impoundments. The species is named for the bright spot on the mid-dorsum of the adult female. This species has long, narrow mouth parts and feeds deeply. This fact, together with an anchoring-feeding tube secretion that nearly always stays in the skin when a lone star tick is removed, accounts for the intense skin response of animals and humans to bites from this species.

Lone star ticks utilize a broad range of hosts; larvae, nymphs and adults of both sexes all parasitize mammals from mice to dogs, raccoons, cattle, horses, deer and humans. Juvenile lone star ticks occasionally parasitize birds. The “seed ticks” that parasitize hikers, campers, and outdoor workers by the hundreds in eastern Kansas during July and August are larval lone star ticks. Adults and nymphs often infest the ears of deer and cattle by the hundreds, but they can feed anywhere on the host.

The life cycle usually requires a year, but the larval stage is the only synchronous stage of the species. Larvae that do not feed seldom survive the winter. Those that find hosts in late summer engorge, detach, molt, and become nymphs. A few of the nymphs find another host, feed, detach, and become adults and pass the winter. Many pass the winter as nymphs. Thus, both adults and nymphs are present to become active on warm days as early as late February, but more typically in April. Mating occurs on the host. Females lay from 6,000 to 8,000 eggs from one to four weeks after feeding. Eggs hatch from three weeks to four months later—all apparently hatching from late June through mid-August in our climate. Lone star tick nymphs and adults, unfed but otherwise under favorable conditions, have been known to survive for 430 and 436 days, respectively.

Control

American dog ticks, blacklegged ticks, and lone star ticks are found

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on grass, shrubs, bushes and other vegetation, especially along paths and animal trails. When a suitable host brushes by, the tick lets go of the plant and attaches itself to the host. Early removal is important, especially in disease transmission.

Frequently examine dogs and cats. Check all over the body and in the ears for ticks. Remove all ticks daily or treat the animal if it is infested.

Keeping grassy and weedy areas clipped short throughout the year helps discourage tick infestation and provides less opportunity for ticks that are present to transfer to a host. Where appropriate, eliminate shrubs and trees as mixed grassy and woody vegetation provides habitat for both rodents and ticks and affords climbing sites from which ticks can attach to passing people and animals. It may also be necessary to apply residual pesticides to lawns, trails and bushy areas.

Bed Bug, Bat Bug and Bird Bugs

The bed bug, bat bug and several species of bird bugs are pests of man and domestic animals, as well as bats and birds. They all feed on warm-blooded animals.

Bed Bug (*Cimex lectularius*)

The mature bed bug is a brown or rusty-red, wingless insect. Its size depends on the amount of blood that it has consumed. An unfed bed bug is from $\frac{1}{4}$ to $\frac{3}{16}$ inch long. When filled with blood, the body becomes elongated and swollen and the color changes from brown to dull red.

Bed bugs feed mostly at night by biting people who are asleep. But if they are very hungry and if the light is dim, bed bugs will feed during the day. When bed bugs bite, they inject a fluid into the skin that assists them in obtaining blood. Often, the fluid causes the skin to become irritated and inflamed. Welts develop and there is much itching. It has never been proven that bed bugs are disease carriers in the United States. If its feeding is undisturbed, a full-grown bed

bug becomes engorged with blood in three to five minutes. It then crawls to its hiding place where it remains for several days digesting its meal. When hunger returns, the bug emerges from hiding and seeks another blood meal.

Bed bugs may be serious pests in animal and poultry houses and in laboratories where rabbits, rats, guinea pigs or birds are kept for experimental purposes. Bed bugs may feed on small animals and birds that are kept as pets. The loss of blood may weaken these animals.

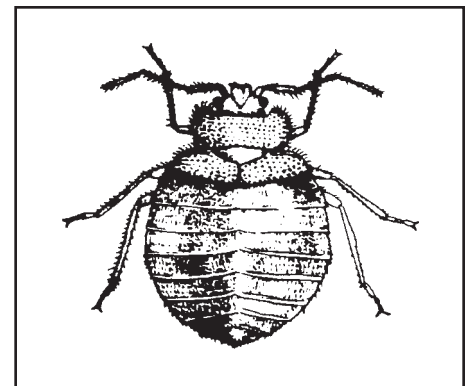
Under favorable conditions, one female bed bug lays about 200 eggs. When the insects feed regularly, eggs are laid at the rate of two or three a day. Maximum egg laying occurs when the temperature is above 21°C (70°F). No eggs are laid at temperatures lower than 10°C (50°F).

Newly hatched bugs feed at the first opportunity. They molt five times before reaching maturity. The bugs will feed a few days after each molt if a host is available. In a year there may be three or more generations.

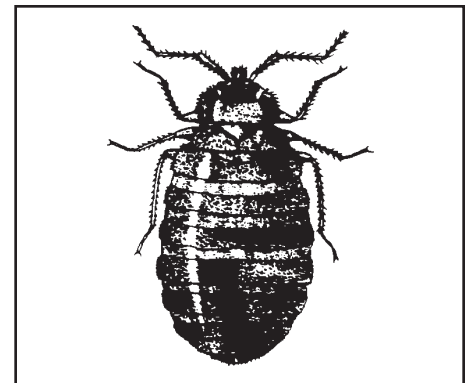
There is considerable variation in the period of development, even among bugs hatching at the same time. As a result, bed bugs in all stages are present at all seasons of the year.

Newly hatched bed bugs may live for several weeks without feeding during warm weather and for several months during cool weather. If they feed occasionally, they may live only about 10 months. However, it is common for older bed bugs to go two weeks to two months or longer without food. It is believed that under some conditions they can live a year or longer without food.

Habitual hiding places are usually made evident by black or brown spots of dried excrement on the surfaces where the bugs rest. Eggs, eggshells and cast skins may also be seen at these sites. At the beginning of an infestation, bed bugs are likely to be found only about the tufts, seams and folds of mattresses and daybed covers. Later, they move to crevices in the bedsteads.

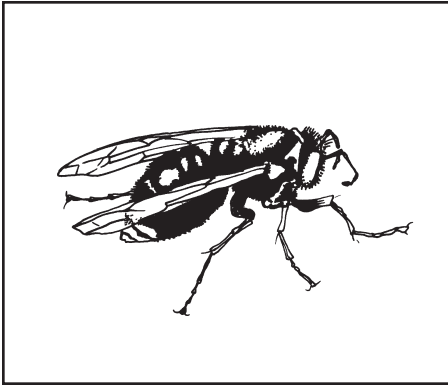


Bed Bug (before engorgement)

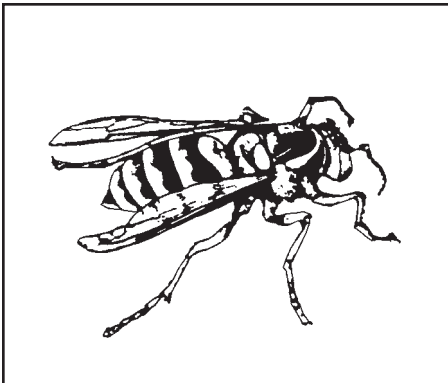


Bed Bug (after engorgement)

Pests Annoying and Attacking People and Pets



Baldfaced Hornet



Yellow Jacket

If allowed to multiply, they establish themselves behind baseboards, window and door casings, pictures, picture moldings, and in furniture, loosened wallpaper, cracks in plaster, partitions, door hinges and cracks in the floor.

Control

To control bed bugs in homes, locate harborage sites and apply an insecticide directly into those areas. Caulk and seal crevices in the structure that serve as harborage.

Bed bugs in hotels, apartments and other multiple-type dwellings may spread quickly from one unit to another. If they are found in one unit, the entire building should be inspected. Control any infestations revealed by the inspection.

Bat Bug (*Cimex adjunctus*)

The bat bug is normally associated with bats. However, it can become a pest of humans, especially when the bats have been driven out of the human quarters and prevented from re-entering. Deprived of their normal bat hosts, bat bugs will quickly seek another source of blood, usually humans and pets.

Control

The first step in control is to eliminate bats from the structure. The procedures for bat control are given on page 78 in this manual. Apply residual insecticides to areas inhabited by the bats and areas in the house where the bat bugs are hiding.

Bird Bugs

Several species of bugs resembling bed bugs infest birds. These include the poultry bug, chimney swift bug and barn swallow bug. As with bat bugs, if the birds leave or are driven away, the bugs will seek blood from humans. To control these bugs, remove the birds and bird nests from the building and apply residual insecticides to infested areas.

Wasps, Bees and Ants

One of the aggravating problems to the homeowner and the vacationer is the nuisance of bee and wasp nests around the dwelling unit.

When the average person sees flying insects swarming out of a crack in the foundation, it is often assumed that there is a swarm of honey bees in the house. However, this is not usually the case, for many wasp species are social in nature and build nests in areas where they may be confused with honey bees. Thus, it will be worthwhile to review the different bees and wasps which may cause concern to the homeowner.

Wasps

Wasps (hornets, yellow jackets, mud daubers and *Polistes* wasps) are identified by the nest they build and by their body shape.

Baldfaced Hornet

(*Dolichovespula maculata*)

The large, gray, paper nests, shaped somewhat like a football and located in trees and shrubs are the product of this hornet species, not of honey bees. Each nest starts new in the spring and is enlarged as the colony becomes more populous. In the fall, the nest is at its maximum size. Only the queens overwinter by hibernating. Meanwhile, the nest is ruined during the winter by birds and other animals, often seeking the remaining larvae in the nest. The nest is not used the following year.

Control

When hornets are a nuisance, they can be controlled by using sprays designed for wasps and bees. Spray the nest in the evening when the hornets are "home" and when the temperature is lower. Direct the spray or dust at the entrance hole at the bottom of the nest. If necessary, repeat the treatment on following evenings. Be sure to spray from the side, because, on being disturbed, the hornets will drop downward.

Yellow Jackets (*Vespa* sp.)

These insects are most often confused with honeybees, appearing at first glance or in flight to be the same size and color of the Italian race of honey bees. But yellow jackets are somewhat more slender and have definite black and yellowish bands on the abdomen.

Pests Annoying and Attacking People and Pets

Yellow jackets usually nest in the ground or along foundations. They often are encountered by the homeowner while trimming shrubs, mowing or weeding. The nest is also a paper nest and is located several inches to a foot underground.

Control

Inject insecticide down the hole and then seal it to hold the fumes and the wasps. Do this at night when the yellow jackets are inactive. For extra safety from stings, cover the hole with screen and treat the hole through the screen. If the nest is against living plant materials, care should be taken with the insecticide so as not to kill or injure the plant.

Polistes Wasps (*Polistes* spp.)

Polistes wasps are long-legged and slender with a spindle-shaped abdomen. They are reddish or brown in color. They often are seen flying up and down outside walls on sunny days in the fall and spring of the year. During the fall, they are seeking shelter, while in the spring they are looking for a nesting site.

Polistes wasps build paper-like nests with only one layer of cells facing downward, appearing like a section of honeycomb. Quite often the nests are located under the eaves or protective overhang of a building. These wasps also use attics, barns and garages as nesting locations. As do other wasps, the polistes abandon their nests in the fall and the mated females are the only insects to overwinter.

Control

A polistes female killed in the fall or the early spring, even with a fly swatter or a folded newspaper, will eliminate an entire nest during the summer. Inspecting under eaves and other protected areas and removing and destroying nests provides an effective eradication system in early summer. In addition, sprays for bees and wasps will be effective on these inverted, open nests.

During the fall and winter months, the hibernating female will sometimes be encountered in the attic, in window

wells or similar areas. She can be removed by crushing or spraying as the situation warrants.

Mud Daubers (*Sphecidae*)

Mud daubers are solitary wasps. Each female constructs her own clump of mud cells. There is no worker caste. In spring, young adults come out of their nests (where they have overwintered as resting larvae) and mate. Each of the females then starts to build a mud or clay nest. First she builds a cell. Next, she catches about 20 immature spiders, paralyzes each with her sting as she catches it, and stores it in the cell. Then, she lays an egg on one of the spiders and caps the cell with clay. She repeats this until she has built six to 20 cells (one nest). She may then build a second nest in another location.

When her nest is finished, she leaves it and does not return. The larvae hatch from the eggs and begin feeding on the paralyzed spiders. In a few days, they spin cocoons and change to pupae. The pupae change to adults in about two weeks.

Control

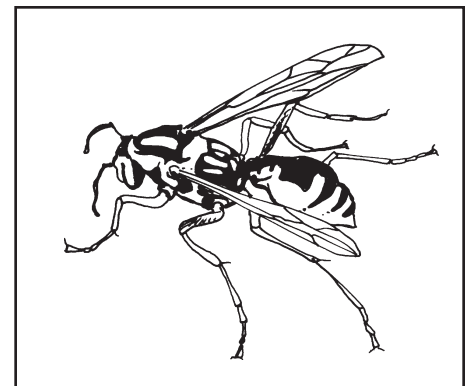
One to three generations of mud daubers can develop each year—the number depends on the section of the country. They are docile and seldom sting unless tightly restrained. Control is difficult and exclusion is probably the best solution. Mud structures should be picked off and destroyed.

Cicada Killers

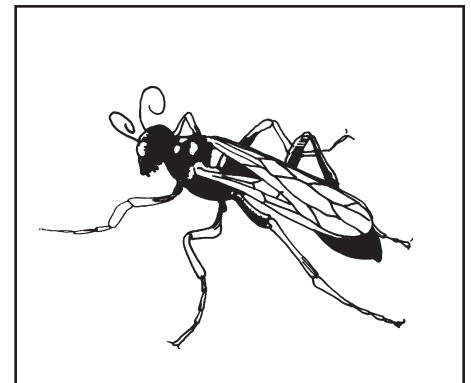
(*Sphecius speciosus*)

Cicada killers are large (up to 2 inches long), black and yellow wasps. They do not sting unless handled, but their size makes many people fearful of them.

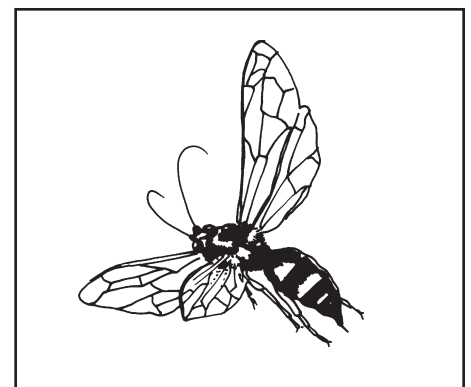
In early summer, adult cicada killers also come out of their nests (where they have overwintered as resting larvae) and mate. The fertilized female then digs a long tunnel in the ground, at the end of which she digs a large oval cell. Then she hunts for a cicada, paralyzes it by stinging, and places it in the cell. She may lay an egg on this cicada or she may bring in another one before laying an egg. She seals the



Polistes Wasp

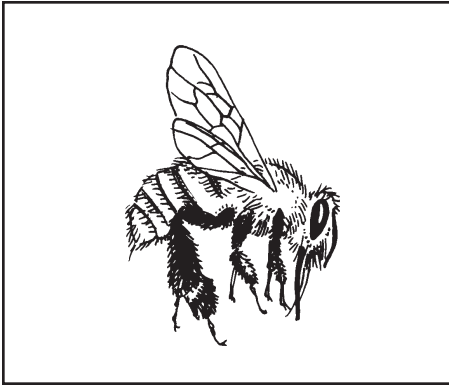


Mud Dauber

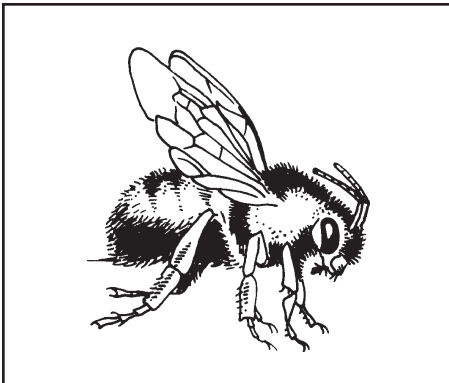


Cicada Killer

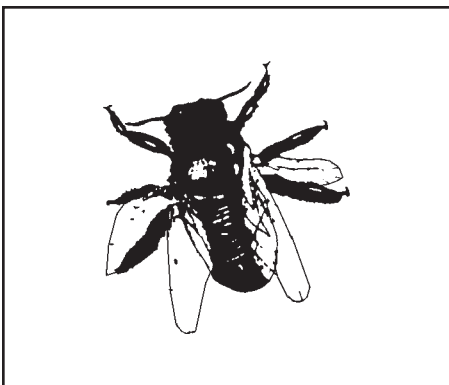
Pests Annoying and Attacking People and Pets



Honey Bee



Bumble Bee



Carpenter Bee

cell with soil and then digs another cell which she provisions in the same way. A completed nest may contain about 16 cells. When the eggs hatch, the larvae feed on the cicadas.

Control

Control may be obtained by applying insecticides to the burrows. But, ordinarily, this species should be left alone.

Bees

While wasps feed on other insects and spiders, bees visit flowers for pollen and nectar to feed their young, consequently serving as flower pollinators. However, sometimes bees and humans conflict. This is particularly true if the bees are within the siding of a house or if they endanger children at play or if they complicate the use of a yard for human recreation.

Honey Bees (*Apis mellifera*)

Poorly managed colonies of honey bees issue one or more swarms in the spring or early summer. These swarms are often a problem to the homeowner.

Unlike wasps, the entire colony of honey bees will persist for many years and will often increase in size. Therefore, it is important to remove undesirable swarms as soon as they are identified.

Control

If removal of swarms is desired, it is sometimes practical to contact a local beekeeper who may capture swarms and either keep them in standard beekeeping equipment or destroy them as a service. Local municipal offices or county Extension offices may have names of beekeepers who will take swarms.

Another suitable method for the removal of an alive colony is to nail a platform onto the side of the building and place an empty hive or a weak colony on the platform so that the entrance of the new hive is near the present exit hole for the swarm. A screen cone is then fitted over the exit hole and directed to the outside. The bees then accept the new home over a period of several weeks.

Unfortunately, this method does not eliminate the wax, honey and brood in the wall—all of which will attract insect pests and rodents as well as bee swarms in following years. It is, thus, wise to remove the siding of the house and clean out the remains of the swarm. After killing the swarm, remove the remains of the swarm to prevent robbing by other honey bees, wax moths or other insects. The wax and honey should be burned and not consumed by humans.

Bumble Bees (*Bombus* spp.)

These are very large, heavy-bodied social insects which usually nest in the ground. They can become a problem if the nest is established close to a building foundation or when they occasionally nest in insulation material. Most species will aggressively defend their colonies. The nest should be treated with an insecticide for wasps and hornets.

Carpenter Bees (*Xylocopa virginica*)

These insects closely resemble bumble bees but have a broader head and a shiny black abdomen. They chew tunnels into solid wood to make their nests and can cause structural damage. An insecticide for wasps and hornets may be directly applied into the tunnels if necessary. Keeping exposed wood painted will deter infestation. After treating carpenter bee holes, fill them and paint over the repaired area.

Digger Bees

Digger bees sometimes cause problems in lawns by interfering with human use and enjoyment. They can be destroyed with an insecticide used for wasps and hornets.

Wasp and Bee Stings

If someone is stung by a honey bee, remove the stinger as quickly as possible. Recent research has shown that speed of removal is far more important than how the stinger is removed. Wasps do not leave a stinger.

Once stung, a person can do little but accept the pain and swelling

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which sometimes lasts for several days.

Some persons are highly allergic to insect poison and experience a general reaction which may be rapidly fatal. If this is suspected, contact a physician and arrange for immediate treatment. An allergy specialist may advise a series of injections to lessen sensitivity.

Ants

Ants feed upon every food consumed by humans and are troublesome household pests. Some ants feed predominately on sweets, whereas other prefer meat and grease. All ants bite and some also sting. Reaction to an ant bite or sting can be severe in sensitive individuals. Some species of ants also act as scavengers and predators of many harmful insects.

Ants are distinguished from other insects by having the first one or two abdominal segments reduced into a knobbed stalk located between the thorax and the abdomen proper and by their elbowed antennae. (Termites have a broad connection between the thorax and abdomen and straight, bead-like antennae.)

The forewings of ants are larger than the hind wings and have comparatively few veins (whereas the two pairs of wings of termites are similar in size and appearance and have many indistinct veins). Ants have chewing mouthparts, their heavy mandibles being suitable for biting, piercing, cutting and gnawing. The smallest ant is less than $\frac{1}{16}$ inch long and the largest ant attains a length of $1\frac{1}{2}$ inches.

Ant colonies may live many years. The colony is established when the newly mated female discards her wings, digs a nest and produces eggs for a new brood. After nourishing her young through the larval stage, the larvae pupate and the young workers emerge and take over the work of the colony.

The worker ants feed the queen, fight off enemies, construct a maze of tunnels, and care for the young. When the colony has matured, a special brood of males and females

is reared to establish new colonies. These winged adults emerge in vast numbers for their marital flight in order to mate and establish new colonies.

Most ant species have only one queen per nest. She lays the eggs to maintain or increase the colony size. Larvae, after hatching from the eggs, are translucent white, soft-bodied, and legless. These larvae, along with the queen, are fed by the worker ants (foragers). Larvae pass through several growth stages before pupation and adulthood are reached.

Carpenter Ant (*Camponotus* sp.)

Carpenter ant or large black ant occurs widely in the United States and is one of the largest common ants. The adults vary in length from $\frac{1}{4}$ inch for small workers to $\frac{3}{4}$ inch for a queen. The body is dark brown to black in color.

Carpenter ants seek soft, moist wood to establish their nests—particularly wood that has weathered and begun to decay. Although the nest is most often begun in the soft wood, later excavations frequently are made into perfectly sound, dry lumber. They may be found in tree stumps and living trees as well as porch columns and roofs, window sills, hollow core doors, wood scraps in dirt-filled slab porches and wood in contact with soil.

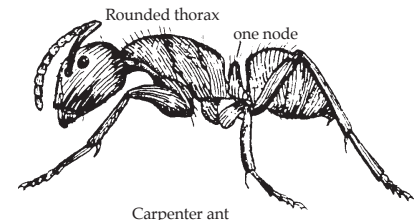
Carpenter ants do not eat wood (which is unlike the termites), but excavate galleries in the wood to rear their young. Carpenter ants eject the wood in the form of a coarse sawdust. The characteristic sawdust piles aid in nest location. They feed on honeydew excreted by aphids, upon other insects, animal remains and household food scraps.

The work of carpenter ants is easily distinguished from that of termites. Their galleries are excavated without regard for the grain. The galleries are kept smooth and clean, having a sand papered appearance. Termite galleries are not smooth and clean.

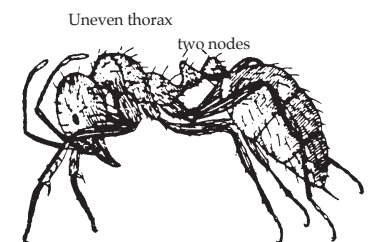
When carpenter ants are found in a structure, either the colony is nesting within the building proper or they are nesting somewhere outside the build-



Digger Bee



Carpenter Ant



Most Other Ants

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ing and merely entering to forage for food. Houses near wooded areas are especially subject to invasion.

Control

The key to the control of carpenter ants is locating the nest or nests. This is the most important part of their control and sometimes the most difficult. If the nest or nests can be found, there is an excellent chance of eliminating the pest. Elimination of the nest outside may be just as important as one established in the building. In some cases, an entire colony may migrate from one nesting site to another from a tree outdoors to structural timber indoors.

As an aid to finding the nest indoors, examine these suggested locations:

- wood affected by water seepage (porch floors, roofs, porch posts and columns).
- wood in contact with soil.
- wood adjacent to soil-filled porches.

Carpenter ants are usually found associated with a moisture condition. Some signs of carpenter ants to look for when inspecting for a nest indoors are:

- piles of coarse "sawdust" on floor or foundation.
- ant activity, since they frequently forage for food in kitchens. However, even when the nest is in a building, very few ants may be seen. They are usually active at night and often forage outside.
- firewood piled in garage or next to a house.

Some of the things to look for outdoors are:

- firewood, stumps, logs, and trees that might contain nests.
- trees with branches hanging over and touching the roof of a house.

Ants may travel over these branches into the building

For non-chemical control, sanitation measures such as removing and destroying logs and stumps that harbor nests will help eliminate the pests. Protection of structures from carpenter ants requires destruction

of the nests in and near the structure.

For chemical control, apply insecticides to the nest and nest areas. Spraying or dusting the infested area without locating and treating the nest will not provide complete control.

Other Ants

Pharaoh's ant or little red ant is usually found in institutional buildings and is very difficult to control. There are often many colonies established in a single building. These ants are under foundations, in walls, under floors, in cellars, etc. They feed on most foods, such as grease, meats, seeds, dead animals, etc. They are $\frac{1}{10}$ inch long and yellowish or reddish-brown in color.

The tiny thief ant is found in cracks and crevices of buildings and especially near the kitchen sink. This pest can nest in the walls or outdoors, under rocks, etc. They often are found around kitchen sinks and cupboards. They usually do not feed on sweets, but consume grease, oils, cheese, meat, dead animals, etc. They are $\frac{1}{6}$ to $\frac{1}{8}$ inch long and yellowish-brown in color. These ants are troublesome during the warmer seasons.

The little black ant is less common than other ants as a household pest. This ant nests principally in the soil and rotting wood. They are about $\frac{1}{10}$ inch long and jet black in color. They will nest both indoors and outdoors. Food habits are general.

The pavement ant is annoying since it gets into practically everything in the house from food to shoe polish. These ants are slow, sluggish, short-legged, and usually nest under pavements and foundations. They feed on animal food, grease, seeds, etc., and are common in the home, especially in the summer. They are $\frac{1}{12}$ to $\frac{1}{4}$ inch long and brownish-black in color.

Cornfield ant is common with its small earth mounds on lawns and in fields. Their nests are also found in pavement cracks around the home. This ant is common outdoors and enters the home to feed on sweets.

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Control

Killing some or part of the workers or foragers merely weakens the colony but does not affect the queen or young unless the food supply is seriously reduced. In controlling ants, the secret of success is to locate and destroy the nests including the queen and young.

Fortunately, most nuisance ants nest outdoors and only occasionally invade buildings. In these cases, a chemical barrier is effective if applied around the outside of the house.

One must first find where the ants are entering the building or at least the direction they approach the area. Once the route is known, careful spot treatments with the proper pesticide will reduce the problem considerably. Treat all points of entry.

Mound-building ants often enter and leave nests through tunnels at a distance from the mound and control may require treatment of areas 10 feet or more in radius. Sprays may be used to saturate nests after the mounds are opened with a hoe.

Inside buildings, sanitation carried out by building occupants is

an important aspect of ant control.

Crumbs, grease, food scraps and foods in open or partly open containers are readily found by foraging workers and can attract large numbers of ants. Heavy infestations in buildings are rarely found where good sanitation is practiced.

Insecticides can reduce ant populations indoors, but they are not effective in eliminating colonies unless the nest itself is treated.

Poisoned baits can be used effectively if they are more attractive to the species present than other available foods. Baits are taken into the nests and fed to the larvae, the reproductives and the soldiers. However, the poisons must be slow acting to provide control, as fast-acting poisons kill the workers before the bait is distributed. Follow manufacturer recommendations for bait use and take care to avoid possible food contamination and contact by children and pets.

Pests Annoying and Attacking People and Pets

Study Questions

1. (29) The housefly eggs will hatch in _____ under favorable conditions.
 - a. 36 hours
 - b. 24 hours or less
 - c. 1 week
 - d. 1 month
2. (29) What is essential for housefly control?
 - a. any type of fly spray
 - b. highly concentrated insecticides
 - c. proper sanitation
 - d. chemical treatment of breeding areas
3. (30) Chemical control of housefly adults indoors usually includes:
 - a. aerosols
 - b. dusts
 - c. baits, when there is exposed food in the room
 - d. rodenticides
4. (30) Drain flies (moth, filter, or sewage flies) are:
 - a. $\frac{1}{16}$ to $\frac{1}{8}$ inch long and light gray or tan in color
 - b. $\frac{1}{2}$ inch long and dark brown or black in color
 - c. $\frac{3}{4}$ inch long with dark wings and a light body
 - d. $\frac{3}{4}$ to 1 inch long and dark gray or brown in color
5. (31) Insecticides should be used on drain flies:
 - a. when they are first detected
 - b. before using a drain cleaner
 - c. before removing organic debris
 - d. only after solving sanitation problems
6. (31) Mating and egg-laying among spiders occur:
 - a. during the warm months only
 - b. during the spring and fall only
 - c. during the winter only
 - d. any time of the year
7. (32) Some young spiders have been carried through the air up to 6 miles by a method known as:
 - a. planing
 - b. ballooning
 - c. flying
 - d. gliding
8. (32) In Kansas, the brown recluse spider is found:
 - a. throughout the state
 - b. only in the eastern part of the state
 - c. only in the northwest area of the state
 - d. only in the southern half of the state
9. (33) A person is most likely to be bitten by a brown recluse:
 - a. outdoors in pastures and weedy areas
 - b. outdoors around plant debris or other decaying organic matter
 - c. indoors when putting on clothes which have been stored
 - d. in the kitchen during the daytime
10. (33) The female black widow spider is normally:
 - a. very aggressive
 - b. found carrying eggs on her back
 - c. shy and nocturnal in habit
 - d. found running on the ground hunting for food
11. (34) An important thing to remember when using chemical control on spiders is:
 - a. do not use residual insecticides
 - b. all spiders do more good than harm
 - c. all nonpoisonous spiders are dangerous and cause a painful bite

Pests Annoying and Attacking People and Pets

Study Questions

- d. spiders are not insects so check label during pesticide selection
12. (34) Scorpions rarely sting humans, but when they do, the sting:
 - a. is deadly
 - b. is not even noticed
 - c. resembles that of a bee or wasp
 - d. causes the skin around the sting area to sluff off
13. (35) To achieve effective flea control:
 - a. only the adult fleas need to be killed
 - b. put a flea collar on the dog or cat
 - c. treat fleas on pets plus areas they frequent
 - d. kill flea eggs with insecticides
14. (36) Flea infestations on pets should be treated:
 - a. by the pest control operator
 - b. by the owner or veterinarian
 - c. by brushing the pet
 - d. a and b
15. (36) The brown dog tick is an important pest of:
 - a. dogs
 - b. humans and cats
 - c. humans, dogs, and cats
 - d. dogs and humans
16. (37) The American dog tick is:
 - a. normally found indoors
 - b. also known as the house tick
 - c. one of the most common ticks in Kansas
 - d. a and b
17. (38) Blacklegged ticks are present in Kansas:
 - a. in the eastern three tiers of counties
 - b. in the central three tiers of counties
 - c. in the western three tiers of counties
 - d. in the far northwest four counties
18. (38) All growth stages of the lone star tick feed on:
 - a. mice, dogs
 - b. horses, cattle
 - c. deer, humans
 - d. all the above
19. (39) The mature bed bug:
 - a. is known to transmit diseases in Kansas
 - b. is a ¼ inch long, rusty-red, wingless insect
 - c. feeds mainly during the day
 - d. all of the above
20. (39) Bed bug hiding places are recognized by:
 - a. black or brown spots of dried excrement
 - b. tan oval-shaped hard pellets on surfaces
 - c. bed bug nests made of dirt and their waste products
 - d. small mounds of dead bed bugs
21. (40) To control bed bugs in homes:
 - a. at night, apply insecticides directly on bed bugs
 - b. destroy all bedding materials
 - c. apply insecticides directly into areas where they hide during the day
 - d. wash blankets and sheets and keep pets out of the house
22. (40) The wasps most often confused with honeybees are the:
 - a. polistes wasps
 - b. mud daubers
 - c. yellow jackets
 - d. hornets
23. (41) The polistes wasps abandon their nests in the fall and overwinter as:
 - a. eggs
 - b. larvae
 - c. unmated female adults
 - d. mated female adults

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Study Questions

24. (41) Mud daubers:
 - a. are solitary wasps
 - b. live in colonies
 - c. have a worker caste
 - d. are very aggressive
25. (42) Bees:
 - a. feed on insects and spiders
 - b. feed on flower nectar
 - c. pollinate flowers
 - d. b and c
26. (42) Carpenter bees:
 - a. make nests inside mattress stuffing
 - b. cause problems in lawns
 - c. make tunnels in wood for nests
 - d. build hives in sidings of homes
27. (43) Ants:
 - a. feed only on sweets
 - b. are predators and scavengers of many harmful insects
 - c. cannot be distinguished from termites
 - d. have sucking mouthparts and feed on blood
28. (43) Carpenter ants:
 - a. eat wood
 - b. feed on honey dew excreted by aphids and food scraps
 - c. excavate galleries in wood that look exactly like termite galleries
 - d. are one of the smallest of the common ants
29. (44) Carpenter ants are usually:
 - a. found near moisture
 - b. active only at night
 - c. not around wood in contact with soil
 - d. found in dry wood and dry areas
30. (44) Nonchemical control of carpenter ants include:
 - a. replacing all infested wood
 - b. keeping house free of dirt and dust
 - c. removing logs and stumps that possibly have nests
 - d. applying insecticide to the nests
31. (45) Mound building ants may enter and leave nests through tunnels and control around the mound may require treatment of areas up to:
 - a. 4 to 6 inches in radius
 - b. 1 to 2 feet in radius
 - c. 5 feet in radius
 - d. 10 feet or more in radius
32. (45) Poisoned baits can be used effectively for ant control:
 - a. if they are fast acting poisons
 - b. if they are slow acting poisons
 - c. if there is other more attractive food available to the ants
 - d. only when used with a contact spray



Entomophobias, Cryptic Infestations, and Imaginary Bugs

Entomophobia means excessive fear of insects. An entomophobic person can be a difficult client for the pest control operator because he or she may become extremely agitated by the sight of one insect flying or crawling in the home. Fortunately, the condition is rare and it is classed as a neuroses, i.e., a psychological condition that can be overcome through conditioning regimes.

Cryptic parasitism is also difficult to deal with. In this case, an actual parasite has caused skin lesions and sometimes itching or biting sensations. Cryptic means hidden or hard to find. Cryptic parasitism may be a non-classical presentation of scabies, or transient or accidental parasitism by animal mange mites, stored product mites, or straw itch mites. Sometimes the cause turns out to be ordinary chiggers or tiny biting gnats that the victim was exposed to outdoors but did not become aware of until several hours later, while indoors. A person's immune response to bites often require several hours before itching occurs or a welt or rash appear. Thus, the person insists that the problem concerns an indoor pest when there is none to be found. A client with cryptic parasitism may be insistent and demand several call backs. The condition is usually of short duration. Despite the best efforts of the victim and the pest control operator, the source often remains unidentified when the problem ceases.

Without finding the cause, cryptic parasitism may be impossible to distinguish from illusory parasitosis. Illusory parasitosis is the illusion or belief that skin sensations caused by an external physical or chemical agent are caused by "bugs." The victim usually thinks that the "bugs" are mites or flying insects too small to be seen. As with cryptic parasitism, there is

an actual, identifiable, external cause of the sensations although they may be difficult to find. Such causes may include urticating hairs of carpet beetle larvae, asbestos fibers, allergies to clothing fabric or dyes, laundering agents, cellulose particles in the air, and even past infestations with head lice, scabies, or fleas that have so piqued the victim that nearly any itch or prickle he or she experiences is interpreted as continuing infestation. The cause(s) may be very difficult to find, but management or elimination of causes brings an end to the torment.

Nearly every pest control operator sooner or later encounters a client who has a much more serious condition, delusory parasitosis. This is the persistent, intensive, acute sensations of, and belief that, parasites (mite, flying insects, worms or a combination thereof) are crawling on, biting, and crawling in and out of one's skin and/or body orifices. The sensations of biting and crawling are real, but the supposed cause is mistaken. The victim may even have rashes or skin lesions that look like insect bites, but these are self inflicted by "treatments" and picking at the "bugs." Clients may have manic episodes and there often is an obsessive compulsive aspect to this malady. Unlike either cryptic parasitism or illusory parasitosis, there is no external physical cause. Unlike entomophobia, the victim is not afraid of the "parasites;" he or she willingly and zealously collects what he or she believes to be the causative specimens. Often, the client provides detailed descriptions of the behavior of various "life stages" of the "bug" or mite and the different crawling, biting, or flying behavior of each. They may attribute impossible feats of surviving extreme cold, heat, or chemical treatments to the supposed parasites. If the pest control operator makes a general household application of insecticide in hopes of killing an unknown but cryptic infestation, the client may report two or three days of relief. But this is only a placebo effect because, invariably, the problem returns in full force.

Entomophobia

Delusory parasitosis is a psychosis—a severe level of psychological derangement that virtually governs every aspect of one’s life. Although victims may be intelligent and capable of conducting rational discussions on a moment-to-moment basis, they persistently return to and cling to their interpretations of the parasitosis. Delusory parasitosis cannot be cor-

rected by reasoning or by additional pesticide use. There are apparently a multitude of underlying causes in different cases. Satisfactory diagnosis and treatment requires a practitioner of internal medicine, often working with a dermatologist. There are curative medications. Along with proper medication, psychiatric counseling may be required.

Study Questions

1. (49) Entomophobia means:
 - a. excessive fear of insects
 - b. excessive fear of snakes
 - c. excessive fear of birds
 - d. excessive fear of heights
2. (49) In cases of "cryptic parasitism," the word "cryptic" means:
 - a. obvious
 - b. imaginary
 - c. hidden or hard to find
 - d. vault for the parasites
3. (49) An example of cryptic parasitism may be caused by:
 - a. animal mange mites
 - b. straw itch mites
 - c. ordinary chiggers
 - d. all the above
4. (49) Without finding the cause of cryptic parasitism, it may be a case of:
 - a. entomophobia
 - b. illusory parasitosis
 - c. transit neuroses
 - d. paranoia
5. (49) In "illusory parasitosis," skin sensations are caused by:
 - a. physical or chemical agents
 - b. straw itch mites
 - c. chiggers
 - d. bed bugs
6. (49) _____ is the most serious condition.
 - a. entomophobia
 - b. cryptic parasitism
 - c. illusory parasitosis
 - d. delusory parasitosis
7. (49) In the case of _____ there is no external, physical cause.
 - a. entomophobia
 - b. illusory parasitosis
 - c. delusory parasitosis
 - d. cryptic parasitism
8. (50) Delusory parasitosis:
 - a. cannot be corrected by reasoning or pesticide use
 - b. can be corrected by reasoning or pesticide use
 - c. can be corrected with two applications of any OP insecticide
 - d. can be corrected with two hours of lecturing on how to reason

Fumigation



The General Manual, S-12, informs you of the basic required information that is common to all pesticide labels including such information as a list of active ingredients, type of pesticide, formulation, EPA registration number, hazard statement, personal protective equipment, etc. Specific information, however, varies from label to label, particularly under directions for use and recommendations for use.

Fumigants are pesticides which, by themselves or in combination with any other substances, are or become gas or a mixture of gases. Fumigants will kill or control a pest and are usually poisonous or dangerous to humans. Various aerosol space sprays are not considered fumigants.

Fumigants penetrate cracks, crevices, and the commodity being treated. They must reach the target pests as gases to be effective. As soon as a fumigant is diffused from the target area, pest reinfestation can occur. Fumigants must be applied in enclosed areas.

Advantages of Fumigation

Fumigation has several advantages over other pest control procedures.

- Fumigants are usually quick acting and can result in eradication of the pest.
- Fumigants being gases, diffuse through all parts of the structure or commodity being treated and, thus, reach pest harborages that cannot be reached with conventional pest control materials or techniques.
- For certain pests/commodities, fumigation is the only practical method of pest control.

Disadvantages of Fumigation

There are several reasons why fumigation may not be the best means of pest control.

- The control achieved through fumigation is temporary. There is no residual action from fumigants, and as soon as the fumigation is completed, the structure, or commodity fumigated is susceptible to reinfestation.

- Fumigants are toxic to humans and special precautions must be taken to protect fumigators and the occupants of fumigated structures.
- Because fumigants are gases, provision must be made to retain the fumigant within the space being fumigated. This requires additional labor.
- Fumigation must not be attempted by one person. Additional labor is required.
- Some commodities or pieces of equipment may be damaged by certain fumigants and must be either removed or protected.
- The technique of applying fumigants requires special training for all members of the fumigation crew, adding to fumigation costs.
- Fumigation usually requires that occupants of the structure vacate the building for a number of hours. This may be inconvenient.

Selection of Fumigants

When choosing a fumigant, the following kinds of factors should be considered:

- label approval for intended use.
- toxicity to the target pest.
- volatility and ability to penetrate.
- corrosive, flammability and explosive potential.
- warning properties and detection methods.
- affect on seed germination or finished product quality.
- residue tolerances.
- availability.
- ease of application.
- cost.

Several factors can change the efficiency of fumigants. Consider these when selecting a formulation and dosage:

Temperature. The fumigant may not kill the pests if the product or space being fumigated is below 10°C (50°F) or above 46°C (115°F).

Moisture. As the moisture content increases, it becomes more difficult for a fumigant to penetrate. This also increase the potential for residues exceeding legal tolerances. Adequate

moisture is required for the generation of some fumigants.

Pests. Susceptibility to fumigants depends on species, habitat and stage development. During some stages of their life cycle, for example, many insects are protected by the product they infest.

Structure. Consider the condition of the structure, the type of construction, and the product it contains.

A wooden structure, even when sealed well, will not retain fumigants as well as metal, plastic, masonry, or concrete. Fumigation in vacuum chambers allows increased efficiency.

Fumigants

NOTE: Fumigation requires specialized equipment and training. The following is generalized information on fumigant products. Applicators must obtain and follow all manufacturer's and label specific directions.

Methyl Bromide At a Glance Required Clothing:

- Loose shirts, long trousers and socks that are cleaned after each wearing. Do not wear jewelry or gloves.
- Full-face shield for eye protection, when handling the liquid such as opening the cylinder to introduce gas into a structure.

Levels:

- <5 ppm no respiratory protection required
- >5 ppm National Institute for Occupational Safety and Health/ Mines Safety Health Administration (NIOSH/MSHA) approved self-contained breathing apparatus (SCBA) or combination air-supplied/SCBA respirator.

Uses:

What. Structures and dwellings, bags, boxes, crates (empty), furniture, lumber and wood products.

Where. Chamber and vault fumigation—vacuum chambers, tarpaulin fumigation.

Methyl Bromide (MB)

Properties. Colorless, odorless gas that is heavier than air and readily penetrates commodities. Relatively harmless to plants and trees. Easily removed by aeration.

Fire hazard. Nonflammable at usage level (flammable at 13.5 to 14.5 percent in air). Extinguish pilot lights and flames in building before using.

Explosion hazard. Non-explosive, although overdosages of methyl bromide may create an explosion hazard because the gas can expand beyond the holding capacity of the vault or tarp.

Human hazard. Not as toxic as some other fumigants but needs caution because of lack of odor. Most suppliers add 2 percent chloropicrin (CP) as a warning agent although CP may be absorbed by commodities and fail to indicate MB presence. Liquid MB will cause severe blisters on contact with skin. Tests with a halide leak detector will indicate dangerous concentrations

by a light green to dark green to blue green to blue flames. Use detector tubes or thermal conductivity apparatus for more exact determination of MB in air. Exposure brings neurological symptoms (headaches, incoordination, visual disturbances). Monthly blood bromide tests are suggested for those using or exposed to near maximum MB levels.

Uses. READ THE LABEL. Not as toxic to insects as Hydrogen Cyanide (HCN) or Ethylene dibromide (EDB) but penetration into commodities enhances its uses. Certain commodities (iodized salt, sponge rubber, leather goods, viscose rayons, photo chemicals, etc.) should not be exposed to MB.

Aluminum Phosphide, Magnesium Phosphide At a Glance

[Hydrogen phosphide, PH₃, (Phosphine, Phostoxin, Fumi-Cel, Detia, Fumitoxin, others)]

Required clothing:

- Dry cotton gloves if contact with the pellets or tablets will be made.

Fumigation

Respiratory protection:

- Respiratory protection required if exposure is likely to exceed the eight-hour time-weighted average (TWA) of 0.3 ppm during application, or is above 0.3 ppm at any time after application has been made.

Levels:

0.0 to 0.3 ppm—No protection required.

0.3 to 15 ppm—NIOSH/MSHA approved full-face gas mask—hydrogen phosphide canister.

0 to 1500 ppm—can use the gas mask described above for escape only.

>15 ppm—or unknown level—NIOSH/MSHA approved SCBA.

Uses:

What. Raw agricultural commodities, animal feed and feed ingredients, processed food, tobacco and certain other non-food items.

Where. Fumigation of railcars, bins, silos, under tarpaulins in small sealable structures and enclosures, mills, food processing plants and warehouses.

Aluminum Phosphide (Phosphine) (PP)

Properties. Colorless gas which may have a carbide or garlic-like odor (due to impurities present when the gas is generated). Penetration into commodities is excellent. Aeration quickly removes PP after fumigation.

Fire hazard. Highly flammable at 1.79 percent in air (and up) which is considerably above the usage concentration. Reacts with all metals and especially copper causing severe corrosion; therefore, all wiring, motors, switches and other equipment must be protected.

Human hazard. Highly toxic to humans with the lowest threshold working limit of 0.3 ppm (.00003 percent air). Garlic odor warns of toxic concentrations but may not always be present when PP is above 0.3 ppm. Detector tubes should be used to ensure safe working levels for employees. Symptoms include fatigue, buzzing in ears, nausea, pressure in chest, intestinal pain, diarrhea

and vomiting. Notify your physician of PP exposure. A special canister is required for gas masks as protection from PP up to 0.5 percent in air.

Uses. READ THE LABEL. Very highly toxic to insects although requiring 72 or more hours of treatment time (aluminum phosphide tablets evolve PP rather slowly, needing 24 to 48 hours to react with atmosphere moisture—may take longer at low humidities). Preadult stages of some insects are resistant to short exposures to PP but are controlled by a 10-day (or more) fumigation period.

Sulfuryl Fluoride At a Glance (Vikane)

Required Clothing:

- Full-body clothing and shoes, no gloves, no rubber boots.
- Wear goggles or full-face shields when handling the liquid, such as opening the cylinder to introduce gas into the structure.

Levels:

0 to 5 ppm none required.

>5 ppm NIOSH/MSHA self-contained breathing apparatus, or combination air-supplied/SCBA respirator.

Uses:

What. Furnishings, dwellings, buildings, vehicles.

Where. Structures, tarpaulins, chambers. Avoid food, drugs, and plants.

Sulphuryl Fluoride (SF) (Vikane)

Properties. Colorless, odorless gas. Noncorrosive and unreactive to most materials. Good penetration of dry wood products and fabrics but requires fans to get good distribution. Not an efficient ovicide.

Five hazard. Nonflammable. In presence of open flame or electric heating element, SF forms a very corrosive gas.

Human hazard. Highly toxic gas requiring proper precautions on part of applicator. Maximum exposure limit is 5 ppm for 40-hour week. Special canisters are required for concentrations above that amount. Expo-

Fumigation

sure symptoms include respiratory irritation and depression. Notify doctor in cases of exposure (manufacturer supplies first-aid booklet).

Uses. READ THE LABEL. Not registered for any food or drug item. Registered for dry-wood termites, powderpost beetles, wood boring beetles, bed bugs and clothes moths. Very effective against larva and adults but not effective against egg stage at regular fumigation concentrations. Aeration removes fumigant rapidly from treated commodities. (SF may be trapped in plastic clothes bags or waterproof mattress covers). Not commonly used in Kansas.

Types of Fumigation

Tarpaulin Fumigation

Tarpaulin fumigation involves the placement of a gas-tight material over the commodity or structure to be fumigated. The tarps may be specially made for fumigation, such as impregnated nylon, or they may be sheet polyethylene.

Polyethylene tarps can be used in thicknesses from 1½ mil. up to 6 mil. Because clear polyethylene breaks down from exposure to sunlight, use black polyethylene films outdoors. Gas impervious adhesive tape may be used to join various sections to polyethylene film. Consideration must be given to the method of obtaining a ground seal. If they are smooth, concrete and asphaltic surfaces are satisfactory. Wood surfaces are not. With wood and soil surfaces, it is necessary to place a section of the tarp material beneath the stack as well as over it.

There are several methods of obtaining a good ground seal. Allow enough tarp materials to skirt outward at least 18 inches from the stack. Loose sand, sand snakes, or water snakes are used to hold the skirt to the ground surface. Snakes are merely tubes of cloth or plastic filled about three-fourths full with sand or water. The snakes should overlap each other about 1½ feet.

Occasionally, a stack may be too close to a wall to obtain a good ground seal. The solution is to seal

the tarp directly to the wall with adhesive tape. Tarpaulin fumigation may be performed either indoors or outdoors. Outdoor fumigation should allow for winds or weather which may disrupt a fumigation attempt.

Advantages. Fumigation is limited to items under the tarpaulin, economical use of fumigant, work may continue in general area (providing tarpaulin is reasonably impervious to fumigant vapors).

Disadvantages. Extra labor of placing and sealing tarpaulins, fumigant may be lost through floor or absorbed by soil moisture.

Atmospheric Vault Fumigation

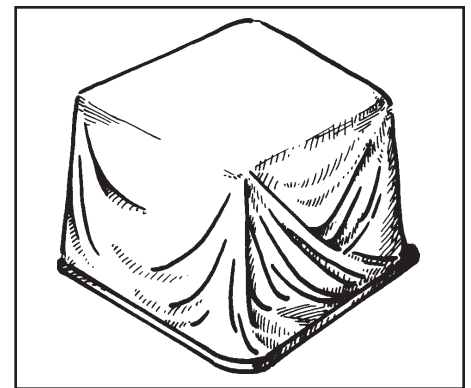
These are usually small buildings located well apart from other structures. Some are specially built for fumigation, others are modified from other structures. Gas concentrations can be monitored through a permanent arrangement. Cased, bagged or palletted commodities are easily moved in and out of the vault without special preparation. The fumigator does not have to compute the cube of the structure each time the fumigation will take place. Almost any fumigant can be used. And while safety precautions must be observed, fewer considerations are necessary.

Advantages. Good control of fumigation, safer than fumigating in buildings, excellent for palletted cargoes.

Disadvantages. Initial cost of setting up a fumigation vault, cost of moving the commodity to and from the chamber, the limited quantity of items that most vaults will hold and economical utilization of facility.

Portable Chambers

A portable fumigation system, developed by B & G Equipment Company, Plumsteadville, Pennsylvania, brings added flexibility to an applicator who may need to fumigate small quantities of items or commodities in various locations. The components of the system are: two pieces of heavy-duty vinyl sheeting that can be zipped together, similar to food storage bags,



Tarpaulin Fumigation

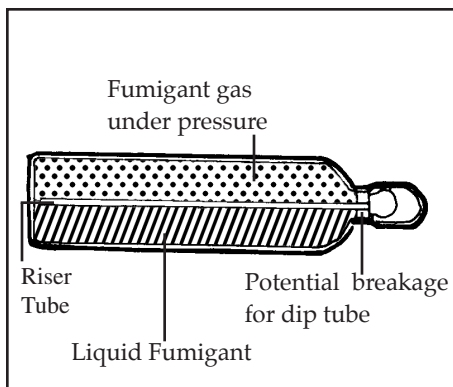
Fumigation



Structural Fumigation



Danger Sign



Problems With Horizontal Transport

fumigation dispensers, connecting hoses, security lock, gas concentration monitoring valve, carrying case, and a gas discharge stand pipe.

The system is designed to allow the operator to develop a vacuum inside the bubble. The vacuum will pull the flexible bubble around the commodity. After collapsing the bubble, the fumigant is applied. Normal safety precautions are necessary, including a self-contained breathing apparatus (SCBA), and monitoring tools to test for leaks.

Structural Fumigation (by taping and sealing)

This essentially is a modification of vault fumigation. No tarp is used and the entire structure becomes a fumigation vault. The building must be of the proper construction (brick, concrete, stucco, etc.) for a tape and seal fumigation. The roof may need to be tarped if its construction alone will not provide a leak-free barrier. Gas concentration test leads must be run throughout the structure and the gas concentrations monitored. Electric fans should be placed so that the fumigant will be circulated throughout the structure in order to achieve rapid equilibrium of the fumigant. Local fire authorities may require the use of non-sparking fans. It may be difficult to compute the cube of the structure. It is very easy to overlook vents, cracks, conduits, etc., that may permit the gas to escape.

Items which could be damaged by the fumigant must be removed. Building occupants must be evacuated for the entire fumigation and aeration period. All pilot lights, flames, and electrical heating elements must be turned off. If ornamental vegetation is too close to the structure to permit the tarpaulin to be sealed to the ground, the vegetation will have to be moved. All edges of the structure which could puncture, or tear the tarpaulin must be well padded.

Precautions and Protective Equipment

Fumigants as a class are the most toxic of all pesticides. Because they are highly volatile, penetrating and highly toxic, they are considered a threat to human life if not used with proper precautions. Therefore, it is essential that fumigants always be used with proper precautions, procedures and protective equipment.

You may be cited by EPA, the state lead agency and/or OSHA for failing to follow instructions in the use or care of protective equipment, as well as the misuse of a pesticide. Directives issued by these agencies and instructions on pesticide labels must be observed. The information given here is to help you better appreciate the need for following procedures for protection and some general instructions. No safety suggestions cover all situations. Follow the label instructions. Remember, there is no substitute for good common sense.

Threshold Limits

Threshold limit values (TLV) refer to airborne concentrations of substances and represent conditions under which nearly all workers may be repeatedly exposed day after day without adverse effect. Because of a wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a small percentage may be affected more seriously by aggravation of a preexisting condition or by development of an occupational illness.

Following are the Threshold Limit Values:

- The Threshold Limit Value-Time Weighted Average (TLV-TWA) is the time weighted average concentration for a normal eight-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Fumigation

	Parts Per Million (ppm)	
	Approx. Odor Threshold	TLV-TWA
Methyl bromide	Odorless	5
Phosphine	0.14	0.3
Sulfuryl fluoride	Odorless	5

Warning Gases

Materials such as chloropicrin may be added to an odorless fumigant in low concentrations so that an individual can be made aware of the presence of a harmful gas. However, they must not be relied upon as the only safeguard for protection, anymore than you would rely upon the detection of a fumigant by its own odor. It must be stressed that:

- Individuals vary in their ability to detect odors and levels of odors.
- The warning gas may have different physical properties than the fumigant and the mixture may stratify, separate or be sorted at a different rate providing a false sense of security.
- Odors do not tell you the concentration of fumigant present.
- You may suffer odor fatigue which is the loss of the ability to smell the particular warning agent.

Warning gasses serve a useful purpose, but are not foolproof. Use them as one of the tools, not as the only tool!

Transporting a Fumigant

Due to the highly toxic nature of fumigants and the lack of control over fumes released as the result of

leaks, spills, or other accidents, the following precautions should be taken:

- Do not transport fumigants by public transportation such as subways, buses, trains or taxis.
- Do not transport fumigants through tunnels without the knowledge and permission of the proper authorities.
- Do not transport fumigants in closed vehicles in the same common airspace as personnel.
- Mark the vehicle in which the fumigant is being transported by attaching the appropriate placards as required by Department of Transportation (DOT) to the front, back and sides of vehicles.
- Transport cylinders upright and secured.
- Mount cylinders so they are protected from rear-end collision.
- Do not remove valve protection bonnet until immediately before fumigant application.

Respiratory Protection Devices

The General Manual, S-12, has additional and similar information concerning respiratory protection beginning on page 96. You are strongly encouraged to be aware of that information as well as the following.

Gas Masks

The respiratory protection devices that furnish the minimum protection are the full-face gas masks equipped with canisters. For protection, the canister must be suitable against the fumigant being used.

Fumigant Toxicity and Flammability

Fumigant Toxicity and Flammability		
Fumigant	Humans	Flammability (Explosive Concentrations in Air)
Phosphine (PP)	Very	Very (1.79%)*
Methyl Bromide (MB)	Medium	Non-flammable
Sulfuryl fluoride (SF)	Very	Non-flammable

* Phosphine reacts with copper alloys, silver and gold, giving severe corrosion. Such metals should be protected from the gas.



Cartridge Respirator



Canister Respirator



Supplied Air Respirator



Self-Contained Breathing Apparatus

Respiratory Protective Devices

Fumigation

The canisters contain chemicals that absorb the fumigant, and may also contain a filter. The life of the canister is limited and varies with the fumigant used and the fumigant concentration. The maximum permissible limits are usually stated on each canister. Do not exceed these maximum limits.

The canister color code for the various fumigants are:

Fumigant	Color Code
Methyl Bromide	Black
Phosphine	Yellow with gray stripe
Sulfuryl Fluoride	White with gray stripe

There are several reasons for using devices other than full-face gas masks with chemical canisters for respiratory protection. The canisters have limited life. Special canisters must be available for each fumigant. The canisters provide no protection at abnormally high fumigant concentrations. They provide no protection in spaces where oxygen is deficient.

General Rules on Canister Use

1. Discard any canister that has been used for more than 30 minutes (total time) in a fumigant atmosphere.
2. Discard any canister whenever an odor of fumigant is detected as coming through (the absorption material is not working).
3. Discard any canister used for less than 30 minutes if it is more than 1 year old.
4. Discard canisters with expired expiration dates or more than two years after manufacture (even if unused) unless instruction sheet specifically says otherwise.
5. DO NOT use a canister-type gas mask to enter a freshly fumigated area. The concentration of fumigant will overpower the absorbent material.

Self-Contained Breathing Apparatus

There are two types of these devices. One is the air pack and the other is the oxygen breathing apparatus (OBA).

Air Pack

With this device, the full-face mask is attached to a tank of air carried on the back of the fumigator. This device gives the fumigator the mobility of the canister mask and does not tie him or her to an air pump. Except for concern about skin absorption of the fumigant, the fumigator can work in any gas.

With the popularity of SCUBA diving, it is not difficult to get the air tanks refilled. Depending upon the size of the tank, the air supply will last up to an hour. There is usually a warning bell that can be set to warn the fumigator when the air supply is running low. The disadvantage of the air pack is that the fumigator has to carry a heavy tank while completing the work.

Oxygen Breathing Apparatus (OBA)

The oxygen breathing apparatus is similar to the air pack. Instead of a tank to carry, a special canister generates the oxygen supply. The canister is lightweight, and is usually worn on the chest. To operate, the fumigator places the canister into its place, tightens up wheel screws, and blows into the air supply tube once or twice. The moisture from the breath activates the chemicals in the canister, which then provide a supply of oxygen. The supply is good for about one hour.

There is usually a warning bell that can be set to warn the fumigator that the life of the canister is about expired. Care must be taken and directions given closely followed, for the disposal of the oxygen generating canisters.

Symptoms

All workers in areas where fumigants are being used should be aware of the symptoms of light exposure to the fumigants. Such symptoms are warnings that the concentration of fumigants in the air is too high for continued safety personnel.

Symptoms of Light Exposure to Fumigants

1. Headache.
2. Dizziness and equilibrium disturbances.
3. Visual disturbances.
4. Irritation of respiratory tract (leads to more "lung colds," asthma attacks, and other lung and throat problems).
5. Narcosis (desire for sleep, drowsiness).
6. Muscle cramps—especially in arms and legs.

NOTE: The ingestion of alcoholic beverages will intensify the symptoms and effects of fumigant poisoning.

Preparing for Fumigation

All new employees should have a thorough physical examination before performing any fumigation duties whatsoever. The examination should include a liver function test and a respiratory capability test (or equivalents).

All persons working with fumigants should have a complete physical examination every six months. Again, the examination should include liver function capability and respiratory capacity.

Understand fully the facility and commodity being fumigated, including the:

- design of the structure, as well as adjacent and connecting structures both above and below ground.
- persons or animals expected to be at or near the area being fumigated.
- the item, its history and condition (previous fumigation, temperature, moisture).
- availability of emergency shutoff stations for electricity, water and gas.
- location of nearest telephone, and numbers for fire and police departments, hospitals and physician.

Understand label directions, warnings and antidotes. You may need to notify local medical, fire, police authorities and other security personnel about:

- chemicals being used.
- proposed date and time of use.
- type of respiratory protection required.
- fire hazard rating.
- name and phone number of person to contact in event of emergency.

Have alternate application and protective equipment and replacement parts available. Display warning signs near points of entry and provide for security of buildings. Have necessary first-aid equipment available. Before treatment is started, develop plans to ventilate the area when the treatment period is over.

Security guards may be necessary if the structure is at an exposed location where the public (especially children) may attempt unauthorized entry.

Security guards may also be needed if plant operations do not permit the security of the fumigated area. The guards must have the authority to refuse entry to anyone not wearing protective equipment. They should have suitable protective equipment available if an emergency requires entry into the fumigated area. They should also be trained in first-aid procedures for fumigant poisoning and have the appropriate materials readily available.

Precautions include an accounting of all personnel known to be working in the area, a room by room and floor by floor check to ascertain that no person has been overlooked and the use of a portable public address system (bull horn) in each space to warn anyone present of the imminent fumigations. If bells, whistles or other devices are used to give warning signals, all personnel must have been instructed as to the meaning of these signals.

Doors, windows and other points of access must be locked or otherwise secured against accidental or unauthorized entry into fumigated areas. Preferably there should be one person ultimately responsible for evacuating all people, securing the affected area and restricting access until the area has been cleared of the fumigant.

Fumigation

Notices of fumigated areas must be provided to night watchmen, janitors, maintenance crews and others who otherwise might have master keys and ready access into the fumigated area. None of these should enter a fumigated area except in an emergency and then only with adequate protection. Other prefumigation precautions.

1. all possible sources of fire must be eliminated. Turn off all pilot lights, gas burners, oil burners and electrical equipment.
2. If possible, provide for the start of post-fumigation ventilation by controls outside of the fumigated area.
3. If several floors or rooms are involved, rehearse the fumigation sequence so everyone knows where the others are and where to exit the area.
4. Discuss emergency plans for handling all possible problems.
5. Locate a nearby telephone for use in case of an emergency.
6. Have fumigant testing equipment available and check it for proper operation.
7. Have first-aid materials ready and available.
8. Notify fire departments.

Premises Inspection

Once it appears to you that fumigation will be required to control a pest problem, you must conduct a serious on-site inspection, you must ask yourself a number of questions and make a number of decisions. Frequently, the success or failure of the fumigation operation will depend upon what you learn, what you decide and how you plan. Some of these questions should include:

- If the structure itself is not infested, could the infested items be moved from the building and fumigated elsewhere?
- Assuming that removal of the infested items from the building is not practical, can you fumigate the items in place?
- Is there enough room between the items and walls or partitions so that you can seal the tarp to the floor?

- What is the cube of the items?
- What is the cube of the building?
- Can the structure itself be made reasonably airtight, or will it be necessary to tarp the entire building?
- From what construction materials is the structure built?
- Are there broken windows that must be replaced?
- Are there cracks in the ceiling, walls or floors that must be sealed?
- Are there floor drains or cable conduits that will require sealing? (Are there hidden floor drains under stacked items?)
- How are you going to handle air conditioning ducts and ventilation fans?
- Will interior partitions interfere with fumigant circulation?
- Are the interior partitions gas tight so that they can be relied upon to keep the fumigant from entering other parts of the structure?
- Are there parts of the building not under the control of your customer?
- Can these other operations be shut down during the fumigation?
- What are building contents?
- Can any of them be damaged by the fumigant?
- Can such items be removed during the fumigation?
- If they cannot be removed, can they be otherwise protected?
- Where are the electrical outlets?
- Of what voltage are they?
- Will the circuits be live during fumigation?
- Can the outlets be used to operate your fumigant circulating fans?
- Look outside the building. If you tarp the entire structure, can you make a good, tight ground seal?
- Is there shrubbery next to the building that might be damaged either by the fumigant, or by your digging to make an air-tight fumigation seal?
- Can this shrubbery be moved?
- How far is it to the nearest building?
- Does that building have air conditioning?

Fumigation

- Does it have air intakes that could draw the fumigant inside—particularly during aeration?
- How are you going to aerate your structure after fumigation?
- Are there exhaust fans and where are the fan switches?
- Are there windows and doors that can be opened for cross ventilation?
- Does the building contain any high priority items that may have to be shipped within a few hours notice?
- If so, can you make provisions for interrupting the fumigation and aerating the building within a certain time requirement?
- Is the structure to be fumigated so located that your operations may attract bystanders? (If so, you should consider asking for police assistance to augment your own guards.)
- Once you are convinced that you have covered everything, prepare a check list of things to do and of materials needed. Don't rely upon your memory.

Then, ask three questions:

- What have I overlooked?
- Is fumigation still the best method of controlling the pest problem?
- Am I qualified to do the fumigation?

Placarding of Fumigated Areas

The applicator must placard or post all entrances to the structures and/or rooms containing equipment under fumigation with signs in English and Spanish, bearing:

- The signal word DANGER/PELIGRO and the SKULL AND CROSS-BONES symbol in red.
- The statement "Area and/or items under fumigation, DO NOT ENTER/NO ENTRE."
- The statement, "This sign may only be removed after the items are completely aerated (contains 0.3 ppm or less of hydrogen phosphide gas). If incompletely aerated item is transferred to a new site, the new site must also be placarded if it contains more than 0.3 ppm. Workers must

not be exposed to more than 0.3 ppm hydrogen phosphide.

- The date and time fumigation begins and is completed.
- Name of fumigant used.
- Name, address and telephone number of the applicator.

All entrances to a fumigated area must be placarded. Where possible, placards should be placed in advance of the fumigation to keep unauthorized persons away. Do not remove placards until the treated equipment and surrounding work areas are aerated down to 0.3 ppm hydrogen phosphide or less.

Application

Always assign two persons to each fumigation. Everyone involved in the fumigation should know first aid and other emergency procedures, including personal decontamination.

Follow label directions exactly when applying a fumigant. Consider prevailing winds and other pertinent weather factors such as temperature and humidity. Apply fumigants from outside the exposed areas whenever possible.

Return to the storage area all unused chemicals in clearly labeled, original containers. Dispose of empty containers correctly.



Provide watchmen, when required. Secure entrances with guards or locks. Post warning signs.

Report to company-retained physician or to designated personnel, indications of illness or physical discomfort, no matter how minor they seem. These symptoms and signs may include dizziness, nausea, headaches and lack of coordination.

Do not consume alcohol for 24 hours before or after a fumigation. Do not eat or smoke during application.

After Application

Aeration procedures vary according to the fumigant being used, the method of fumigation and the items being fumigated. Because of these factors always read and follow the label instructions for the fumigant and situation in which it is being used.

DANGER		
	PELIGRO	
AREA AND/OR COMMODITY UNDER FUMIGATION, DO NOT ENTER/NO ENTRE		
This sign may only be removed after commodity is completely aerated (contains 0.3 ppm or less phosphine gas). If incompletely aerated commodity is transferred to a new site, the new site must also be placarded and workers must not be exposed to more than 0.3 ppm phosphine.		
FUMIGATION WITH		
Brand Name: _____		
Fumigation Being Performed By	Date of Fumigation	Emergency Telephones
NAME: _____	Date Applied _____ : 10 _____ Day _____	_____
ADDRESS: _____	Do not open _____ AM _____ PM Night _____	_____
	Before _____ AM _____ PM	

Placard

Fumigation

Before re-entry, use a suitable gas detector, as indicated on the label, to determine fumigant concentration. Do not depend on odors. Some fumigant gases are odorless. Wear correct respiratory equipment.

Turn on all ventilating or aerating fans. Check for gas concentrations in areas that are expected to aerate slowly. Remove warning signs only when the gas concentration is within safe limits for human exposure.

Factors Affecting Aeration Time

In addition to the characteristics of the fumigant itself, the rate of ventilation or aeration is affected by several factors. The more important of these are:

- Rate of air exchange.
- Temperature.
- Sorption and desorption.

The rate of air exchange and the temperature controls the amount of sorption and the rate of desorption.

Free gas should be released and items aerated immediately following fumigation. It is important to consider and protect human health at all times. When a fumigation chamber is inside any other enclosure where employees are likely to be present, intake and exhaust stacks should be provided. The exhaust stack must lead outside the building. The intake and exhaust stacks should be opened after the fumigation exposure is completed. The normal air circulation equipment in a chamber can be made to conduct air from the chamber to the outside.

When a chamber is outside a building, it may be aerated safely by opening the door slightly at the beginning of the aeration period and turning the blower on. The door should be held in the partially opened position so that it cannot accidentally close. Air discharged from the blower should be vented to the outside.

Remove and dispose of packaging and waste products of solid fumigants.

Safe Use of Fumigants

There is a tendency for employees who commonly work with fumigants to become lax in their safety precautions. ALL FUMIGANTS CAN BE LETHAL if they are used carelessly or without adequate safety precautions.

Humans can be poisoned by inhaling the gases of fumigants and by absorption through the skin. Most commercial products have an unpleasant odor but the pure chemicals can be either odorless or have a sweet smell.

Do not wear jewelry, bandages, gloves, contact lenses or tight-fitting clothing when applying fumigants. These articles may trap gases causing blistering or burning of the skin.

Safety Recommendations (Summary)

1. Carefully read the labeling and follow instructions explicitly.
2. Post warning placards on fumigated areas.
3. Prior to fumigation, notify appropriate company employees. Provide relevant safety information to local officials on an annual basis for use in the event of an emergency.
4. Never fumigate alone from inside structures.
5. Never allow uninstructed personnel to handle the fumigant.
6. Approved respiratory protection must be available for fumigation inside structures.
7. Wear dry gloves of cotton or other materials if contact with metal phosphide tablets, pellets or dust is likely. Aerate used gloves and other contaminated clothing in a well-ventilated area prior to laundering. Wash hands thoroughly after handling metal phosphide materials.
8. Never open metal phosphide fumigant pouches in a flammable atmosphere. It is preferable to open them in open air, near a fan or other appropriate ventilation which will rapidly exhaust contaminated air.

Fumigation

9. Do not allow the metal phosphide to pile up or contact liquid water.
10. Dispose of empty containers and spent metal phosphide fumigant in a proper manner consistent with the label instructions.
11. Hydrogen phosphide fumigants are not to be used for vacuum fumigations.
12. Exposures to hydrogen phosphide must not exceed the eight-hour TWA of 0.3 ppm during application, or a ceiling concentration of 0.3 ppm after application is completed.
13. Fumigated areas must be aerated to 0.3 ppm hydrogen phosphide or less prior to reentry by unprotected workers.
14. Transfer of a treated commodity to another site without complete aeration is permissible provided that the new storage site is plac-
arded if its concentration is above 0.3 ppm and workers are not over-exposed during transfer.
15. Do not open pouches until just prior to application of the Prepacs.
16. Protect or remove materials containing metals such as copper, silver, gold and their alloys and salts from corrosive exposure to hydrogen phosphide.
17. Do not use metal phosphide fumigant containers for any purpose other than recycling or reconditioning.
18. Two trained persons must be present during reentry into fumigated and/or partially aerated structures or rooms housing treated equipment.

Fumigation

Study Questions

1. (52) Fumigants are pesticides that:
 - a. control fungi
 - b. are or become a gas mixture
 - c. are usually non-poisonous to humans
 - d. are aerosol sprays (liquid suspension in air)
2. (52) Factors that can change the efficiency of fumigants are:
 - a. application ease, cost, and corrosiveness
 - b. toxicity to the pests
 - c. residual tolerances, flammability and finished product
 - d. temperature, moisture, pests, and structure
3. (53) Even when this building material is well sealed, it does not retain a fumigant very well.
 - a. plastic
 - b. metal
 - c. wood
 - d. concrete
4. (54) This fumigant is highly flammable in air:
 - a. methyl bromide
 - b. phostoxin
 - c. vikane
 - d. carbon dioxide
5. (55) For tarp fumigation, polyethylene traps with a minimum thickness of ____ can be used.
 - a. ½ mil.
 - b. 1 mil.
 - c. 1½ mil.
 - d. 2 mil.
6. (56) As a class, ____ are the most toxic of all pesticides.
 - a. organophosphates
 - b. organochlorines
 - c. phenoxy herbicides
 - d. fumigants
7. (56) Threshold limit values (TLV) refer to ____ concentrations.
 - a. water borne
 - b. soil borne
 - c. airborne
 - d. pesticidal limits
8. (57) The respiratory protection device that provides the minimum protection is the:
 - a. full face gas mask with canisters
 - b. air pack
 - c. oxygen breathing apparatus
 - d. full face mask with supplied air
9. (59) Symptoms of light exposure to fumigants include:
 - a. headache
 - b. irritation of respiratory tract
 - c. muscle cramps
 - d. all the above
10. (60) Once it appears fumigation is necessary, you must:
 - a. call in two consultants
 - b. conduct a serious on-site inspection
 - c. contact the Department of Health
 - d. contact the police and fire departments
11. (61) Warning signs for fumigation must be printed in:
 - a. German and French
 - b. German and Spanish
 - c. English and German
 - d. English and Spanish
12. (62) Factors affecting aeration time include:
 - a. rate of air exchange
 - b. temperature
 - c. sorption and desorption
 - d. all the above



Birds

Roosting concentrations of birds can lead to problems. They can be noisy, their droppings may create an objectionable smell, contamination may occur, and the droppings and the weight of the birds can break tree limbs and destroy vegetation. The droppings also form a medium for growth of bacteria and fungi.

Take precautions when working around an old or abandoned roost site. Wear a respirator or face mask with dust filter to prevent inhalation of fungus spores. If an area that was once a bird roost is going to be cleared or bulldozed, do the work when the weather is wet or cold or both. Avoid clearing under the dry, dusty conditions of late summer.

When birds are removed and excluded from a building, search the nesting and roosting sites for evidence of parasitic arthropods such as bed bugs or their relatives, northern fowl mites, and poultry red mites. If present, they should be chemically controlled while they are still concentrated near the nests and roosts. Otherwise, once the birds are gone, the parasites will wander in search of a host and will bite people that they encounter. After dispersing, they are more difficult to control.

Laws and Regulations

Federal and state regulations protect blackbirds and other migratory birds. A federal permit is required to take, possess or transport migratory birds for depredation control purposes. But no permit is required to scare or herd these birds, except federally listed threatened or endangered species, bald or golden eagles (50 CFR 21.41).

A standing order exists for blackbirds, cowbirds, grackles, crows and magpies. No federal permit is required and control measures—including lethal measures—may be taken when these species are found “committing or about to commit depredation,” or when they “constitute a health hazard or other nuisance.”

A state permit is required for lethal control of nuisance birds, except pigeons, English sparrows, or starlings, with poisonous chemicals (KAR 115-16-3). Contact the Kansas Department of Wildlife and Parks regional offices for this permit or more information on rules and regulations.

Pigeons

The domestic pigeon is also known as the rock dove or pigeon.

Damage caused by pigeons can be extensive. Their droppings deface and accelerate deterioration of buildings and automobiles and may land on unwary pedestrians. Pigeon feces are a common contaminant. Pigeon nests may clog drain pipes, interfere with awnings and render fire escapes hazardous. The nests harbor numerous ectoparasites.

Biology

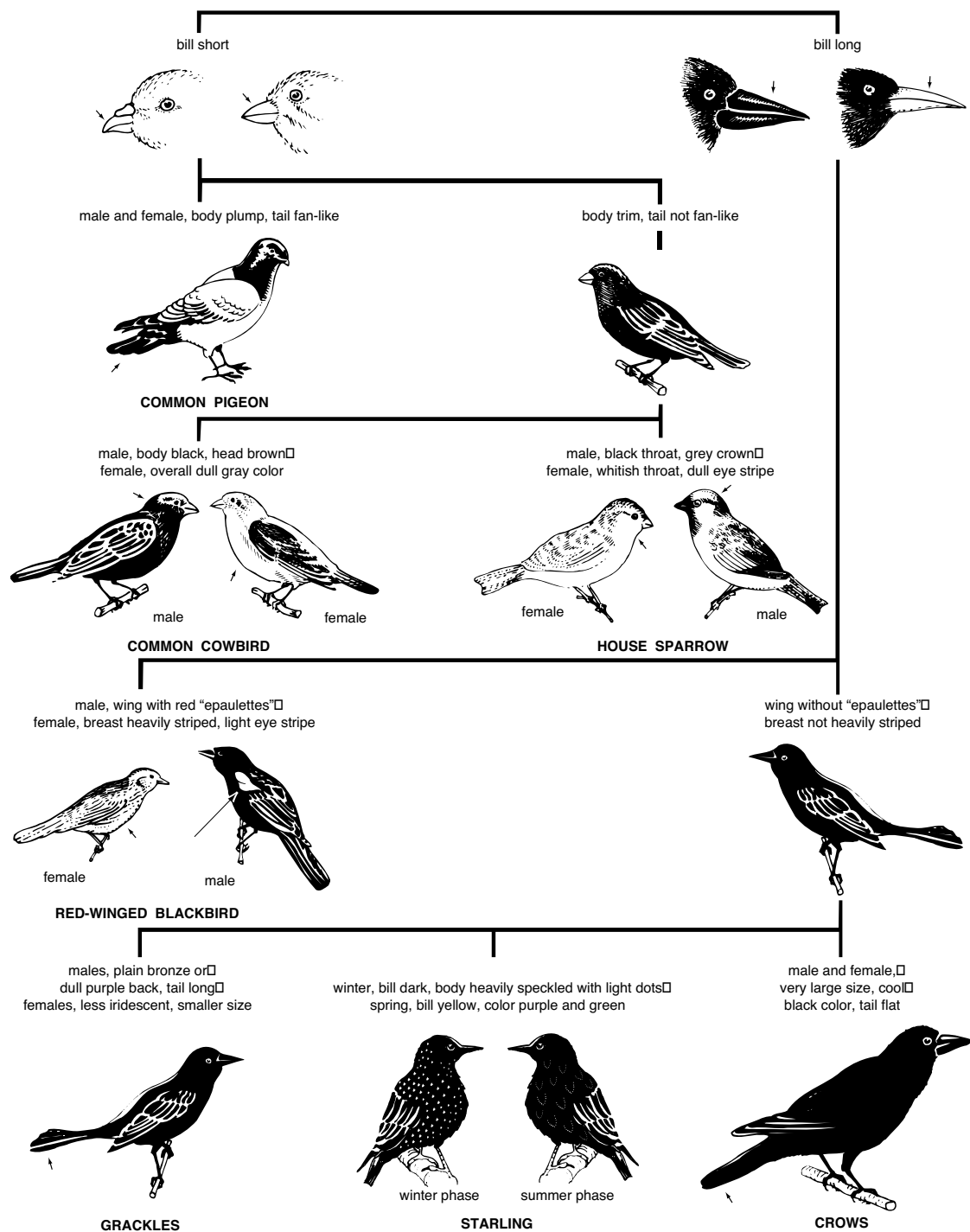
Building ledges, rafters and similar man-made shelters are usual nesting sites. The pair constructs a rather messy nest in which the female lays one or two eggs. The male cares for and guards the female and nest. The incubation period is 17 to 19 days. The young are fed predigested food until they are weaned just before leaving the nest at 35 to 37 days of age. More eggs are laid before the first young are weaned. Breeding occurs at all seasons and several broods are raised each year. The average pigeon lives five to seven years and some live over 15 years.

An adult pigeon will eat about 454 grams (1 pound) of food a week, consisting of seeds and other grains augmented with some amounts of fruit, green feed, insects and sufficient grit for digestion. Pigeons are generally monogamous although when a mate dies the survivor will select a new mate.

Control Methods

Nest removal. Removing nests and destroying young helps depress populations but inaccessibility of nests makes the cost/benefit ratio unattractive.

Vertebrate Pests



Exclusion. Netting to exclude entry or porcupine wire to prevent roosting.

Frightening devices. Pigeons have a strong territorial sense and are less responsive to noises than are most other birds. No practical alarm or distress calls have been found. Recording of loud noises sometimes works to frighten pigeons. Scarecrows such as stuffed owls are ineffective for repelling pigeons. Flags, dangling paper, foil strips, etc. will sometimes work but only briefly.

A fright producing chemical prepared on a grain bait has shown success in some situations.

Repellents. As a pigeon's sense of smell is rudimentary, odor repellents like naphthalene are not effective except under confined locations. Sticky materials which are available commercially are applied to ledges or rafters where birds roost. They repel pigeons by entangling their feet and sometimes their feathers. It is advisable to protect porous surfaces with tape or a silicone spray undercoating as these sticky materials may seriously stain buildings.

Shooting. Where local ordinances permit, a flock of pigeons may be shot. Normally, .22 shorts or shotguns are necessary, but compressed air guns or .22 dust shot may be effective at close range.

Trapping. A colony of pigeons tends to use regular feeding and roosting areas and can sometimes be controlled by intensive trapping at these locations. Large, walk-in traps have been reported to be more effective than smaller ones. Smaller traps are less expensive to construct and easier to transport. Suggested, baits include whole or coarse-cracked corn, wheat or milo. Water should be available in the trap at all times.

Traps with a funnel entrance are the most effective.

Heavy pre-baiting for a period of time in and around traps with the doors left open may be necessary to get pigeons to visit the trap readily. Place live decoys in the trap to help attract other pigeons. White- or

light-colored birds make better lures than drab, blue-gray ones. If possible, leave the same individuals in the trap.

Return pigeons marked with leg bands to their owners or turn over to the local humane society.

Toxicants. A single dose poison (Avitrol®), applied on whole grain corn can be used effectively provided pre-baiting shows bait acceptance and you follow this general procedure:

Before exposing treated baits, make thorough observations to determine the number of pigeons present, their feeding habits, their preferred locations, their daily behavior patterns, and the presence of nontarget species. Continue observations throughout the day. During these observations, desirable locations for bait exposure should be selected. If adequate precautions are taken in selecting bait sites no other species should be harmed.

When the daily pattern of the birds has been established and baiting locations selected, try several clean baits to determine the preferred bait. Continue pre-baiting for several days or until there is good bait acceptance. Do not expose toxic baits until good acceptance of clean bait occurs.

Leave toxic bait out for not more than two days. Pick up all dead birds.

Toxic perches containing a fenthion and oil mixture product called "Rid-a-Bird" can be installed in roost areas. These may be attached to buildings where birds are roosting. The birds absorb the toxic material in the feet resulting in death. Dead birds must be picked up and properly disposed of to prevent the possibility of secondary poisoning.

Extreme caution must be used with Rid-a-Bird toxicant as it is not species specific. Therefore, it must be used in areas where non-target birds species, pets and humans will not come in contact with it.

House Sparrow (English Sparrow)

The house sparrow causes contamination of buildings, sidewalks, lawns

Vertebrate Pests

and storage sheds. The noise and filth associated with their nests are nuisances.

Biology

Nest building begins as early as April with both sexes participating in the activity. Nests are constructed of grass, straw and debris and may be located almost anywhere. Three to seven eggs are laid, commonly five, and two or three broods are raised each year. The same nest has been occupied by up to four different females in a season.

The incubation period is 11 to 12 days and the age at first flight is about 15 days. Soon after the young leave the nest they gather in small flocks. As the summer advances, the juveniles are joined by adults until the flock may number several hundred.

The house sparrow is primarily a seed eater and an adult bird eats about 6 grams (.1 pound) of dry seed a week. Bread crumbs and other human debris substitute for grain in cities.

Control Method

Frightening devices. The sparrow's range of hearing is reported between 675 to 11,500 cps (cycles per second). This makes ultrasonic devices ineffective. Fireworks, blanks, shell crackers and other noise-making devices, if permitted by local regulations and persistently carried out, will eventually dislodge birds from an evening tree roost. These devices are usually ineffective where they are also nesting.

Chemical control that produces a fright reaction in sparrows has been effective in some situations.

Repellents. Sticky repellents applied to ledges, tree limbs, rafters, beams, etc. are effective in keeping sparrows away.

Shooting. Shooting with .22 bird shot and using a spot light is effective in reducing the number of birds. The home range of sparrows is about one-half mile.

Trapping. A wide variety of traps have been used for local control of house sparrows. Traps that are designed to catch only a few birds

at a time include the double funnel trap, nest trap and the commercial available elevator trap. Modified Australian crow traps have caught larger numbers of birds. Wire of 13 × 13 millimeters ($\frac{1}{2} \times \frac{1}{2}$ inch) mesh hardware cloth should be used for the wire covering of these traps. Chick scratch, fine cracked corn, milo, wheat, bread crumbs or their combinations make good baiting material and food sources for decoy and captured birds.

Exclusion. The use of netting or porcupine wire products to prevent access of birds is a good non-toxic and long-lasting solution.

Toxicants. Toxic baits are usually applied to a variety of cracked grains—chick scratch being the most widely used.

The success of single dose toxicant grain bait (Avitrol®) depends upon pre-baiting, bait acceptance and use of poison bait for a short time, one to two days. Use bait of this type when other food is limited. Do not use this type of control procedure but once every six months or once a year.

Toxic perches containing a fenthion and oil mixture product called "Rid-a-Bird" can be installed in roost areas. These may be attached to buildings where birds are roosting. The birds absorb the toxic material in the feet resulting in death. Dead birds must be picked up and properly disposed of to prevent the possibility of secondary poisoning.

Extreme caution must be used with Rid-a-bird toxicant as it is not species specific. Therefore, it must be used in areas where non-target birds species, pets, and humans will not come in contact with it.

Starling Biology

The nest of a starling is built in any tree cavity, hole in a building, or deserted woodpecker hole of suitable size. Nests used in successive seasons become foul-smelling. Two to eight eggs are laid, usually four to six. The incubation period is 11 to 13 days. Both sexes assist in this activity. Age at first flight is 19 to 22 days.

As fledglings come off the nest they gather in small family groups of up to 10 birds including one or two adults. These small groups eventually merge together until large flocks are formed. Merging continues until all of the birds in a local area are in one large flock. These flocks are scattered throughout the state in summer and are responsible for depredations to soft fruits and other summer crops. Population buildups in cattle feedlots begin by mid-October. Starlings share a communal roost at night, often in or near buildings.

Control Methods

Frightening devices. Devices, such as shell crackers, spraying with water, propane exploders, and devices to broadcast distress calls, and electronically produced sounds, can successfully frighten starlings from roosts. Begin the use of these devices as soon as birds make an appearance; delays will make bird removal more difficult. It generally takes a persistent effort to rout the birds from a favorite roost. Continue efforts for five to 10 consecutive nights. Use a combination of frightening devices as soon as the first birds arrive at the roosts. Continue until complete darkness has fallen.

Proper location of sound devices is important and enough of them must be used to provide sound over the entire area to be protected. Place devices to take advantage of the prevailing winds and do not locate them in areas where the trees muffle the sound. Observations to determine their effectiveness should be made and individual units moved to new locations if necessary.

Repellents. Sticky repellents, mechanical barriers, etc. may be effective when starlings are roosting on buildings or structures.

Shooting. Shooting is costly and rather futile as a method because of the large number of starlings. However, shooting can be used in conjunction with frightening devices so as to reinforce the frightening effort.

Trapping. Modified Australian crow traps have been effective for capturing large numbers of starlings.

The location of the trap is important. Observations should be made to determine starling flyways, resting or perching areas and feeding areas before the traps are placed in operation. These traps have been most effective when placed in the open near, but not necessarily under, perching or feeding areas.

Toxicants. Starlicide, a chemical compound developed for starling control, is now commercially available as a pelletized bait. This slow-acting toxicant is for controlling starlings and blackbirds around livestock and poultry operations. It is toxic to other birds in differing amounts but will not kill house sparrows at registered rates. Toxic perches containing fenthion can be used for certain industrial and structural roost situations.

Directions for Using Toxic Baits

General Procedure. Before exposing treated baits, make a thorough observation to determine the number of house sparrows present, their feeding habits, their preferred locations, their daily behavior patterns, and the presence of nontarget species. Continue observations throughout the day. During these observations, select desirable locations for bait exposure. If adequate precautions are taken in selecting baiting sites no other species should be harmed.

When the daily activity pattern of the birds has been established and baiting locations selected, use clean bait to determine the preferred bait. Continue pre-baiting for several days or until there is good bait acceptance. Do not expose toxic bait until good acceptance of clean bait occurs.

Placement of bait trays. Flat bait trays or V-shaped troughs can be placed on rafters in garages, sheds, barns, hangers on standards, etc., where house sparrows frequent to feed or perch, and where there is no danger to man or other animals. Construct trays and troughs soundly to prevent bait spillage.

Pre-baiting: Pre-baiting with clean, untreated bait is essential for good

control. Pre-bait and treated bait should be of the same grain bait. If trays and troughs are well located and birds are numerous, acceptance of bait should be well established within one week. If at the end of 10 days some fail to show acceptance of bait, move bait to a new location. Expose prebait sparingly but replenish as needed to keep birds feeding.

Exposing toxicant bait. When pre-bait is accepted freely in all or nearly all trays or troughs, they should be emptied and poison bait substituted. Spread poison bait sparingly and evenly. Place bait in troughs during early morning. Do not allow bait to become wet. Pick up all dead birds and burn these in an incinerator. After two days, remove poison bait.

Rats and Mice

There are five important steps each to be followed in order to assure best control of rat and mouse populations. You cannot start at step 2 and get good control. You must start with step 1. The five steps are:

1. Put population under stress. Take away food, water and shelter. Clean up the area as much as you can.
2. If the population is high, use a single dose toxicant. Be sure to comply with label instructions. Use bait stations, prebait.
3. Use a multidose toxicant, keep good, clean bait out even when population appears to be greatly reduced. Use bait stations.
4. Use traps.
5. Rodent proof the place where the problem occurred to the best of your ability. Watch for reinfestation.

Rats

The common brown rat (*Rattus norvegicus*, also called the Norway rat) is a destructive animal pest. Found in and around towns and farms throughout Kansas, these rodents eat and contaminate large amounts of feed, damage structures by their gnawing, and spread diseases that affect livestock and man.

Recognizing Rat Infestations

The presence of rats can be detected by droppings or evidence of fresh gnawing. Tracks can be seen in mud and on dusty surfaces. Runways and burrows may be found next to buildings, along fences, and under low vegetation and debris.

Rat Biology

The rat will eat nearly any type of food but prefers high-quality foods such as meat and fresh grain. Rats require $\frac{1}{2}$ to 1 ounce of water daily when feeding on dry food.

Rats have keen taste, hearing and sense of smell. They will climb to find food or shelter, and they can gain entrance to a building through any opening larger than $\frac{1}{2}$ inch in diameter.

Rats have litters of six to 12 young, which are born 21 to 23 days after mating. Young rats reach reproductive maturity in about three months. Breeding is usually most active in spring and fall, and the average female has four to six litters per year.

Rat Control

Sanitation. Poor sanitation and the presence of garbage allows rats to exist in residential neighborhoods. Good sanitation will effectively limit the number of rats that can survive in and around the home. This involves good housekeeping, proper storage and handling of food materials and refuse, and elimination of rodent harborage.

On farms where food grains are handled and stored, or where livestock are housed and fed, it is difficult to remove all food and harborage that rats may utilize. Attention to good sanitary practices, however, will make the environment less suitable for rats to thrive.

Warehouses, grain mills, silos, and corn cribs are especially vulnerable to rodent infestation. Bulk foods should be stored in rodent-proof buildings, rooms, or containers. Sacked food should be stacked on pallets with adequate space left around and under stored articles to allow inspection for rodent sign.

Rat-Proof Construction. The most successful and permanent form of rat control is to build them out by making their access to structures impossible. All places where food is stored, processed or used should be rat-proof.

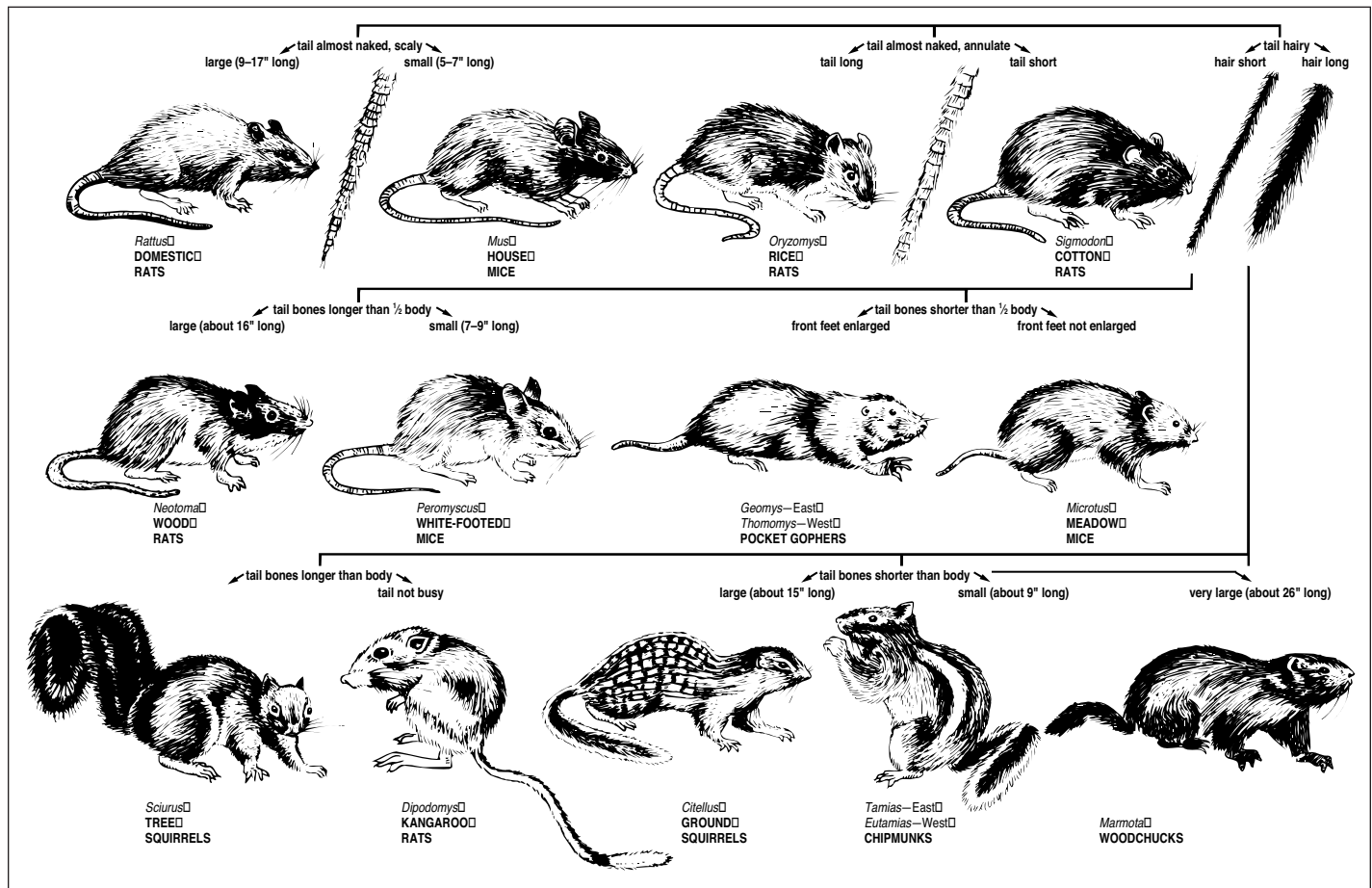
Any opening larger than $\frac{1}{4}$ inch should be closed to exclude both rats and mice. Openings where utilities enter buildings should be sealed tightly with metal or concrete. Floor drains and sewer pipes should have tight-fitting grates with openings less than $\frac{1}{4}$ inch in diameter. Doors, windows and screens should fit tightly. Edges should be covered with sheet metal to prevent gnawing.

Traps. Trapping can be an effective method of controlling rats, but it requires more skill and labor than most other methods. Trapping is recommended where poisons seem inadvisable, and it is the preferred

method to try first in homes, garages, and other small structures where there may be only a few rats present. Trapping has several advantages:

1. it does not rely on inherently hazardous rodenticides,
2. it permits the user to view his or her success, and
3. it allows for disposal of the rat carcasses, thereby eliminating odor problems which may occur when poisoning is done within buildings.

The simple, inexpensive wood-based snap trap is available in most hardware and farm supply stores. Traps should be baited with a small piece of hot dog, bacon or nutmeat tied securely to the trigger. Set traps close to walls, behind objects, in dark corners and in places where rat activity is seen. Place the traps so that rats, following their natural course of travel (usually close to a wall),



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will pass directly over the trigger (see figure on page 70, Snap Traps).

Use enough traps to make the campaign short and decisive. Leaving traps unset until the bait has been taken at least once reduces the chance of rats becoming trap-shy.

Rodent Baits. Both single-dose and multiple-dose (anticoagulant) rodenticides are available for rat control. Although finished baits are available in a wide variety of types, some persons trained in rodent control prefer to mix their own baits using rodenticide concentrates. When possible, finished baits should be used because they do not require that the applicator handle the concentrate, a more hazardous material.

Pre-baiting. Rats are cautious feeders and may reject new foods or consume only small amounts for the first several days. Acceptance of a toxic bait can be increased by conditioning rats to feed on a nontoxic version of the same food, or pre-bait.

Pre-baiting is highly recommended before using a single-dose toxicant. Maximum benefit is obtained when rats have fed on pre-bait for about five days. The amount of pre-bait eaten helps determine the amount of toxic bait needed. All uneaten pre-bait should be removed when the toxic bait is applied.

If acceptance of pre-bait is poor, toxic bait should not be applied. Poor acceptance may be corrected by changing bait material or its placement.

Single-dose rodenticides. Single-dose poisons will give a quick knock-down of a rat population, and may be preferred where rats are abundant, or where it is difficult to get the rats to accept a bait for several days in succession because of competing food items. When rats consume a sublethal amount of an acute toxicant such as zinc phosphide and red squill, "bait shyness" or "poison shyness" may result. Because of this bait rejection problem, these three single-dose poisons should not be used more than twice a year at a given location, and preferably only once.

Anticoagulant rodenticides: These rodenticides are generally considered much safer than single-dose poisons, although red squill has a good safety record. Bait shyness does not result when properly formulated anticoagulant baits are used.

These baits cause death to rats only after they are fed on for a number of days. Of the rodenticides, brodifacoum and bromadiolone are atypical because they are capable of causing death after a single feeding. However, death does not occur for several days.

When anticoagulant rodenticides are used, fresh bait must be made available to rats continuously for at least two weeks or until all signs of feeding cease.

Tracking powders. Toxic dusts or powders have been successfully used for many years to control rats and mice. When rodents walk through a patch of toxic powder, they pick some up on their feet and fur and later ingest it while grooming. Tracking powder is useful to control rats when food is plentiful and good bait acceptance is difficult to achieve.

Bait Selection and Placement

Anticoagulant baits are available in several types. Grain baits in a meal or pelleted form are often available packaged in small plastic, cellophane or paper packets. These place packs keep baits fresh and make it easy to place baits into burrows, walls or other locations. Rats will readily gnaw into these bags to get at an acceptable bait.

Anticoagulant baits that have been formulated into paraffin blocks are available from various manufacturers. These blocks are particularly useful in sewers or where moisture may cause loose grain baits to spoil. Acceptance by rats of paraffin block baits is usually less than acceptance of loose grain baits.

Sodium salts of anticoagulants to be mixed into a water solution are available. Since rats require water daily, they can be drawn to water stations in some situations. Water baits are particularly useful in grain storage structures, warehouses and in other

such locations where water is scarce.

Use of bait boxes protects rodenticides from weather and provides a safeguard to people, pets and other animals. Bait stations should have at least two openings approximately 2½ inches in diameter and should be large enough to accommodate several rats at a time. Bait boxes should be placed next to walls with openings close to the wall, or in other places where rats are active. All bait boxes should be clearly labeled “rat bait” as a safety precaution.

Where it is impossible to exclude rodents from buildings, permanent bait stations should be established and maintained with fresh bait to control invading rats before breeding populations are established.

Fumigants (Poisonous Gases)

Fumigants are most commonly used to control rodents in their burrows in outdoor situations. Compounds such as aluminum phosphide, methyl bromide, chloropicrin, and gas cartridges have been used to kill rats. CAUTION! Such fumigants, being highly toxic to people and animals, should not be used in any situation which might expose the occupants of a building to the vapors.

Only licensed structural pest control operators should use fumigants in any situation involving buildings or other structural enclosures.

Safety Precautions

Certain general safety precautions should be followed besides those appearing on the labels of products. Consider all rodenticides dangerous enough to cause death, and place baits where only rodents can get them.

There are no known rodenticides which do not present some degree of hazard to animals other than rodents.

Label all bait containers and stations clearly with appropriate warnings. Store unused bait and concentrates in a locked cabinet out of the reach of children.

Carefully follow the label directions on all rodenticide products. Pick up all dead rats after a poison-

ing program. The carcasses should be handled with rubber gloves or a pair of long tongs. Dead rats should be disposed of by burning or deep burial.

Sound and Electronic Devices

Rats quickly become accustomed to regularly repeated sounds. Ultrasonic sounds, those above the range of human hearing, have very limited use because they are directional and do not penetrate behind objects. Also, they lose their intensity with distance. There is little evidence that sound of any type will drive established rats from buildings.

Several types of electromagnetic devices have been marketed which claim effectiveness in repelling rats or causing them to behave abnormally. Scientific tests of many such devices have shown that they failed to control rodents as claimed by their advertising.

Predators and Biological Control

Although house cats, some dogs and other predators may kill rats, they do not give effective rat control under most circumstances. It is not uncommon to find rats living in very close association with dogs and cats. Rats frequently live beneath a dog house and soon learn that they can feed on the dog's food when he is absent or asleep. Many rat problems around homes can be related to the keeping of pets.

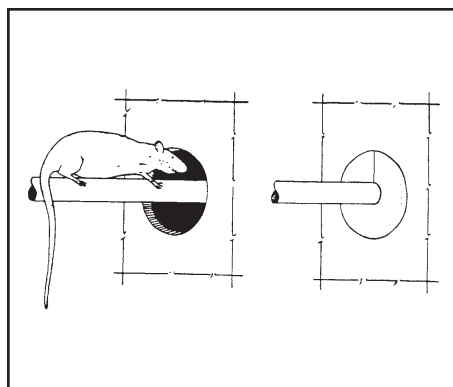
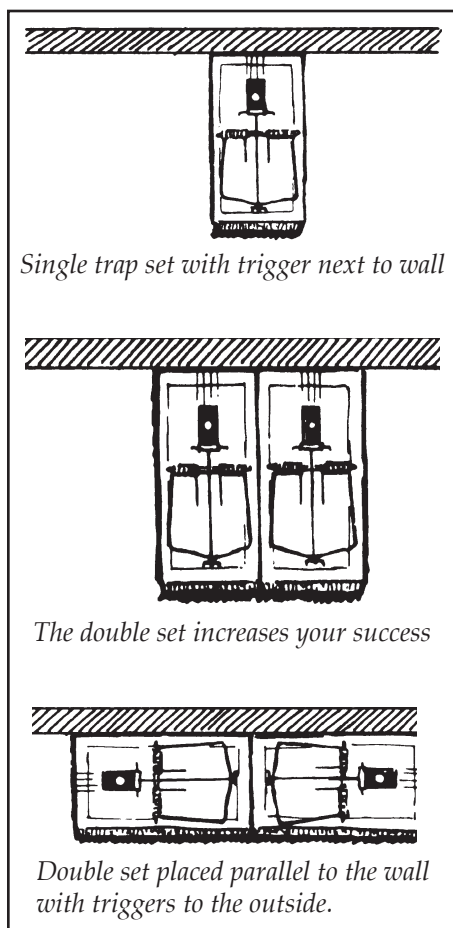
Mice

The house mouse (*Mus musculus*) is considered one of the most troublesome and economically important rodents in the United States. House mice live and thrive under a variety of conditions; they are found in and around homes and farms as well as in open fields and agricultural lands. House mice consume and contaminate food meant for humans, livestock and other animals, cause damage to structures and property, and may transmit diseases.

Recognizing Mouse Infestations

Droppings, fresh gnawing and tracks indicate areas where mice are

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Openings

active. Mouse nests, made from fine shredded paper and other fibrous material, are often found in sheltered locations. House mice have a characteristic musky odor that identifies their presence, and they may occasionally be seen during daylight hours.

House Mouse Biology

Although house mice usually feed on cereal grains, they will eat many kinds of food. They are sporadic feeders, nibbling bits of food here and there.

Mice have keen senses of taste, hearing, smell and touch. They are excellent climbers and can run up any rough vertical surface. They will run horizontally along wire cables or ropes and can jump 12 inches from the floor onto a flat surface. Mice can squeeze through openings slightly larger than $\frac{1}{4}$ inch in diameter.

In a single year a female may have five to 10 litters of usually five or six young each. Young are born 19 to 21 days after mating, and reach reproductive maturity in six to 10 weeks. The life span of a mouse is one to two years.

House Mouse Control

Effective control involves three aspects: sanitation, mouse-proof construction and population reduction.

The first two are useful as preventive

measures but when a house mouse infestation already exists, some form of population reduction is nearly always necessary. Reduction techniques include trapping, poisoning and fumigation. A flow chart outlining steps in house mouse control is found in the figure below.

Sanitation. Because mice can survive in very small areas with limited amounts of food and shelter, it is nearly impossible to eliminate them, particularly on farms. Most buildings in which food is stored, handled or used will support house mice if not mouse-proof, no matter how good the sanitation. However, although good sanitation will seldom eliminate mice, poor sanitation is sure to attract them and will permit them to thrive in greater abundance.

Mouse-Proof Construction. The most successful and permanent form of house mouse control is to "build them out" by eliminating all openings through which they can enter a structure. All places where food is stored, processed or used should be made mouse-proof. Seal any opening larger than $\frac{1}{4}$ inch to exclude mice. Cracks and openings in water pipes, vents and utilities should be sealed tightly with metal or concrete. Doors, windows and screens should fit tightly. It may be necessary to cover

Can mice's food source be removed or limited? Yes —Remove or limit food source.	No	Are the mice within a building or structure that can safely be fumigated? Yes —Contact a pest control agent for fumigation.	No
Can mice's shelter be removed or limited? Yes —Reduce or limit shelter.	No	Can a single-dose poison be used safely? Yes —Use single dose poison.**	No
Are mice numerous? Yes	No*	After using a single-dose poison, do some mice remain? Yes	No
Is a quick reduction in mice numbers needed? Yes	No*	Can an anticoagulant rodenticide be used safely? Yes —Use anticoagulant rodenticide.	No*
Will the presence of dead mice cause an odor or sanitation problem? Yes*	No	After using an anticoagulant, do some mice remain? Yes*	No

continued on next column

*Use traps: Snap traps; Multiple-capture traps; or Glue boards if not apt to entrap children, pets or wildlife.
**Assistance of a pest control agent may be required.

Chart of steps in house mouse control. Additional factors, such as the cost of particular control methods, must be considered when planning a control program.

the edges with metal to prevent gnawing. Plastic sheeting or screen, wood, rubber or other gnawable material is unsuitable for plugging holes used by mice.

Traps. Trapping, although time-consuming, is an effective control method. It is the preferred method in homes, garages, and other structures where only a few mice are present. Trapping has several advantages:

1. it does not rely on inherently hazardous rodenticides;
2. it permits the user to view his or her success; and
3. it allows for disposal of the mouse carcasses, thereby eliminating dead mouse odors which may occur when poisoning is done within buildings.

The simple, inexpensive wood-based snap trap is effective and can be purchased in most hardware and grocery stores. Bait traps with peanut butter, chocolate candy, dried fruit or a small piece of bacon tied securely to the trigger. Set them so that the trigger is sensitive and will spring easily. Leaving traps baited but unset until the bait has been taken at least once reduces the chance of creating trap-shy mice.

Multiple-capture live traps for mice, such as the Victor Tin Cat and the Ketch-All, are also available in some hardware and feed stores.

Set traps close to walls, behind objects, in dark corners and in places where evidence of mouse activity is seen. Place them so that mice will pass directly over the trigger as they follow their natural course of travel, usually close to a wall. Traps can be set on ledges or on top of pallets of stored materials if mice are active in such locations.

Use enough traps to make the campaign short and decisive. Mice seldom venture far from their shelter and food supply, so traps should be spaced no more than 10 feet apart in areas where mouse sign is observed.

An alternative to traps are glue boards, which catch and hold mice attempting to cross them in much the same way flypaper catches flies.

Place glue boards along walls where mice travel. Do not use these where children, pets or desirable wildlife can contact them. Glue boards lose their effectiveness in dusty areas, and extremes of temperatures also may affect the tackiness of the adhesive.

Single-dose rodenticides will give a quick knock-down of a mouse population, and may be preferred where mice are abundant or where it is difficult to get mice to accept a bait for several days in succession because of competing food items.

Prebaiting. Prebaiting with unpoisoned bait for several days before the rodenticide is offered is highly recommended as a way to get the best control. Because "bait shyness" or "poison shyness" may occur with single-dose rodenticides, they should not be used more than twice per year at a given location, and preferably only once. Because they are more hazardous than anticoagulants, single-dose rodenticides should be used only by professional pest control operators or other persons familiar with their use.

Anticoagulant rodenticides.

Multiple-dose rodenticides are generally considered much safer to use for mouse control than single-dose poisons. These baits cause death only after they are fed on for a number of days.

When anticoagulant rodenticides are used, fresh bait must be available continuously for at least two weeks or until all signs of feeding cease.

Bait Selection and Placement.

Anticoagulant baits are available in several forms. Grain baits in a meal or pelleted form are available in small plastic, cellophane or paper packets. These sealed place packs keep baits fresh and make it easy to place the baits in burrows, walls and other locations. Mice gnaw into the packet to feed on the bait.

Anticoagulant baits which have been formulated into paraffin blocks are useful in damp locations where loose grain baits would spoil quickly, but their acceptance by mice is generally not as good.

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A particularly good bait material for house mice is whole canary grass seed (*Phalaris canariensis*).

Where no water is available, water or food items of high water content are often more readily accepted than are dry baits. Sodium salts of anticoagulant rodenticides to be dissolved in water to make a water bait are available. Although mice require little water to survive, water baits used where moisture is scarce can be an effective supplement to other control measures.

Proper placement of baits and the distance between placements is important. Bait placements should be spaced no farther than 10 feet apart, and preferably closer. For effective control, baits or traps must be located where the mice are living. Mice living in wall spaces or in sacks of feed stacked on pallets, for example, seldom may be found at floor level.

Use of bait boxes or stations protects rodenticides from weather and provides a safeguard to people, pets and other animals. Bait stations should have at least two openings approximately 1 inch in diameter and should be large enough to accommodate several mice at a time. Place bait boxes next to walls with the openings close to the wall, or in other places where mice are active. All bait boxes should be clearly labeled, "CAUTION, Mouse Bait," as a safety precaution.

Where it is impossible to exclude rodents from buildings, establish permanent bait stations in buildings and around their perimeter. Fresh anticoagulant bait in these stations will control invading mice before breeding populations become established.

Fumigants (Poisonous Gases). Fumigants are sometimes used in house mouse control, usually in a structure, railway car or other enclosed area. When possible, fumigation is a very quick way to achieve 100 percent rodent control. If a building has to be completely tarped, however, the operation is expensive.

CAUTION! Fumigants are highly toxic to people and animals, and must not be used in any situation which might expose the occupants of a building to the vapors.

Because of inherent potential hazards, only licensed structural pest control operators should use fumigants in any situation involving buildings or other structural enclosures.

Safety Precautions. Certain general safety precautions should be followed in addition to those appearing on the labels of products. Consider all rodenticides dangerous enough to cause death, and place baits where only rodents can get them. There are no known rodenticides which do not present some degree of hazard to animals other than rodents.

Whenever possible, it is best to buy prepared or ready-to-use baits, thus reducing risks involved in handling concentrated toxicants.

Label all bait containers and stations clearly with appropriate warnings. Store unused bait and concentrates in a locked cabinet out of the reach of children or animals.

Follow the label directions on all rodenticide products carefully. Pick up all dead mice after a poisoning program. Handle the carcasses with rubber gloves or a pair of long tongs. Dispose of large numbers of dead mice by incineration or deep burial. With only a few mice, place them in a plastic bag, close it tightly and dispose of it with the other household garbage.

Remove and destroy all uneaten bait at the end of the poisoning period. Never leave single-dose baits exposed for more than three or four days.

Sound and Electronic Devices. Although mice are easily frightened by strange and unfamiliar noises, they quickly become accustomed to regularly repeated sounds and are often found living in grain mills and factories. Ultrasonic sounds, those above the range of human hearing, have very limited use in rodent control because they are directional and do

not penetrate behind objects. Also, they lose their intensity with distance. There is little evidence that sound of any type will drive established mice or rats from buildings.

Several types of electromagnetic devices have been marketed recently which claim effectiveness in repelling rodents or causing them to behave abnormally. Scientific tests of many such devices have shown that they failed to control rodents as claimed by their advertising.

Predators. Although cats, dogs, and other predators may kill mice, they do not give effective control under most circumstances. It is not uncommon to find rodents living in very close association with dogs and cats. Mice and rats may obtain much of their diet from the pet's dish or from what pets spill.

Bats

Bats are the only mammals capable of true flight. There are 15 species of bats that occur with some regularity in Kansas. About one-third of these are found only in the red hills area of southcentral Kansas where natural caves provide them with suitable habitat.

Vampire bats are not found in the United States but do occur in Mexico and Central and South America. Bats are found worldwide to the limits of tree growth and become more numerous as one approaches the tropics. All Kansas bats are insectivorous (insect-eating). In addition to insects, some bats eat fruit, nectar, fish and meat.

Bat Habits

Studies have shown that bats locate objects by using reflected sound waves. Quick reflexes and this system of echo-location allows bats to pursue and capture insects while avoiding collisions with objects. They do not attack humans or tangle themselves in people's hair.

By day, bats roost in dark, sheltered places, such as caves, hollow trees, rock crevices, barns, attics, under loose tree bark, etc. They prefer an area that is dark and free of drafts. Some bats are solitary, but most con-

gregate in groups or colonies. They leave their roosting places at dusk to fly about in pursuit of the night-flying insects which provide the bulk of their diet. The bats found in Kansas are small, averaging 3 to 5 inches in length.

Some bats migrate with the change in season, whereas others will hibernate. In most cases, bats live in buildings only during the warmer months, hibernating elsewhere during winter. Uncommonly, bats may be present in a building in winter, hibernating during cold weather, and flying and feeding whenever the weather warms.

Females usually collect in buildings in spring to bear and rear their young, whereas males tend to be solitary and scattered at that time. By mid-August, the young bats are able to fly and, afterwards, the males may join the group.

The bats usually leave the buildings as the weather cools and insect activity decreases. Although bats normally use buildings for daytime roosts, some buildings are attractive to bats primarily at night, where they are used as resting areas between feeding forays. The major objection to bats in buildings is the highly objectionable odor from their droppings and urine. The noises made by crawling and squeaking bats are also disturbing to homeowners.

Bats and Rabies

Random sampling of North American insectivorous bats has shown rabies in less than half of 1 percent of those tested. Testing of rabies-suspect (usually sick or dead) bats has yielded about 10 percent positive.

"Outbreaks" of rabies in bats are extremely rare or nonexistent. Finding one rabid bat in a colony does not mean that an outbreak will follow. Only 1 to 3 percent of infected bats display evidence of "furious" rabies wherein they make unprovoked attacks. The species exhibiting this behavior are extremely small and do not live in buildings.



Little Brown Bat

Vertebrate Pests



Skunk

Most bites occur from handling sick bats and are “defensive bites.” Apparently, any bat capable of transmitting the rabies virus will eventually die. However, bat saliva may contain the virus as early as 12 days before the bat shows any symptoms of the disease. Many bats are capable of contracting rabies and surviving, but apparently those that survive do not pass on the disease.

Although the number of bats found positive for rabies has increased since the 1950s, the proportion of bats tested and found positive has remained relatively constant. Since unprovoked attacks by bats are extremely rare, people should be educated not to try to pick up or handle bats. If a person is bitten, recover the bat and send it to a diagnostic laboratory for testing. If the bat is not recovered and tested, the person receiving the bite will have to undergo the painful and expensive antirabies treatments.

Bat Control

The only lasting solution to a bat problem is to physically bar their entry to the building or to their roosting areas within the building. This should be done after the bats have left on their evening feeding flights or after they have departed in the fall. Bats do not gnaw, so it is relatively easy to block their entry.

Any attempt to rid a building of bats should take into account the seasonal behavior of these animals. Bat proofing buildings or efforts to expel bats should not be attempted from spring to mid-August, because young bats, incapable of flight, will be present in the roosts. These young would either be trapped inside or scattered outside. Trapped bats may crawl to the interior of the building and grounded bats could bite children and pets.

Bat proofing can vary considerably from one building to another. In general, any opening greater than $\frac{1}{4}$ inch should be sealed. Larger openings can be covered with sheet metal or $\frac{1}{4}$ inch hardware cloth, if ventilation is required. Smaller openings can be sealed with caulking compound. In

those instances where bat proofing is impossible or impractical, roosting slots or crevices can be covered or filled. Light can often be used to an advantage in these situations. If the roost is not too large in terms of number of bats, sticky compounds may be effective when applied to roost entrances.

If a person is going to be working in or around a roost when bats are present, he/she should wear coveralls and leather work gloves. In general, if bat-proofing operations are conducted between November and March, there should be no bats present in the building.

Like many other animals, bats create problems when they come into conflict with humans. When this happens, control measures, not necessarily lethal, should be taken to solve the problem. The mere presence of bats in the area or neighborhood is not detrimental. In fact, bats provide many more benefits than most people realize.

Some people place bat houses around their dwellings to provide a roost for bats and reduce the chances of them using their attic. Plans for building a bat house are available from your K-State Research and Extension county office. Commercially made bat houses are also available.

Skunks

There are two species of skunks in Kansas. The striped skunk is about the size of a large house cat, generally black in color with two white stripes running from the base of the skull to the large bushy tail. Solid black individuals are known to occur, but only rarely.

The spotted skunk is a smaller mammal about the size of a half-grown house cat. The spotted skunk is now rarely found in Kansas and is fully protected as a threatened species under state regulations. Striped skunks are classified as fur bearers in Kansas. “Problem” skunks can be controlled without a permit, subject to some restrictions.

The striped skunk is most often found close to buildings and houses. It is generally more tolerant of humans and is much more abundant than the spotted skunk. The spotted skunk prefers a hillside habitat, more brushy than wooded, dry and somewhat rocky. When found in buildings, it prefers those that are intermittently occupied.

Biology

Skunks may sleep for several days during very cold weather, but do not hibernate. Mating occurs from January to May. The gestation period is 62 days. Skunks give birth to four to six naked, blind young, usually in May. The babies eyes will open in about three weeks, and they will nurse for six to seven weeks. Only one litter a year is raised. Adults weigh about 8 to 10 pounds; females are usually somewhat smaller. Skunks are most active at night.

Control

Control is best achieved by removal and relocation, exclusion or destruction, in that order. Exclusion is a desirable measure.

Properly constructed foundations will prevent skunks from denning beneath buildings. In lieu of continuous foundations, screening with quarter-inch hardware cloth is effective.

Removal and Relocation

This procedure with individuals or families of skunks is best accomplished with live traps. Other traps that kill or maim may result in serious odor problems. Bait box or live traps with chicken parts, a portion of canned pet food with a meat or fish base, canned or fresh raw fish, bacon or whole eggs.

Skunks are relatively easy to trap and, providing the trap is handled with a minimum of jarring or shaking, can be transported to a remote area and released with little concern for possible musk discharge. Use a syringe on a long pole to inject a tranquilizer into the skunk so as to render the skunk unconscious thus avoiding being sprayed.

It is not a good idea to release a trapped striped skunk. When a skunk is infected with rabies, the disease may not be apparent and symptoms may not appear for weeks or months. A healthy looking skunk may actually be diseased and may infect other animals it contacts. In this case, you will not be helping the animals by transporting the skunk to a "new home."

Tree Squirrels

Kansas has three species of tree squirrels. Gray squirrels, fox squirrels, and southern flying squirrels inhabit various areas of the state. Gray and fox squirrels are the main nuisance animals in U.S. urban areas. "Problem" squirrels can be controlled without a permit, subject to some restrictions.

A squirrel trapped inside a building can cause extensive damage. In addition to damage from attempts to gnaw through siding, etc., there is also the fire hazard resulting from gnawing on electrical conduit or wiring. Gnawing can make structures unattractive. Squirrels in attics or other confined areas may create odor problems.

A knowledge of squirrel behavior and abilities is helpful; for example, squirrels, like other rodents, can gain entry through an amazingly small opening. Keep this in mind when a structure is examined for squirrel entries. If not, it is very easy to overlook doorways through which squirrels come and go.

Control

As with any wildlife damage control problem, the best first step is to exclude animals. Squirrels must be removed prior to sealing a building against squirrel entry. If not, they may create more of a problem than if allowed free access. Repel all resident squirrels before plugging entry and exit holes.

Naphthalene is registered as a squirrel repellent. Broadcast 5 pounds for each 2000 cubic feet of space used by squirrels. Once squirrels have been repelled, make an all-

Vertebrate Pests



Raccoons

out effort to locate and squirrelproof every opening. Remove tree branches that may give squirrels access to roof and upper stories of buildings. Metal guards can be placed around trees adjacent to buildings but are ineffective if nearby trees are unguarded.

Nuisance squirrels can be directly eliminated by trapping and hunting. However, it should be understood that as long as attractants exist, problems will recur.

Trapping may involve use of live or kill-traps. Trap selection will depend on personal preference. In either case, place traps as close as possible to travelways and areas being used. Baits must be alluring, i.e., peanut butter or nut meats. Often, best results will be obtained when baited, unset traps are allowed to remain until squirrels overcome fear of these. After setting, inspect traps frequently and remove trapped animals. This prevents remaining squirrels from becoming alarmed and trap-shy. When live trapping, take animals a minimum of 5 miles before release.

Shooting can alleviate the problem. As with trapping, shooting will not prevent recurrence if attractants remain.

There is no toxicant registered for use against tree squirrels.

Raccoons

Raccoons are a problem in and around buildings in some cities, towns and on many farms in Kansas. Raccoons are classified as fur bearers in Kansas. "Problem" raccoons can be controlled without a permit, subject to some restrictions.

Control

There are no poisons or repellents registered for taking or repelling raccoons. The best approach is to build them out of a building by repairing entrances used by raccoons. If this is not practical, then live trapping should be considered.

Raccoons are easily captured to live traps using fish, fish-flavored canned cat food or fresh chicken parts. Provided a permit is given the captured raccoon can either be killed or transported 25 miles away and released along a stream or river.

Study Questions

1. (65) When working around old or abandoned bird roost sites a respirator or face mask with dust filter should be worn to prevent inhalation of:
 - a. putrid odors
 - b. fungus spores
 - c. toxic fumes released from decaying droppings
 - d. ectoparasites
2. (65) The female pigeon will lay _____ eggs several times a year.
 - a. 1 or 2
 - b. 5 to 7
 - c. 8 to 10
 - d. 12 to 14
3. (67) What frightening devices are used to remove pigeons from an area?
 - a. no practical alarm or distress signals have been found
 - b. scarecrows such as stuffed owls are effective
 - c. flags and dangling paper have a lasting effect
 - d. they will always fly away if they hear noises
4. (67) A single dose poison applied to whole grain corn:
 - a. is a chemosterilant
 - b. is a frightening device
 - c. does not need prebaiting
 - d. is a toxicant
5. (68) A female sparrow will commonly lay 5 eggs at a time and _____ brood(s) is(are) raised each year.
 - a. 1
 - b. 2-3
 - c. 5-10
 - d. 10-12
6. (68) A trap that catches a larger number of sparrows at a time is the:
 - a. nest trap
 - b. double funnel trap
 - c. modified Australian crow trap
 - d. elevator trap
7. (69) The following trap has been effective for capturing large number of starlings:
 - a. modified Australian crow trap
 - b. elevator trap
 - c. double funnel trap
 - d. nest trap
8. (70) The first step in controlling rats and mice is:
 - a. set traps
 - b. use bait stations
 - c. put the population under stress
 - d. use multidose and single dose poisons
9. (70) Rats reach reproductive maturity in about:
 - a. 1 month
 - b. 3 months
 - c. 6 months
 - d. 1 year
10. (71) Rat traps should be set close to a wall and baited with a small piece of:
 - a. fruit
 - b. hotdog or bacon
 - c. anticoagulant
 - d. rodenticide bait
11. (72) Rats can become bait shy when they:
 - a. eat a sublethal amount of acute poison
 - b. do not like the taste of the prebait
 - c. eat any type of multiple dose rodenticides
 - d. eat anticoagulant baits more than 2 days

Study Questions

12. (73) Water baits are particularly useful on rats in:
 - a. garages
 - b. basements
 - c. grain storage structures
 - d. rodent burrows
13. (73) Cats and dogs:
 - a. will always give effective rat control in homes
 - b. do not control rats
 - c. can be related to rat problems around homes
 - d. do not kill rats but keep them out of the area
14. (74) House mice eat many kinds of food but usually feed on:
 - a. cheese
 - b. cereal grains
 - c. paper
 - d. flour products
15. (75) Mouse traps should be spaced no more than _____ apart in areas where signs of mice are observed.
 - a. 3 feet
 - b. 7 feet
 - c. 10 feet
 - d. 16 feet
16. (76) Anticoagulant baits formulated into paraffin blocks:
 - a. are useful in dry locations
 - b. are useful in damp areas
 - c. are accepted well by mice
 - d. cause grain bait to spoil quickly
17. (76) Fumigants for rodents:
 - a. are quick acting with 100% rodent control
 - b. are highly toxic to humans and animals
 - c. may control insect pests and house mice
 - d. all of the above
18. (77) The only true mammals capable of true flight are:
 - a. flying squirrels
 - b. bats
 - c. sail fish
 - d. flying red fox
19. (77) Female bats usually collect in buildings in the _____ to bear and rear young:
 - a. fall
 - b. winter
 - c. spring
 - d. summer
20. (77) "Outbreaks" of rabies in bats are:
 - a. extremely rare or nonexistent
 - b. documented every year in Kansas
 - c. documented every five years in Kansas
 - d. documented every 10 years in Kansas
21. (78) In general, bat proofing of buildings involves sealing of any openings greater than:
 - a. $\frac{1}{4}$ inch
 - b. $\frac{3}{4}$ inch
 - c. 6 inches
 - d. 18 inches
22. (78) Which species of skunk is protected by Kansas regulations?
 - a. tree skunk
 - b. striped skunk
 - c. spotted skunk
 - d. long-tailed skunk
23. (79) The first step in squirrel control is to:
 - a. tame the animals by feeding them
 - b. squirrel-proof every opening
 - c. exclude them from buildings
 - d. remove tree branches near building roofs
24. (80) When removing a raccoon from an area, it must be taken at least _____ from the capture site and released along a stream.
 - a. 1 mile
 - b. 5 miles
 - c. 15 miles
 - d. 25 miles

Answers

Pages 4–5

1. a 2. b 3. d 4. a

Pages 6–16

1. a 2. d 3. d 4. c 5. a
6. d 7. d 8. a 9. d 10. a
11. d 12. b 13. d 14. b 15. a
16. d 17. c 18. c 19. d 20. a
21. b

Pages 19–26

1. b 2. a 3. c 4. b 5. d
6. b 7. c 8. c 9. d 10. a
11. b 12. a 13. d

Pages 29–45

1. b 2. c 3. a 4. a 5. d
6. b 7. b 8. a 9. c 10. c
11. d 12. c 13. c 14. b 15. a
16. c 17. a 18. d 19. b 20. a
21. c 22. c 23. d 24. a 25. d
26. c 27. b 28. b 29. a 30. c
31. d 32. b

Pages 49–50

1. a 2. c 3. d 4. b 5. a
6. d 7. c 8. a

Pages 52–63

1. b 2. d 3. c 4. b 5. c
6. d 7. c 8. a 9. d 10. b
11. d 12. d

Pages 65–80

1. b 2. a 3. a 4. d 5. b
6. c 7. a 8. c 9. b 10. b
11. a 12. c 13. c 14. b 15. c
16. b 17. d 18. b 19. c 20. a
21. a 22. c 23. c 24. d

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