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PESTICIDE APPLICATOR CERTIFICATION TRAINING

Category 8 Manual

Public Health

Pest Control

PUBLIC HEALTH PEST CONTROL

A Training Program for the Certification
of Pesticide Applicators

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KEYS TO PROPER USE OF PESTICIDES

1. Read the label on each pesticide container before each use. Follow instructions to the letter; heed all cautions and warnings, and note precautions about residues.
2. Keep pesticides in the containers in which you bought them. Put them where children or animals cannot get to them, preferably under lock and away from food, feed, seed, or other material that may become harmful if contaminated.
3. Dispose of empty containers in the manner specified on the label.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES.

CONTROL PRINCIPLES

Many insects, mites, ticks, spiders (called collectively "arthropods"), and rodents that are of public health importance can be controlled by a variety of methods - such as sanitation practices, water management, mechanical methods, and pesticides. In an emergency disease situation when insects and their relatives are involved, pesticides are usually the recommended control, due to the necessity for a rapid reduction of pest populations. Non-chemical means have a dominant and preferred role in control of many arthropods and rodents, but are usually too slow in emergency situations. The cost of pesticides and their usually quick but temporary control must be balanced with non-chemical methods that may give much longer-lasting reductions in pest populations - but may be initially more expensive.

Persons directing public health pest control programs must be able to assess their operation and determine that they are achieving their objectives without adversely affecting man or the environment. Proper survey and identification techniques are essential for the applicator to be able to apply the correct control method at the proper time and place, and keep the use of pesticides at a minimum.

Balanced pest control programs require the support of other agencies - i.e., proper garbage collection and disposal for fly and rodent control, and design of impoundments and drainage

ditches for mosquito control. Education of the general public and other agencies is an essential element in getting the understanding necessary to carry out your objectives.

PESTS

Mosquitoes

Life Cycle and Habitats - Mosquitoes have four distinct stages in their life cycle; the egg, larva, pupa and adult. The first three stages occur in water. There are many different species or kinds of mosquitoes.

Each species will lay its eggs in its specific type of site. For example, various salt marsh mosquitoes will lay their eggs in

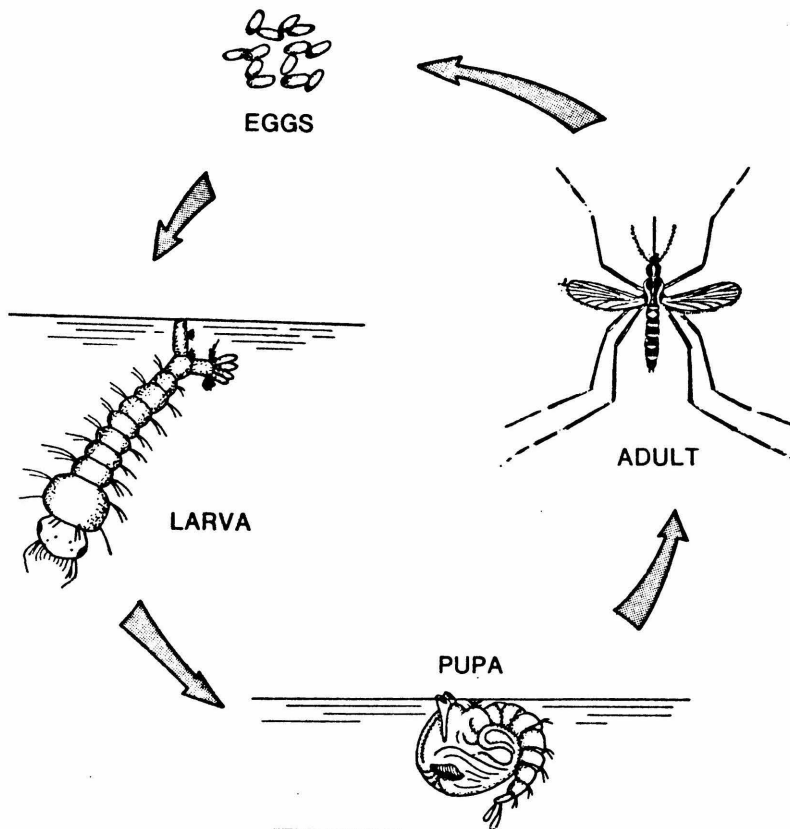


Figure 1. Life Cycle of a Mosquito

the damp sod of salt marshes; species preferring containers will lay their eggs in tree holes, tires, and various other artificial containers (cans, bottles, etc.); some species will prefer the polluted water (and others the clear water) of ditches, ponds and lakes; and some the temporary puddles of rain water. The eggs will hatch when they are in contact with water.

The larvae of all mosquitoes live in water. They are called "wigglers."

The pupae also live in water, and unlike many insect pupae, are very active. They are called "tumblers."

After the adults emerge from the pupae, most females require a blood meal before laying eggs. Each species of mosquito prefers to feed on certain types of animals (such as birds or rodents) or even on a particular species of animal (such as horses, cattle, or man). Some species of mosquito will fly only a city block or two while others will fly up to 10 - 20 miles. Some are active during the day while others are active at night.

When mosquitoes are causing a public health problem, it is essential to conduct a survey to identify the species involved. Knowledge of the life cycle and habitat of the species involved is essential in order that control may be directed at the proper place at the right time.

Public Health Importance - Mosquitoes have probably had a greater influence on human health and well being than any other

insect group. Mosquito bites are irritating and itch, so that mosquitoes can interfere with outdoor activities, and decrease the value of property.

There are numerous disease organisms carried by mosquitoes that can cause severe illness or death in man. Most of those that once occurred in the United States (malaria, dengue and yellow fever) are no longer present. However, there is still one group that appears periodically. It is the group of viral diseases that affect the central nervous system, causing encephalitis. There are several major types of encephalitis; the one found along the Atlantic and Gulf Coast States is called eastern encephalitis. This disease normally occurs in

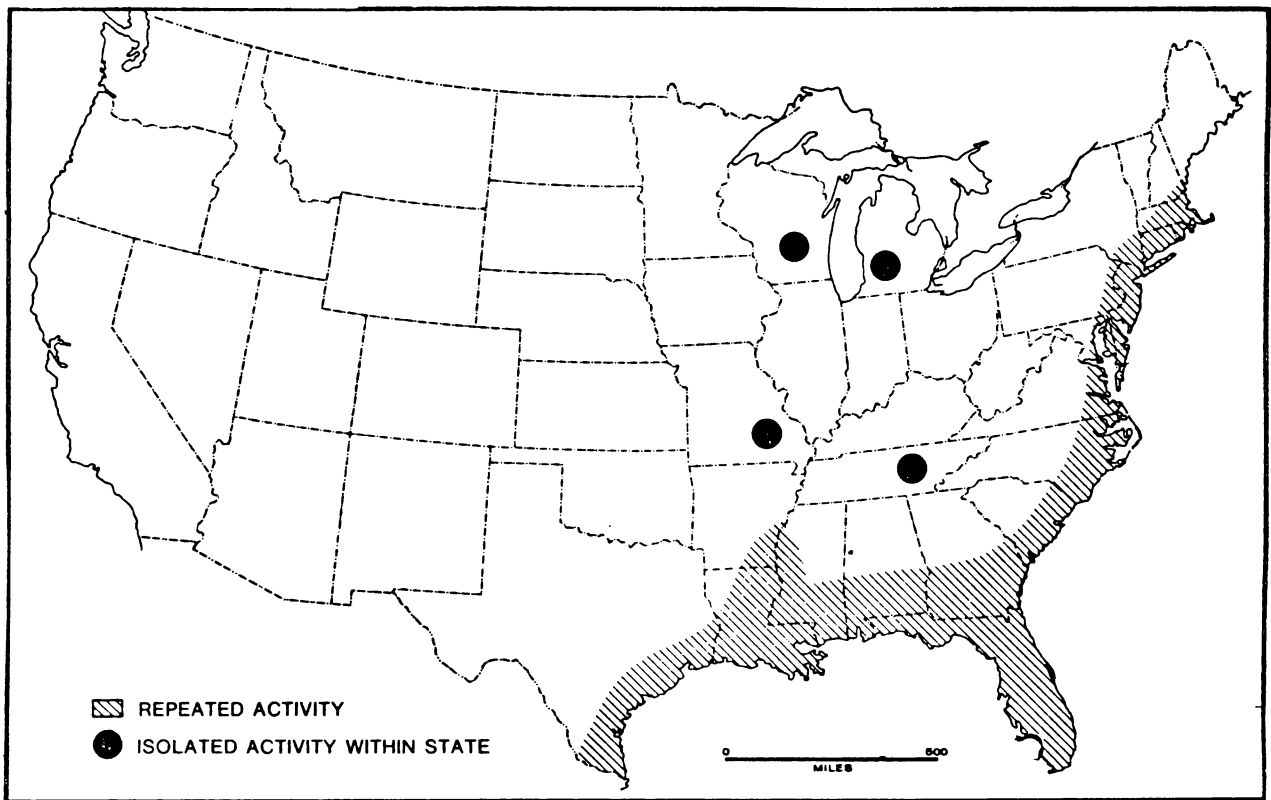


Figure 2. Locations of Eastern Encephalitis

various species of birds. Some species of mosquitoes prefer to suck the blood of birds and carry the virus from bird to bird. Other species of mosquitoes occasionally feed on horses and man as well as birds and will cause the disease to "spill over" into human populations. The human death rate from this disease is high.

Non-Chemical Control - The application of pesticides is a never ending cycle as long as favorable habitats are available for mosquito breeding. The initial investment in eliminating favorable aquatic breeding sites is high, but savings can be realized over time. Filling, draining, water management and the use of mosquito-eating fish are well developed techniques that can be very effective. In filling, draining or water management operations, expert advice should be sought and utilized so as to prevent environmental problems. For example, filling may block drainage patterns creating new breeding sites or interfering with aquatic life. Drainage can be accomplished in many ways. The depth of the drains, their placement and location can create a more favorable environment for mosquito breeding and result in changes in vegetation that affect wildlife if incorrectly done. Water management (i.e., the creation of steep banks on impoundments and ponds to reduce the area for the growth of aquatic vegetation, fluctuating the water level to control vegetation and to allow fish access to mosquito larvae) often involves other interests such as fishing, recreation, water for drinking

and electrical power, and these interests must be consulted prior to initiating any such measures. Remember, non-chemical methods have been used successfully for many years; in fact, much longer than most pesticides have been available. There is a great deal of information available which will enable you to achieve your objectives and to safeguard environmental and other interests even though compromises may sometimes be necessary.

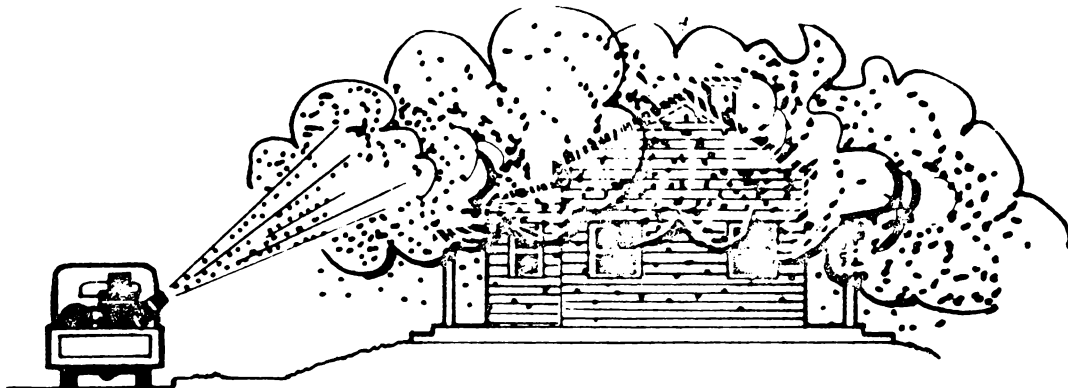
Non-chemical control of adult mosquitoes is more limited. Screening of dwellings and the wearing of tightly woven clothing are the most effective non-chemical control measures available.

Control with Pesticides

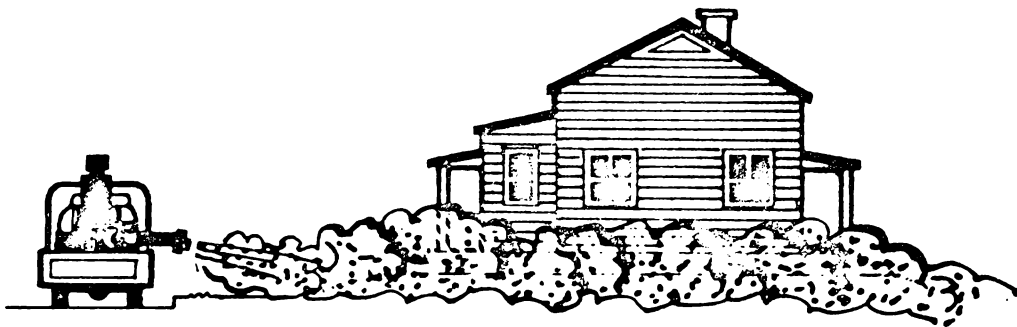
- a. Continuous Vapor Dispensers - A formulation of dichlorvos in wax or resin allows the gradual release of insecticidal vapors over an extended period of time. This type of treatment is effective against adult mosquitoes in enclosed areas such as homes, catch basins, and cisterns. Vapor dispensers should not be used where infants or the aged are continuously exposed, or in areas where food is prepared, served or stored. Follow label directions in detail.
- b. Space Treatments - Space treatment in the form of fogs, mists, ultra-low volume (ULV) or dusts can be very effective in quickly reducing adult mosquito populations.

This is the most common control technique used when large mosquito populations become serious pests, or in an emergency situation such as an outbreak of encephalitis.

The city block is the unit treated when spraying for mosquitoes in an urban environment. Mists are directed over the house tops while fogs are kept as close to the ground as possible. Mists carrying the



MIST IS DIRECTED OVER HOUSETOPS



FOG IS KEPT AS NEAR THE GROUND AS POSSIBLE

Figure 3. Application of Mists and Fogs in Urban Adult Mosquito Control.

larger sized particles are generally more suitable for daytime use, while fogs carrying much finer droplets, should be applied only when updrafts from the warm earth or water are minimal, usually in the mid-morning, or evening.

The chief advantages of mists and fogs are:

- (1) Economy of operation.
- (2) The ability of a small amount of pesticide to cover a large area.
- (3) The rapidity with which large areas can be treated during emergencies.

The chief disadvantages of mists and fogs are the spotting of cars and windows and the burning of shrubbery due to the oil if the spraying is not done properly. Fog applicators are usually preferred to mist applicators in mosquito control programs conducted in urban areas due to their smaller particle size and the lesser likelihood of spotting automobiles and "burning" vegetation. However, fogging can cause serious traffic hazards.

Ultra-low volume (ULV) spraying is the application of a technical grade (concentrated) pesticide. Some pesticides may be used in a concentration as low as 0.5 ounces per acre. In ULV spraying, the technical pesticide is applied in a particle size similar than

that found in fogs and aerosols. A major advantage of ULV spraying is the application of relatively small amounts of concentrated pesticide in a given area. This permits ULV applications to be less expensive since diluents are eliminated and larger areas can be treated on a single tank of pesticide. The use of concentrated or technical material, however, increases the danger of causing damage to automobile finishes unless the particle size is kept small enough.

Dusts can be used as a space application, but it is more difficult to control their particle size and they are more likely to drift into non-target areas.

Honey bees are especially susceptible to pesticide drift.

There are a variety of different small portable power duster-misters, and larger truck-mounted power duster-misters available.

Mechanical fog generators produce small sized particles of insecticides by expelling them between discs turning at high speed.

Thermal fog generators produce small sized particles of insecticide by means of hot exhaust gases. There are many different types of small portable generators as well as large truck mounted models available. Smaller units can be used in city

parks, summer camps and other small areas while the larger units can be used in treating urban areas. Oil solutions must be used as emulsions and do not produce satisfactory thermal fogs.

The "cold fogger" is another type of mechanical fog generator that uses a special nozzle. The "cold fogger" has several advantages over that of thermal fog generators:

- (1) No visible fog to cause traffic hazards.
- (2) No potential breakdown of the pesticide from the heat.
- (3) Reduction of costs since it permits the use of water emulsions rather than oil solutions.

Ground ULV generators are available in a variety of sizes but are usually smaller and lighter than the heavier thermal fogger, cold fogger or ground mist machines.

- c. Repellents - A number of effective chemical repellents are available for personal protection.
- d. Larvicides - While the mosquito passes through three stages of development in water (egg, larva and pupa) most treatments are directed against the larval stage, because the eggs and pupae are more resistant to chemical treatment. Proper identification of the species to be

controlled, knowledge of its habitat, and the proper timing of applications are essential to effective control.

The effectiveness of pesticide applications are influenced by the degree of pollution and amount of vegetation in the water. Heavily polluted water may require more frequent applications to maintain control of mosquito larvae. Granular formulations may be preferable in the presence of heavy vegetation since they will penetrate the foliage better than solutions or emulsions. Both emulsions and oil solutions of a pesticide can be used with the latter being particularly effective in water with high organic content (or polluted). ULV aerial applications have been very successful in treating large areas covered by water. Petroleum oils (No. 2 fuel oil, and Flit MLO) were among the first larvicides to be developed and are now again being widely used. They are effective against mosquito eggs, larvae, and pupae.

Due to the repeated applications of the organochlorines and organophosphates as larvicides, many species of mosquitoes have become resistant to these chemicals. Unfortunately, a resistant larva results in a resistant adult. Since the use of the same pesticide for both adults and larvae may cause resistance

to develop faster, it is usually recommended that a different chemical be used for the control of adults than is used for the control of larvae.

In many areas, the use of petroleum oils as larvicides has become common practice because:

- (1) Eggs, larvae and pupae do not become resistant to this chemical.
- (2) The environmental hazard to aquatic life is reduced.
- (3) Organophosphates and carbamate compounds can be restricted to use as adulticides only, thereby delaying the development of resistance.

Flies

Life Cycle and Habitats - There are four stages in the life cycle of a fly: the egg, larva, pupa and adult. The larval habitat chosen by the adult female differs among the various species.

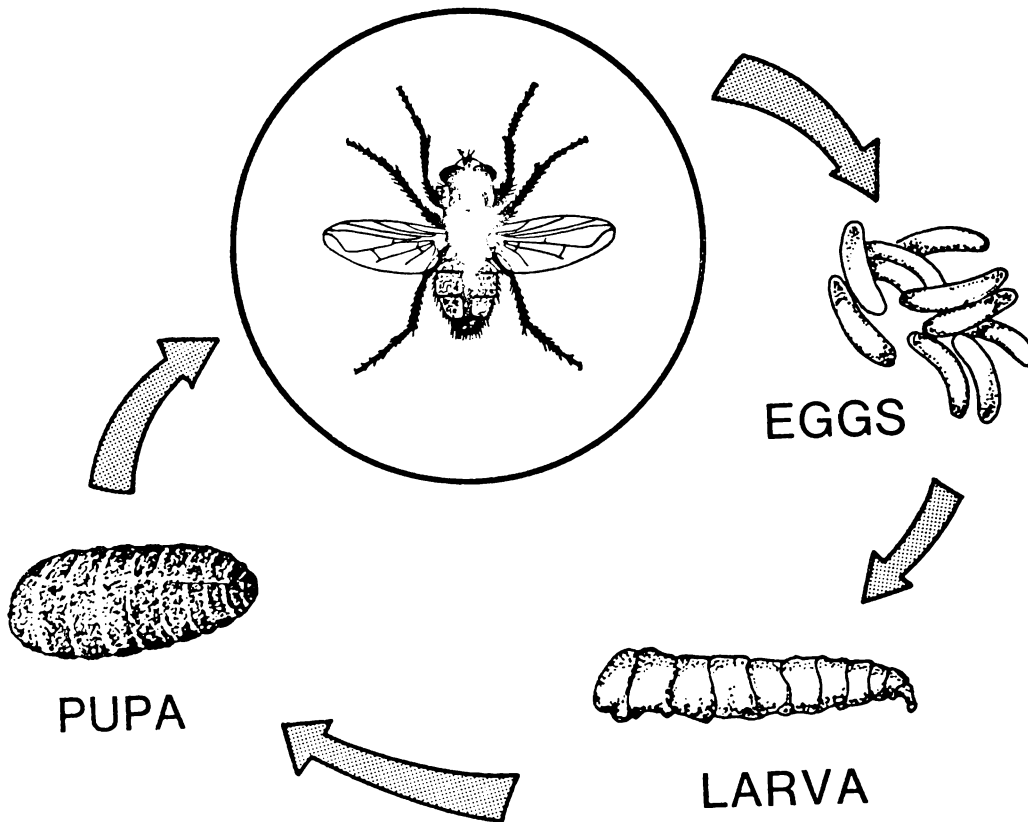
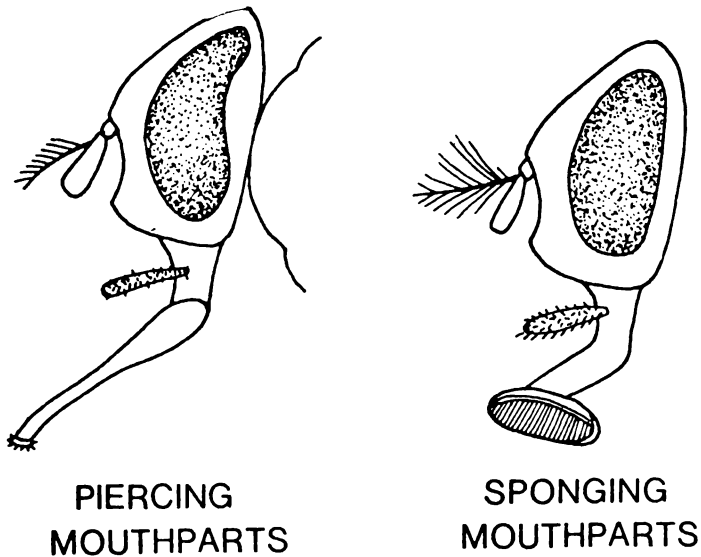


Figure 4. Life Cycle of the House Fly.

Many flies (such as house flies, stable flies and deer flies) of public health interest to man lay their eggs in decaying organic matter - human garbage and waste, manure of domesticated animals, and decaying vegetation. Following the hatching of the

eggs, the larvae feed upon organic material, and in a few days to several weeks develop into the inactive stage, the pupa. The pupal period may last from a few days to several weeks, after which the adult fly emerges.

Some flies, such as the house fly, have sponging mouthparts; others (such as deer and stable flies) have biting or piercing mouthparts. Some flies can fly many miles from the breeding site.



It is essential that proper identification of the species of fly to be controlled is made. Larval breeding sites and habits of the adult must be known so that control efforts may be directed toward the proper target area.

Figure 5. Piercing and Sponging Mouthparts of Flies.

Public Health Importance - Flies, especially in large numbers, can be very annoying and thus seriously interfere with work and recreational activities. Biting flies (such as stable flies and deer flies) cause pain and discomfort. In addition, since flies often lay their eggs and feed on decaying organic material (garbage, sewage, waste), they can transfer any disease organisms that may be present to table food which is consumed by man.

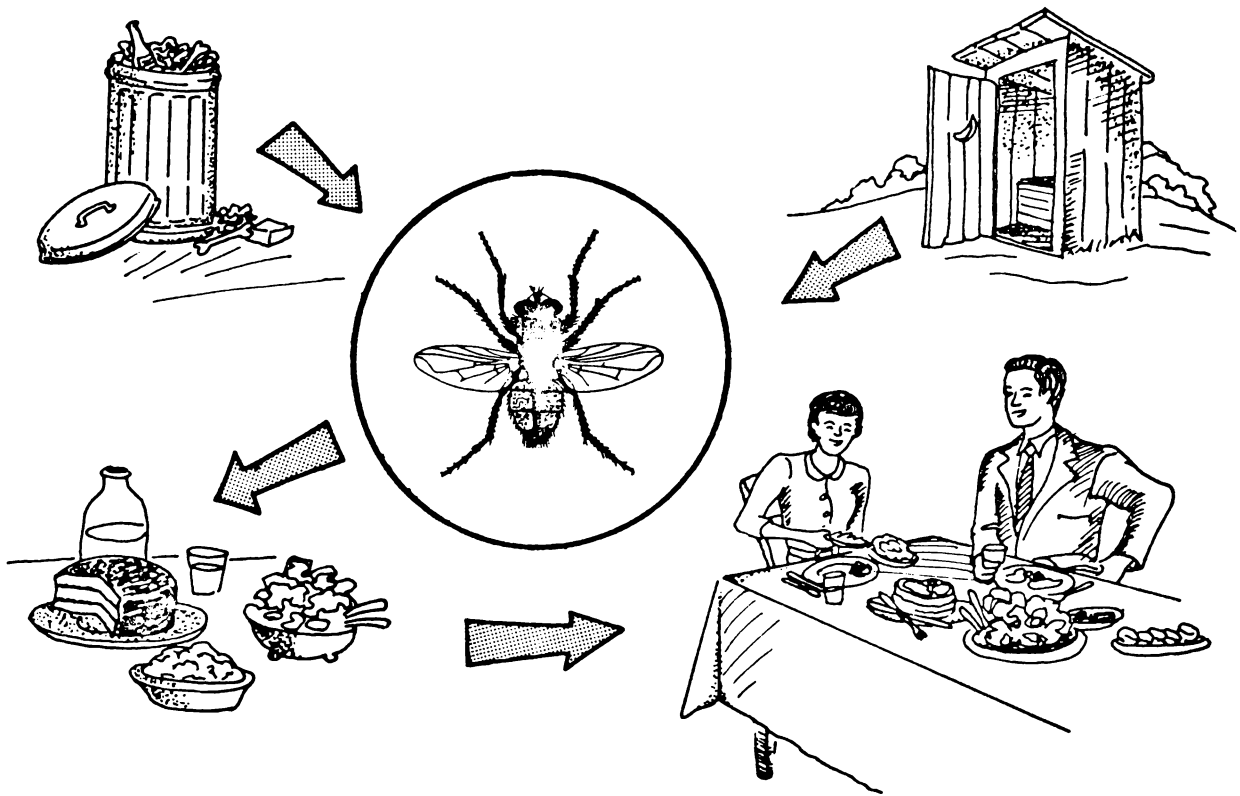


Figure 6. Transmission of Disease by Flies to Man.

Non-Chemical Control - The removal of any fly breeding sites located near human habitation is the best remedy. This includes the proper covering of garbage cans and the collection of garbage at least twice a week from residences, and daily from business establishments. If flies do gain access to the garbage, this schedule of collection will remove them before a new generation reaches the adult stage.

Garbage should be buried in a sanitary landfill. Incinerators may be practical for large cities where landfills are too remote. However, unless they are properly constructed they may contribute to air pollution problems. Sanitary disposal of sewage and industrial wastes is essential for an effective fly control program. Open sewage pits and wastes from canneries, feed mills



and packing houses provide excellent conditions for fly proliferation. Either adequate disposal methods, or holding facilities from which wastes can periodically be trucked out to a sanitary landfill should be available at the plant.

Figure 7.
Removal of Garbage.

Public health agencies will require the support of other governmental agencies in the disposal of these wastes.

Another method is the mechanical control of flies through screening, fly traps, electrocution devices and electric fans over doorways. A combination of chemical and environmental sanitation procedures is usually the most effective approach to the control of flies.

Control with Pesticides

- a. Residual Treatment - Because flies reproduce rapidly, the use of long-lasting residual insecticides has tended to select out resistant individuals relatively quickly. Adult resistance in some species of flies has emerged after using a pesticide for only one or two years.

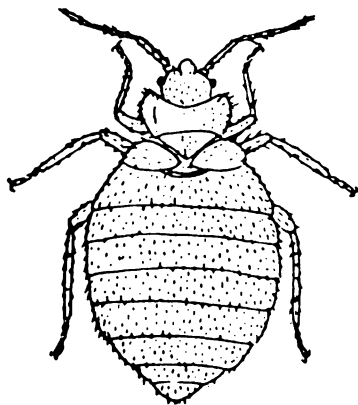
Bait stations consist of an attractive food containing a pesticide poison. They may reduce fly populations drastically but successive treatments and maintenance is necessary for continued results.

- b. Larvicides - Larvicides are most commonly used where there are accumulations of garbage, manure, rotting vegetation or other wastes and large numbers of fly larvae. Larvicide applications often do not penetrate the organic matter sufficiently to reach the areas of greatest concentration of fly larvae. Larvicides frequently break down rapidly due to the effects of the organic matter. Parasites and predators that prey upon the flies are destroyed, and the use of pesticides in such an environment encourages the development of resistance. Sanitation practices including the removal of fly breeding areas and the chemical treatment of adults are usually more effective in controlling flies than is complete dependence upon chemical control.

Bedbugs

Life Cycle and Habitats - The bedbug has three stages in its life cycle; egg, nymph (which, though smaller in size, is very similar in appearance to the adult) and adult. Bedbugs are usually well hidden, but their presence may be recognized by a characteristic odor, blood stains from squashed bugs, and excretory spots - most often found near the site of feeding.

The eggs and other stages of the bedbug are found in baseboards, wall crevices, bedsteads, and mattresses. Bedbugs have piercing



mouthparts and feed on the blood of humans. They may be carried from infested to uninfested areas in such things as furniture, bedding, clothing, baggage, and theatre seats.

Figure 8. Adult Bedbug.

Public Health Importance - Bedbugs have not been identified as disease carriers, but they do inflict irritating bites.

Control with Pesticides - A single application of an insecticide at their breeding sites will usually control bedbug infestations. Only a light application, not a soaking spray, should be given mattresses and upholstery. Infant bedding and cribs should not be treated with an insecticide.

Fleas

Life Cycle and Habitats - There are four stages in the life cycle of the flea: the egg, larva, pupa and adult. They are small wingless, bloodsucking insects with piercing mouthparts.

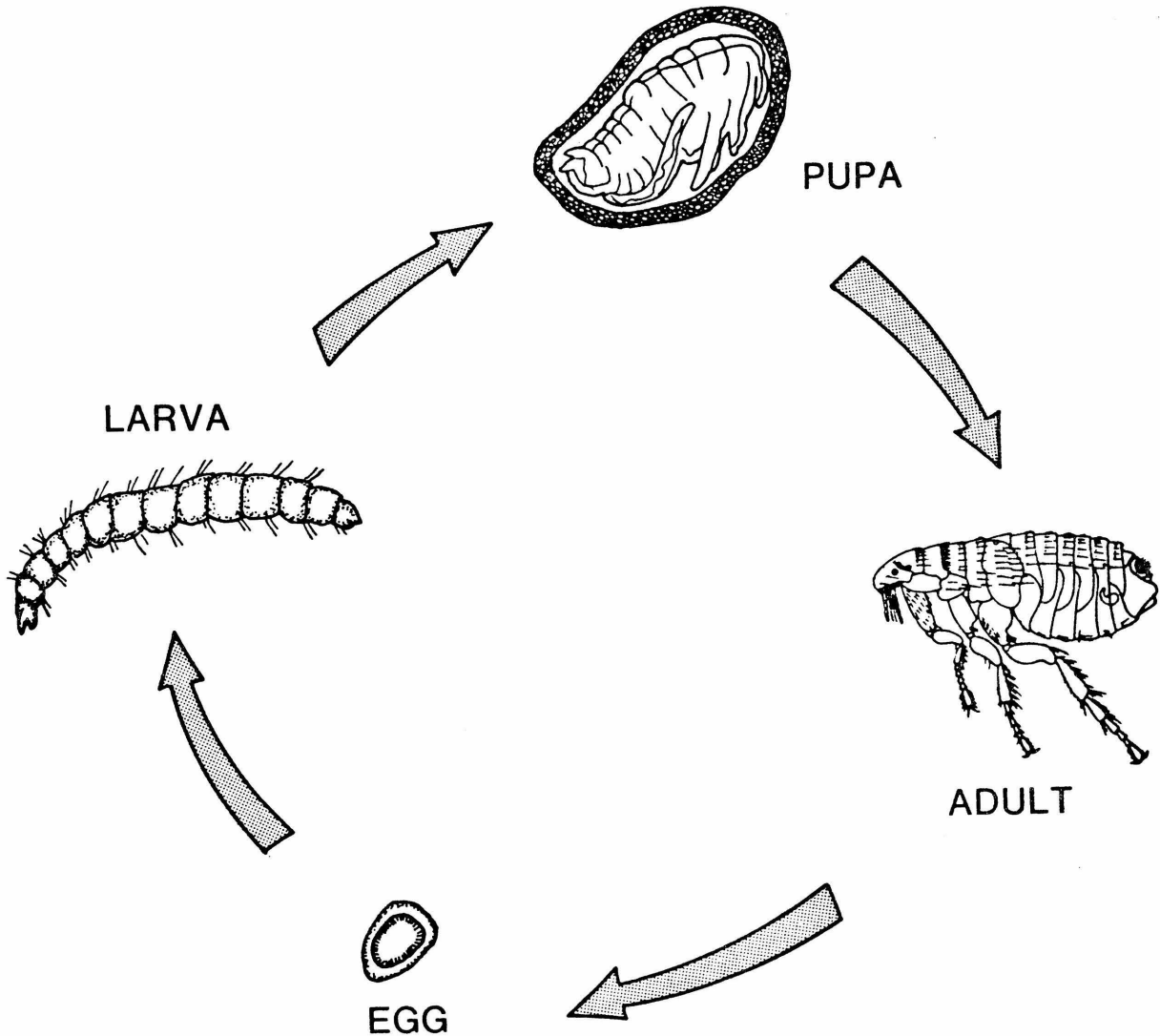


Figure 9. Life Cycle of a Flea.

Adults are usually very active and can move on and off a host to obtain a blood meal. Most species infest small animals (such as

mice, rats or squirrels) but some prefer larger animals and birds. Animals that burrow or nest are favored since they provide shelter to the temperature sensitive adults, and organic food for the larvae.

Eggs are usually laid loosely on the host. They drop off and larvae emerge within a few days to several weeks. Organic material serves as the food source - especially in the nest or bedding of the host where they eventually pupate. If the host dies or leaves a nesting area and fails to return, the adult fleas will actively seek a new host.

Public Health Importance - There are several species of fleas that live on rats. When rats die (as from a disease or a rodenticide) or for some reason fail to return to their nest, it is then that rat fleas are most likely to bite man.

Flea bites may be very irritating to some people. They can occur in large numbers in and around yards and homes, and are especially disturbing to man when the normal host (often a dog or cat) has been absent for a few weeks.

There are two important diseases that fleas can transmit from infected rats to man: plague and fleaborne typhus.

Fleas serve as the intermediate host in the life cycle of the dog tapeworm (*Dipylidium caninum*) that can also infect humans.

Control with Pesticides - The principal method of flea control on either cats, dogs or rodents is the application of insecticides.

Various types of insecticides of plant origin, organo-chlorines, organophosphates and carbamates are available as dusts for flea control. Oil solutions, wettable powders, and emulsions are also available for treating the premises. It is essential to read the label carefully since some insecticides are for dogs only, and some are for premise treatment only - not animals. The favorite resting place of pets requires treatment since eggs, larvae and pupae will commonly be found here. Various types of resin collars impregnated with an organophosphate are used successfully for flea control. Dusts and wettable powders are the safest to use around plants and bushes. Emulsions, and especially solutions, may "burn" plants if label directions are not followed carefully.

Reducing flea populations on domestic rats is best accomplished by reducing the rat populations with a combination of rat killing, rat proofing, sanitation and clean-up.

Lice

Life Cycle and Habitats - Sucking lice have three stages in their life cycle: egg, nymph, and adult. There are three different species of lice that infest man. Head lice are found primarily on the head and neck, and cement their eggs called

"nits" to the hairs close to the scalp. Body lice are found mainly in the clothing except when feeding and lay their eggs in the seams of clothing. Crab lice fasten their eggs on the body hair; are found primarily among the pubic hair but also infest hairy areas of the chest and armpits.

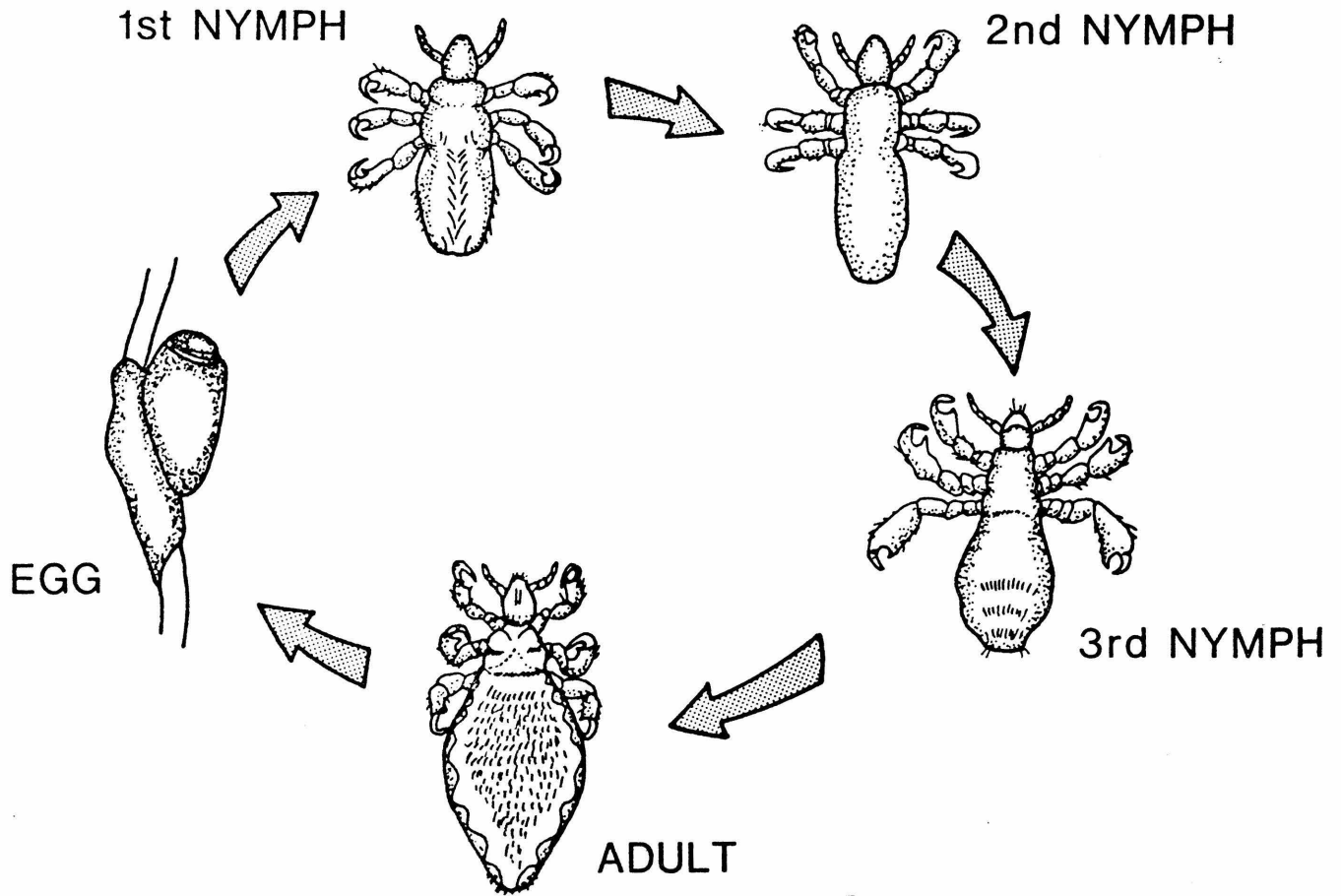
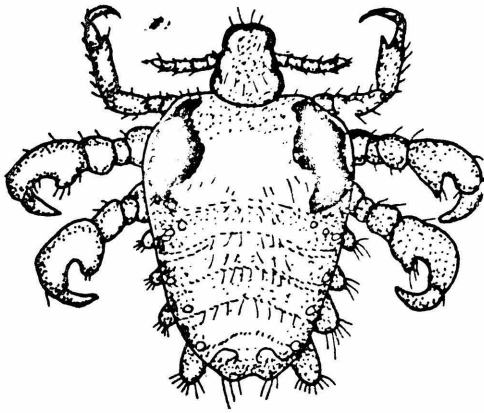


Figure 10. Life Cycle of Head Louse.

All three species of lice suck blood, and usually spend their entire life cycle on man. Body and head lice are disseminated mainly by personal contact between people and by infested clothing.



Head lice may be acquired by individuals attending school and carried home where they may infest other family members. Crab lice are spread mainly through sexual contact, but may also be transmitted by infested toilet seats and beds.

Figure 11. Crab Louse.

Public Health Importance - The organism that causes epidemic or louse borne typhus is carried to man by the body louse, but has not been present in the United States for many years.

Pediculosis is a skin condition resulting from a continuous and severe infestation of lice. A scarred, hardened and pigmented skin results from the scratching the itching caused by secondary infections and louse bites. All three kinds of human lice can cause pediculosis.

Human lice are generally associated with lower socio-economic conditions; however, members of any class can become infested.

Control with Pesticides - The three species of lice that infest man differ considerably in habits and, therefore, require different methods of control.

The body louse spends most of its life on clothing, except when feeding. Laundering with hot water or dry cleaning will destroy all stages of this louse in the clothing.

Insecticidal dusts can be used effectively against all three kinds of lice. While they may be unsightly, dusts are probably the most efficient approach to louse control and has the added advantage of not requiring the removal of clothing prior to treatment. Liquid preparations for application to the infested areas such as shampoos, lotions and emulsions are usually more acceptable. Some of these contain prescription drugs and, therefore, can be secured only on a physician's prescription. Since you will be applying pesticides directly to the skin, and many pesticides are absorbed through the skin, it is essential that the product be labelled for the purpose of louse control and that label directions be followed exactly.

Cockroaches

Life Cycle and Habitats - Cockroaches have three life stages: egg, nymph, and adult. The eggs are deposited in capsules containing many eggs in each. These hatch, becoming tiny nymphs - similar to the adults, but without wings and then develop into adults with wings. There are several species of cockroaches that are well adjusted to living in close association with man. They live in cracks and crevices, and come out to feed on bits and pieces of food.

Cockroaches prefer starchy foods and will feed on such materials as cereals, bakery products, book binds, wallpaper, beer, cheese and leather. Most cockroaches come out to feed

only at night. They are most commonly found around food handling areas, preferring a warm moist environment - such as is provided by cracks and crevices located near stoves, sinks, water pipes, drains and garbage cans.

Public Health Importance - Cockroaches give off fluids that impart an unpleasant odor to food and the areas they infest. They can carry a variety of disease producing organisms from sewers and garbage cans to the food of man. They regurgitate food while feeding, deposit feces containing bacteria, and spoil far more food than they eat.

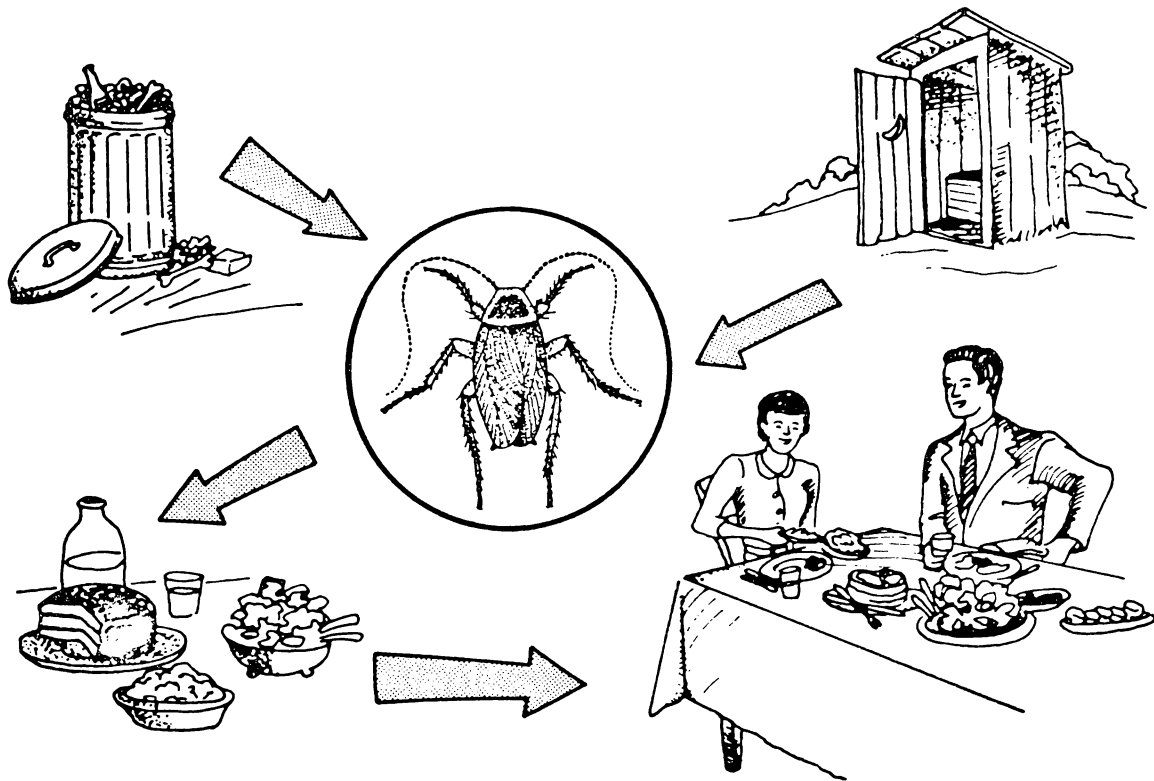


Figure 12. Transmission of Disease to Man by Cockroaches.

Non-Chemical Control - Cleanliness and sanitation in food handling areas are essential to cockroach control. Floors, counters and shelves must be kept clean. Food must be adequately covered or sealed. The design of food handling areas is very important in facilitating the cleaning of all floors, counters, and surface areas. Cracks and crevices should be sealed.

Control with Pesticides - There are several organochlorine, organophosphate, carbamate and botanical pesticides labelled for use against cockroaches. It has become common practice to apply one or more of these chemicals with small hand sprayers on a routine basis to baseboards, cracks, crevices and other harborage areas. Label directions must be carefully followed to avoid contaminating food and food handling surfaces. A pyrethrum aerosol should be used just prior to a residual treatment in order to secure an initial quick kill. The constant exposure of cockroaches to these pesticides has resulted in the development of resistance to many of them in the insects.

Venomous Arthropods

Injury caused by the venoms of stinging or biting insects and spiders is a common public health hazard. In addition to the discomfort caused by the venom, some people are very sensitive to it and suffer severe reactions. The stings of honey bees, spiders and wasps have caused more deaths each year than snake bites. Nests that are built in or near dwellings, working or recreational areas can cause a problem - especially to children.

Although all spiders possess biting mouthparts and venom (or poison), only two are of any serious importance to man in most states - the black widow spider and the brown recluse spider.

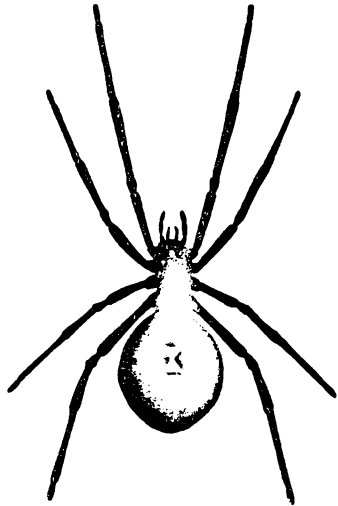


Figure 13.
Black Widow Spider.

The black widow will often make her web under buildings, in piles of old lumber or brick, in basements or greenhouses and in privies. The bite is extremely painful and sometimes fatal if not treated by a physician.

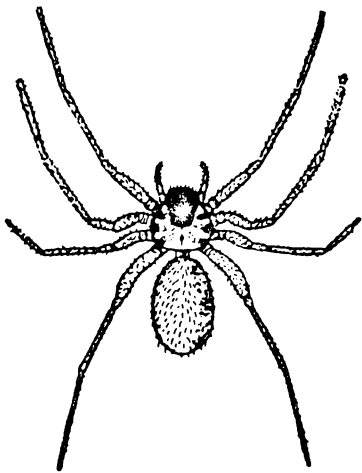


Figure 14.
Brown Recluse Spider.

The brown recluse spider favors storage areas - such as closets and attics. The venom from this spider causes the death of the tissue surrounding the site of its bite. While serious tissue damage and scarring may result, rarely will death occur.

Direct spot treatment of nests with a liquid or dust is a common practice. For larger recreational, suburban, and sometimes agricultural areas (fire ants), pesticides in baits are the most practical. The method of application differs with the pest and the pesticide; label directions must be carefully followed to avoid injury to children and non-target animals.

Ticks and Chiggers

Life Cycle and Habitats - Ticks and chiggers (mites) are not insects, but they are closely related to them. Both ticks and chiggers are parasites that feed on a variety of hosts.

Ticks have four stages in their life history - egg, larva, nymph, and adult. The female tick will usually drop off the host to the ground and lay her eggs on or near the earth, which then hatch into larvae of "seed ticks." Some "seed ticks" will climb up on vegetation and wait for a passing rodent to which it may become attached. Others will actively seek a host, guided by the odor of the animal. After the larvae or "seed ticks" have engorged themselves, they may or may not drop off the host (depending on the species), but all of them will shed their skins and emerge as 8-legged nymphs. The nymph will again attach itself to a host, feed, drop off, shed its skin, emerge as an adult, and attach itself to another host. The number and variety of hosts, and the length of time between stages differs with the different

species of ticks. The adult female will drop from the host after a blood meal, lay her eggs and the cycle is repeated. Adult ticks are usually found outside, but some species may be found in homes in large numbers after being introduced by dogs.

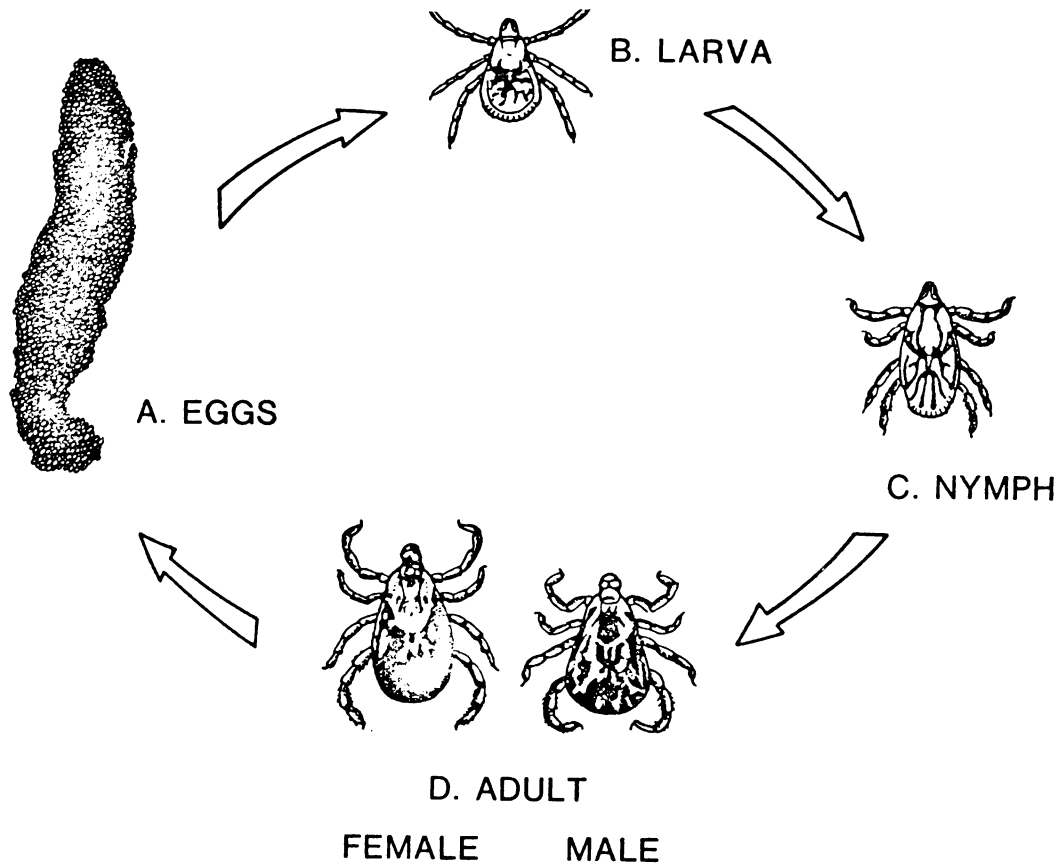
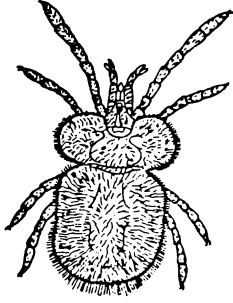


Figure 15. Life Cycle of Tick.

Many species of mites parasitize agricultural crops, some domestic animals, and a few man. One of the most common of the latter is the chigger mite. The chigger passes through the egg, larva, nymph and adult stages. It is only the larval stage that

is parasitic to man and other animals. The small, red adult mites lay their eggs in the spring and by mid-summer the eggs hatch into 6-legged larvae that actively seek a variety of hosts. They will crawl upward, and frequently stop where they encounter an obstacle - such as a tight garter or belt. The



chigger pierces the skin by inserting its mouthparts and sucks juices from the skin. The digestive fluids from the chigger causes severe itching. Mites from rats and mice, birds, flour and grain, and herbaceous plants may infest homes and some cause skin irritation.

Figure 16.
Adult Chigger.

Public Health Importance - The bite of the tick and chigger is irritating, often causing itching, with infection resulting.

Spotted fever is the most important disease carried by a tick (American dog tick) to man in the eastern states. Recovery is often slow and the death rate can be high in untreated groups.

Non-Chemical Control - Chiggers do not like open dry areas that permit direct sunlight and air to circulate. Close-cut lawns, well kept paths, and the elimination of tall weeds and shrubs- particularly blackberries and raspberries that furnish food for the rodent and bird hosts of chiggers - will help to reduce the number of chigger mites in the area.

Control with Pesticides - Various organochlorines, organophosphates and carbamates are labelled for tick control and organochlorines for mite control. Selected treatment in areas most often frequented by humans and dogs - paths, trails, picnic sites - may be more practical than area-wide treatment. In treating outdoor areas, avoid application to ponds, streams and other bodies of water since some of the pesticides labelled for use against ticks or mites will be toxic to fish. When organochlorines are considered a hazard due to the possibility that they may cause environmental damage, the organophosphates and carbamates should be used.

In treating indoor areas for tick infestations, a spray or dust is applied as a spot treatment to baseboards, floors, and wall crevices, window frames, and other harborage sites - such as the sleeping quarters of the dog, and the animal itself. Be certain the insecticide is labelled for indoor use against ticks. A different chemical may be necessary to treat the dog - always read the label and follow the directions.

Rodents

Life Cycle and Habitats - There are three common species of rodents that live in close association with man; the Norway rat, the roof rat, and the house mouse. These are sometimes called domestic rodents.

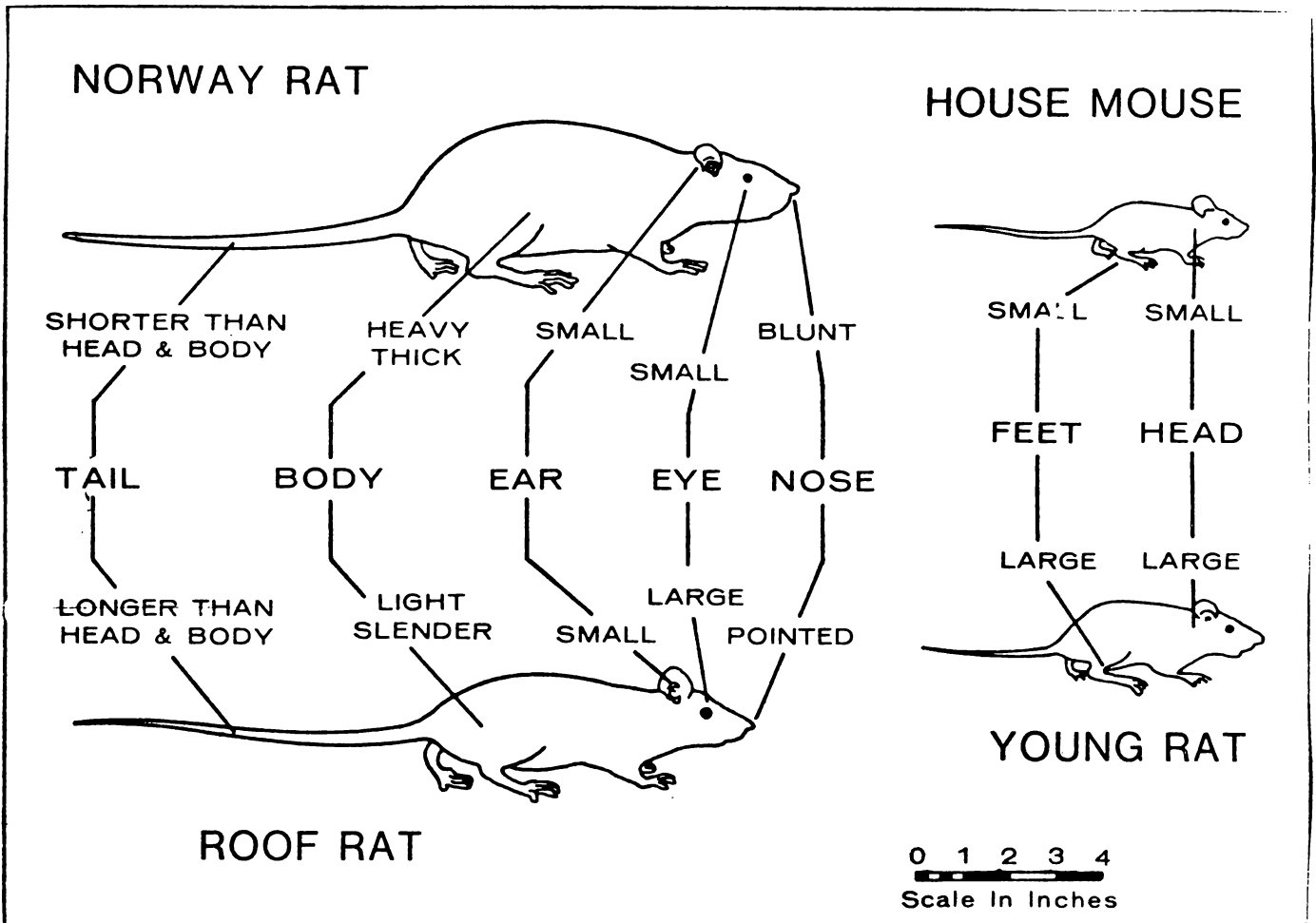


Figure 17. Identification of Domestic Rodents.

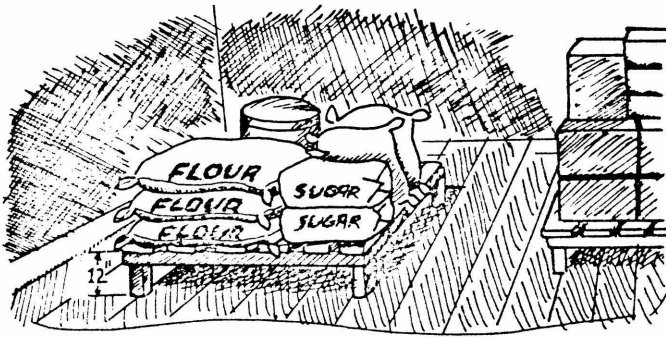
The roof rat is an excellent climber and usually prefers the upper parts of human structures in which to live. The heavier Norway rat likes to burrow under trash embankments with heavy grass and under buildings. The house mouse often builds her nest in buildings. All three species are secretive, and are usually most active at night. The Norway rat may have well-worn paths outside

from its burrow to its food supply. These rodents do not like to travel in the open any more than necessary and usually have their nests close to their food supply. The presence of rodent droppings is a good indication that these pests are nearby. The number of rats and mice in a given area is directly related to the amount of food, water, and harborage areas available. If any one or more of these three is significantly reduced, there will be a reduction in the rodent population.

Public Health Importance - Domestic rodents destroy far more food than they actually eat by partially eating, urinating on and dropping feces on it. In the lower socio-economic areas where poor sanitation is most likely to exist, rats will bite infants especially if they are not kept clean and have food on their faces or hands. Rats may carry a variety of diseases that can attack man.

Non-Chemical Control - The use of rodenticides alone requires continuous application, is expensive, and quite frequently not very successful. Chemicals should be used only in conjunction with improved sanitation. Rats will not remain, not increase significantly where food and harborage are not available. Garbage should be kept in covered cans, and removed regularly. Every effort should be made to bar rats from access to food - this may include rat-proofing buildings to prevent their entry. Where food is available and cannot be readily

removed - as in a grain elevator, the reduction of areas of harborage alone will reduce rat populations. Storing materials



off of the floor on racks, cutting the grass, removing trash, and keeping materials on concrete slabs will all help to reduce nesting areas and thus the rat and mouse populations.

Figure 18. Proper Storage of Bulk Food.

Control with Pesticides

- a. Anticoagulant Rodenticides - Anticoagulants are commonly used to kill rats. Rats must consume at least a small amount of this poison daily over several days for it to be effective. Since repeated feedings are required to kill a rat, permanent bait stations are needed. The development of resistance to these compounds in some rat populations has been reported from Georgia, North Carolina, Virginia and other areas. Anticoagulants are relatively safe to use around children and pets. They can be mixed with dry baits, water, or in a damp environment such as sewers and drains compounded with wax.
- b. Single-Dose Rodenticides - Single-dose rodenticides kill with a single dose and are valuable when the rapid

reduction of a rodent population is desirable. These baits require less time for maintenance than do the anticoagulants and use less bait materials; however, most are poisonous and some extremely so to humans and pets. There are several fumigants (such as calcium cyanide) that can be very successfully used in rodent burrows, but these should be used only by well-trained personnel.

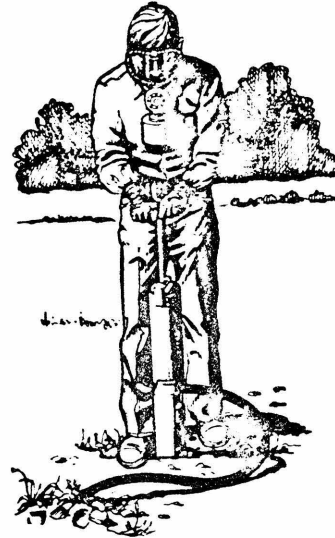


Figure 19. Food Pump for Fumigation
of Rodent Burrows with
Calcium Cyanide.

- c. Baits - Rats will not eat just anything. They prefer certain foods over others. The same species of rat may vary in the kinds of foods they prefer in different areas and at different times. For this reason, it is essential that the baits used be acceptable to the rats prior to initiating a baiting program with a single-dose rodenticide. In order to determine the rat's preference, a procedure termed "pre-baiting" is commonly used. In this approach the rats are given a choice of several bait

materials (such as yellow corn meal, bacon, rolled oats or corn) that do not contain the rodenticide. Once a successful bait has been identified, it is then prepared with the rodenticide included. Improper placement may reduce the effectiveness of the rat reduction program. Where a variety of food is readily available, a liquid bait may be more effective. Baits must be kept fresh since dirty or moldy baits are not attractive to rats.

- d. Traps and Rat-Proofing - Traps, either baited or unbaited, are widely used. Rat-proofing can be effective in preventing the entry of rodents into buildings.

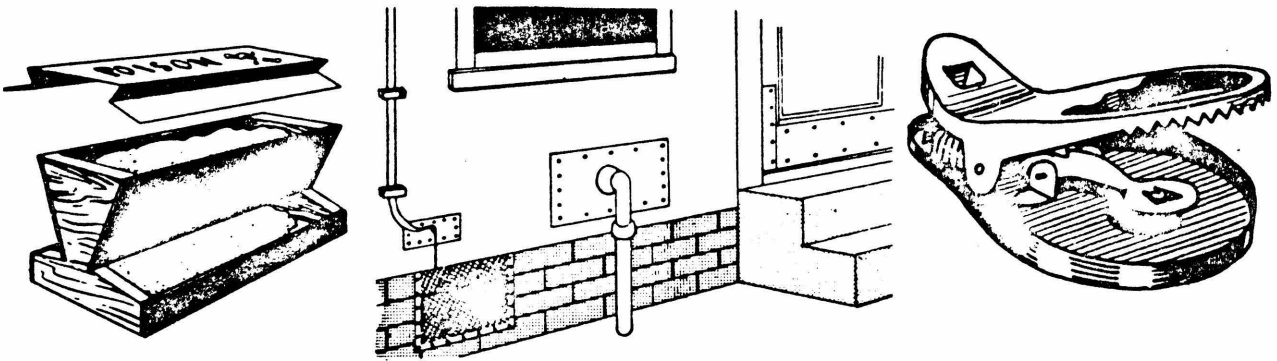


Figure 20. Bait Station, Rat-Proofing, and a Mouse Trap.

House Mice

The use of many small well-distributed baits is more successful than the use of fewer but larger ones. Since mice tend to nibble rather than take large quantities, a slightly higher concentration of anticoagulants for them than for rats will be required. Liquid anticoagulants are not very successful in a program designed for mice. Snap traps baited with an aromatic bait such as peanut butter is a successful and inexpensive mouse control technique.

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