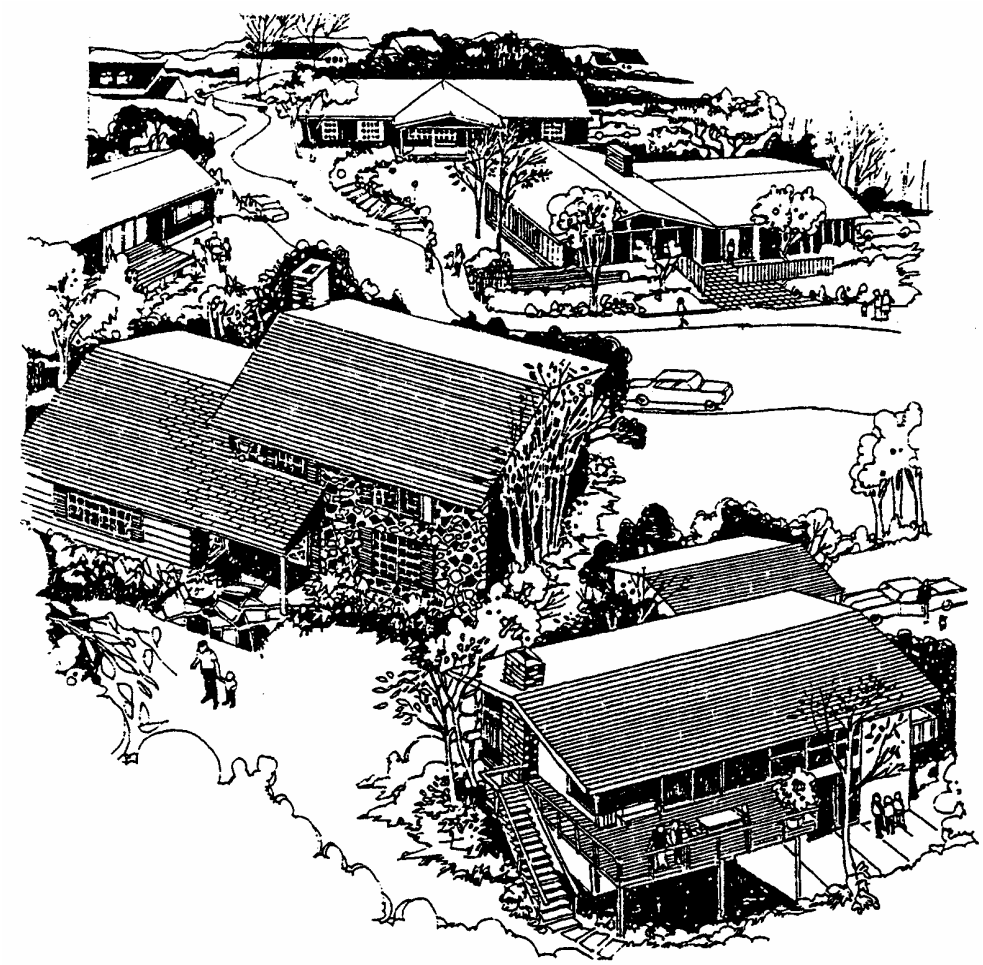
STRUCTURAL AND HEALTH RELATED PEST MANAGEMENT

Study Guide for Pesticide Application and Safety
Category 7



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Revised December 2003
Revised 12/2008 UDAF

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STUDY GUIDE FOR
STRUCTURAL PEST CONTROL

The educational material in this study guide is practical information to prepare you to meet the written test requirements. It doesn't include all the things you need to know about this pest-control subject or your pest-control profession. It will, however, help you prepare for your test.

Contributors include the Utah Department of Agriculture and Utah State University Extension Service. This study guide is based on a similar one published by the Colorado Department of Agriculture. Materials for that guide were prepared by Colorado State Extension Service. Other contributors include: Extension Service personnel of California, Illinois, and Georgia. Materials prepared in the previous draft by Metro-Pest Management Consultants, Inc., were used freely and with appreciation in preparing that study guide.

The information and recommendations in this study guide are based on data believed to be correct. However, no endorsement, guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Other topics that may be covered in your tests include First Aid, Personal Protective Equipment (PPE), Protecting the Environment, Pesticide Movement, Groundwater, Endangered Species, Application Methods and Equipment, Equipment Calibration, Insecticide Use, Application, Area Measurements, and Weights and Measures. Information on these topics can be found in the following books:

1. **National Pesticide Applicator Certification Core Manual,** Published by the National Association of State
   Departments of Agriculture Research Foundation.

2. **The Workers Protection Standard for Agricultural Pesticides – How to Comply: What Employers Need**
   to Know. U.S. EPA, Revised September 2005, Publication EPA/735-B-05-002.

These books can be obtained from the Utah Department of Agriculture or Utah State University Extension Service. Please contact your local Utah Department of Agriculture Compliance Specialist or Utah State University extension agent.

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INTRODUCTION

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STUDY GUIDE

This study guide provides information specific to the control of common structural and health related pests in Utah. Structural and health related pests include structural, biting and stinging, spider, stored food, and domestic rodent pests. This guide does not discuss the many desirable attributes of insects and insect relatives.

The classification of an animal or insect as a pest is often dependent upon their relationship with humans. Problem animals and insects are often difficult to control because of their proximity to buildings, farmsteads, homes, food storage, and humans. The basic strategies for the control of structural pests include inspection of the structures, diagnosis of the problem, prescription for control, application or treatment, and evaluation of the control measures.

BASIC STRATEGIES

Inspection

Inspection includes asking questions of the customer, inspecting the structure or structures, and examining the adjacent areas thoroughly to learn as much as possible about the pest problem. During the inspection an applicator should look for locations where conditions of heat, moisture, or darkness favor infestations. Note the presences of food and/or water that will attract pests and structural defects or openings that may serve as a means of pest entry. Also, look for evidence of infestation such as structural damage and pest droppings or tracks.

The inspection process should provide some idea of the control measures to use, safety precautions that may be necessary during the control effort, and the best time and method of control. Thoroughness during the inspection is a critical component of effective pest management.

Diagnosis

Diagnosis includes identifying the pest and any factors contributing to infestation such as spilled food or the presence of other items that attract pests. Once the pest is located, it must be positively identified in order to proceed effectively. Many times identification must be made from indirect clues such as damage or droppings. After the pest is identified it is easier to identify shelter areas and the means by which the pest gained entry. Some knowledge of the biology of the pest is very useful for thorough diagnosis. Failure to properly identify the pest can result in wasted time, money, chemicals, and labor.

Prescription

Prescription includes how, when, where, and what control techniques are needed to control the pests. Effective prescriptions are determined only after inspection and diagnosis are completed. The prescription should include the appropriate control strategy and any modifications to the existing habitat that will need to occur. Customers should clearly understand that the effectiveness of any control strategy is reduced if problems such as sanitation, ease of entry, and re-infestation are not addressed.

Successful pest control strategies commonly include a pesticide application combined with other control measures such as habitat adjustments. Habitat adjustments should include sanitation efforts to remove sources of food, water, or other attractants that the pest needs to survive. Exclusion of pests to prevent re-infestation is a necessary part of any prescription. Exclusion can involve screening openings and caulking cracks and crevices.

Habitat manipulation is an effective management strategy for excluding many structural and health related pests. Closing small openings in buildings can insect and rodent proof structures.

Application

Pesticides are often used to supplement other control methods against structural pests. When pesticides are prescribed, they should target areas visited and inhabited by pests. Because of potential hazards, the choice and application of pesticides depend on other characteristics of the site such as closeness to human food, access by children or pets, and ventilation systems.

Evaluation

Effective pest control programs should include ongoing evaluation. Changes in pests and their susceptibility to pesticides occur, as do the pest products available to the applicator. Periodic inspections to assess the effectiveness of management strategies are critical.

INSECTS AND

INSECT RELATIVES

Insects comprise one group of animals within a larger group called arthropods. Arthropods have specific characteristics that make them distinctive. They have segmented bodies, jointed appendages, a skeleton on the outside of their bodies, known as an exoskeleton, and their growth involves molting.

Insects, as a distinct class of arthropods, are characterized by the following. They have three body regions that include the head, thorax, and abdomen. They also have three pairs of legs on the thorax, one

pair of antennae, and wings usually present during the adult stage.

Characteristics of the other common arthropod groups or classes are as follows. The crustaceans include crayfish, shrimp, sowbugs, and pillbugs. They have five to seven pairs of legs, two pairs of antennae, and two body regions know as the cephalothorax and abdomen. The arachnids include spiders, ticks, mites, and scorpions. They have four pairs of legs, no antennae, and two body regions known as the cephalothorax and abdomen. The diplopods are millipedes and they have elongate, usually rounded bodies, typically consisting of 50 body segments, and appear to have two pairs of legs at each body segment. The chilopods are centipedes and they have elongate, flattened bodies, consisting of fourteen to twenty body segments, and appear to have one pair of legs at each segment.

Insect Growth

All insects begin their development as eggs produced by the adult female. Although a few species, such as aphids, may also appear to give live birth, this occurs from the eggs hatching inside the mother.

After egg hatch, insects grow in a series of distinct stages. Each stage, known as an instar, is separated by a period when the insect sheds or molts. An insect's exoskeleton is produced during molting and each new exoskeleton is larger than the previous one. A few hours after a molt, the new exoskeleton becomes hardened, and there is no further change in body size until the following molt. Body parts that remain soft, such as the thorax and abdomen of caterpillars, may expand to a limited extent during the course of an instar. All growth ceases following the final molt to the adult stage of the insect.

As insects develop, there are also changes in form. These changes are called metamorphosis. The kinds of changes may vary among different insect groups, but there are two common types of metamorphosis known as simple and complete metamorphosis.

During simple metamorphosis insects pass through three basic life forms that include egg, nymph, and adult stages. The nymphs typically pass through three to five instars. Nymphs and adults often live in the same habitat, with the principal changes during metamorphosis being body size, body proportions, and the development of wings. Some of the insects that undergo simple metamorphosis are grasshoppers, crickets, earwigs, and aphids.

During complete metamorphosis insects pass through four basic life forms that include egg, larva, pupa, and adult. Caterpillars, maggots, and grubs are typical examples of larvae. During the larval stage, there may be three to seven instars, during which the larvae usually feed. The pupal stage occurs within a cocoon, puparia, or chrysalid and is a non-feeding stage.

During the pupal stage insects change into the adult form. Adults are usually winged and differ from the larvae in a number of ways, including type of legs, mouthparts, and feeding habits. Adult insects that have completed metamorphosis are very different from the larvae and may be found in very different habitats. Insects that undergo complete metamorphosis include butterflies, moths, beetles, flies, and lacewings.

II. STRUCTURAL PESTS

TOPIC **PAGE**

COCKROACHES

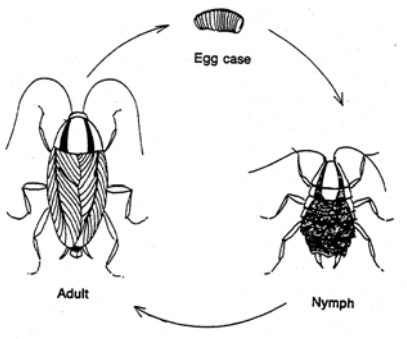
BIOLOGY AND BEHAVIOR

Cockroaches are oval, flattened, fast moving insects. They have long, hair like antennae and a broad, saddle like plate called a pronotum that covers the head. Adult stages of most species have wings, with the front pair of wings being thick and leathery. Cockroaches go through gradual metamorphosis in the three stages consisting of egg, nymph, and adult. The eggs are laid in beanlike egg capsules called ootheca, which may contain several dozen eggs. These egg capsules are often dropped around food sources or secured to surfaces. Some cockroaches carry the ootheca during its development.

The immature stages are called nymphs. Several nymph stages occur, each separated by a molt. The nymphs generally appear similar to the adult stage, but they lack wings and are smaller. Typically it requires two to three months to complete a life cycle.

Cockroaches are among the oldest insects known, with fossils dating back 200 million years. As a group, the cockroaches have shown exceptional ability to adapt to and survive in a wide range of environments. Most cockroaches can develop on a wide range of food and their flattened body form allows them to move into most areas. Cockroaches have also developed a resistance to many commonly used insecticides.

Life Cycle of Cockroach



Cockroaches can enter buildings and containers of all kinds. They also may enter around loose fitting doors, windows, and through utility lines, and they may travel through sewers. Once within a home, cockroaches tend to prefer warm, dark, moist shelters and are often found near kitchens and food handling areas. Since cockroaches are nocturnal, they are rarely seen during the day.

Aside from their importance as a household nuisance, they may soil areas with their salivary secretions and excrement, leaving an unpleasant odor. Cockroaches and cockroach parts also produce allergic reactions in some humans. Cockroaches have not been found to be direct carriers of human disease. However, their feeding on filth or disease organisms is why they often contaminate food and utensils. They are suspected of helping to spread diseases such as dysentery, diarrhea, and food poisoning.

Most cockroaches are tropical or subtropical in origin and possess generally harmless habits. A few have developed into serious pests, including several species of cockroaches that have been introduced into Utah. The habits of common cockroaches are as follows.

German Cockroach

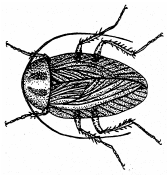
The German cockroaches are the most common species in Utah. Adults are pale brown to tan and about 1/2 inch in length. Adults have wings and are distinguished by having two dark stripes that run lengthwise along the pronotum that is located at the back or top of the head. This species has the highest reproductive potential, meaning it is capable of laying the greatest number of eggs in the shortest life cycle, of all the house infesting cockroaches.

Females carry their egg capsule protruding from their abdomen until the eggs are ready to hatch. Females produce four to eight capsules in their lifetime. Each capsule contains 30 to 50 eggs, which hatch in about 28 days at room temperature. The eggs usually die if the mother is killed. Females live an average of 250 days. German cockroaches are generally found close to moisture and food, such as in kitchens and other food areas, restrooms, and around plumbing fixtures. Infestations found scattered throughout a building, including nonfood areas, indicate very high populations.

Brown Banded Cockroach

Brown banded cockroaches are slightly smaller than the German cockroach and are the smallest cockroach found in Utah, brown banded cockroaches vary from light tan to glossy dark brown in color. The adult stages are marked with two light colored bands at the base of the wings.

German Cockroach



Brown banded cockroaches usually secure their egg capsules to surfaces in dark areas such as cabinets, chairs, boxes, drawers, and high areas of a building. This is why the eggs are easily transported to new buildings.

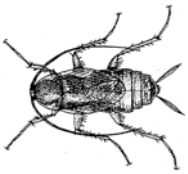
Females produce about 14 capsules during their lifetime, averaging 18 eggs in each capsule. Eggs hatch in about 50 to 75 days. The adult female may typically live about

200 days. Brown banded cockroaches tend to scatter thoroughly throughout a building. They prefer areas with temperatures of 80°F or higher. Brown banded cockroaches tend to occur more often in homes, apartments, hotels, and hospitals than in stores or restaurants.

Oriental Cockroach

Oriental cockroaches are not as common in Utah as the brown banded cockroach and the German cockroach. Adults are about 1 inch in length and dark brown or black in color. Wings of the oriental cockroach are short. Females only have small wing pads, while males have wings that only cover about 3/4 of their abdomen.

Oriental Cockroach



Females drop egg capsules in warm, sheltered areas near a food supply. Each female produces an average of eight egg capsules, each containing about 160 eggs. Under room temperature conditions, eggs hatch in about 60 days. Adult females may live about 180 days. Oriental cockroaches are almost always found around moist, dark sites. Common habitats include floor and storm drains, water meter boxes, around plumbing fixtures, moist crawl spaces, sewers, and around garbage.

Oriental cockroaches are referred to as waterbugs and may be found outdoors during the warmer months of the year. Oriental cockroaches are rather sociable, and clusters of them may be found in favorable habitats. They are seldom found high on walls, in high cupboards, or in the upper floors of buildings.

COCKROACH CONTROL METHODS

The control of cockroaches requires care and planning on the part of the pest manager. Cockroach control also

American Cockroach

requires that a business or homeowner change the environmental conditions that contribute to infestations.

An infested site should be thoroughly surveyed to determine the extent of infestation and to identify the type of treatments that will be required. Fundamental to this is determining the cockroach species present. Since different cockroach species have differing habits, this will allow treatments to be better targeted. A search should be made of all suspected hiding places. Since cockroaches are rarely active during the day this can be difficult. Flushing infected sites with pyrethrin sprays can irritate the cockroaches and cause them to move.

Sticky traps can be used to detect cockroach hot spots. Several different types of traps exist and some also contain the sex attractant chemicals used by certain cockroach species. These traps should be placed in areas where cockroach activity is suspected and they should be checked frequently. Traps can also be used to help control cockroaches, but they are not a substitute for other control practices.

Sanitation is fundamental to cockroach control. Any methods that can be used to deny cockroaches food, water, and shelter will greatly aid in control. Cleanliness is essential. Food should be kept in tightly closed containers and should not be left exposed. This includes garbage, food scraps, and pet foods.

Cockroaches need water. Dripping faucets, leaking pipes, and other sources of moisture should be eliminated. Bottles and cans collected for recycling should be stored outdoors. Sewer openings should be screened.

It is also important to bar the potential paths of re-infestation. Cracks, crevices, and other openings should be sealed. Openings should be caulked, blocked, or screened. Items moved into building should be checked for evidence of cockroach infestation.

Several approaches to chemical control are possible. Regardless of the chemical or formulation chosen, applications made near regular hiding places are most effective. Chemical controls usually provide only temporary suppression, especially when they are not combined with a vigorous sanitation effort.

Another serious limitation of insecticides is that cockroaches have developed a resistance. Many populations of German cockroaches are no longer susceptible to the insecticides formerly used. Furthermore, cockroaches are repelled by some insecticides and will avoid treated surfaces.
Initial treatments should include a thorough cleanup combined with insecticide spray or dust treatments. Follow up treatments are often required because some cockroaches and cockroach eggs may not be eliminated by a single treatment.

Control chemicals can be oil based sprays, water emulsion sprays, dusts, tracking powders, or baits. The type of treatment should be matched to the conditions of the infestation site. Most treatments involve sprays in order to provide a residual effect. These applications leave a toxic residue on the treated surface that cockroaches pick up when moving across it. The length of time that treatments remain effective varies, depending on such factors as the concentration of chemical applied, choice of insecticide, and application surface. Two to four weeks of residual activity is fairly typical.

Sprays should be applied to cockroach harborages with emphasis on cracks and crevices. If exposed surfaces are treated, a low pressure spray should be used. Oil based sprays should not be applied near open flames, to tile floors, or onto plants. Water based sprays should not be used near electrical outlets.

Several precautions should be taken when making insecticide applications for cockroach control. Pets should be removed from the treatment areas and aquariums covered. If sprays must be applied to areas where food, cooking utensils, or dishes are stored, these items should be covered or removed prior to spraying. Furthermore, applications around these sites must be limited to cracks and crevices, avoiding exposed surfaces. Also, treatments made near air ducts and ventilation systems should be done with extreme care to avoid air contamination.
Dusts and tracking powders can penetrate hiding areas that sprays may not reach. They are also useful on very rough surfaces or on surfaces that would absorb liquid sprays. Dusts and powders kill by penetrating the insect body or when ingested as the cockroach cleans its antennae and legs. Dusts should be applied as thin films since concentrations may repel cockroaches. Some dusts, such as boric acid, may be applied in water, which quickly dries. To be effective, dusts must remain dry. Dusts are not appropriate for use in areas where they would be unsightly or cause contamination problems.

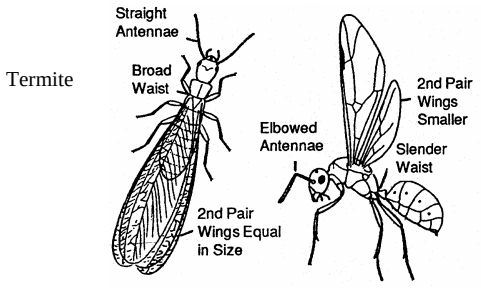
Baits are generally long lasting and can be applied to areas that cannot be treated with sprays or dusts. Baits may include an attractant such as peanut butter or syrup in combination with a non-repellent type of insecticide, such as boric acid. Often, baits may be placed inside small containers to help keep them away from pets and humans. To be effective, baits should be used in small amounts placed in many locations. The effectiveness of baits is dependent on the amount of competing food sources available. If sanitation efforts have not been thorough baits perform poorly.

ANTS

BIOLOGY AND BEHAVIOR

Ants are social insects that produce a colony made of various specialized types of individual ants. Most ants are known as workers, they are wingless, do most of the food foraging, rearing of young, and defend the colony. Eggs are produced by the large queens that have wings until after they have mated. Smaller winged ants are the males. Ants are characterized by having a very narrow, pinched waist and antennae that are bent or elbowed. They are sometimes confused with termites, especially when swarms are produced. However, termites have a broad waist and beaded antennae.

Development of ants involves complete metamorphosis. Eggs are extremely small. The developing larvae are fed by the worker ants and pass through several molts before pupation. The pupae do not feed and are immobile, soft, and white. Ant nests are usually underground and colonies can contain tens of thousands of workers. The large carpenter ants build nests in wood, usually wood that is partially decayed. Relatively few ants in Utah form a nest indoors.



Termite

Winged Ant

Ants feed on a wide variety of different foods. Sugary materials are preferred by some species while others feed on fatty or protein rich foods. Some ants are important predators of insect pests.

Problems with ants often occur when they forage for food indoors during the warmer months. Carpenter ants can cause structural damage. House infesting species can move disease organisms around. The following are descriptions of some common species of ants.

Pavement Ant

The pavement ant can be one of the most frequent nuisance ants in areas of the state where they are established. They are small, blackish-brown ants with pale legs and antennae. As the name might suggest, pavement ants commonly nest under pavement slabs, especially next to lawn areas. Rocks and areas under slab

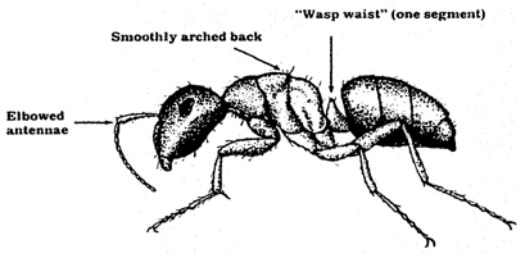
construction homes are commonly used as nest sites. Foraging in the home commonly occurs during summer, but nests adjacent to homes can allow foraging to occur year round.

Field Ant
There are a great many species of field ants. These ants are medium sized, and they may be brown, red, black, or any combination of these colors. Nesting occurs outdoors, often near pavement. The ants are attracted to sweets.

ANT CONTROL METHODS
Sanitation is an important aspect of any ant control program. Crumbs, grease, food scraps, and other foods should be eliminated. Heavy infestations of ants in buildings are rarely found where thorough sanitation is practiced. Sanitation is also important to increase the effectiveness of ant baiting. Most species of nuisance ants nest outdoors. Perimeter treatments with residual sprays applied around foundations can prevent many ants from foraging indoors.

For more permanent control nests can be located and treated. Dusts are usually more effective for this than sprays since the dusts are more readily tracked into the colony. Slow acting insecticides are more effective because they allow the forager to return to the nest and feed the poison to the queens and young.

Carpenter Ant
Carpenter ants are the largest ants, reaching 1/4 to 1/2 inch in length. They are often black or dark brown, although some eastern plains species are lighter in color. The most distinctive habit of carpenter ants is their nesting in wood. The ants excavate galleries and pile coarse sawdust at the nest openings. Unlike termites, carpenter ants do not eat wood. Instead, they scavenge on dead insects, insect honeydew, and other materials.



Carpenter ants almost always nest in wood that is softened from water and decay damage. Rarely, nests originating in damaged wood will extend into sound wood, causing structural damage. Carpenter ants do not sting, but they can produce a mildly painful pinch from their jaws.

CARPENTER ANT CONTROL **METHODS**
Effective control of carpenter ants requires finding the nest. Carpenter ants do not readily accept baits and residual spray treatments fail to kill colonies. When carpenter ants are found in a building, they are either nesting inside the building or nesting outside the building and entering to forage for food. In some circumstances, an entire colony may migrate from one nesting site to another, so it is important to eliminate indoor and outdoor nests.

The indoor inspection should concentrate on looking for areas of wood associated with high moisture. Critical areas include plugged drain gutters, poorly fitted or damaged siding and flashing, wood shingle roofs, hollow porch posts and columns, and leaking doors and window frames. Look for wood in contact with soil, wood in crawl spaces, or wood under concrete slabs.

Wood debris ejected from a carpenter ant colony has a shredded quality that looks like shavings in pencil sharpeners. Debris is similar to that produced by some wood boring beetles common in firewood. Sometimes this debris is deposited in the voids of the wall and is not visible. Windows or small openings to the nest may not be present since the ants may use existing cracks.

Carpenter ants often forage in kitchen pantries, garbage, and other areas for food. These ants are more active at night and few ants may be seen during the day. Swarmers are sometimes found trapped in spider webs.

The surface of wood and timbers may appear solid, but by sounding, the damaged areas can be located. An active carpenter ant colony at times produces a distinct dry, rustling sound that may be heard from outside the nest. Sometimes the noise is very loud, but generally it can only be heard when conditions are very still and outside noises are at a minimum.

Control of carpenter ants indoors should involve the elimination of high moisture conditions suitable for carpenter ant nesting. Insecticide application must be made to nests and nest areas. Dusts are especially effective in treating nest galleries. Nest treatments may be used with dusts or in conjunction with sprays. Spraying or dusting infested areas with residual insecticides without locating or treating the nest itself usually does not provide complete control. Insecticides should be applied to areas inhabited or traveled by the ants.

BOOKLICE

BIOLOGY AND BEHAVIOR

Booklice, also known as Psocids, are small pale colored insects that are found outdoors feeding on molds under bark, in piled grass clippings, on damp wood, and in similar locations. Occasionally, they may also enter homes and occur as nuisance pests. Since booklice require high humidity and feed on molds, almost all household infestations are located in warm, dark, moist areas. Bathrooms are the most common sites of infestations, but leaking pipes can provide suitable conditions. Newer homes may be more likely to be infested, since higher humidity conditions generally occur for a few months after construction.

BOOKLICE CONTROL METHODS

Booklice can become very abundant and annoying. They rarely cause damage to stored products. Control of booklice should involve methods of eliminating moisture sources by improving ventilation and repairing leaks.

CLOTHES MOTHS

BIOLOGY AND BEHAVIOR

Infestations of clothes moths are relatively rare in Utah. Occasional infestations arise from the purchase of infested items coming from countries where clothes moths remain a common pest. Adult clothes moths are small, measuring 1/4 inch long and they are yellow or buff colored. They are easily distinguished from other common household moths. Other moths, such as the Indian meal moth, have a distinctive dark banding along the end of their wings.

Larvae of the clothes moths develop by feeding on woolen fabrics and furs. The caterpillars may produce a webbing as they feed and one species weaves the silk into a case in which it lives. In a warm building several generations may be produced during a year.

CLOTHES MOTH CONTROL METHODS

Female moths rarely fly until they have laid most of their eggs, so killing the flying moths is ineffective for control. Items known to be infested and susceptible items stored nearby should be treated in a way that will kill the eggs and larvae. Dry cleaning or storage with paradichlorobenzene (PDB) moth crystals can kill all stages of the clothes moth. Use of dichlorvos (DDVP) pest strips can also kill many of the insects. Proper storage is very helpful in preventing infestations.

Tight fitting containers may be used to store susceptible clothing, although the young caterpillars can penetrate fairly small openings. Cold storage can also prevent or retard infestations.

MILLIPEDES

BIOLOGY AND BEHAVIOR

Millipedes are a common arthropod found in Utah yards and gardens. Millipedes are typically dark brown and wormlike. On close inspection they have numerous small legs. Millipedes feed on decaying plant materials and thrive in moist areas such as lawns.

Occasionally they will move into homes, sometimes in very large numbers. The arid climate of Utah almost always kills the millipedes within a day or two. After dying, the hardened, curled body of the millipede may persist for a long period.

Millipede

MILLIPEDE CONTROL METHODS

Millipede movements into homes typically occur during spring or fall, shortly after a period of rainfall. Eliminating sheltering debris around the foundation, sealing openings, and using insecticides around the exterior foundation will reduce household migrations.

CENTIPEDES

BIOLOGY AND BEHAVIOR

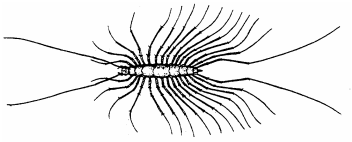
Centipedes are arthropods that are marked by having a single pair of legs per body segment. They are general flattened and elongate in form. Centipedes move fast and are predators of insects and other arthropods.

Utah centipedes rarely invade homes, preferring to be outdoors and remain under cover during the day.

Centipede

Household invasions by centipedes are restricted since they do not reproduce or survive long in most homes.

House Centipede



An exception is the house centipede that is better at colonizing homes. Legs of the house centipede are very long, allowing it to crawl and climb fast. House centipedes survive in low numbers in many homes as long as live prey such as insects and spiders are available.

CENTIPEDE CONTROL METHODS

Centipede movements into homes can be reduced by removing sheltering debris from around homes and by applying a pesticide around the building foundation.

ARMY CUTWORMS

BIOLOGY AND BEHAVIOR

The army cutworm is one of the most common nuisance moths in Utah. Army cutworm moths, one of the moths known as miller moths, can be extremely annoying during late spring when they enter homes, cars, and buildings. Army cutworms do not breed or reproduce indoors and they die within a few days.

ARMY CUTWORM CONTROL METHODS

Insecticides are ineffective for army cut worm control and preventive steps should be taken to minimize problems. Openings around doors and windows should be sealed during the periods when flights are greatest. Evening lighting should be reduced since it attracts the moths.

Moths in the home can be individually vacuumed. Suspending a light over a bucket of soapy water can also trap moths. Problems with the moths end as migration flights cease. Migration occurs over several weeks.

BOX ELDER BUGS

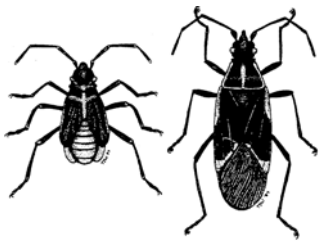
BIOLOGY AND BEHAVIOR

Box elder bugs become nuisance pests as they move into buildings. Problems are most severe along south and west sides of structures, since the bugs tend to move into cracks and crevices in these sun warmed areas.

Adult box elder bugs are about 1/2 inch in length, dark brown or black, with conspicuous red markings. Immature box elder bugs are smaller and a solid bright red color. Only the adults are capable of overwintering successfully.

Immature Box Elder Bug

Mature Box Elder Bug



elder bug develops during the warm

seeds and other plant materials. The first generation usually feeds on seeds fallen from trees the previous year. The box elder tree seeds, produced on female box elder trees, are the food of the second generation. The severity of box elder bugs as nuisance pests is correlated with such factors as the amount of seed produced the previous year, nearness of female box elder trees, and length of the growing season.

When inside a building, box elder bugs are in a semi-dormant state. They cannot reproduce and do not feed. Bites on humans are rare, but occasionally occur.

BOX ELDER BUG CONTROL METHODS

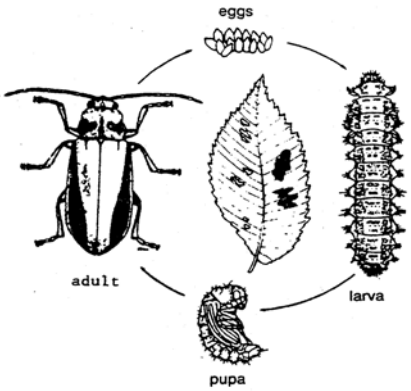
Habitat changes such as cleaning of debris around foundations and removal of female box elder trees will reduce box elder bug populations. Insecticide treatment around the perimeter of buildings will offer some control. Caulking and sealing of cracks and other opening points will reduce the number that enter homes and buildings. Box elder bugs that gain entry can be vacuumed or trapped using sticky traps or glueboards.

ELM LEAF BEETLES

BIOLOGY AND BEHAVIOR

Elm leaf beetles are very common pests of elm trees, especially Siberian elm. Larvae or grubs are mottled with black or dark brown and they feed on elm leaves. Damage to the leaves is characteristic, called skeletonizing, because the beetles typically feed between the larger leaf veins. Adult beetles also feed on the leaves, usually chewing small holes. Typically, there are two to three generations of the beetle during a growing season.

At the end of the year adult beetles move to overwintering shelters. Houses, sheds, log piles, and other areas are common overwintering sites. As with most overwintering insects, activity of elm leaf beetles is largely suspended during the coldest months. As temperatures warm during the spring, increasing numbers become active and emerge from overwintering sites. However, the entire period spent in building involves nonfeeding stages with no reproduction. Infestations detected during spring are related to the numbers of beetles that moved into the structure for hibernation during fall.



Elm Leaf Beetle Life cycle

ELM LEAF BEETLE CONTROL METHODS

Insecticide treatment around the perimeter of buildings will offer some control. Caulking and sealing of cracks and other opening points will reduce the number that will enter homes and buildings. Elm leaf beetle that gain entry can be vacuumed or trapped using sticky traps or glueboards.

GROUND BEETLES

BIOLOGY AND BEHAVIOR

Ground beetles are one of the most easily recognized and beneficial groups of insects. They are commonly seen outdoors, under logs or debris, running quickly for cover when disturbed. Hundreds of species occur, in a wide range of sizes from 1/8 to 1 inch in length and in colors such as of black, brown, and metallic green.

Ground beetles are predators of other insects, such as cutworms and other pests that occur in or on the soil. However, ground beetles may invade buildings through windows, doors, or cracks in the foundation. This is especially common following rains or during other high moisture periods that force them to move. When inside homes ground beetles are harmless and they do not feed.

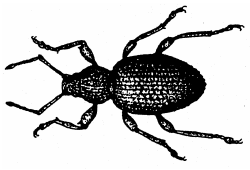
GROUND BEETLE CONTROL METHODS

Insecticide treatment around the perimeter of buildings will offer some control. Caulking and sealing of cracks and other opening points will reduce the number that will enter homes and buildings. Ground beetle that gains entry can be vacuumed or trapped using sticky traps or glueboards.

ROOT WEEVILS

BIOLOGY AND BEHAVIOR
Several species of root weevils occur in Utah. Larval stages of these insects feed on the roots of a wide range of plants, including berries, Douglas fir, and many ornamental shrubs. One root weevil species, the black vine weevil, is a serious pest of several landscape plants, such as lilac, euonymus, and yew.

Clover Mite



Adult root weevils are a common nuisance invader of buildings during summer. Problems are especially common in mountain areas of the state. They do not damage household furnishings, but they can be very abundant and persist for several months.

ROOT WEEVIL CONTROL METHODS
Insecticide treatment around the perimeter of buildings will offer some control. Caulking and sealing of cracks and other opening points will reduce the number that will enter homes and buildings. Root weevils that gain entry can be vacuumed or trapped using sticky traps or glueboards.

EARWIGS

BIOLOGY AND BEHAVIOR

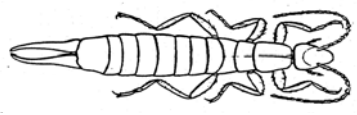
Earwigs are infrequent invaders of structures in Utah. Earwigs are nocturnal feeders and seek dark tight areas for daytime shelter. As a result, they invade cracks and crevices around buildings, from where they may enter living areas.

Earwigs are general feeders. Occasionally, they feed on tender plant parts and they can damage flowers such as dahlias and roses. Earwigs mostly feed on small soft bodied insects such as aphids. Most problems with earwigs in homes occur during middle to late summer.

EARWIG CONTROL METHODS

Reducing the amount of sheltering debris around a building's foundation is important in limiting earwig movements into structures. Residual insecticide sprays applied around the building foundation will reduce indoor earwig populations.

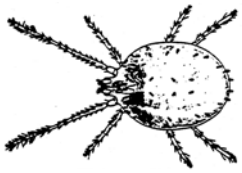
Earwig



CLOVER MITES

BIOLOGY AND BEHAVIOR

Clover mites are small red-green mites that move into buildings from surrounding areas of lawns and other vegetation. During these periods, clover mites use walls for egg laying and may seek shelter in building cracks. Many of the mites may inadvertently enter living areas during these activity periods.



When indoors clover mites are often described as walking dust specks. When crushed, they leave a rusty stain. Infestations of clover mites are usually confined to the sun exposed south and west sides of buildings. They are most severe during late winter and early spring.

CLOVER MITE CONTROL METHODS

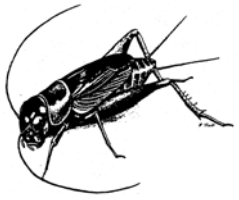
Since mites do not readily cross loose, clean, cultivated soil, an unplanted border around the building can help prevent indoor migrations. Spot treatment with miticides on or along the foundation walls can further help control clover mite migrations.

CRICKETS

BIOLOGY AND BEHAVIOR
Crickets are relatively infrequent invaders of Utah structures and rarely cause significant damage.

Occasionally they feed on fabrics and paper, but cricket populations are rarely large enough to cause serious damage. Their chirping, produced by rubbing the outer wings, can make them very annoying. Most cricket problems occur as a result of outdoor populations moving inside.

Cricket



CRICKET CONTROL METHODS

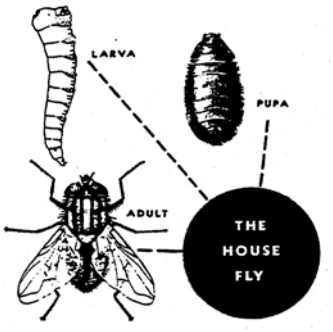
Favorable cricket habitat around a foundation such as plant debris, tall grass, and mulch, can contribute to the severity of cricket invasions. Crickets may also move into buildings when attracted to evening lights. Perimeter treatments with insecticides can reduce cricket movement into structures.

FLIES

BIOLOGY AND BEHAVIOR

Flies undergo complete metamorphosis. The winged adult stage is most commonly observed feeding on liquids that are usually sponged with their mouthparts. Immature stages of flies are pale legless maggots.

After becoming fully grown, maggots often wander from the breeding site in search of a place to pupate. Many flies complete development, egg to larva to pupa to adult to egg, in as little as 7 to 14 days, and numerous generations are completed during a typical season. Flies are a nuisance during the warm seasons and some flies, such as the cluster fly and face fly, over winter in buildings and are a problem year round.



Flies that develop in manure or filth, such as houseflies, face flies, and blowflies, are commonly contaminated and can transmit diseases causing bacteria. The movement of flies between filth and human food has been associated with several diseases.

Blowflies

These are metallic green, blue, or black flies that are common throughout Utah. Blowflies tend to breed on decaying carcasses and dog droppings. Garbage is also used as food for the maggots. Occasionally, blowfly maggots are found in homes wandering off the carcass of a dead rodent or bird present within a home. Adult blowflies may also be attracted to gas leaks.

Houseflies

These are the best known of the domestic flies. They are generally gray in color, with the thorax marked with broad dark strips. Often there is some yellow coloring along the sides differentiating them from the face flies. Houseflies are intimately associated with humans and larvae almost always develop in manmade sources of food. These include garbage, animal waste, culled fruits and vegetables, and spilled animal feed.

The adult flies feed on a wide range of liquid waste. Houseflies also can feed on solid foods, such as sugar, by regurgitating and liquefying the food. Houseflies can be serious health threats because they transmit disease organisms. During mild winters houseflies may continue to fly and breed.

Face Flies

These are closely related to houseflies and are hard to identify. The wide separation of the eyes in the male flies and the absence of yellow coloring can often help distinguish face flies. Although similar in appearance, their habits differ greatly from houseflies and they often are more common than houseflies, especially in rural areas.

Face flies pass the winter in the adult stage, often seeking shelter in upper stories of buildings, such as attics, steeples, and little used upper rooms. They become active in spring and females lay eggs in fresh bovine manure less than one day old.

Adult flies may feed on many types of fluids. They are often attracted to the exudations around the eyes, nose, and mouth of cattle. They have been implicated in transmitting pinkeye disease.

Cluster Flies

Cluster flies are one of the most annoying flies found within homes during the cool seasons. They are also serious pests of office buildings, often concentrating in upper stories. The cluster flies are somewhat larger than houseflies and during the period they spend indoors they are semi dormant and fly awkwardly.

Habits of cluster flies are very different from other common domestic flies. Immature stages develop as a parasite of earthworms. Eggs are laid in the soil and the maggots enter and feed within the earthworms. Cluster flies do not feed on garbage and animal manure. In late summer, cluster files seek overwintering shelter. Late in the afternoon, they often fly to buildings and rest on areas exposed to the sun. As the sun sets, the flies creep upwards ultimately moving to upper stories. They then seek out cracks and other openings into the building. Once inside the building, the cluster flies may appear in large groups.

Fungus Gnats

Fungus gnats are small dark colored flies that are most often observed collecting around windows, usually during fall and winter. Fungus gnats commonly occur outdoors, where they breed in mushrooms and decaying plant materials. Indoors, fungus gnats infest potting mixes used for houseplants. High organic matter plant mixtures or use of organic fertilizers, such as fish emulsion, can encourage fungus gnat development. Over watering encourages fungus gnats by increasing fungus development.

Fungus gnats cause little, if any, damage to houseplants and are primarily a nuisance problem. Attention to correcting conditions of the breeding area, such as moist potting soil, is the most effective means of controlling infestations.

Fruit Flies

Fruit flies are among the smallest flies found in homes. They are usually a light brown color and may be marked with bright red eyes. Most often they are found hovering around overly ripe fruit or around fermenting materials, such as leftover beer or soft drinks remaining in opened containers. Fruit flies are best controlled by removing breeding sources.

FLY CONTROL METHODS

Sanitation practices that remove breeding areas are fundamental to control filth breeding flies, such as houseflies and blowflies. Garbage should be regularly removed or covered. Spilled animal feed and manure should be cleaned up. However, face flies that typically develop in pasturelands and cluster flies which are earthworm parasites, are often hard to control through breeding area management.

Screening and other exclusion techniques can be very important to management of indoor fly problems. Openings into homes should be caulked, blocked, or covered to prevent flies from entering. Efforts to exclude flies must be done prior to periods when they enter. For example, cluster flies are rarely observed indoors until winter and spring months, but they typically enter during late August and September.

Use of insecticides for fly control should only be considered supplemental to other controls. Insecticide resistant flies are a widespread problem and many fly populations are poorly controlled with insecticides. Spot treatments of insecticides applied to areas of high fly activity are most efficient. For example, insecticide impregnated resin strips may be used inside garbage cans. Flies that tend to rest in dark corners can be controlled by applications to these areas. Cluster flies are controlled by treatments applied to upper stories of building exteriors immediately before periods when flies move indoors for overwintering.

Several types of traps for flies are also available and can supplement other controls. Flypaper and electrocution light traps can kill flies, but these should only be considered for sites where exclusion and sanitation efforts have reduced the fly populations to low numbers. Various bait traps are also offered for sale and can supplement other controls.

III. BITING AND STINGING PESTS

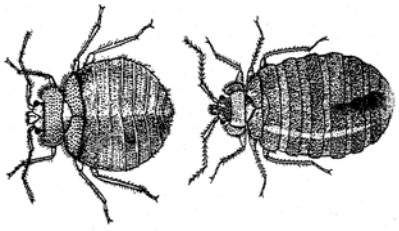
TOPIC **PAGE**

BEDBUGS AND BAT BUGS

BIOLOGY AND BEHAVIOR

The human bedbug and its relatives form a small group of bloodsucking. Bat bugs are rare in Utah. Bat bugs and bedbugs are characterized by short broad heads. The head is attached to the prothorax and an oval body. The body, as a whole, is broad and flat, enabling the bugs to crawl between narrow crevices. The adults are 1/4 to 3/8 inch long, brown, and wingless. After taking a blood meal, bedbugs change enough in size, shape, and color so as to make them look like an entirely different insect. The immature stages, known as nymphs, resemble the adults in shape, but are yellow-white in colo

Bedbug Bat Bug



The adult female deposits eggs in cracks, crevices, behind woodwork, and in similar locations. Eggs hatch in six to 17 days with 10 days being the average. The newly hatched nymphs feed as soon as food is available. The average time for complete development of bedbugs and bat bugs is 1-1/2 months. Adults can then live for a year or more. The bite of these bugs is often painless, but a toxic saliva injected during the bite will later cause severe itching and a large inflamed area often called a weal. Humans may vary widely in sensitivity to these bites. This bite can be distinguished from a fleabite by the absence of a red surrounding halo and the presence of a red central area within the inflamed area.

Bedbugs commonly move from one location to the next in infested furniture and bedding. Bedbugs also relocate by way of water pipes, gutters, through windows, along walls, and other such paths. Migrations often occur if a structure is vacated and their food supply is cut off. Populations of bat bugs usually develop on nesting bats, birds, or small mammals before invading living areas through cracks and crevices. Typically, bat bug infestations originate from animal populations established in the attics.

Problems with bat bugs are often severe for a few days or weeks before dying down. This time is short because survival is poor without the natural animal hosts. As an infestation increases, bat bugs and bedbugs will infest other areas of the home or structure.

Indicators of an infestation may also include bloodstains on walls and bed linens, excrement spots, and cast skins from immature stages. An odor resembling the smell of fresh red raspberries is associated with bedbugs but not with bat bugs.

BEDBUG AND BAT BUG CONTROL METHODS

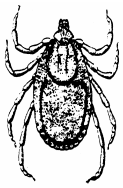
Where bedbugs and bat bugs are a problem, the original sites of infestation should be treated. Applications should be concentrated on living areas by treating cracks and crevices and areas around light fixtures and any other place the bedbugs and bat bugs may use to migrate or hide. With bat bugs, exclusion and removal of bats and other hosts in the home or structure should also occur. This last step should be coordinated with insecticide treatments, since an increased movement of bat bugs into the living area may occur after removal of the animals.

Follow up bedbug and bat bug control with a thorough examination to find hiding places of the insects. Any place offering darkness and protection such as areas behind baseboards, under loose rugs or wallpaper, and in mattresses should be checked. Also examine folds in chairs, beds, and couches. In barn swallow bug control, federal and state laws protect swallows and their nests. Management of these birds and their nests must involve taking these regulations into account.

BROWN DOG TICKS

BIOLOGY AND BEHAVIOR

Brown dog ticks are a common indoor tick in Utah. Unlike the more common wood ticks that are commonly encountered in hiking, the brown dog tick is capable of reproducing indoors. Almost invariably, dogs must be present on which the ticks feed and reproduce. Humans are rarely bitten by this species.



Brown Dog Tick

The brown dog tick is a subtropical and tropical tick that is not thought capable of overwintering outdoors in Utah. Most infestations originate by direct contacts with infested dogs or during warmer months, when dogs travel through areas previously frequented by an infested dog. Kennels are a common location of brown dog tick contact.

The egg stage of the brown dog tick occurs within a large mass, usually numbering several hundred eggs. Eggs hatch in about two weeks, and the small six legged seed ticks move about to find dogs or rodents on which to feed. After feeding on the blood of the host animal for a few days, the young ticks drop off and hide in cracks or similar protected areas usually near where the dog commonly rests. They then shed their skin, known as molting, and reappear in a slightly larger form with eight legs. Another feeding cycle is then completed and the third adult stage appears.

Adult brown dog ticks typically feed between the toes, near the ears, or around the anus of the dog. During the final blood feeding, the ticks may remain attached for one to five weeks. After becoming fully engorged, they drop from the dog. At this time, the ticks may be almost 1/3 inch in size and bloated. Grown ticks often show a strong tendency to climb and can be found climbing walls or hidden in cracks of ceilings and kennel roofs.

Under favorable conditions the entire life cycle of the brown dog tick may be completed in as little as two months. When temperatures are cool or the ticks are unable to find a host for feeding, the life cycle may extend as long as a year.

BROWN DOG TICK CONTROL METHODS

Brown dog tick control can be a difficult and lengthy process. If a host animal is to remain in the infested area, insecticides must be selected and applied in a manner that will not endanger the animal. Several products are registered for use as pet shampoos, sprays, or dips to kill ticks present on the animal. It is usually desirable to get the help of a veterinarian for prescription of materials used on pets, since some breeds are especially susceptible to certain insecticide products. Insecticides used on dogs almost invariably mention that they are not to be used on puppies, convalescing or sick dogs, or nursing mother dogs.

Attention must also be given to the areas where ticks molt or lay eggs. Often these are located near the area where the dog usually rests. Insecticides with residual effects must be applied to these areas for effective control. Removal of dogs from infested locations can cause infestations to eventually die out. However, ticks can survive for six to eight months without feeding and re-infestation is possible if a susceptible host animal is present.

FLEAS

BIOLOGY AND BEHAVIOR

Pets such as dogs and cats and wildlife, especially ground dwelling rodents, can occasionally develop seriously annoying infestations of fleas. Fortunately, problems in Utah are less frequent than in more humid areas of the country and are usually of short duration. However, a more serious concern in some areas of the state is the ability of fleas to transmit bubonic plague.

Fleabites to humans appear as itchy, red spots, usually surrounded by a red halo. Bites often occur in clusters, especially at the edges of tight fitting clothing. Some individuals are extremely sensitive to fleabites, while others are fairly immune. Humans are not a favored host of fleas and most bites occur when the fleas are starved, such as following a long absence of a pet.

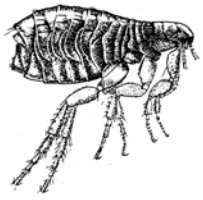
Adult fleas are 1/13 to 1/8 inch in length, reddish-brown, and flat. They are wingless but they can jump. The adult stage of this insect feeds on blood.

Flea eggs are usually laid around areas used by pets. The eggs hatch and a wormlike larval stage follows. It feeds on organic matter such as hair, skin flakes, or blood excreted by the adult fleas. Several months are required for the larvae to complete development. Low humidity prolongs flea development.

FLEA CONTROL METHODS

Flea control measures should be directed at all stages of the flea's life cycle. Controls of the egg and larval stages include washing pet bedding and thoroughly cleaning areas where pet hair accumulates. Larval control can further involve use of insecticides applied to cracks and crevices in locations where the pet lives. Among the more effective chemicals are newer insecticides that affect flea growth (insect growth regulators).

Flea



The adult fleas on the pets can be controlled by use of insecticides applied in shampoos or powders, in collars, and skin applications. There are flea strains that have developed insecticide resistance and they are difficult to control.

In areas where wild rodents harbor fleas that may carry the plaque disease organism, control involves dusting of rodent burrows. Rodents such as ground squirrels and rock squirrels that have died suddenly may indicate plaque outbreaks. Suspected plaque incidents should be reported to the Utah Department of Public Health, Epidemiology. The telephone number is 801-538-6191.

WASPS, HORNETS, AND BEES

BIOLOGY AND BEHAVIOR

Several different wasps, hornets, and bees are found in Utah and the majority are highly beneficial habits. Bees, such as the honeybee and leafcutter bee are essential to the pollination of many crops and native plants. Most wasps and hornets are predators of pest insects, feeding them to their developing young. Problems with these insects occur when nests are located near high traffic areas or in buildings. Late summer foraging by yellow jacket wasps can be a serious nuisance problem for outdoor restaurants and other areas where food is served outdoors. Also, wasps and hornets may enter homes and buildings during fall in search of overwintering shelter.

Social Wasps and Hornets

Almost all nuisance problems involve social wasps within or adjacent to structures. Social wasps include yellow jackets, European paper wasps, and others. These insects produce new paper colonies or nests each year. Those produced by yellow jackets and European paper wasps are usually located under eves of structures, in holes, or in wall voids. Bald face hornets make large paper nests among tree branches. Fertilized females over-winter in protected areas, including buildings, and begin to build nests in the spring. As the season progresses, more workers are present to help with colony development and nests rapidly increase in size. By late summer colonies may house hundreds of insects.

At this time, the colony starts to break up and many of the large females leave.

Following several hard frosts the nests are completely abandoned. Nests are not reused the following year. Social wasps feed their young protein rich foods, mainly insects. Late in the season, food preferences switch to include more sugary materials and they are attracted to soft drinks, syrup, and other materials. During this period, they can be extremely annoying. Almost all stings involve social wasps and hornets.

SOCIAL WASP CONTROL METHODS

Destruction of wasp and hornet colonies is fairly easy if the nest can be located. Insecticide dusts are usually most effective for ground nesting yellow jackets, since dust is readily tracked into the colony. Aerial nests are best controlled with use of directed sprays forced into the opening. It is best to use an aerosol formulation that includes a fast acting insecticide such as pyrethrums to knock the insects down, combined with a more persistent insecticide. Colonies often are not completely killed for at least a week after application, since developing wasps and hornets remaining in rearing cells continue to emerge for several days. Early in the morning or in the evening wasp and hornet activity is reduced and this is the safest time to treat their colonies.

Light colored protective clothing is best to avoid stings. In some cases it is safer to wait out wasp and hornets infestations. Colonies are abandoned at the end of the season and if the insects are not too much of a nuisance, problems can be resolved without treatment.

Solitary Wasps

Several wasps do not produce a social colony and instead individually rear their young in nests of mud or in tunnels underground. These are hunting wasps that collect spiders, cicadas, caterpillars, and other prey for their young. Many are highly beneficial. Although the solitary wasps sometimes appear rather fearsome, they rarely sting, and their sting is less painful than the social wasps.

SOLITARY WASPS CONTROL METHODS

If necessary, colonies of mud nesting species can be controlled simply by pulling down nests. Residual insecticide sprays can also prevent wasps from nesting.

Honeybees

Unlike the social wasps and hornets, honeybees form a semi-permanent colony. Nests are constructed of wax and most colonies are maintained by beekeepers. Honeybees feed on nectar and pollen, which they feed their young and use to produce products such as honey and beeswax. Honeybees also may collect water to cool the hive and plant sap to help seal cracks.

Periodically, overcrowded colonies form swarms that leave the hive. The swarms rest temporarily on a tree or shrub while scout bees search for a nesting cavity. Although the swarms are very striking, the bees are very docile at this time. Most beekeepers are willing to collect honeybees in a swarm.

HONEY BEE CONTROL METHODS

Problems with honeybees occur when swarming bees find a building wall opening and construct nests in buildings. These nests can sometimes get very large over several years and the removal becomes difficult. Although colonies can be relatively easily killed with insecticides, the wax, honeybee debris, and other hive debris remain behind. The wax can melt with high temperatures and old colonies attract rodents and other pests. As a result, the old colony must be removed, which can require tearing out parts of the wall.

Honey Bee

Yellow Jacket

SCORPIONS

BIOLOGY AND BEHAVIOR

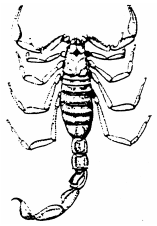
Scorpions are easily distinguished by their lobster like appearance with a tail that terminates in a bulbous sack and prominent stinger. The larger front pincers are modified mouthpart and are used to capture and hold prey while feeding. The stinger is used to subdue prey and for defense.

Scorpions are not common, but they can be found in Utah. They commonly encountered around rocks or debris where scorpions hide during the day. Occasionally scorpions enter homes. Scorpions can produce a painful sting when handled or disturbed. Fortunately, local species are not considered to be highly poisonous.

Scorpions have a life cycle of two to five years. They do not lay eggs and the females bear live young seven to twelve months after mating. A female may produce litters of 14 to as many as 100 and the young are carried on the back of the mother until they have molted. The immature scorpions then leave the mother and become mature in about one year.

Scorpions spend the daytime under cover or in burrows in the ground. At night, they emerge to defend their territory and to feed. Since scorpions have poor eyesight, they do not stalk their prey. They lie in wait for ambush. Insects, spiders, millipedes, and small vertebrates are common scorpion prey.

Scorpion



SCORPION CONTROL METHODS

During dry weather, scorpions are attracted to moisture. Scorpions can also be discouraged from areas around homes by removing potential cover, such as stones, lumber, and other debris. Sealing entrances into homes can also exclude scorpions. Scorpions fluoresce brightly when exposed to ultraviolet or black lighting. They may be easily spotted for capture from several yards away using this technique.

Outdoor applications of residual insecticides can reduce scorpion problems. Applications should be directed to harborage areas, such as stone piles. It is not necessary to treat grass lawns. Exterior foundation treatments can also help provide additional control.

IV. SPIDER PESTS

TOPIC **PAGE**

SPIDERS

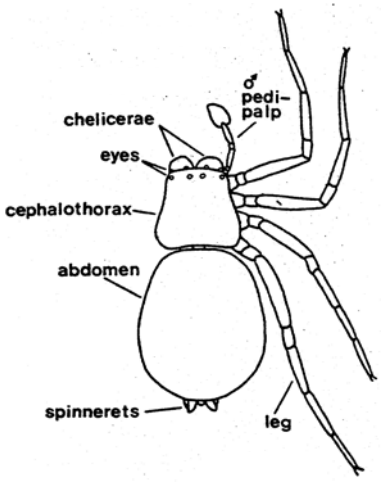
BIOLOGY AND BEHAVIOR

Spiders are a group of animals classified as arachnids. They are not insects, instead being more closely related to mites and ticks. Spiders are characterized by having eight legs and the two distinct body regions of the cephalothorax and abdomen.

All spiders feed only on insects and other small arthropods. Their activities are highly beneficial since they help control many pest species in yards and in and around homes. Unfortunately, there is a widespread fear of spiders by people.

Spider fears also exist because of a few poisonous species such as the black widow. Many spider species occur throughout Utah. They begin life as eggs laid in egg sacs that are bound by silk. These eggs sacks may be guarded or even carried by the female. The young spiders, known as spiderlings, emerge from the eggs and scatter. Many spiders disperse by ballooning. This occurs by spiders producing silken threads that are caught by the wind. Although they do not have wings, spiderlings have been carried hundreds of miles on wind currents. The developing spiders feed and grow over a period of several months. Spiders molt several times before becoming fully grown. Many common spiders have one generation per year and become full grown in late summer. However habits vary and mating and egg laying can occur during almost any time during the year depending on the species.

All spiders can produce silk. Many of the more conspicuous species build webs to capture prey. Some spiders do not produce a web, but instead hunt their prey. These spiders ambush prey and use their silk for building egg sacs or retreats. Spiders eat live prey. Victims are killed by venom that the spider injects through fangs.



Spiders may survive for months without food. Most species of spiders found in homes are attracted to water sources. Water pipes, floor drains, and plumbing fixtures commonly attract spiders. Some spiders prefer warm, dry, undisturbed sites and can be found in air vents or room corners. Spiders found indoors often hide in cracks, darkened areas, or silken retreats they have built.

Movement of spiders into homes greatly accelerates after cool weather arrives in early fall. Also, male spiders of most species are often highly mobile and range widely while searching for mates.

Although all spiders bite and produce venom, few pose any health threat. The venom of most spiders is not very toxic to humans and many smaller spiders cannot break the skin. Also, spiders are not usually aggressive and only bite when accidentally handled or trapped. Two poisonous species of spiders do occur in Utah, the black widow and the hobo spider.

COMMON UTAH SPIDERS

Wolf Spiders

Wolf spiders are fairly large hunting spiders that often cause alarm because of their appearance. Most are gray or brown and fast moving. Many species exist and most are about 1/2 inch in length. One genus of wolf spiders, the giant burrowing spider, may be 1-1/2 inches. Wolf spiders most commonly enter homes late in the season. They hide in cracks and do not produce webbing. Larger species can produce a mildly painful bite, but symptoms do not last long.

Wolf Spider

Jumping Spiders
Jumping spiders are brightly colored active spiders. Their bodies are often densely covered with colored hairs and some may appear iridescent. They have a stout body and large eyes. They are active during the day and may jump or move sideways with ease. They rarely reproduce in homes and often appear as late season invaders after frosts.

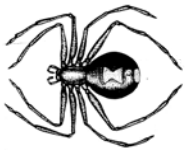
Orb Weavers
Orb weavers produce characteristic large webs that have radiating threads from a central point. Some of the orb weavers become quite large, such as the common garden argiopes and the monkey faced or cat faced spiders. They attract attention because of their conspicuous size and web. They rarely enter homes.

Funnel Weavers
Funnel weavers are medium sized spiders varying from 1/8 to 3/4 inch in length. Their funnel webs are easily seen on lawns in late summer. Funnel weavers may also inhabit corners of cellars or outbuildings. Egg sacs are often laid in a cocoon that remains attached to the web.

Cobweb Spiders
Cobweb spiders are very common in homes and many are well adapted to survival indoors. These are small to medium sized spiders that typically are found hanging upside down from irregular webs in corners of rooms and other darkened areas. When prey is tangled in the web, they throw anchoring silk strands over it. They do not completely wrap the prey, as do the orb weavers. Although almost all cobweb weavers are harmless, the black widows also belong to this family of spiders.

POISONOUS SPIDERS

Black Widow Spiders
The black widow is a common species in many parts of Utah. Black widows produce a loose web and prefer to inhabit dark, undisturbed areas. Typical locations of black widow nests include locations such as shrubbery, around log piles, in crawl spaces, under porches, in garages, and around piled debris.



Essentially, all human bites occur from the female black widow, often as she is guarding her egg sac. A grown female is about 1/2 inch in length and appears shiny black or dark brown with a spherical abdomen. Most black widows also have orange-red markings on the underside of the abdomen, sometimes appearing as an hourglass. However, these markings may be reduced and even absent among many of the black widows.

The venom of the black widow spider is a nerve poison that produces distinctive symptoms. Often the original bite is not painful. It then produces a burning sensation with local swelling and redness. Pain may become intense in one to three hours and last up to 48 hours. Cramping of the legs, arms, and chest may follow. The abdominal muscles become rigid in many cases.

Black widow bites should receive prompt medical attention. Although fatalities are very rare,

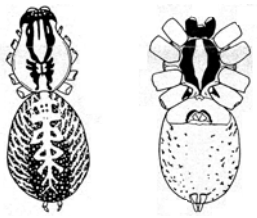
symptoms are very painful. Antiserums are available and injections of calcium gluconate can help to relieve symptoms. When possible, transport the spider and the victim to the doctor. This will allow proper identification and treatment. If a spider is crushed during capture it may not be recognizable.

The Hobo Spider

The hobo spider, sometimes called the aggressive house spider, was first identified in Utah in 1990. The hobo spider is of importance because its bite causes necrotic wounds similar to those of the brown recluse spider.

The hobo spider builds funnel or tube shaped webs. It is a long legged and swift running spider. It has a brown cephalothorax and brown legs. The abdomen has a distinctive pattern of yellowish markings on a grayish background, although this pattern may be hard to see without a microscope.

Hobo Spider Dorsal Marking



The complete life cycle of the hobo spider lasts for two years. Hobo spiders prefer to use habitats that have holes or cracks to support their funnel like webs. They are poor climbers and are rarely seen above ground level.

Hobo spiders are most commonly encountered from June through September when males wander in search of females. For this reason, most bites occur during July through September. Males generally have a more toxic bite than females, while immature hobo spider bites seem to produce the most serious wounds. Females of the species tend to stay in their webs and are not usually found running about.

The hobo spider is medically important because of its ability to cause necrotic wounds. Necrotic spider bites have been reported in Utah for many years and are usually blamed on the brown recluse spider. As of 2003, only a few specimens of the brown recluse spider have been documented in Utah and these were imported.

The bite of the hobo spider is relatively painless and is reported to feel like a pinprick. Within fifteen minutes of the bite, numbing sensations may occur at the bite site and other areas of the body and dizziness may occur. After about one hour, reddening around the bite begins and enlarges in area. The bite site becomes hardened and swollen within about 18 hours. Blistering at the bite, visual or auditory disturbances, severe headache, weakness, and joint pains may occur within the first 36 hours.

Within 24 to 36 hours, a discharge of fluids and blistering may occur. After two or three days, the area around the wound may blacken. After seven to ten days, the necrotic area will usually take on a characteristic elliptical shape. Spells of nausea and sweating often persist through this time period and headaches may persist even longer.

If a bite is suspected to be that of a hobo spider, seek immediate medical attention. The treatment for all necrotic spider bites is similar.

SPIDER CONTROL METHODS

Control methods for spiders are most effective if they include habitat elimination, exclusion, avoidance of risk, and chemical control. Keep shelter materials such as rocks, debris, and trash away from the building foundations. Seal cracks and other openings. Apply insecticides to exterior foundations. In cases of interior infestation, insecticides should be selected and applied according to label directions. Sticky traps and glueboards can be used to detect spiders and provide some degree of control. Under optimal conditions they can complete a generation in less than two months. Adult beetles may live for a year or more.

V. STORED FOOD PESTS

TOPIC **PAGE**

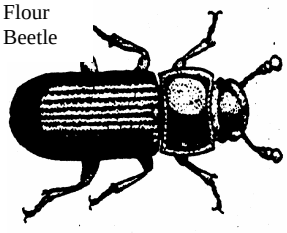
FLOUR BEETLES

BIOLOGY AND BEHAVIOR

Flour is most commonly infested by the confused flour beetle or the red flour beetle. Small pieces of cracked grains may also be sources of flour beetle infestation. The adult flour beetles are reddish-brown in color and less than 1/8 inch in length. They are sometimes referred to as bran bugs since they are common in milling operations.

Both species of flour beetles have wings, but rarely, if ever, do they fly. Immature stages are pale colored and wormlike. On close inspection, a pair of pointed forks can be seen on the rear body segment. Development of the

Flour Beetle



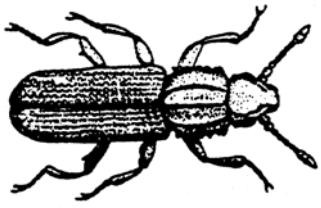
immature stage typically takes one to two months and adults lay eggs over a period of five to eight months. Both adult and immature stages feed on flour.

SAWTOOTHED GRAIN BEETLES

BIOLOGY AND BEHAVIOR

The sawtoothed grain beetle is often the most common beetle found infesting coarser cereal products. It can develop in flour, but most infestations occur in processed grain products such as breakfast cereals, oatmeal, corn meal, and pasta. Dried fruit and chocolate are occasionally infested.

Sawtoothed Grain Beetle



The adult beetles are about 1/10 inch in length, similar in size to the flour beetles. Their body shape is elongated, flattened, and distinctively marked with a series of saclike projections along the sides of the thorax. They have wings, but do not fly.

Eggs are laid in crevices in the food supply. The larvae are yellowish-white with a dark head and wormlike in shape. Larvae and adult stages feed on the same foods.

SPIDER BEETLES

BIOLOGY AND BEHAVIOR

Spider beetles are larger than the other common stored products beetles and appear similar in shape to a spider. However, the three pairs of legs easily distinguish them from spiders that have eight legs. Spider beetles can infest a wide variety of animal or vegetable products. They are most commonly associated with grains, although feathers, wool, dried meat, and other products can be eaten.

Eggs of the spider beetles are white and may be conspicuously laid around food products. The larvae are C-shaped and resemble small white grubs. Pupation of spider beetles often occurs in cavities that they chew out of wood or other soft materials.

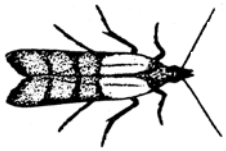
INDIAN MEAL MOTHS

BIOLOGY AND BEHAVIOR

The Indian meal moth commonly infests food products in Utah homes. Nuts, seed, dried pet foods, spices, dried fruits or vegetables, and coarse grains such as oatmeal and grits are suitable materials for Indian meal moth development. The Indian meal moth rarely infests flour.

The adult stage of the Indian meal moth is about 1/2 inch in length, generally gray in color, with bronzy wing tips. This small flying moth is common in Utah homes. The larvae or worms, usually pale yellow to pink, with a dark

Indian Meal Moth



head, are responsible for feeding damage. When feeding, the larvae produce webbing that is mixed with food particles and droppings.

The Indian meal moth is an established insect in most large permanent storages of susceptible foods. Generally, household infestations originate from the purchase of infested products. During warm months, localized outdoor movements of the moths can resulting in household infestations.

Adult moths lay eggs near suitable foods and in locations along cracks or folds of packages. Larvae when newly hatched are very small and capable of penetrating loosely closed packaging. Development can be rapid under favorable conditions and the larvae ultimately reach a length of about 1/2 inch. After feeding, the larvae will move away from the food source to seek a place to pupate.

Indian Meal Moth Larva

After pupation the adult moths emerge. Adult female moths are capable of laying 200 to 400 eggs during the several weeks of their lifetime. The time needed for complete development of the Indian meal moth varies depending on temperature and food, but it typically takes at least a month to complete.

STORED FOOD PESTS CONTROL METHODS

Control of insects infesting stored foods requires a thorough search of all food areas. Flour, nuts, and other dried food in storage areas should be inspected. Also check areas such as pet foods, crafts made of grains, and birdseed. The presence of larvae, larval skins, or webbing is positive identifying an Indian meal moth infestation.

If possible, infested materials should be discarded and storage areas thoroughly cleaned. Susceptible stored items should be treated to kill the insects. Freezing for several days or heating to 130 degrees F. for a few hours is effective. Foods that are insect free can be stored in tight fitting containers to prevent re-infestation.

Insecticide use around food storage areas will supplement sanitation efforts. If insecticides are to be used, they should be restricted to crack and crevice treatment. If large commodity storages are infested, fumigation may be necessary.

CARPET BEETLES

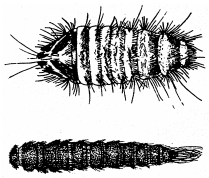
BIOLOGY AND BEHAVIOR

Various species of carpet beetles are found throughout Utah. Carpet beetles are common outdoors and invade homes by flying. Almost all homes have some carpet beetles present. Carpet beetle eggs are laid around foods used by the developing larvae.

Carpet
Beetle

Carpet beetle larvae are distinctive, being light brown in color and having an elongated, tapering shape. Carpet beetle larvae are rather bristly, often with long hairs protruding from the hind end. Carpet beetles are slow to develop and may require several months or even a year to become fully grown. Carpet beetles are scavengers, they feed on a variety of plant and animal materials, but they prefer animal products, such as wool and skins.

Carpet Beetle Larvae



Household lint or small animals that have died in the vicinity of the home are common materials in which carpet beetles may breed. The carpet beetle name is based on their former importance as a pest of woolen carpets. Modern carpet of synthetic fabrics is not susceptible to these beetles. Carpet beetles are most damaging to items such as woolen fabrics, stuffed animals, and furs. Residual populations also may breed on debris that collects in or under furniture, around the edge of carpets, or in cracks and crevices.

CARPET BEETLE CONTROL METHODS

Detection of carpet beetle breeding areas is the first step in management. Materials likely to be infested should be examined for the presence of the insects or for the shed skins of the larvae. If possible, heavily infested materials should be discarded. In some instances they may be treated. Small items may be frozen since the insects are normally killed within four days of exposure to temperatures of 0 degrees F. Fumigation with paradichlorobenzene (PDB) moth crystals can kill adult and larval stages in nonfood products. Large items, such as furniture, may need to be removed to a fumigation chamber.

Thorough cleaning is an important component of carpet beetle control. Household lint, collections of dead insects around window wells, and other debris can be an important food source for carpet beetles. If large populations of carpet beetles suddenly occur, also look for the presence of a dead bird or rodent. Sprays may be used to improve control of carpet beetles, but beetles have a natural resistance to insecticides, especially against water based sprays. The use of wetting agents in both oil and water sprays will improve coverage and penetration.

Treatments should be applied to areas where carpet beetles tend to concentrate, such as cracks and crevices. If carpeting is to be treated, chemicals should be applied so that penetration is deep enough to reach the base pile but not enough to wet the rubber or synthetic backing. Oil sprays can damage some backing materials.

VI. DOMESTIC RODENT PESTS

TOPIC **PAGE**

The three main domestic or commensal rodents found in Utah are the Norway rat, the house mouse, and the deer mouse. Domestic rodents are the chief vertebrate pests of humans because of their great reproductive capacity and their ability to adapt to new environments.

NORWAY RATS

BIOLOGY AND BEHAVIOR

The Norway rat is the common domestic rat in Utah. It has coarse hair, close set ears, and its muzzle is blunt. The tail is dark on the top and light on the underneath side. The tail is shorter than the combined length of the head and body.

The fur is gray brown on the back and gray white on the belly. The adults weigh between 12 and 20 ounces and the combined length of the head and body is 7.5 to 10 inches long. The tail length is between 6 and 8.5 inches. The feces are capsule shaped and about 0.75 inch long.

Norway rats can be found in warehouses, farm buildings, houses, sewers, rubbish, dumps, woodpiles, and building foundations. They are good climbers and they can jump 24 inches vertically. The Norway rat has poor vision but keen senses of smell, touch, taste, and hearing. Long whiskers on the snout serve the sense of touch. Their home range is often 100 to 200 feet.

Norway rats and other domestic rodents are mainly nocturnal, but they may go about in undisturbed places during the day. They feed on virtually anything edible, are unable to vomit, and must drink water to survive.

HOUSE MICE

BIOLOGY AND BEHAVIOR

The most common household rodent is the house mouse. This mouse has large ears, a pointed muzzle, and a slender body. The tail is unicolored, has little hair, and is about as long as the head and body combined. Adults weight 0.5 to 0.75 ounce and the combined length of the head and body are 2.5 to 3.5 inches long. The tail measures between 3 and 4 inches long. The feces are rod shaped, 1/8 to 1/4 inch long.

Although house mice are commonly found living in structures built by humans, they are also well adapted to living outdoors. They are common inhabitants of grassy fields and cultivated grain crops. Wild populations often move into buildings when weather becomes severe. The house mouse has poor vision and is colorblind. Mice have keen senses of smell, taste, hearing, and touch. They use their sense of smell to locate food items and recognize other individual mice.

Mice use their long, sensitive whiskers on the nose and above the eyes as tactile sensors. The whiskers and guard hairs enable the mice to travel easily in the dark. House mice feed on a wide range of foods, although cereals seem preferred over other items. Most mice favor grains. Supplemental food items include foods high in fat and protein, such as lard, butter, nuts, and dried meats.

The two main feeding periods of mice are at dusk and dawn. Because of their small size, mice must feed several times during a 24-hour period. This means that they are active day and night. Their range is normally 10 to 30 feet from the nest.

DEER MICE

BIOLOGY AND BEHAVIOR

The native deer or white-footed mouse occasionally invades buildings adjacent to fields or woodlands. Deer mice are about the same size or slightly larger than house mice. Deer mice can be differentiated from house mice by a distinct, bicolored tail with the upper portion brown gray and the lower portion white. Deer mice have small ears and eyes and a relatively short tail.

The deer mouse is the most common host of the Hantavirus, but other small animals may carry the disease. Hantavirus is a viral illness that is transmitted from saliva, stool, or urine of infected animals. Once these waste products dry, the virus can become airborne. Infection usually results when the virus is inhaled. The illness is described as a severe respiratory illness that results in death for about 50 percent of its victims. Avoid activities involving exposure to mouse droppings.

Domestic rodents contaminate food by defecation, destroy structures by gnawing, transmit diseases, and harbor parasites hazardous to humans and animals. Some of the diseases that rodents convey to humans are plague, murine typhus, infectious jaundice, food poisoning, ratbite fever, and rabies.

PHYSICAL CAPABILITIES OF RODENTS

The Norway rat can:

Gain entrance through any opening that is larger than 0.5 inch square.
Crawl horizontally on any pipe or conduit.
Climb both horizontal and vertical wires.
Climb inside pipes that are 1.5 to 4 inches in diameter and outside of pipes up to 3 inches.
Climb vines, shrubs, and trees or travel along telephone or power lines.
Climb brick or other rough exterior walls that offer footholds.
Jump vertically as much as 36 inches.
Jump horizontally as much as 48 inches.
Jump a gap of 8 feet and greater from an elevation of 15 feet.
Drop 50 feet without being seriously injured.
Burrow vertically in earth to a depth of 4 feet.
Swim as far as 0.5 mile in open water, travel submerged in and in sewers.
Gnaw through a wide variety of materials, including lead, adobe brick, cinder block, and aluminum sheeting.

The house mouse can:

Gain entrance through openings slightly larger than 0.25 inch in diameter.
Jump 12 inches horizontally.
Jump against a vertical surface and use it as a springboard to gain additional height.
Jump from a height of 8 feet without injury.
Run up almost any rough vertical surface, including weathered sheet metal and cables.
Run horizontally along wires and small rope.
Travel upside down along hardware mesh.
Swim if it needs to, but do not dive below the surface, as do rats.

DOMESTIC RODENT CONTROL METHODS

Rodent control may involve the use of several control measures, including cleanup or sanitation, rodent proofing, and the use of toxicants and traps. Sanitation is important for rodent control. The elimination of shelter, food, and water is important.

Keep grass, weeds, and other vegetation away from buildings. Piles of lumber, rocks, rubbish, and old equipment should be located away from buildings. Information specific to the control of domestic or commensal rodents in and around structures is covered in the Study Guide for Structural Pest Control.

Rodenticides

Both single dose and multiple dose anticoagulant rodenticides are available for rat and mouse control.

Finished baits are available in a wide assortment and rodenticide concentrates can be purchased to prepare poison baits.

Prebaiting
Mice and rats are cautious feeders and may reject new foods or eat only small amounts for the first several days. Conditioning rats to feed on a nontoxic version by prebaiting can increase acceptance of toxic bait. If acceptance of prebait is poor, the bait should be changed. After a prebait is accepted the toxic bait should be used.

Single Dose Rodenticides
Single dose rodenticides will give a quick knockdown of rat and mouse populations, and they may be preferred where rats and mice are abundant or where it is hard to get rats and mice to accept bait for several days in succession because of competing food items.
When rats or mice consume a sub-lethal amount of an acute toxicant, "bait shyness" or "poison shyness" may result. Because of bait rejection problems, single dose poisons should not be used more than twice a year at a given location, and preferably only once.

Multiple Dose Rodenticides
Multiple dose anticoagulant rodenticides are generally considered much safer than single dose rodenticides. When anticoagulant baits are properly formulated bait shyness does not occur. Most anticoagulants rodenticides cause death to mice and rats after several days of feeding. When using anticoagulant rodenticides, fresh bait should be made available for at least two weeks or until all signs of feeding cease.

Bait Selection and Placement
Anticoagulant baits are available in several types. Grain baits in a meal or pellet form are packaged in small plastic, cellophane, or paper packets. These packets keep baits fresh and make it easy to place baits into burrows, walls, or other locations. Rats and mice will readily gnaw into these bags to get at the bait.

Anticoagulant baits that have been formulated into paraffin blocks are also available. These blocks are useful in sewers or where moisture
may cause loose grain baits to spoil.
Acceptance of the paraffin-block baits by rats and mice of is usually less than acceptance of loose grain baits.

Sodium salts of anticoagulants are available to be mixed with water. Since rats require water daily, they can be drawn to baited water stations. Although mice require little water to survive, water baits used where moisture is scarce can be an effective supplement to other control measures.

The use of bait stations or boxes protects rodenticides from weather and provides a safeguard to people, pets, and other animals. Bait stations should have at least two openings and be large enough to accommodate several rats or mice at one time. Bait boxes should be placed where rats or mice are active. All bait boxes should be clearly labeled "Rat Bait" or "Mouse Bait," as the case may be.

Pest control professionals should keep a written record of the locations of all bait stations so that another person can inspect and replace baits as needed. Records should be kept of activity indicating whether baits have been disturbed, if dead rodents were found, and the observation of droppings or tracks.

Fumigants
Fumigants are often used to control rodents in their burrows in outdoor situations, sometimes in rail cars, and on ships. Fumigants are highly toxic to people and animals and they must not be used in any situation that might expose the occupants of a building to the vapors. Because of the hazards involved with fumigants, only persons licensed for fumigation pest control should use fumigants.

Rodenticide Safety Precautions
All rodenticides present some degree of hazard to animals other than rodents. Persons who formulate rodent baits for their own use should use extreme care in handling the materials. Follow the label directions when handling rodenticide formulations. Wash thoroughly after preparing baits, using soap and water. Ready to use baits are safer to
handle because they reduce risks involved in handling concentrated toxicants.

The carcasses of poisoned rats and mice should be collected using tongs or rubber gloves. The bodies should be disposed by incineration or burial. In instances where there are only a few, they can be placed in a plastic bag and dispose of with other refuse. Remove and destroy all uneaten bait at the end of the poisoning period.

Traps
Trapping can be an effective method of controlling rats and mice. Trapping is recommended where

poisons seem inadvisable and it is the preferred method for areas where only a few rodents are present.

Trapping has several advantages:
1. It does not rely on rodenticides.
2. The effectiveness can be observed.
3. Rodent carcasses can be removed, thus eliminating odor problems.

Snap traps are generally more effective than cage traps. For rats, bait the traps with peanut butter, chocolate candy, dried fruit, or a small piece of bacon tied securely to the trigger. For mice, use bacon, nuts, hard sugar candy, gumdrops, or peanut butter. Leaving traps unset until the bait has been taken at least once reduces the chance of rats or mice becoming trap shy.

Place the traps so that the rats and mice following their natural course of travel will pass directly over the trigger. Use enough traps to make the campaign short and decisive. Since mice seldom venture far from their shelter and food supply, traps should be placed from 3 to 10 feet apart in areas where mouse activity is noted. Place traps within 20 feet of each other for rats.

Glueboards

Glueboards are an alternative to traps. Glueboards catch and hold mice and rats that step on the surface. Like traps, glueboards need to be placed along the travel path of mice and rats. Glueboards should not be used where children, pets, or desirable wildlife can come in contact. Glueboards lose their effectiveness in dusty areas and temperature extremes may affect the tackiness of the adhesive.

VII. WORKER PROTECTION STANDARD

The U.S. Environmental Protection Agency's Worker Protection Standard (WPS), as revised in 1992, must be complied with when pesticides are used on agricultural establishments, including farms, forests, nurseries, and greenhouses, for the commercial or research production of agricultural plants. The WPS requires employers to provide agricultural workers and pesticide handlers with protections against possible harm from pesticides. Persons who must comply with these instructions include owners or operators of agricultural establishments and owners or operators of commercial businesses that are hired to apply pesticides on the agricultural establishment or to perform crop-advising tasks on such establishments. Family members who work on an agricultural or commercial pesticide establishment are considered employees in some situations.

WPS requirements for employers include:

- **Displaying information** about pesticide safety, emergency procedures, and recent pesticide applications on agricultural sites.
- **Training** workers and handlers about pesticide safety.
- Helping employees get **medical assistance** in case of a pesticide related emergency.
- Providing **decontamination sites** to wash pesticide residues off hands and body.
- Compliance with **restricted entry intervals** (REI)– the time after a pesticide application when workers may not enter the area.
- **Notifying** workers through posted and/or oral warnings about areas where pesticide applications are taking place and areas where REI are in effect.
- Allowing only **trained and equipped workers** to be present during a pesticide application.
- Providing **personal protective equipment** (PPE) for pesticide handlers and also for workers who enter pesticide treated areas before expiration of the REI.
- **Protecting pesticide handlers** by giving them safety instructions about the correct use of pesticide application equipment and PPE and monitoring workers and handlers in hazardous situations.

One of the provisions of the WPS is the requirement that employers provide handlers and workers with ample water, soap, and single use towels for washing and decontamination from pesticides and that emergency transportation be made available in the event of a pesticide poisoning or injury. The WPS also establishes REI and the requirements for PPE. PPE requirements are specified for all pesticides used on farms and in forests, greenhouses, and nurseries. Some pesticide products already carried REI and PPE directions. This rule raised the level of protection and requirements for all pesticide products.

Other major provisions require that employers inform workers and handlers about pesticide hazards through safety training. Handlers must have easy access to pesticide label safety information and a listing of treatments site must be centrally located at the agricultural facility. Handlers are prohibited from applying a pesticide in a way that could expose workers or other people.

References: ***The Worker Protection Standard for Agricultural Pesticides–How to Comply: What Employers Need to Know***. Web site <www.usda.gov/oce/oce/labor-affairs/wpspage.htm>.

VIII. PROTECTING GROUNDWATER AND ENDANGERED SPECIES

INTRODUCTION

Federal and state efforts to protect groundwater and endangered species have resulted in special requirements and restrictions for pesticide handlers and applicators. Pesticides that are incorrectly or accidentally released into the environment can pose a threat to groundwater and endangered species. Whether pesticides are applied indoors or outdoors, in an urban area or in a rural area, the endangered species and groundwater must be protected and state and federal agencies rigidly enforce this requirement.

The need for special action by the pesticide handler/applicator depends on site location. Groundwater contamination is of special concern in release sites where groundwater is close to the surface or where the soil type or the geology allows contaminants to reach groundwater easily. In the case of endangered species, special action is normally required in locations where the species currently live or in locations where species are being reintroduced. The product labeling is the best source to determine if pesticide use is subject to groundwater or endangered species limitations.

The U.S. Environmental Protection Agency (EPA) establishes the specific limitations or instructions for pesticide users in locations where groundwater or endangered species are most at risk. These limitations and instructions may be too detailed for inclusion in pesticide labeling. In such cases the labeling will direct the applicator or handler to another source for instructions and restrictions. The legal responsibility for following instructions that are distributed separately is the same as it is for instructions that appear on the pesticide labeling.

PROTECTING GROUNDWATER

Groundwater is water located beneath the earth's surface. Many people think that groundwater occurs in vast underground lakes, rivers, or streams. Usually, however, it is located in rock and soil. It moves very slowly through irregular spaces within otherwise solid rock or seeps between particles of sand, clay, and gravel. An exception is in limestone areas, where groundwater may flow through large underground channels or caverns. Surface water may move several feet in a second or a minute. Groundwater may move only a few feet in a month or a year. If the groundwater is capable of providing significant quantities of water to a well or spring, it is called an aquifer. Pesticide contamination of aquifers is very troubling, because these are sources of drinking, washing, and irrigation water.

Utah has implemented a comprehensive and coordinated approach to protect groundwater from pesticide contamination. Formulation of the Utah Groundwater and

Pesticide State Management Plan is a cooperative effort between federal, state, private agencies, producers, and user groups. It provides a basis for continuing future efforts to protect groundwater from contamination whenever possible. Furthermore, this plan provides agencies with direction for management policies, regulations, enforcement, and implementation of groundwater strategies.

Utah recognizes that the responsible and wise use of pesticides can have a positive economic impact, yield a higher quality of life, enhance outdoor activities, and give relief from annoying pests. The EPA has authorized the Utah Department of Agriculture and Food (UDAF) to enforce the protection of groundwater from pesticides.

The UDAF, in concert with cooperating agencies and entities, demands strict compliance with all pesticide labels, handling procedures, and usage to protect groundwater in the state.

Prevention of groundwater contamination is important, because once the water is polluted, it is very difficult and costly to correct the damage and in some instances impossible. City and urban areas contribute to pollution because water runoff can contain pesticides. Shallow aquifers or water tables are more susceptible to contamination than deeper aquifers or water tables. Sandy soils allow more pollution than clay or organic soils, because clays and organic matter adsorb many of the contaminants. For more information about what groundwater is and where it comes from, read the study manual ***Applying Pesticides Correctly: A Guide for Private and Commercial Applicators.***

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, establishes a policy for determining the acceptability of a pesticide use or the continuation of that use, according to a risk/benefit assessment. As long as benefits outweigh adverse effects, the EPA can continue to register the pesticide. Although the intent of a pesticide application is to apply the pesticide to the target or pest, part of the pesticide will fall on the area around the target or pest. Rain or irrigation water then can pick up the part that is not degraded or broken down and carry it to the groundwater via leaching.

There are many factors that influence the amount of pesticide contamination that can get into groundwater. The major factors are the soil type, soil moisture, persistence in soil, placement of the pesticide, frequency of application, pesticide concentration and formulation, pesticide water solubility, and precipitation. Each of these factors will influence the amount of pesticide that can penetrate the soil surface, leave the root zone, and percolate into groundwater.

Although some pesticides may have a high adsorption quality, when they are applied to sandy soil, they may still migrate to the water table because there are few clay particles or little organic matter to bind them. The management and use of pesticides is up to the individual applicator and/or landowner as to whether safe practices are used. Groundwater is a very valuable resource and it must be protected form pesticide contamination.

PROTECTING ENDANGERED SPECIES

The Federal Endangered Species Act lists the three classifications as endangered, threatened, and experimental. Endangered has the highest level of protection. The phrase "endangered species" is used when referring to these classifications. This Act was passed by Congress to protect certain plants and wildlife that are in danger of becoming extinct. A portion of this Act requires EPA to ensure that these species are protected from pesticides.

EPA's goal is to remove or reduce the threat to endangered species that pesticides pose. Achieving this goal is a portion of the larger continuing effort to protect species at risk. Normally these restrictions apply to the habitat or range currently occupied by the species at risk. Occasionally the restrictions apply where endangered species are being reintroduced into a habitat previously occupied.

Habitats are the areas of land, water, and air space that an endangered species needs for survival. Such areas include breeding sites, sources of food, cover, and shelter, and the surrounding territory that provides space for normal population growth and behavior.

Utah's endangered species plan is a cooperative effort between federal, state, private agencies, producers, and user groups. This plan provides agency direction for regulations, enforcement, management policies, and implementation of threatened and endangered species protection strategies.

EPA launched a major project known as Endangered Species Labeling (ESL). The goal is to remove or reduce the threat to endangered species from pesticides. EPA has the responsibility to protect wildlife and the environment against hazards posed by pesticides. The ESL program is administered by the U.S. Fish and Wildlife Service (FWS) in the U.S. Department of Interior. The FWS reports to EPA concerning endangered species. EPA and FWS work cooperatively to ensure that there is consistency in the pesticide restriction information provided to agencies and pesticide users.

The UDAF acts under the direction and authority of EPA to carry out the ESL project as it relates to the use of pesticides in Utah. Many states have web sites with maps designating the habitat boundaries and listings of endangered plants and wildlife. Utah's site is www.utahcdc.usu.edu.

References: ***Applying Pesticides Correctly: A Guide for Private and Commercial Applicators.*** Also, Endangered Species Act of 1973, with amendments through 1996 <www.house.gov/resources/105cong/reports/105_c/esaidx.htm>.

IX. CALIBRATION INFORMATION

Conversion:

Units

One acre = 43,560 square feet	**Example: ½ acre = 21,780 square feet**
One mile = 5,280 feet	Example: ¼ mile = 1320 feet
One gallon = 128 fluid ounces	Example: ½ gallon = 64 fluid ounces
One quart = 2 pints = 4 cups = 32 fluid ounces	Example: 2 quarts = 64 fluid ounces
One pint = 2 cups = 16 fluid ounces	Example: ½ pint = 1 cup = 8 fluid ounces
One tablespoon = 3 teaspoons = 0.5 fluid ounces	Example: 2 tablespoons = 1 fluid ounce
One pound = 16 ounces	Example: ¼ pound = 4 ounces
One gallon = 231 cubic inches	Example: 2 gallons = 462 cubic inches

Weights

1 ounce = 28.35 grams
16 ounces = 1 pound = 453.59 grams
1 gallon water = 8.34 pounds = 3.785 liters = 3.78 kilograms

Liquid Measures

1 fluid ounce = 2 tablespoons = 29.573 milliliters
16 fluid ounces = 1 pint = 0.473 liters
2 pints = 1 quart = 0.946 liters
8 pints = 4 quarts = 1 gallon = 3.785 liters

Lengths

1 foot = 30.48 centimeters
3 feet = 1 yard = 0.9144 meters
16 1/2 feet = 1 rod = 5.029 meters
5280 feet = 320 rods = 1 mile = 1.6 kilometers

Areas

1 square foot = 929.03 square centimeters
9 square feet = 1 square yard = 0.836 square meters
43560 square feet = 160 square rods = 1 acre = 0.405 hectares

Speeds

1.466 feet per second = 88 feet per minute = 1 mph = 1.6 kilometers per hour (kph)

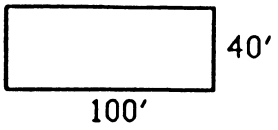
Volumes

27 cubic feet = 1 cubic yard = 0.765 cubic meters
1 cubic foot = 7.5 gallons = 28.317 cubic decimeters

Area and Volume Calculations:

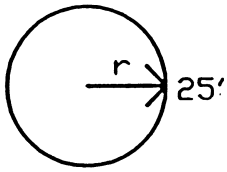
Area of Rectangular or Square Shapes

The area of a rectangle is found by multiplying the length (L) times the width (W).
(Length) x (Width) = Area
Example: (100 feet) x (40 feet) = 4000 square feet



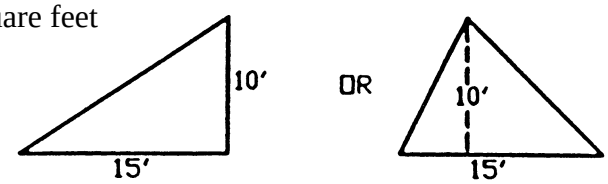
Area of Circles

The area of a circle is the radius (radius = one-half the diameter), times the radius, times 3.14.
(radius) x (radius) x (3.14) = Area
Example: (25 feet) x (25 feet) x (3.14) = 1962.5 square feet



Area of Triangular Shapes

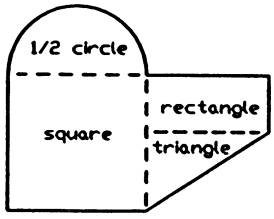
To find the area of a triangle, multiply ½ times the width of the triangle's base, times the height of the triangle.
(½) x (base width) x (height) = Area
Example: (½) x (15 feet) x (10 feet) = 75 square feet



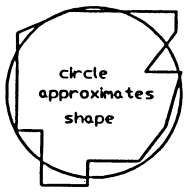
Area of Irregular Shapes

Irregularly shaped sites can often be reduced to a combination of rectangles, circles, and triangles. Calculate the area of each shape and add the values together to obtain the total area.

Example: Calculate the area of the rectangle, triangle, square, and one-half of a circle.



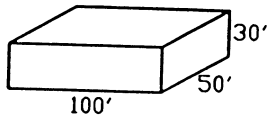
Another method is to convert the site into a circle. From a center point, measure the distance to the edge of the area in 10 or more increments. Av measurements to find the radius, and then calculate the area using the forn
Example: Approximate the area by calculating
the area of a similarly sized circle.



Volume of Cube and Box Shapes

The volume of a cube or box is found by multiplying the length, times the width, times the height.
(Length) x (Width) x (Height) = Volume

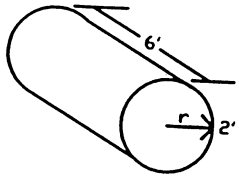
Example: (100 feet) x (50 feet) x (30 feet) = 150,000 cubic feet



Volume of Cylindrical Shapes

The volume of a cylinder is found by calculating the area of the round end (see formula for circle) and multiplying this area times the length or height.

Example: (radius) x (radius) x (3.14) = Area of Circle
(Area of Circle) x (Length) = Volume of Cylinder
(2 feet) x (2 feet) x (3.14) x (6 feet) = 75.36 cubic feet



Sprayer Calibration Formulas:

To Calculate Travel Speed in Miles Per Hour
The travel speed of a sprayer is determined by measuring the time (seconds) required to travel a know distance (such as 200 feet). Insert the values in the following formula to determine the miles per hour.

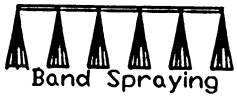
$$\frac{\text{Distance in Feet x 60}}{\text{Time in Seconds x 88}} = \text{Miles Per Hour}$$

Example: $\frac{\text{(200 feet) x (60)}}{\text{(30 seconds) x (88)}} = \frac{12{,}000}{2640} = 4.55$ mph

To Calculate the Gallons Per Minute Applied During Broadcast Spraying
The application rate in gallons per minute (GPM) for each nozzle is calculated by multiplying the gallons per acre (GPA), times the miles per hour (MPH), times the nozzle spacing in inches (W); then dividing the answer by 5940. For small adjustments in GPM sprayed, operating pressure is changed. For large adjustments in GPM sprayed, travel speed (miles per hour) is changed or nozzle size is changed.

$$\frac{\text{GPA x MPH x W}}{5940} = \text{GPM}$$

Example: $\frac{\text{(12 GPA) x (4.5 MPH) x (24")}}{5940} = \frac{1296}{5940} = 0.22$ GPM



To Calculate the Gallons Per Minute Applied During Band Spraying
Broadcast spraying applies chemicals to the entire area. Band spraying reduces the amount of area and chemicals sprayed per acre. To use the above formulas for band sprayer applications, use the band width (measured in inches) rather than nozzle spacing for the "W" value.

Pesticide Mixing:

Terminology

The ***active ingredients*** of a pesticide are the chemicals in a formulation that control the target pests. The ***formulation*** is the pesticide product as sold, usually a mixture of concentrated active ingredients and an inert material. Restricted use pesticides are purchased in formulations requiring ***dilution prior to application***. Formulations are diluted with inert substances such as water. The ***percentage of active ingredients*** in a pesticide formulation directly affects dilution and application rates. Given two pesticides, A = 50% active ingredients, B = 100% active ingredients; twice as much pesticide A formulation is required to equal pesticide B formulation.

To Determine the Total Amount of Pesticide Formulation Required Per Tank

To calculate the total amount of pesticide formulation needed per spray tank, multiply the recommended dilution, ounces/pints/cups/teaspoons/tablespoons/etc. of pesticide per gallon of liquid, times the total number of gallons to be mixed in the sprayer. A full or partial tank of pesticide spray may be mixed.

(Dilution Per Gallon) x (Number of Gallons Mixed) = Required Amount of Pesticide Formulation Example: (3 ounces per gallon) x (75 gallons) = 225 ounces

Note: 1 gallon = 128 ounces; through unit conversion 225 ounces = 1.76 gallons

To Calculate the Amount of Pesticide Formulation Sprayed Per Acre

The calculate the total amount of pesticide formulation sprayed per acre is determined by multiplying the quantity of formulation (ounces/pounds/pints/cups/teaspoons/tablespoons/etc.) mixed per gallon of water, times the number of gallons sprayed per acre.

(Quantity of Formulation Per Gallon) x (Gallons Sprayed Per Acre) = Formulation Sprayed Per Acre

Example: (1/2 pound per gallon) x (12 gallons per acre) = 6 pounds per acre

To Calculate the Amount of Active Ingredients Sprayed Per Acre

The total amount of active ingredients (AI) applied per acre, multiply the amount (pounds, gallons, ounces, etc) of pesticide formulation required per acre, times the percentage of active ingredients in the formulation (100%, 75%, 50%, 25%, etc.), and divide the value by 100.

$$\frac{\text{(Amount of Formulation Required Per Acre) x (Percentage of AI)}}{100} = \text{Active Ingredients Per Acre}$$

Example: $\frac{\text{(4 pounds formulation sprayed per acre) x (75\% AI)}}{100}$ = 3 pounds of AI sprayed per acre

Note: 75 % = 0.75

To Calculate the Gallons of Pesticide Mixture Sprayed Per Acre

The total amount of pesticide mixture sprayed per acre is determined by dividing the number of gallons sprayed by the number of acres sprayed.

$$\frac{\text{Gallons Sprayed}}{\textbf{Acres Sprayed}} = \text{Gallons Sprayed Per Acre}$$

Example: $\frac{\text{200 Gallons Sprayed}}{\text{10 Acres Sprayed}}$ = 20 gallons of pesticide mixture sprayed per acre

GLOSSARY OF TERMS

A

ACTIVE INGREDIENT - The chemical(s) in a pesticide responsible for killing, poisoning, or repelling the pest.

ANTICOAGULANT - A chemical that prevents normal blood clotting.

ANTIDOTE - A treatment to counteract the effects of poisoning.

APPLICATION - The process of spreading something on or over the surface of objects or materials.

ATTRACTANT - A substance or device that will lure pests to a trap or poison bait.

B

BACTERIA - Microscopic organisms, some of which are capable of producing diseases in plants and animals.

BAIT - A food or other substance used to attract a pest to a pesticide or trap.

BIOLOGICAL CONTROL - Control of pests by means of predators, parasites, disease-producing organisms or competitive microorganisms.

C

CONCENTRATION - The amount of active material in a given volume of diluent.

CONTACT REPELLENT - A compound that the pest must make contact with for the substance to repel pest.

CONTAMINATION - The presence of an unwanted substance in or on plants, animals, soil, water, air, or structures.

CULTURAL CONTROL - A pest control method that includes changing sanitation and/or work practices.

D

DECONTAMINATE - To remove or break down a chemical from a surface or substance.

DERMAL TOXICITY - Injury when absorbed through the skin.

DIAGNOSIS - The identification of the nature or cause of problem or fault.

DOSE OR DOSAGE - Amount or rate of chemical applied to a given area or target.

E

ECOSYSTEM - The physical and biotic factors that allow infestation by pests.

ECTOPARASITE - A parasite that lives on the outside of its host.

ENDANGERED SPECIES - Legally classified as a species in danger of extinction.

ENDOPARASITE - A parasite that lives inside its host.

ERADICATION - Pest management strategy that attempts to eliminate all members of a pest species.

EVALUATION - To examine or investigate for the purpose of judging the value, extent, or success.

EXPOSE - To be subjected to or come in contact with a material.

EXPOSURE ROUTE - The dermal, oral, or inhalation (respiratory) route by which a substance may enter an organism.

F

FORMULATION - Pesticide as prepared by the manufacturer.

FUMIGANT - Pesticide that controls by giving off fumes.

G

GROUNDWATER - Water sources located beneath the soil surface from which water is obtained.

H

HARBORAGE - A site that shelters and provides the food and water required for a particular organism to survive.

HOST - Plant or animal that is invaded by a parasite and from which the parasite gets its nutrients.

I

INERT INGREDIENT - In a pesticide formulation it is an inactive material without pesticidal activity.
INSPECTION - A critical examination an evaluation aimed at forming a judgment or determination.
INTEGRATED PEST MANAGEMENT (IPM) - A planned pest control program in which various techniques are used to keep pests from causing economic, health related, or aesthetic injury.

L

LEACHING - Process by which some pesticides move through the soil.

N

NONLETHAL – Not capable of causing death.
NONTARGET ORGANISM - Any plant or animal other than the intended target of a pesticide application.

P

PARASITE - An organism that lives on or in a living host and that gets all or part of its nutrients from the host.
PATHOGEN - Any organism capable of causing disease.
PERCOLATE - To pass slowly through a material or spread throughout a place.
PERSISTENCE - To have a continued or prolonged effect after treatment.
POLLUTION - The act of polluting or contaminating the environment with harmful chemicals or waste products.
PRECIPITATION - The formation of a suspension of an insoluble compound by mixing two solutions.
PRESCRIPTION - A proven formula for the control of pests.
PREVENTION - An action that makes it impossible or very difficult for an unwanted activity to happen.
PHYTOTOXICITY - Injury to plants by a chemical.
PREDATOR - An animal that attacks, kills, and feeds on other animals.

R

RATE OF APPLICATION - The amount of pesticide applied, usually measured as per acre, per 1,000 square feet, per linear foot, or per cubic foot.
RE-ENTRY INTERVAL - The length of time following an application of a pesticide when entry into the areas is restricted.
REPELLENT - A compound that keeps pests away.
RISK - A probability of an adverse effect in a given situation.
RODENTICIDE - A pesticide used to control rodents.

S

SIGNAL WORDS - Required word(s) that appear on every pesticide label to denote the relative acute toxicity of the product.
SOLUBILITY - The extent to which one substance is able to dissolve in another.
SURFACE WATER - Water on the earth's surface in rivers, lakes, ponds, streams, etc.

T

TARGET - The plants, animals, structures, areas, or pests at which the pesticide or other control method is directed.
TOXIC - Poisonous to living organisms.
TOXICITY - The degree or extent to which a chemical or substance is poisonous.

V

VECTOR - An animal that can carry and transmit a pathogen.

W

WATER TABLE - The upper level of the water saturated zone in the ground.