Florida Certified Operator Exam Reference Package

General Household Pest Control Exam

GHP CO EXAM

- **200 QUESTIONS (1/2 POINT EACH)**
- **YOU NEED 75% CORRECT = 150 CORRECT TO PASS = YOU CAN MISS UP TO 50 QUESTIONS**
- **ALL MULTIPLE CHOICE**
- **~24 PICTURES WITH ~27 QUESTIONS ABOUT THESE PICTURES. MOST Q'S ASK WHAT IS IT?**
- **2 Insecticide Labels with ~ 25 questions that are simple and answered directly from items on the label.**
- **READ ALL QUESTIONS CAREFULLY**
- **THERE IS ALWAYS ONE INTENDED BEST ANSWER**
- **DON'T READ INTO A QUESTION ANY MORE THAN WHAT IS ASKED**
- **ANTICIPATE THE ANSWER, THEN LOOK FOR IT**
- **ELIMINATE ANSWERS THAT YOU KNOW ARE INCORRECT**
- **THE EXACT ANSWER WILL PROBABLY NOT BE THERE AND A LOGICAL INTERPRETATION WILL BE NEEDED**
- **NEVER GUESS AT AN ANSWER TO A QUESTION THE FIRST TIME THROUGH THE TEST. LEAVE CONFUSING QUESTIONS UNANSWERED UNTIL THE END OF THE TEST**
- **DON'T BE AFRAID TO ASK THE PROCTOR QUESTIONS ABOUT WHAT APPEARS AMBIGUOUS, TO MAKE SURE YOU UNDERSTAND THE QUESTION. PROCTORS OFTEN NOD WHEN YOU ARE RIGHT AND LET YOU KNOW THAT YOU ARE CORRECT, BUT DO NOT ASK TOO MANY Q'S!**

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GENERAL HOUSEHOLD PEST CONTROL

APPLICATOR TRAINING MANUAL

Second Edition

Philip G. Koehler

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General Household Pest Control Applicator Training Manual

Second Edition

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IFAS Extension

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Contents

1 **Introduction** 1

How to Use This Book 2

Pest Control Regulations 4

Employee Identification Cards 5

Regulatory Agencies 7

Study Questions 12

2 **Pest Management** 13

Locating and Monitoring Pests 15

Establishing Action Thresholds 19

Pest Control Methods 21

- Sanitation and Habitat Modification 21
- Trapping 27
- Biological Control 28
- Pesticides 28

Equipment 28

Summary 35

Study Questions 36

3 **Using Pesticides Safely** 37

Pesticide Types 42

Human Pesticide Injury 51

- Poisoning Symptoms 52

Human Protection 54

Applicator Safety 55

- Protecting Pets and Domestic Animals 60
- Pesticide Drift 61

Characteristics of Treated Surfaces 61

Transporting Pesticides 63

Study Questions 66

4 Pests On or Near Food 67

Cockroaches 68

Ants 82

Flies 99

Study Questions 110

5 Parasitic, Biting, and Stinging Arthropods 113

Mosquitoes 114

Black Flies 115

True Bugs 117

Fleas 120

Ticks 125

Bees and Wasps 128

Scorpions 135

Spiders 135

Study Questions 139

6 Fabric Pests 141

Carpet Beetles 142

Clothes Moths 145

Study Questions 147

7 Stored Product Pests 149

Birds 150

Rodents 151

Fungi and Other Microorganisms 153

Insects 154

- Beetles 154
- Moths 157
- Booklice 161

Mites 162

Study Questions 163

8 Occasional Invaders 165

Mites 166
- Bird Mites 166
- Insect Mites 167
- Rodent Mites 167
- House Dust Mites 167

Insects 168
- Booklice 168
- Silverfish and Firebrats 168
- Crickets 170
- Springtails 171
- Plaster Bagworms 171
- Earwigs 171

Sowbugs and Pillbugs 172

Centipedes and Millipedes 173

Study Questions 175

9 Vertebrate Pests 177

Rats 178

Mice 181

Nuisance Vertebrate Control Laws 192

Bats 198

Birds 207

Study Questions 215

References 217

Glossary 223

Index 239

Appendix A: Answers to Study Questions 245

Chapter 1: Introduction

Learning Objectives

After completing the Introduction, the trainee should be able to:

- Know pest control regulations.
- Know regulatory agencies for pesticide applications.
- Know the responsibilities of the certified operator.
- Know types of pest control certification.

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Many living organisms can be pests in or around structures. These may be insects and related arthropods, fungi, rats, mice, bats and certain birds. Some pests, such as those that damage furnishings or fabrics, or pests that infest or contaminate stored food and other items, cause huge economic losses. A few pests spread disease organisms that can cause serious human illness. Certain types of pests inflict annoying or painful stings or bites. In addition, nuisance pests like earwigs or sowbugs are unwelcome invaders in homes and can also contaminate products or cause legal concerns in commercial areas.

Pests that damage property, injure people or affect people's quality of life need to be managed safely, effectively, and economically. Sometimes there are several ways to control pests, such as sanitation, habitat modification, trapping and pesticide use.

Pesticides can be very effective tools for controlling pests. But if you use pesticides improperly, you may injure yourself and other people and create environmental problems. In addition, some improperly used pesticides may damage treated surfaces. To prevent problems and accidents, you must always follow pesticide-label instructions and use basic common sense. This book contains important information to help you use pesticides properly in and around structures.

How to Use This Book

Use this book to make effective pest management decisions that will reduce hazards to yourself, other people and the environment. If you are preparing for the General Household Pest Control examination to obtain a pest control operator certificate, use this book as one of your study guides.

When you apply pesticides in or around structures, use this book as a reference for information on pests, pest management and pesticide use. You should find the book helpful if you supervise or train persons who handle or apply pesticides in any type of residential, industrial or institutional situation.

Shaded boxes present helpful information about pesticides and their alternatives. Many tables summarize important points in the text and give additional information.

The references at the end of this book include many well-illustrated books and pamphlets that provide additional information on identification, biology and pest management. Furthermore, you can obtain pest management information and control recommendations for specific pests from University of Florida Cooperative Extension offices in Florida counties.

Pesticide Concerns

Pesticides have been and will continue to be the focus of a great deal of public attention. Many people have genuine concerns over the use of pesticides, although many others use them regularly to manage pest problems and find the risks acceptable.

Pesticide concerns arise from reported incidents where exposure has produced mild to severe illness (or death) in farmworkers, pesticide applicators, manufacturing plant workers, and even in consumers of improperly treated produce.

Injuries caused by some pesticides have included skin rashes, headache, nausea, and nervous system disorders. Long-term or chronic illnesses associated with or suspected of being caused by certain pesticides include cancer, birth defects, and reproductive disorders. Pesticides also have been implicated in environmental problems such as groundwater contamination and wildlife injury.

The debate over the advisability of using pesticides will continue for many years. In the meantime, pesticide hazards must be reduced by proper handling and application techniques, accurate timing of applications, and by seeking and using alternate control methods whenever possible.

Figure 1-1. Pest management in structures is regulated by the Florida Department of Agriculture and Consumer Services.

Figure 1-2. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is the law governing the registration of pesticide products. It balances a pesticide's risk with its benefit to society.

Pest Control Regulations

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), enacted in 1947 and amended several times, replaced the Federal Insecticide Act of 1910. The most important amendment to FIFRA is called the Federal Environmental Pesticide Control Act (FEPCA) of 1972. This amendment shifted the emphasis from pest control regulations to the role of protecting the public health and environment.

FIFRA governs the registration of pesticide products. No pesticide may be marketed in the United States until the US Environmental Protection Agency (EPA) reviews an application for registration, approves each use and assigns a product registration number. Pesticide manufacturers must demonstrate that the pesticide's use will not result in unreasonable adverse effect to human health. In other words, FIFRA balances a pesticide's risk with its benefit to society. Risk is defined by EPA as the probability that a pesticide will have an adverse effect. FIFRA is the law and requires that:

- EPA register all pesticides as well as each use of those pesticides and approve product labels,
- pesticides be categorized either as general-use pesticides or restricted-use pesticides and,
- users of restricted-use pesticides be certified or under the direct supervision of certified applicators.

FIFRA also:

- establishes tolerances for residues that may remain on raw agricultural products or in processed food,
- provides penalties for "use inconsistent with the labeling" of a pesticide,
- makes it illegal to store or dispose of pesticides or containers other than as directed by regulations; provides penalties for illegal handling of containers,
- provides civil penalties when the violation of a regulation is unintentional. *(Fines can be as much as $5,000 for each offense by commercial applicators. An applicator may request a hearing in his/her city or county before being fined.),*
- provides criminal penalties when the law is knowingly violated *(commercial applicators may be fined up to $25,000, serve one year in prison, or both),* and
- permits states and tribes to establish more stringent standards, but not more permissive standards.

Regulated under Florida Statute 482, pest control is the use of any method or device, or the application of any substance to prevent, destroy, repel, mitigate, curb, control, or eradicate any pest in, on, or under a structure, lawn, or ornamental. All persons doing pest control in Florida must be certified under Statute 482 except for pest control applied to:

1. a person's own individual residential property (however, fumigation does require certification),
2. US Department of Defense installations or other federal property, or
3. greenhouses, plant nurseries, agricultural crops, trees, groves, or orchards.

Exemptions

Chapter 482 does not apply to:

(1) Pest control, except for fumigation, performed by a person upon her or his own individual residential property.

(2) Pest control performed on a United States Department of Defense installation or other federal property, except as outlined in the memorandum of agreement between the Department of Agriculture and Consumer Services and the United States Department of Defense.

(3) Pest control performed in greenhouses, in plant nurseries, or on agricultural crops, trees, groves, or orchards.

(4) Aerial application of pesticides.

(5) Aquatic weed control.

(6) Other weed control not specifically regulated by Chapter 482.

(7) Mosquito control activities conducted by a local government or district established under chapter 388 or by special act, or by a contractor of the local government or district.

(8) Pest control performed for lawns and ornamental plants which is performed on an agricultural area.

(9) The use of wood preservatives during the manufacturing process when applied only on wood, pretreated lumber, or metal shields for use in the construction of structures.

(10) The use of the antibiotic oxytetracycline hydrochloride or other antibiotic for the control of lethal yellowing.

(11) A yard worker when applying a pesticide to the lawn or ornamental plants of an individual residential property owner using pesticides owned and supplied by the individual residential property owner, provided the yard worker does not advertise for or solicit pest control business and does not hold herself or himself out to the public as being engaged in pest control. The yard worker may not supply her or his own pesticide application equipment, use pesticide-applying power equipment, or use any equipment other than a handheld container when applying the pesticide.

Employee Identification Cards
2006 Florida Statute 482.091

(1)(a) Each employee who performs pest control for a licensee must have an identification card.

(b) Either the licensee or the licensee's certified operator in charge must apply to the department for an identification card for each employee who will perform pest control therefor within 30 days after employment of that employee, on a form prescribed by the department. The licensee and the licensee's certified operator in charge are jointly responsible for obtaining such identification cards.

(2)(a) An identification cardholder must be an employee of the licensee and work under the direction and supervision of the licensee's certified operator in charge and shall not be an independent contractor. An identification cardholder shall operate only out of, and for customers assigned from, the licensee's licensed business location. An identification cardholder shall not perform any pest control independently of and without the knowledge of the licensee and the licensee's certified operator in charge and shall perform pest control only for the licensee's customers.

(b) The identification card shall be carried on the employee's person while performing or soliciting pest control and shall be presented on de-

Figure 1-3. Each employee who performs pest control for a licensee must have an identification card.

mand to the person for whom pest control is being performed or solicited, to any inspector of the department, or to any of such other persons as are designated by the rules of the department.

(c) An employee may not perform pest control without carrying on her or his person a current identification card affixed with the employee's signature and current photograph.

(d) An identification cardholder may use only the licensee's pesticides, equipment, and other materials when performing pest control.

(e) An identification cardholder shall consult regularly with the licensee's certified operator in charge concerning:

1. The selection of proper and correct chemicals for the particular pest control work to be performed;

2. The safe and proper use of the particular pesticides applied; and

3. The correct concentrations and formulations of pesticides used for the various types of pest control work performed.

(3) A licensee or certified operator may not assign or use an employee to perform any category of pest control without providing trained supervision unless the employee is trained and qualified in that category of pest control. An employee may not perform, solicit, inspect, or apply pest control without first having been provided at least 5 days of field training in the appropriate category of pest control under the direct supervision, direction, and control of a certified operator.

(4) An identification card automatically expires when the holder thereof ceases to be an employee of the licensee for which the card was secured. In such case, either the licensee or certified operator in charge shall obtain and destroy the expired card. An identification card expires on the licensee's next anniversary date after issuance or upon transfer of business ownership, change of business name registered with the department, or change of licensee's business location address. Each identification card must be renewed annually thereafter on or before the licensee's anniversary date as set by the department for each licensed business location.

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Figure 1-4. Employees who put up or take down tents are not required to hold an identification card.

(6) An employee whose duties are confined to office secretarial, bookkeeping, office clerical, office filing, trenching, digging, raking, putting up or taking down tents, clamping, or carrying away debris or such other activities as specified by the department shall be exempted by the department from being required to hold an identification card.

(7) A person may not be issued, or may not hold, an identification card for more than one licensee at any one time, except a certified operator for the express and sole purpose of, and period for, obtaining experience to qualify for examination in a category for which such person is not certified and seeks certification. The period of time for which a second card may be issued may not exceed 1 year from the date of issuance, except in the category of fumigation for which a card may be issued for 2 years.

(8) A licensee having more than one licensed business location may temporarily assign an identification cardholder, other than a certified operator in charge, to any of its licensed business locations without obtaining another identification card for such holder.

(9) For every employee who performs inspections for wood-destroying organisms pursuant to s. 482.226, the licensee or certified operator in charge must apply for an identification card that identifies that employee as having received the special training specified in this subsection in order to perform inspections pursuant to s. 482.226. The application for such identification card must be accompanied by an affidavit, signed by

the prospective identification cardholder and by the licensee or certified operator in charge, which states that the prospective identification cardholder has received training in the detection and control of wood-destroying organisms, including but not limited to training in:

(a) The biology, behavior, and identification of wood-destroying organisms with particular emphasis on ones common in this state and the damage caused by such organisms;

(b) The inspection forms to be used to report the finding; and

(c) Applicable federal, state, and local laws or ordinances.

Such identification cards must be applied for, and shall be issued and used, in accordance with this section. This subsection does not apply to a certified operator who is certified in the category of pest control with respect to termites and other wood-destroying organisms. A person may not perform such inspections except under the supervision of a certified operator in charge who is certified in the category of termites and other wood-destroying organisms pest control.

(10) In addition to the training required by subsection (3), each identification cardholder must receive 4 hours of classroom training in pesticide safety, integrated pest management, and applicable federal and state laws and rules within 6 months after issuance of the card or must have received such training within 2 years before issuance of the card. Each cardholder must receive at least 2 hours of continuing training in pesticide safety, integrated pest management, and applicable federal and state laws and rules by the renewal date of the card. Certified operators and special identification cardholders for fumigation who maintain their certificates in good standing are exempt from this subsection. The department shall adopt rules regarding verification of such training.

History.--s. 1, ch. 59-454; s. 1, ch. 65-295; s. 5, ch. 67-520; ss. 19, 35, ch. 69-106; s. 2, ch. 74-74; s. 3, ch. 76-168; s. 376, ch. 77-147; s. 1, ch. 77-457; s. 5, ch. 78-292; ss. 2, 3, ch. 81-318; ss. 4, 14, 15, ch. 82-229; s. 6, ch. 89-180; ss. 33, 59, ch. 92-203; s. 428, ch. 97-103; s. 4, ch. 2001-280; s. 2, ch. 2003-35; s. 3, ch. 2006-289.

Regulatory Agencies

U.S. Environmental Protection Agency (EPA)

EPA is responsible for the registration of pesticides, reviewing labels for accuracy and safety, development of pesticide applicator training materials, and enforcement of federal pesticide laws and regulations. Through its Office of Pesticide Programs (OPP), EPA uses FIFRA to manage its mandate.

The EPA regulates pesticides to protect humans and the environment. Enforcement of FIFRA is the responsibility of the EPA which, in turn, may, through cooperative agreements, delegate the authority for enforcing the act to states and native American tribes. EPA has developed regulations for pesticide registration and use. Registered pesticides are unclassified or restricted use. Applicators of restricted-use pesticides must be certified as private applicators (essentially agricultural pesticide applicators) or commercial applicators. Commercial pesticide applicators may be certified to work in certain categories.

Figure 1-5. EPA logo.

Figure 1-6. FDACS regulates all pesticide use within Florida.

Figure 1-7. FDACS logo.

Each state and tribe has laws governing pesticides and their uses; these laws are at least as strict as the federal law. State certification plans are approved and evaluated by EPA. Because pesticide applicators are directly regulated and certified by their state agencies, these applicators must have a thorough knowledge of the state and federal pesticide laws.

In Florida, the Florida Department of Agriculture and Consumer Services (FDACS) establishes qualifications, administers examinations, and licenses and certifies persons engaged in pest control (Figure 1-6). Legally, however, all users of pesticides must apply pesticides according to label instructions, and cannot apply restricted-use products without becoming FDACS certified.

Florida Department of Agriculture and Consumer Services (FDACS)

FDACS is responsible for the protection of the health, safety and welfare of pest control employees and the general public from hazards and consequences of pest control activities. FDACS insures that all pesticides are used in accordance with the registered labels and labeling. The department requires that vehicles and trailers used in pest control work are permanently marked with the licensee's name. FDACS requires written contracts for control of termites and wood destroying organisms. The department also certifies people who do pest control work in residential, industrial or institutional buildings (and other areas) as part of their regular employment. Such people include building superintendents, caretakers and maintenance workers who are employed by apartments, schools, government agencies, manufacturing plants, private businesses, hospitals or similar facilities.

FDACS regulates all pesticide use within Florida, issues permits for restricted-use pesticides, and enforces regulations dealing with pesticide safety, handling, application, and disposal. FDACS permits and enforcement functions are coordinated primarily through the Bureau of Entomology and Pest Control.

Bureau of Entomology and Pest Control

The Bureau of Entomology and Pest Control administers examinations and issues certificates to individuals performing any type of structural pest control for hire, including pesticide application. The bureau establishes the state's structural pest control standards and training requirements. It also regulates and monitors the pest control activities of businesses and individuals.

Licensing and Certification

The Bureau's Pest Control Section regulates and licenses the pest control industry under the authority of the Structural Pest Control Act, Chapter 482, Florida Statutes, and the associated Rules, Chapter 5E-14, Florida Administrative Code. The Pest Control Section consists of the Document Issuance, Enforcement, and the Examination/Certification Subsections. The practice of commercial pest control in Florida is strictly regulated under the provisions of Chapter 482. This law is administered and enforced by the Department of Agriculture and Consumer Services.

Commercial Structural Pest Control. "Pest control," within the meaning of this law, includes one or more of the following activities: (a) The use of any method or device or the application of any substance to prevent, destroy, repel, mitigate, curb, control, or eradicate any pest in, on or under a structure, lawn, or ornamental; (b) The identification of or inspection for infestations or infections in, on, or under a structure, lawn, or ornamental; (c) The use of any pesticide, economic poison, or mechanical device for preventing, controlling, eradicating, identifying, inspecting for, mitigating, diminishing, or curtailing insects, vermin, rodents, pest birds, bats, or other pests in, on, or under a structure, lawn, or ornamental; (d) All phases of fumigation.

Structural pest-control businesses and their employees

Four categories of certification are provided:

- General Household Pest Control
- Wood-Destroying Organisms
- Fumigation
- Lawn and Ornamental Pest Control

For educational requirements, approved training institutions and examination information, contact:

Bureau of Entomology and Pest Control
Florida Department of Agriculture and Consumer Services
Agricultural pest control businesses and their employees

For licensing and examination information, contact:

Pesticide Certification Section
3125 Conner Blvd., Bldg. 8 (L-29)
Tallahassee, Florida 32399-1650
(850) 488-3314
www.flaes.org/complimonitoring/pesticidecertification.html

Limited pest control certification

Employees of apartments, hospitals, schools, etc. who apply pesticides or supervise pesticide application as part of their employment need limited certification in the appropriate pest control category. For information on training requirements and examination applications, contact:

Pest Control Section
1203 Governors Square Blvd., Suite 300
Tallahassee, Florida 32301
(850) 921-4177
www.doacs.state.fl.us/onestop/aes/pestcont.html

Table 1-1. Agencies Regulating Residential, Industrial, and Institutional Pesticide Applications.

Contact the Bureau of Entomology and Pest Control

Bureau Chief
(850) 921-4177 (phone)
(850) 410-0724 (fax)

Enforcement Administrator
(850) 921-4177 (phone)

Field Operations Administrator
(386) 418-5515 (phone)
(386) 418-5506 (fax)

Document Issuance
(850) 921-4177 (phone)
(850) 410-0724 (fax)

Mosquito Control
(850) 922-7011 ext. 101, 103, and 106 (phone)
(850) 413-7044 (fax)

www.flaes.org/aes-ent/index.html

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Figure 1-8. The Limited Commercial Landscape Maintenance Certification Program allows commercial landscape maintenance workers the use of certain pesticides on ornamental plants and plant beds only.

Briefly, for Structural Pest Control, the law provides that each pest control business location must be licensed by this agency and that a Florida certified operator must be in charge of the pest control operations of the business location.

The certified operator must be certified in the category (or categories) in which the business wishes to operate, and their primary occupation must be in the pest control business, and who is employed on a full-time basis by the licensed firm. Presently, the available categories are: General Household Pest and Rodent Control, Termite and Other Wood-Destroying Organisms Control, Lawn and Ornamental Pest Control, and/or Fumigation.

Pest control operator's certificates are issued to persons who pass the written examination(s) given by FDACS and who are not minors. Qualifications for examination can be met by experience or education plus experience.

Those qualifying by experience must document high school education or equivalency and three years verified experience as a service employee of a licensee who performs pest control in the category or categories in which certification is desired, at least one year of which experience must have been under a licensee in this state immediately preceding application for examination.

Those qualifying through education may qualify with a degree and 20 semester hours or 30 quarter hours advanced training or a major in entomology, botany, agronomy, or horticulture from a recognized college or university. You may also qualify without a degree, provided you have 24 semester hours or 36 quarter hours advanced training in the above fields of study. Those qualifying through education must also document one year of service employment as a service employee of a licensee that performs pest control in any category or categories that the person is seeking to be examined in. (Those persons attending a public university in this state specializing in urban pest management that includes practical pest management experience will satisfy the one year service employment requirement.)

If the training is in entomology, the applicant is qualified for examination in all categories. If the training is in horticulture, botany, or agronomy, the applicant is qualified for the examination only in the category of lawn and ornamental pest control.

Summarizing, a person entering the structural pest control business must be licensed by FDACS. In order to be issued a business license, he/she must first either obtain a certificate through certain qualifications and examination, or obtain the services of a person already certified, and qualified to be in the charge of the pest control operations of the business.

Limited Certification Programs. The Bureau also administers two Limited Certification Categories to certify Governmental or Private applicators and the Commercial Landscape Maintenance applicators. Neither of these certifications allows the operation of a commercial pest control business.

Commercial Landscape Maintenance Applicator Certification. The Limited Commercial Landscape Maintenance Certification Program was designed to allow commercial landscape maintenance personnel to make pesticide applications (using herbicides, insecticides and fungicides, with a signal word of Caution) to ornamental plants and plant beds only. It does not allow landscape maintenance workers to make any kind of pesticide applications (including weed control and/or weed and feed products) to any turf areas. Furthermore, this certification does not allow or authorize the maintenance company or the certificate holder to supervise company employees under their certificate or operate a pest control business.

Individuals who wish to make pesticide applications to plant beds and ornamentals no longer need to qualify for the Limited Commercial Landscape Maintenance examination by providing proof that they have worked in the landscape industry for three (3) years. An application for the LCLM certificate is made to the Bureau and an exam admission slip is provided to the applicant provided they have obtained six (6) hours of Department approved plant bed and ornamental training. The applicant makes arrangements with the local County Extension Service office or an approved provider to take the Limited Commercial Landscape Maintenance examination. The exam is then graded in Tallahassee and certificates issued to applicants who successfully pass the examination.

Finally, an applicant seeking certification will have to provide proof of insurance which indicates that they or their employer meets the minimum financial responsibility requirements for bodily injury and property damage. Proof of insurance coverage must be provided prior to issuance of the certificate. Presently, these amounts are set at: Bodily injury: $100,000 each person and $300,000 each occurrence; and property damage $50,000 each occurrence and $100,000 in the aggregate; or combined single limit coverage of $400,000 in the aggregate.

Questions regarding this limited certification should be directed to the Bureau office at (850) 921-4177.

Limited Governmental or Private Applicator Certification. Limited Certification for Governmental and Private Applicators was designed for individuals and employees of government entities who make pesticide applications in, on, around or under structures or to the turf and ornamental areas of the property.

Limited Governmental/Private Certification allows the use of both general and restricted use materials. For smaller municipalities and/or companies, each applicator must be individually certified. (For larger operations, the program has provisions for an employer to hire a Florida Pest Control Certified Operator to be in charge of the pest control program and they are responsible for providing training and guidance to any applicator(s) in lieu of individual applicator certification).

Application for examination is made to the Bureau and an admission slip is issued to the exam candidate. The candidate then makes arrangements with their local County Extension Service office who administers the exam. The exams are then returned to the Bureau for grading and issuance of the credential to passing candidates. The certificate is valid for four years. When renewing, the certified applicator must provide proof of having obtained four hours of acceptable continuing education.

There are two categories within this certification program: “Structural Pest Control” for applications in, on, around or under structures, and “Lawn and Ornamental” for pesticide applications to exterior property areas. Depending on the applicator’s job duties, one (or both) of the categories may be required.


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Study Questions | Chapter 1

1. The responsibility of the Environmental Protection Agency is to ________________________.

   A. regulate state agencies
   B. sue pesticide applicators
   C. protect public health and the environment
   D. regulate DOD pesticides

2. Pest control applicators may be certified in either of two classifications: ________________________.

   A. certified and limited certification
   B. fumigation and non-fumigation
   C. urban and agriculture
   D. certified and non-certified

3. Pesticide registration decisions are based on the demonstration that the use of a pesticide will not result in "unreasonable human health or environmental effects."

   The law that mandates that is called the________________________.

4. The state agency that regulates pesticide applicators and their certification is________________________.

   A. FDA
   B. USDA
   C. EPA
   D. FDACS

For answers refer to Appendix A.

Chapter 2: Pest Management

Learning Objectives

After completing the study of Pest Management, the trainee should be able to:

- Know benefits and limitations of pesticide application equipment.
- Know simple methods for calibrating urban pesticide application equipment.
- Understand how safety is part of every phase of equipment use.

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Pest control involves safe prevention, reduction, or elimination of unwanted organisms. To do this, you must learn about the habits and life cycles of many pests and understand the conditions that affect pest populations. A good pest control program follows the principles of integrated pest management (IPM).

One important IPM practice commonly used around structures is pest-problem prevention. Managing pests through prevention is usually less expensive than trying to control an established pest population. Furthermore, pest prevention reduces the chance for substantial economic loss or

Integrated Pest Management

Integrated pest management is an ecological approach to managing weeds, insects, vertebrates, and other pest organisms that often provides economical, long-term protection from pest damage. IPM has been shown to be very successful in commercial agricultural situations. The benefits of IPM are becoming more widely recognized in the management of urban pest problems.

Pests must be properly identified so aspects of their life cycle and developmental stages can be understood and their activity can be monitored. Conditions that promote or support the pest are identified so they can be either eliminated or suppressed.

Management methods are appropriate to the life cycle and development stages of the pest. Usually, two or more management methods are used, and commonly different methods are used at different times or locations, rather than using the same method for the same pest at all times. Control methods that might be used in an IPM program include exclusion, sanitation, modifying or eliminating habitats, biological control, and the selective use of pesticides.

Pesticides usually play an important role in an IPM program. However, pesticides are selected carefully and are nearly always combined with other control methods. The timing of the pesticide application is especially important. Pesticides are selected to be least disruptive to natural controls that may be present. Environmental concerns and human and animal safety are an utmost priority. Sometimes emphasis is placed on spot treatment or reduced rates so that smaller quantities of pesticide need be applied.

An important component of an IPM program involves frequent evaluation of the control strategies and modification of the approach to keep pace with changes or anticipated changes in the pest's activities.

irreversible damage. Prevention avoids some of the disruption associated with control efforts that may be needed after pests become established.

Once a pest becomes established, the most common management goal is elimination. This can only be successful if the conditions that originally favored the pest can be modified or the pest's entry into the area can be completely blocked.

Locating and Monitoring Pests

Decisions to use pesticides and other control methods should be based in part on pest detection and monitoring results. Visual inspection of an area with pests or their damage is the most common detection method. Inspection involves careful and thorough searching in and around a structure for signs of the pest and conditions that favor pest buildup. Monitoring is a systematic method of observing pests or pest signs over a period of time. Monitoring may help detect unwanted pests and determine from where pests are coming and where they are living. Monitoring is also helpful in evaluating control programs. Special devices and tools are available to detect and monitor certain pests.

Visual Inspection

The purpose of a visual inspection is to search for pest evidence. During an inspection, look for: (1) conditions such as food, shelter, access and suitable environments that favor pests; (2) signs of pest damage, entry or presence (such as tracks, trails, droppings, nests, and cast skins); and (3) the pest itself (Figure 2-1).

When you make an inspection, you may find it helpful to prepare sketches of the structure and surrounding areas (Figure 2-2). Include locations of heating or air conditioning ducts and vents, plumbing inlets, attic, basement and crawlway vents; wall and sub-cabinet voids, and other

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Figure 2-1. Look for the pest itself, along with conditions that favor pests and signs of pests.

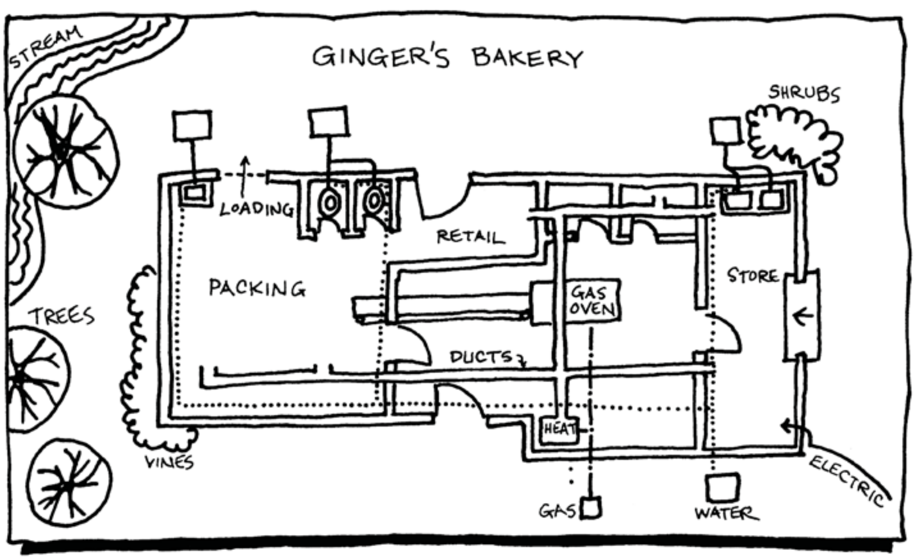

Figure 2-2. Prepare a diagram of the structure and surrounding areas, as shown here, while inspecting for pests and pest damage. Indicate the elevations of doors, windows, utilities, ducting, and any other areas that will require special care or attention.

Pheromones and attractants for these pests are available from various suppliers:

Almond moth
Ambrosia beetle
Angoumois grain moth
Cigarette beetle
Confused flour beetle
Drugstore beetle
Fruit flies
House fly
Indianmeal moth
Khapra beetle
Lesser grain borer
Mediterranean flour moth
Raisin moth
Red flour beetle
Sawtoothed grain beetle
Tobacco moth
Warehouse beetle

Table 2-1. Pheromones and Other Commercially Available Attractants for Pests Inhabiting Buildings and Storage Areas.

features of the building that allow pests to enter in or provide shelter for them. Also, observe conditions that may cause problems during pest-control operations. Be sure to note areas of poor or faulty construction or places where the building has been damaged by the careless operation of equipment, plumbing leaks, or other reasons. Also, note areas that you were unable to inspect because they are inaccessible. Show the locations of trees, shrubs, trash and garbage storage, water sources and other features of the surrounding area that may attract or harbor pests or promote pest buildup.

Detection and Monitoring Devices

Different simple devices can assist you in detecting and monitoring many of the pests found in structures. Devices include pheromones and other attractants, light traps, flypaper, spring traps, glue boards and nontoxic tracking powder.

Pheromones and Other Attractants. Pheromones are chemicals normally produced by certain insects (and other animals) to affect the behavior of individuals of the same species. Pheromones are used by insects for mating, aggregation, feeding, trail following and recruitment. Synthetically made pheromones mimic the action of pheromones produced by some pest insects. These are useful for monitoring the adult forms of pest moths, certain beetles and weevils, and some species of flies and fruit flies (Figure 2-3). Certain other materials are also used as trap attractants. For example, ammonium carbonate attracts many different species of flies; foodlike odors attract certain insects or rodents.

For monitoring, pheromones and other attractants are used in sticky traps or rodent spring traps (Table 2-1). Inside a building where food is stored, you can use these attractant traps to locate infestation sources.

The effectiveness of attractant traps inside buildings is influenced by the number used and their locations. Figure 2-4 shows a typical placement of pheromone traps for monitoring stored-product insects. In small areas, use one trap for each 250 to 500 square feet of storage space. Larger areas such as warehouses require one trap to every 1,000 to 2,000 square feet. Keep traps away from doors, windows, or bright lights, which

Figure 2-3. Pheromone traps are useful for monitoring the activity of certain pests in buildings.

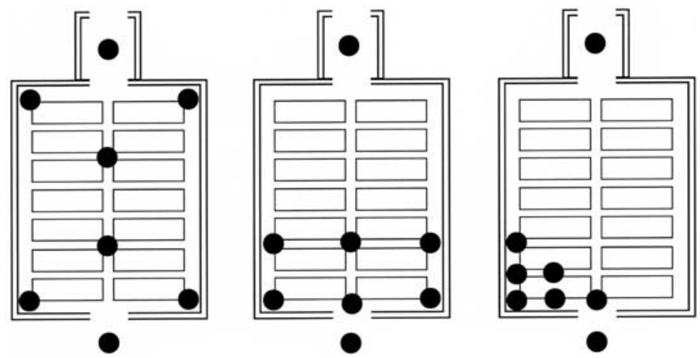

Figure 2-4. One way of using pheromone traps in a building such as a warehouse is illustrated here. Begin by distributing traps throughout the building as shown by the drawing on the left. After several days, move traps that caught few or no target pests closer to the traps where catches were higher, as shown in the center drawing. Repeat this process again several days later, as shown on the right, to pinpoint the source of infestation. Keep a trap near each entrance at all times.

may repel the target insects. Trap design (Figure 2-5) can affect the results of the trapping program — some styles appear to work better with certain species of insects. Check the supplier's recommendations for the most effective trap style. Also, choose a style based on the location where traps will be used; "wing" traps hung overhead, for instance, hide trapped insects from the public's view.

Check traps regularly. For insects, check traps once or twice per week at a minimum and remove all insects. Rodent traps must be checked every day. Clean or replace sticky surfaces whenever they become covered with debris. Replace pheromone lures periodically because they lose their

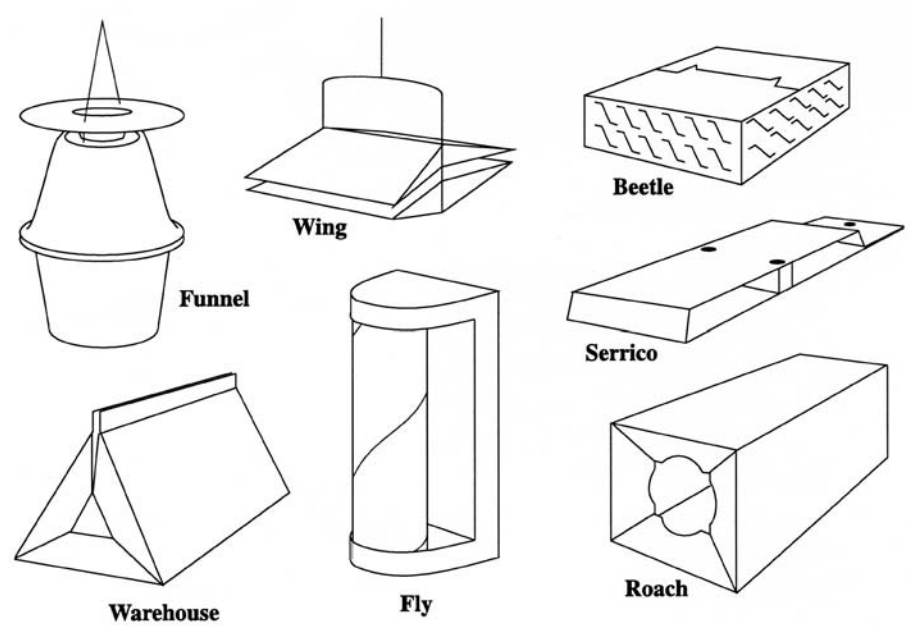

Figure 2-5. Several styles of pheromone traps are available, depending on the type of pest and type of location being monitored.

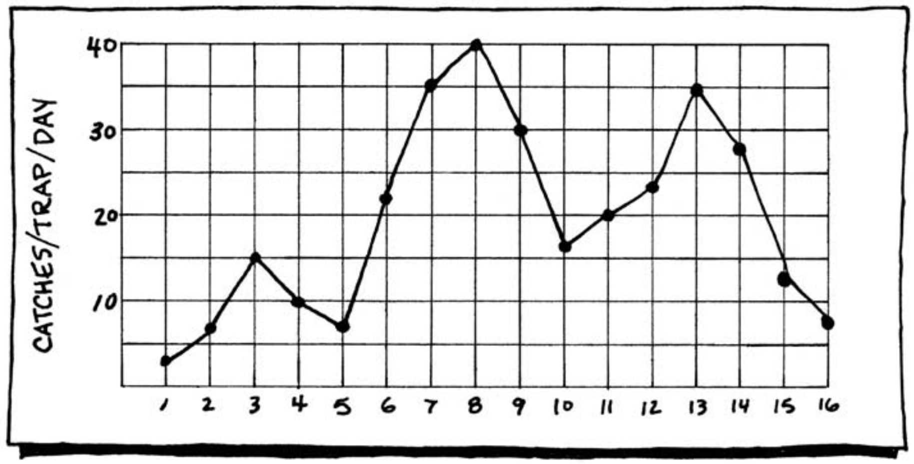

Figure 2-6. A simple graph like this can help visualize the periods of peak activity of insects being monitored with pheromone traps.

effectiveness over time. Consult the manufacturer's guidelines for the effective duration of the attractant used.

Record the number of target insects removed from traps each time they are checked. Plot trap catches on a per-day basis, using a simple graph like the one in Figure 2-6. This will allow you to perceive changes in the insect's activity and verify the success of control measures. Compare this activity with that in traps in other locations.

Figure 2-7. Traps equipped with ultraviolet or "black" lights attract some species of flying insects. These traps are most effective in enclosed areas, usually at night.

Light Traps. Traps equipped with ultraviolet lights, or black lights, attract several species of flying insects (Figure 2-7). These traps usually have a container with a funnel-shaped entrance that allows insects to enter easily but blocks their escape. Some light traps have an electrically charged grid that kills insects as they approach the light. Electrocutor traps are usually not used for insect monitoring.

Use light traps inside warehouses, grocery stores and other enclosed areas for monitoring adult stages of flies, some species of fruit flies, and some stored-product insects such as Indianmeal moths and almond moths. Light traps usually are not effective for outdoor insect control.

In a large building, use one blacklight trap for every 1,000 square feet of floor space. Locate traps so the light is visible from all directions, but avoid placing them near windows or doors where the light may attract insects from outside. For monitoring stored-product insects, put traps in areas of the building where pest insects are most likely to be found — usually near a food source — but keep traps at least five feet away from food preparation or processing areas. Keep traps low if you are attempting to attract day-flying insects such as houseflies; in this case, traps should be no more than five feet above the floor.

Clean blacklight traps at least once a week to prevent dead insects from becoming food for carpet beetles or other dermestids. Record the number and identity of the insects removed from the traps. Use this information to determine locations of greatest infestation and to detect cycles of pest outbreak. This information will also help you evaluate control efforts.

Blacklight traps are less effective in bright sunlight or where sodium vapor lights are being used. Also, the ultraviolet tubes used in light traps gradually lose their attractiveness to insects over time. Tubes should be replaced once a year.

Flypaper. You can use flypaper for monitoring flies within confined areas. Some manufacturers add a fly pheromone to the sticky coating to make it more effective.

Space several flypaper traps evenly throughout areas being monitored to find out where flies are concentrated. Do not use flypaper in dusty areas because accumulated dust will clog the sticky surface and prevent flies from sticking. Flypaper traps are unsightly, so locate them out of the public's view. Check and replace traps frequently. Examine the captured insects to determine their identity. Keep records of the numbers and species of pests caught and use this information for selecting and evaluating control methods.

Glue Boards and Traps. Glue boards are occasionally useful for monitoring crawling insects, mice, and, in some instances, rats (Figure 2-8). Glue boards are sometimes used to locate areas where cockroaches congregate. By examining individuals caught on the sticky surface, you should be able to identify the species and perhaps determine areas of heavy infestations. Glue boards may also enable you to identify other types of insect pests within a confined area. Glue boards become ineffective when they are coated with dust, debris or moisture.

For monitoring cockroaches, place glue boards along travelways next to intersections of walls and floors.

To monitor rodent activity, set glue boards along known runways and near areas believed to be nesting sites. Be sure to check the traps daily and dispose of any in which a rodent has been caught.

Mice and rats can also be monitored with spring-type or multiple-catch traps. Place traps along runways and near nesting areas. Check these daily and remove captured rodents. Traps are most effective when they are baited with a substance that attracts rodents.

Figure 2-8. Glue boards can be used to monitor or control insects and small rodents. They lose their effectiveness if the sticky substance becomes coated with dust or debris.

Nontoxic Tracking Powder. Nontoxic tracking powders are fine dusts that provide a visual record of rodent or insect activity. Nontoxic tracking powder offers an alternative to glue boards and spring traps, which must be checked daily. Powders are also a safe way to evaluate the success of a control program.

Talcum or baby powder can be used for tracking pests, and commercial tracking powders are available that fluoresce under ultraviolet light, making it easier to locate pest trails. Avoid using any powders where they might contaminate food.

Spread a thin layer of tracking powder evenly over surfaces where pests are known or suspected to occur (Figure 2-9). For easy cleanup when monitoring is completed, spread the tracking powder on sheets of paper. Look for tracks left in the powder as evidence of pest activity. Sometimes a trail of the powder leads to nests or hiding places.

Figure 2-9. Tracking powders are used to monitor the activity of small rodents and insects. Toxicants sometimes are added to the powder to poison the animal.

Establishing Action Thresholds

Pest control decisions are influenced by health or safety dangers created by the pest, legal restrictions on pest infestation, and pest-tolerance levels. Occasionally a pest control decision depends on the costs to control a pest weighed against the benefits. On the basis of any of these factors, an action threshold can usually be established to determine the type of control and when it should begin.

Health and Safety Thresholds

Health or safety threats commonly require fast, extensive and sometimes costly pest control measures. Several pests associated with structures, stored food products, food preparation facilities, hospitals and other areas have the potential for causing injuries to people (mosquitoes, biting bugs, fleas, spiders, bees and wasps, for example) or transmitting diseases to people or animals (rats and mice, cockroaches, fleas, flies, and mosquitoes). Some others, such as rodents, fungi, termites and wood-boring beetles, cause damage that makes structures unsafe or reduces their value.

Decisions to control pests are based on knowledge of their potential harm. If serious injury or damage may result, the control threshold must be very low. For instance, one rat chewing on electrical wiring can cause a serious fire.

Legal Thresholds

Health codes, marketing orders and other regulations set limits on the amount of pest damage or contamination allowed in food products for sale or transported. Public safety codes often require control of pests in public buildings, commercial housing, food service facilities and other public structures. Building and safety standards address the control of structural pests as well as the repair of damage they cause. These legal thresholds dictate when pest control methods must be used, even though in some cases control methods cannot be economically justified or the pests may not be a hazard to public health or safety.

For information on laws that regulate pest infestation in certain buildings and on foods, contact state and local health departments and housing and community development offices. The Bureau of Entomology has information on laws that apply to the control of structural pests. Federal marketing orders list the allowable tolerances of specific pests or pest damage in fresh and stored food items. This information can be obtained from the US Department of Agriculture, Agricultural Marketing Service.

Pest Acceptance Threshold

People have different degrees of acceptance of pests in their homes and workplaces. Pest acceptance thresholds may be high because of social or cultural factors or because of concerns about the costs or hazards of pest control methods used. A pest acceptance threshold can be very low due to a person's revulsion or fear of the pest. Acceptance thresholds may sometimes be modified if you can provide factual information about specific pests, pest damage potential and pest control methods.

Economic Threshold

In certain instances, the cost of control measures may need to be justified. Economic thresholds may apply if there are no health and safety, legal or tolerance thresholds that need to be considered. An economic threshold is a level of pest abundance at which the potential loss caused by damage is expected to be greater than the cost of controlling the pest.

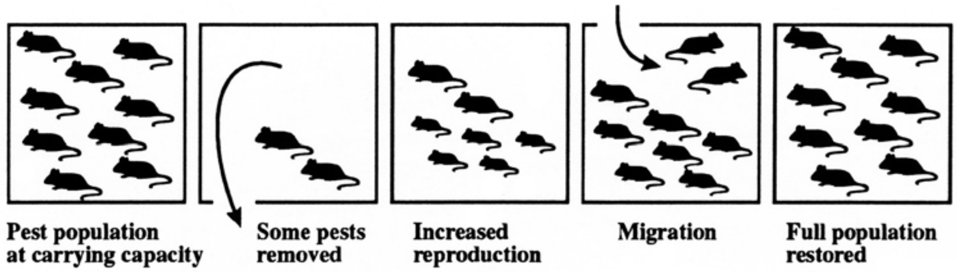

Figure 2-10. Populations of pests tend to remain fixed in size due to the carrying capacity of an area. In a building, for example, the carrying capacity is restricted by space, food, and water. If individuals are removed by some pest control method, the population may soon return to its original size as remaining individuals increase reproduction or as new individuals migrate into the area.

Pest Control Methods

Pests can be prevented through sanitation and habitat modification or they can be controlled by trapping, pesticide use, and in some instances, biological control. Pests in structures are usually more effectively controlled by using a combination of compatible control methods.

Sanitation and Habitat Modification

Habitats are areas within the larger environment that are suitable for a pest's survival. Habitats provide a pest with some or all of its necessary living requirements such as food, water, shelter, optimum temperatures and humidity, and protection from enemies. A habitat can only accommodate a maximum number of pests due to limitations of one or more of these requirements. This maximum number is known as the carrying capacity. Where large quantities of food are available and shelter and other requirements are ample, the carrying capacity is high. Such a habitat can support an almost unlimited number of individuals of a pest species. If the carrying capacity is limited, however, the population tends to remain fixed in size. If you remove individuals from a habitat through pest control measures or if they die off due to natural causes, they will be replaced soon by others, unless the carrying capacity is reduced at the same time. Population size is maintained at the carrying capacity by increased reproduction among remaining individuals or by new individuals migrating in (Figure 2-10). Table 2-2 lists ways that modifying a habitat lowers its carrying capacity.

Habitat modification usually involves improving sanitation, including removal of food, water, breeding sites, and shelter used by pests (Figure 2-11). Outdoors, you may need to trim or remove dense, pest-harboring vegetation near buildings, clean up trash, keep garbage in closed containers, provide for drainage of standing water, clean up animal wastes and spilled animal feed, and eliminate items that attract pests. Inside, sanitation includes storing foods and food wastes in tightly closed containers, cleaning up spills and residues, removing trash and other materials that can be used for nests, and thorough vacuuming and dusting regularly. The cleaning of surfaces may also improve the effectiveness of pesticides

Figure 2-11. Sanitation practices are helpful in reducing pest problems because good sanitation restricts the pests' access to food, water or shelter.

MODIFICATION	EFFECT ON PESTS
Caulk cracks in cabinets, moldings, and other areas.	Reduces amount of hiding and nesting places available for cockroaches and certain fabric pests. Excludes ants and other crawling insects.
Seal food in pestproof containers or place in refrigerator or freezer.	Eliminates access to sources of food for cockroaches, ants, stored-product pests, flour beetles, rats, and mice.
Increase light and ventilation.	Makes area unsuitable for fungi and molds, subterranean termites, flea larvae, and other insects such as cockroaches and silverfish by reducing moisture. Reduces condensation, which can be a water source for many different pests.
Reglue loose wallpaper, patch peeling plaster or paint.	Reduces hiding and nesting sites for cockroaches and silver fish.
Remodel to eliminate false bottoms in cabinets and other structural voids, or blow sorptive powder into wall voids, beneath cabinets, and in other inaccessible areas.	Eliminates hiding places for cockroaches, rats, mice, spiders, silverfish, firebrats, and other pests.
Insulate water pipes (seal well to prevent insulation from being a habitat for cockroaches).	Prevents condensation, which provides free water for some pests.
Store food wastes in tightly closed containers; remove from building frequently and clean containers.	Eliminates food sources for fruit flies, cockroaches, flies, mice and rats.
Clean up food or liquid spills quickly.	Prevents attracting flies, fruit flies, cockroaches, rats, and mice.
Thoroughly clean food preparation and eating areas at least daily.	Eliminates food sources for fruit flies, cockroaches, flies, rodents, and other pests.
Launder or dry clean clothing and linens before storage; seal in heavy plastic.	Reduces problems with fabric pests.
Blow sorptive powder into wall voids, beneath cabinets, and in other inaccessible areas.	Denies hiding places for cockroaches due to its repellency.

Table 2-2. How to Modify Habitat to Lower the Carrying Capacity for Certain Pests.

by removing grease, oils, dust and other contaminants that interfere with their function. To assist in good sanitation, make sure interior areas are well lighted to simplify cleaning and easy detection of pests and pest damage. Sweepings and other wastes should be taken to a disposal area outside of the building.

Other sanitation practices include removing dirt mounds, wood pieces and other cellulose debris from areas beneath buildings to keep from promoting termite or rodent problems. To protect against fungi, never leave

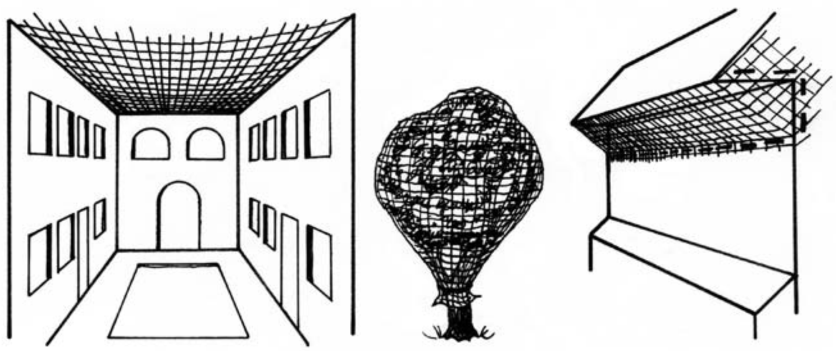

Figure 2-12. Various methods can be used to keep birds from roosting or building nests on buildings. Netting is helpful in excluding birds from trees or courtyards.

unprotected wood in contact with soil or other moisture sources such as leaking pipes or faulty drains. Provide adequate ventilation to areas beneath buildings to reduce moisture.

Outdoor lights placed near entrances to buildings attract many flying and crawling insects at night. If possible, locate light fixtures away from entrances. Otherwise, modify the type of light being used. Sodium vapor lights are better than mercury vapor lights or standard incandescent lights for outdoor use because they emit a spectrum of light that is less attractive to insects; yellow "bug" bulbs work on the same principle.

Birds can become pests when they use outside surfaces of buildings for roosting or nesting. Birds generally prefer flat surfaces that offer protection from wind, rain and extreme temperatures. To prevent birds from roosting or nesting, use plastic or wire mesh screening, cloth netting or metal flashing. You can also modify flat surfaces or overhangs to make them unsuitable for birds (Figure 2-12). The ultimate decision on how best to deal with pest birds usually depends on the species causing problems, its location on the building and the building's physical features.

A program of sanitation and habitat modification requires cooperation between pest-control specialists, building owners and inhabitants, housekeeping staff, and building and landscape maintenance workers. It is necessary that everyone understand how these practices influence pest problems (Table 2-3). People living or working in a building must keep food, food waste and trash in pestproof containers and store other items in designated places where they cannot attract pests. Inhabitants should promptly report pest problems. Housekeeping and landscape maintenance workers can help by keeping interior and exterior areas free of trash, nesting sites, and other items that might be attractive to pests. They should provide containers for wastes and specify locations for storage of other materials. Buildings must be monitored regularly to ensure that sanitation is maintained and to spot new problems. Tenants and persons responsible for housekeeping and landscape maintenance must be notified of conditions that promote pest buildup so they can correct these.

Figure 2-13. Caulking a pipe. Pests may be excluded from a building through good construction techniques or by adding weatherstripping, caulking, or other materials.

Exclusion. Exclusion is a type of habitat modification useful for keeping fleas, ants, cockroaches, stored-product pests, termites, rodents and other pests from entering buildings (Figure 2-13). The design and construction of a building may either promote pests or exclude them. Pestproof design and construction should be an important consideration when planning new structures or remodeling older ones.

	Shelter	Animal wastes	Debris or clutter	Firewood	Garbage	Flours/grains/cereals	Cardboard/newspapers	Vines/shrubbery	Soiled clothing	Spiderwebs	Spoiled fruits/vegetables	Stored linens	Sugar/sweets	Moisture or free water	Weeds	Sawdust/wood scraps	Humans/dogs, cats, other pets	Structural lumber	Furniture/cabinets
Ants		◆			◆			◆			◆		◆	◆					
Bats	◆																		
Bees					◆						◆		◆	◆					
Birds	◆					◆		◆						◆	◆				
Biting bugs	◆		◆																
Carpenter ants	◆			◆									◆	◆		◆		◆	
Carpenter bees	◆			◆															
Carpet beetles							◆		◆	◆		◆							◆
Clothes moths									◆			◆							
Cockroaches	◆	◆		◆	◆	◆	◆	◆			◆	◆	◆	◆					◆
Decay fungi														◆					
Firebrats	◆		◆				◆	◆				◆		◆					◆
Fleas	◆														◆		◆		
Flies		◆			◆						◆		◆				◆		
Flour beetles						◆													
Fruit flies					◆						◆		◆						
Grain moths						◆													
Granary weevils						◆													
Mice	◆	◆		◆	◆	◆	◆	◆			◆		◆	◆	◆				
Mites			◆			◆											◆		
Rats	◆	◆		◆	◆	◆	◆	◆			◆		◆	◆	◆		◆		
Silverfish	◆		◆				◆	◆				◆		◆					◆
Spiders	◆			◆			◆	◆							◆				◆
Termites				◆			◆							◆		◆		◆	
Ticks								◆							◆		◆		
Wasps	◆				◆			◆			◆		◆	◆					
Wood-boring beetles				◆										◆		◆		◆	◆

Table 2-3. Factors that Contribute to Pest Problems In and Around Buildings.

Check building exteriors for ways that insects, rodents or other pests can enter. Obvious entrances for many types of pests are doorways and windows. These should have tight-fitting screens and doors. Properly installed weatherstripping eliminates small cracks that provide access for some pests. Also, check attic and foundation vents to ensure that they are tight and screened to exclude rodents (Figure 2-14). Look for foundation or wall cracks, gaps in siding or joints, and areas where pipes, wires, or other objects pass through walls. Fill openings with concrete or another suitable patching material, or cover openings with metal flashing. Inspect chimneys and roof-vent pipes for adequate screening.

Select pest exclusion materials according to the type of pests encountered. Refer to Table 2-4 for selection of materials for excluding pests and repairing openings. Insects can enter through extremely small openings. Mice are able to squeeze through cracks as small as ¼ inch and many rats manage to get through a ½ inch opening. Rodents can chew through wood, thin metal, caulking, soft patching compounds and even some concrete mixtures. Bats, on the other hand, do not chew through walls, roofs or other surfaces, but enter structures through existing openings one inch or larger. Exclude bats by using thin wire mesh, sturdy cloth mesh or almost any type of well-secured patching material.

Figure 2-14. Properly screened vents prevent rodents and other pests from gaining access.

MATERIAL	SPECIFICATIONS	USES	PESTS EXCLUDED
Bird netting	¼ inch mesh plastic or cloth	Under eaves, around roof openings	Birds, bats
Brick	Must have strong mortar seams	Protective barrier for structural wood	Rats, mice, most insects
Caulking	Architectural grade, must be flexible; silicone type works best	Fill cracks and small holes in wood, masonry, and plaster	Ants, cockroaches, bats, spiders, carpenter ants, wasps
Concrete	1:2:4 mixture (cement:sand: aggregate – use ⅜ inch or smaller aggregate); add water to a wet sand consistency	Patch holes in walls or construct barriers	Rats, mice, insects
Door sweeps	Metal, leaving less than ¼ inch gap at bottom of door	Close gaps at bottom of doors	Rats and mice, bats
Duct tape	Heavy duty	Temporary seal for large cracks, holes, seams	Bats, some insects
Expanded metal	Heavy gauge galvanized metal or aluminum, mesh less than ¼ inch	Cover vents, large openings	Rats, mice, bats
Glass jars	Must have screw-on metal lids or tight-fitting plastic lids; jars with rubber seals and snap caps work best.	Store small quantities of dried foods, sugar, syrup, honey	Stored-food pests, ants, wasps (outdoors), mice, rats
Hardware cloth	¼ inch mesh or smaller, 19 gauge galvanized metal	Ventilators, louvers, large opening, vents	Mice, rats, bats, birds
Insulation	Roll or blow-in type	Attics, wall voids	Bats
Metal grills	Heavy gauge galvanized metal or aluminum, slots should be ¼ inch wide or smaller	Cover vents, large openings	Rats, mice, bats

Table 2-4. Materials Used for Excluding Pests and Repairing Openings In Structures (continued on next page).

MATERIAL	SPECIFICATIONS	USES	PESTS EXCLUDED
Metal sheeting or flashing	19 gauge galvanized metal or 22 gauge aluminum	Roof valleys, construction joints, openings and holes in wall or roofs, or covering of exposed wood surfaces	Mice, rats, bats, termites
Metal threshold	Must seal with bottom of door	Closes gaps at door bottom	Rats, mice, ants, cockroaches, spiders, most other crawling insects
Mortar	1:3 mixture	Fill cracks in masonry and concrete	Ants, cockroaches, bats, spiders, carpenter ants, wasps
Perforated metal	Heavy gauge galvanized metal or aluminum; openings should be 1/4 inch in width or smaller	Cover vents and large openings	Rats, mice, bats
Plastic bags	Heavy duty type (must be sealed well)	Store linens, woolens, cereals, sugar, flour, other dried foods and sugary foods	Clothes moths, carpet beetles, ants, cockroaches
Plastic containers	Must have tight-fitting lids	Store quantities of dried foods, nuts, grains, sugar, syrup, honey	Stored food pests, ants
Putty	Nonshrinking, weatherproof; silicone type works best	Fill cracks and small holes in wood, masonry, and plaster	Ants, cockroaches, spiders, wasps
Self-expanding polyurethane foam		Fill large voids and irregular openings, seams in corrugated tile and metal roofing	Bats, ants, cockroaches, spiders
Silicone rubber	Caulking type	Fill cracks and small holes in cabinets, baseboards, moldings, around windows, tubs, etc.	Ants, cockroaches, spiders, wasps
Steel wool	Fine grade (#00) tightly packed into hole, seal with caulking	Plug holes in wood (rusts when exposed to moisture	Carpenter ants, carpenter bees (can be used to temporarily plug holes to exclude mice
Weatherstripping	Rubber or felt	Seal cracks around doors and windows	Bats, ants, cockroaches, spiders, other small insects
Window screening	Galvanized metal or aluminum	Vents, windows, and doors	Bats, birds, spiders, flies, bees, wasps, mosquitoes, other flying or crawling insects

Table 2-4. Materials Used for Excluding Pests and Repairing Openings In Structures (continued).

Pests also can be brought into buildings on items such as those listed in Table 2-5.

Inspection. Inspect items brought into a building for pest infestation. For example, firewood may harbor carpenter ants, spiders, cockroaches, wood-boring beetles, termites, or similar pests, or eggs of some pests. Furniture, rugs and other items moved from an infested building can be contaminated with cockroaches, carpet beetles, or fleas. Dogs and cats bring in fleas and ticks.

Managers of grocery stores, cafeterias, restaurants or other food-handling establishments should work with pest control specialists to develop systems for examining bulk containers for cockroaches and stored product insects. Small packages of items suspected of being infested can be

MATERIAL	PESTS
Appliances	Mice, cockroaches
Books/papers	Cockroaches, silverfish, firebrats
Cardboard containers	Cockroaches, silverfish, firebrats; stored product moths, spiders, mice, rats (occasionally)
Carpets/rugs	Carpet beetles, fleas, cockroaches, clothes moths
Clothing	Clothes moths, lice, fleas, carpet beetles
Cut flowers	Carpet beetles, spiders
Firewood	Spiders, wood-boring beetles, termites, carpenter ants, cockroaches
Fruits/vegetables	Fruit flies, spiders, ants
Furniture	Spiders, wood-boring beetles, cockroaches, fabric pests, fleas, bed bugs, sometimes mice
Grains/cereals	Stored product beetles and moths, cockroaches, mice in bulk containers
Groceries/dry goods	Cockroaches, spiders, silverfish, firebrats, mice, rats (occasionally)
Lights near entrances	Spiders, carpet beetles, flying insects
Pets	Fleas, ticks
Plants	Ants, spiders, mites
Vacuum cleaner bags	Fleas, cockroaches, carpet beetles, fabric pests

Table 2-5. Ways Some Pests Gain Entry Into Buildings. Pests may gain entry by being carried in on items such as those listed here.

Figure 2-15. A special type of pheromone trap may be placed in shipping containers to detect contamination during transit and to ensure that the product is pest free.

placed in a freezer for a few days to destroy insects. Persons responsible for purchasing can help by buying from suppliers that can deliver pest-free merchandise. Some manufacturers are now using pheromone traps in shipping containers as a way of monitoring the pest-free status of their products (Figure 2-15).

Trapping

Besides their benefits as monitoring devices, traps are used to kill or catch pests so they can be removed from an area. Many types of vertebrate and invertebrate pests can be controlled through trapping. Traps do not require potentially hazardous chemicals, and the user can easily see the success of the trapping program. However, successful trapping programs require skill, time and attention to develop workable techniques. Even so, trapping may not always work well enough, under some conditions, to satisfactorily control target pests. Trapping techniques that are successful in one situation may not always work as well under different conditions or at other locations.

Types include snap, live animal, pheromone and light traps; and glue boards. Specific uses of trapping devices are described in detail elsewhere in this manual. For example, glue boards, snap and live-animal traps for rodent control are in Chapter 9.

Biological Control

Biological control is gaining more importance as a pest control method for certain insects in structures. For instance, parasitic nematodes are occasionally effective in controlling some species of termites. Parasitic flies and a disease caused by a protozoan have been used as biological controls for fire ants. Cockroach populations have been successfully reduced in certain locations by introducing parasitic wasps. Biological control techniques either augment other control practices or replace more disruptive or hazardous methods.

Pesticides

The application of pesticides is the most common pest control method used in and around buildings, enclosed areas and vehicles. Some pesticides provide chemical barriers to prevent insects from getting in. Pesticides are also used to treat soil, wood, fabrics and other items to prevent pest damage.

Pesticides are available as baits, tracking powders, desiccants (inert dusts or sorptive powders), liquids, dusts and gases. The type pesticide used and the kind of formulation selected is based on the life habits of the pest, its density and location.

Chapter 3 discusses safe methods of pesticide use.

Equipment

The most needed and reliable tool of all in pest management is the ability of a technician to use his/her knowledge of pest management along with well cared for equipment and good supplies. Pesticide application equipment used in urban pest management is, for the most part, time-tested and reliable. It is reassuring and convenient to have tools that seldom fail. Time, training and encouragement of regular cleaning, calibration and repair of tools means a planned program with good supervision.

Failure to care for equipment properly can cause serious problems. Using worn or clogged spray nozzles or caked dusters results in misapplied pesticides. Accidents from breaking hoses and exposure from leaking valves can result in lost time, illness, and complaints or lack of confidence from clients. Lack of attention to these activities is a sign of mismanagement of time, overscheduling, miscommunications and unclear priorities.

The more commonly used equipment includes:

- Hand-held compressed air sprayers
- Gel bait gun or syringe
- Power sprayers
- Canned insecticides
- Aerosol and fog generators
- Dusters

- Traps, monitoring devices, etc.
- Bait stations

Hand-held Compressed Air Sprayers

The small (one or two gallon) stainless steel sprayer (Figure 2-16) is the workhorse and the tool most familiar to pest control technicians. It can be used in many different ways and by many different industries. In pest management, the "sprayer" applies a flushing agent or a residual pesticide. Depending on the nozzle selection, the sprayer applies different spray patterns and, depending on the amount of pumping, it delivers the pesticide under high or low pressure.

Spray Patterns. The most common nozzle for the hand-held compressed air sprayer is made of brass and usually can be set in one of four spray patterns, although more than four patterns are available. The most common patterns include two-pin streams, flat-fans and cones.

Pin streams can be coarse or fine and do not produce the pest crack and crevice application. Even when set for fine spray, the stream splashes back from all but the widest crack, so many nozzles have a connection for a narrow-diameter plastic extension tube. Remember to use equipment as directed (e.g., injection tool for cracks and crevices). The end of the extension tube is inserted into or at the edge of a crack and delivers an accurate pin stream. Overall, this is the most effective spray pattern for cockroach pesticide application.

Coarse and fine flat-fan streams apply general or spot applications, as do hollow or solid cone sprays. Cone sprays deliver a circle of pesticide and are often used outside on uneven surfaces and plants.

Figure 2-16. Hand-held compressed air sprayer.

Pressure. Spray tank air pressure varies according to the amount of air the technician pumps into the tank. Pressure gauges can be attached to sprayers. Low pressure is usually recommended for spray application inside structures. Constant use of high pressure with compressed air sprayers sets up the possibility of overuse and misapplication. It causes part of the sprayed liquid to break into droplets as soon as it exits the nozzle; this wastes material that can drift onto non-target surfaces. High pressure also causes splash back on surfaces or quickly traps air in crevices and keeps the pesticide from entering small spaces. As well as being uneconomical and wasteful, the practice encourages rapid application of pesticides whether they are needed or not, from distances that affect accuracy. This style of pesticide application will seldom result in effective pest control, especially where German cockroaches are a problem.

Technicians who use hand-held compressed air sprayers should periodically attend training for cleaning and sprayer maintenance. They should familiarize themselves with their own equipment and know how to repair it. It is recommended that technicians:

- rinse their sprayers daily; especially the hose,

(Always empty liquid from the hose: hold the nozzle high and squeeze the trigger to drain the hose into the tank. If this is not done, liquid from the last use remains; it will be applied first at the next use, regardless of any new spray mix in the tank.)

- clean the sprayer on a regular schedule,
- never use warm water to mix sprays unless specifically recommended by the pesticide label (warm water helps break down pesticides, creates droplets that easily float, and increases a pesticide's odor),
- as stressed in the Core manual, always use gloves when spraying. Always use safety glasses or goggles when treating those areas above the head or close to the face.

Power Sprayers

As their name implies, power sprayers (Figure 2-17) use electric or gasoline engines to pump liquid insecticides from a relatively large tank, usually over 100 gallons. The liquid is discharged through a ⅜ to ½ inch hose of sufficient length to reach from the pump to the application site. Power sprayers are generally used for one of two types of urban pest control: (1) controlling termites, and (2) spraying building perimeters and lawns.

In the southern United States, power spraying outside in conjunction with inside treatment for cockroaches is common. In warmer climates, large cockroaches (American, oriental, smokybrown, etc.) are active outdoors as well as indoors. Other types of outside pests (e.g. ticks, crickets, millipedes and other miscellaneous invaders) are also treated by outside spraying. Here, too, low pressure is more effective than high pressure because the pesticide will not blast away the surface dust or soil and runoff. Low pressure allows for a more careful application, better soaking and better penetration through short grass.

Special attention should be paid to the hose of power sprayers — both in the quality and points of wear. Wear or cuts cause hoses to burst; when this happens, pesticides spill and cause contamination. Shut-off valves should always be in good working order. Equipment to take care of spill contamination should always be carried in the service truck.

Figure 2-17. Power sprayer.

Why Calibrate Spraying Equipment?

In urban pest management, much is up to the technicians' judgment. A pest control technician should know that the proper dosage of pesticide is being applied. Therefore, accurate calibration of power sprayers is important or the amount of pesticide delivered will be incorrect. Overdosage will contaminate the spray area or result in runoff. Less than recommended dosage may fail to control the pest. Technicians need to regularly look at the output of their equipment. Flow meters are very helpful to let them know the output of the sprayer over time.

- It is estimated that 60 percent of sprayers have a calibration error of up to 10 percent.
- A large percentage of sprayers have greater than ten percent variation in discharge from individual nozzles or tips.
- Application methods used by different applicators vary, depending upon pressure, nozzle tip, etc.
- Soil types and types of soil cover (grass, mulch, gravel) can influence the rate of pesticides a technician applies.

Manufacturers' instructions, university extension training meetings, label instructions and company policy should be considered and used to calibrate sprayers. Refer to company policy and core manual for calibration instructions.

Canned Insecticides

Figure 2-18. Three different canned insecticides.

Pressurized cans of insecticides became common in the late 1940s and were first used as aerosol foggers or "insect bombs." Canned insecticides in urban pest management include canned aerosol foggers (volumetric sprays, total release fogs) and pressurized liquid sprays.

Canned Aerosol Pesticides. Canned aerosol pesticides (Figure 2-18) consist of a pressurized fluid that produces an aerosol or fog droplet that floats in the air for a period of time, then settles to the ground. The droplet size is governed by the nozzle and valve at the top of the can. After use, a more or less uniform coverage will be attained on exposed horizontal surfaces. Very little pesticide lands on vertical surfaces, penetrates opened cabinets, or clings to undersurfaces. The droplets contact pests that have left hiding places, and any other insects that fly into the insecticide are killed.

Canned Pressurized Liquid Sprays. Canned pressurized liquid sprays are not aerosols. Because the coarse, wet spray is not made up of aerosol droplets, little becomes airborne. Compressed gas mixes with the pesticidal liquid in a pressurized spray. The gas forces the pesticide through the exit port, quickly vaporizes, and leaves pesticide on surfaces. When canned pressurized liquids are part of a system that includes crack and crevice nozzles, the insecticide can be placed precisely on the target area. In a closed crevice, the expanding gas propels the insecticide in all directions, forcing it on all surfaces in the crevice rather than shooting it across in a straight line like a compressed air sprayer. Using canned pressurized liquid sprays requires a firm understanding of the target pests' habits so that pest harborage can be effectively treated.

Aerosol and Fog Generators

Power aerosol and fog generators (Figure 2-19) break liquid pesticides into aerosol droplets. Reducing the liquid into droplets is done either mechanically (cold foggers) or by using heat (thermal foggers). Caution should always be taken to protect the applicator's respiratory system with a canister-type respirator when these generators are used. Table 2-6 lists precautions for using this equipment indoors.

Cold Foggers. Cold foggers break an insecticide into aerosol-sized droplets and propel them into the air in a light cloud or fog. Large, ultra low dosage (ULD) and ultra low volume (ULV) cold foggers are mounted on trucks and used in mosquito control programs, to control pests in large warehouses, and for fly control in some operations. Cold-fog generators drive pesticidal fog over a relatively large area. Droplets fall on flying or resting mosquitoes or are deposited in very small amounts on plant leaves on which mosquitoes rest.

Hand-held cold foggers are used inside buildings where they fill rooms, small warehouses, etc., with aerosol droplets. These floating droplets kill flying insects as well as exposed insects on horizontal surfaces. Fogs do not enter tight spaces or cracks and crevices. While some aerosol generators are used for crack and crevice applications, they also produce aerosol droplets that float.

Thermal Foggers. Thermal foggers use heat to vaporize oil in an oil-based insecticide formulation. Large truck-mounted thermal aerosol generators are used in mosquito control programs where the insecticide fog rolls across open spaces killing flying insects as air currents move it. Indoors, portable thermal foggers work like cold foggers except droplets are smaller.

Figure 2-19. Fog generator.

For general application. Fogging should not be used as a single method of treatment but as a supplementary method to other types of application. Fogging or aerosol application is a general pesticide application and only pyrethrins or insecticides labeled for unclassified application can be used in this way. If fogging treatments begin to be used at increasingly closer intervals, it means that the pest population is not being suppressed and may be increasing.

Dusters

Dusters apply fine, dry layers of a powdery mixture containing a small amount of pesticide. Dust applied on porous surfaces is not absorbed like liquids; it rests on them like a layer of insecticidal powder. This dust accumulates on body parts (insect hairs, legs and mouthparts) of insects who touch it. Pesticides in dusts are absorbed by the insecticide in the same way as liquid sprays. Additionally, if the pest ingests particles (when grooming or cleaning itself), the dust can also cause the pest stomach poisoning.

Three types of hand dusters are commonly used by pest management technicians: bulb, bellows, and plunger dusters (Figure 2-20). Dusts are also driven by gas in some formulations of canned insecticides, but with this method, dusts are applied like canned liquid pesticides.

Figure 2-20. Bellows duster (top) and plunger duster.

Applicators should wear respirators.
Occupants must leave until the area has been adequately ventilated.
Pets must be removed; house plants and aquariums must be covered, and aerating pumps turned off.
Exposed foods and food-preparation surfaces must be protected. After treatment, all food-preparation surfaces and any exposed utensils must be washed.
Pilot lights and any other open flame must be extinguished. This is particularly critical when the oil-based thermal fog is used. Any spark can set off a thermal-fog atmosphere.
Thermal-fog generators can burn surfaces that they contact, including the operator.
Aerosol droplets will not move into spaces where air is not circulating nor into any dead-air cracks and crevices (e.g., under molding into partially closed cabinets, drawers, closets.)
Furnace, air conditioning, and ventilation equipment should be turned off. (Ventilation will evacuate the insecticide and may carry it to other places outside the target area.)
After an appropriate interval, and before people or pets reoccupy the area, treated rooms should be thoroughly aired.

Table 2-6. Precautions When Using Fogging or Aerosol Generating Equipmment Indoors.

Bellows dusters consist of a closed rubber cylinder made rigid by an internal spring, a spout at one end, and a stoppered refill hole at the other. These dusters, originally called Getz dusters, are held with the spout at the top. A slight pressure from top and bottom pushes air and dust from the spout. The more pressure applied, the more dust ejected. The spout is tapered at the tip and slight puffs will propel small amounts of dust into cracks and crevices. The slight puffs distribute a thin layer of dust in the pest harborage.

Bulb dusters have a rubber bulb with a removable spout at one end. The spout screws off for refilling. Dust application is much like the bellows duster except that the bulb is squeezed. Both dusters come in several sizes.

Plunger dusters hold more dust than the first two hand-held dusters discussed. Plunger-type dusters have been used for garden dusting for a century, but the plunger duster used in urban pest management is smaller, made of high-impact plastic and has several nozzle styles.

Power Dusters. Most power dusters use compressed air to deliver insecticidal dusts to large spaces. Fire extinguishers have been converted to dusters and filled with compressed air. Other dusters are plastic (Figure 2-21) and are pumped up much like the hand-held compressed-air sprayer used to apply liquids. The plastic dusters release small or large amounts of dust with better control than the fire extinguisher type.

Power dusters are often used in spaces where the dust can lie undisturbed providing a residual pesticide coating. They are also applied in sewers as contact pesticides and in trash chutes of high-rise buildings. The dust is introduced at the lowest level at a trash compactor and rises up through the chute where it is vented at the top. The chute must be closed at each floor. Dusts can also be placed in wall voids, crawl spaces and almost any unused space. Sometimes drilling into voids is necessary to inject dust. Great care must be taken to confine dust so that it does

Figure 2-21. Power duster.

not drift and is not carried into non-target spaces. If using a combustible dust, remember to turn off pilot lights and flame- or spark-producing equipment. Protect smoke alarms when using dust.

Dusters clog easily. They must be agitated often and the dust kept dry at all times. Dusters work much better if they are washed and dried often.

Traps, Bait Boxes, Monitoring Devices, and Pheromone Dispensers. Traps (Figure 2-22) have been used for pest control for centuries. Rodent-control traps range from snap traps to boxes with trap doors, spring-loaded multiple-catch and small animal traps. Rodent bait boxes, or bait stations, are containers that hold poisonous baits or glue boards. Under certain conditions, they must be tamper-proof for safety. Other traps to catch pest birds are baited so they can enter but cannot get out. Fly traps are sticky tapes or cylinders that hang vertically, taking advantage of the fly's tendency to cling to vertical poles, strings, etc. Electric fly traps are made with an attracting light that lures flies to electrocution grids or glue boards. Sticky traps are small glue boards used to catch cockroaches. These are used to monitor roach populations and to survey for other insects.

Pheromone traps lure insects with a pheromone (a natural attractant) to a sticky holding surface. These traps are used to evaluate insect populations; their catches indicate which species are present. They may also be used to control or reduce pest populations.

Figure 2-22. Traps, from left: yellowjacket and flying insect trap, stored-product moth trap, and fly and wasp trap.

Bait Stations. There are many kinds of bait stations (Figure 2-23). These devices confine toxic substances to units that are removable rather than leaving them exposed. Cockroach bait stations offer pesticides as attractive bait. The bait stations themselves offer natural harborage. They can augment sprays, dusts and fogs or they can be used in place of other more toxic formulations. The key to using these devices is to know where and how to place them.

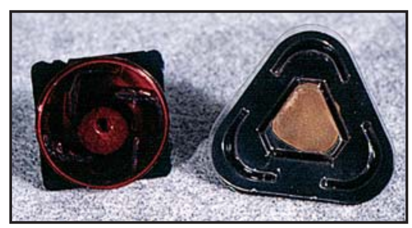

Figure 2-23. Bait stations for ants and cockroaches.

Bait Guns. A bait gun is a device that allows small, precise, gel bait placements. Small cartridges (filled with bait) are inserted into the bait gun; the bait is dispensed by squeezing the bait gun trigger. Most professional bait guns allow an adjustment for applying larger or smaller bait placements, as situations might require.

Summary

In urban pest management and control, equipment suppresses pest populations; however, it is effective only when used by competent pesticide applicators. Pest control equipment used by an untrained applicator who has little practical knowledge will be ineffective. Ill-cared-for equipment is ineffective and dangerous.

To use pesticides efficiently and economically (without under application [lack of control] or over application [unsafe]), applicators must understand their equipment capabilities and be able to depend on correct calibration. They must also be aware of the many types of equipment available. Urban pest control equipment is not only sprayers and dusters, but includes other devices such as traps, bait stations, lights and excluders.

Study Questions | Chapter 2

1. New sprayers are well calibrated until they have been used one season.

   A. True
   B. False

2. Hand-held sprayers can be calibrated if the following is known: ________________________.

   A. pressure used
   B. amount of liquid used
   C. time elapsed per liquid used
   D. area sprayed per amount of liquid used
   E. all of these
   F. none of these

3. Fogging fills a room volume, including cracks, crevices and cabinets.

   A. True
   B. False

4. High pressure must be maintained in hand held sprayers to be effective.

   A. True
   B. False

5. If a sprayer malfunctions, ________________________.

   A. repair it immediately
   B. increase pressure by pumping
   C. release pressure and remove it to a repair area
   D. use very soft thin wire to clear nozzle after releasing pressure

6. Equipment safety is best maintained by ________________________.

   A. daily rinsing
   B. daily hose inspection
   C. scheduled cleaning
   D. all of these

For answers refer to Appendix A.

Chapter 3: Using Pesticides Safely

Learning Objectives

After completing the study of Using Pesticides Safely, the trainee should be able to:

- Mix pesticides safely.
- Apply pesticides safely.
- Store pesticides safely.
- Dispose of pesticides safely.

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When you apply any pesticide, you assume the legal responsibility for using it strictly in accordance with label instructions. You must always protect people who live or work in the treated area so they are not exposed to harmful residues. Avoid using pesticides or application methods that might injure nontarget animals or plants, or damage property. Pesticide use should not endanger the environment or cause contamination of groundwater, soils, air, or human and animal foods. In addition, you must use pesticides in ways that avoid excessive exposure to any part of your own body.

This chapter gives a brief introduction to pesticide types, formulations, hazards, and safety precautions for pesticides used in General Household Pest Control. Precautions that must be observed when handling pesticide containers, guidelines for mixing pesticides, some steps to properly apply pesticides, ways to safely store these materials, and information on pesticide disposal are summarized in this chapter.

Handling Pesticides

Undiluted pesticides in their original containers must be handled carefully. Wear rubber gloves and protective clothing, such as a waterproof apron, when handling pesticides. Do not drop or throw containers or packages because this may cause damage and leaks. Check for contamination or leaks on all packages being handled, and do not let damaged packages or spilled pesticide come in contact with your skin or clothing. If a container is damaged and leaking, the pesticide should be transferred to another container and must be properly identified. When working around a leak, you may need to wear respiratory and eye protection — check the pesticide label for all precautions and required safety equipment. Never walk through a spilled pesticide.

Never leave pesticide containers unattended or stored in unlocked areas. Always keep pesticides away from food and water and away from sources of heat and fire. Never allow paper containers to get wet.

Do not eat, drink, or smoke while handling pesticides and pesticide containers. Wash thoroughly when you finish handling pesticide containers and before eating, drinking, smoking, or using the bathroom.

Mixing Pesticides

Pesticides must be properly mixed to ensure that the correct amount of pesticide is thoroughly incorporated into a measured amount of water or other solvent. Techniques for mixing pesticides are the same for large and small volumes. Before beginning, read the mixing directions on labels of all pesticides you will be using and decide on the proper order that chemicals should be added to the spray tank (see below). If adjuvants are needed, these are usually added before pesticides unless label instructions give a different order.

General rules for mixing pesticides include:

- Read the label.
- Determine what protective clothing is required for mixing by checking the pesticide label.
- Before adding pesticide to the spray tank, check for leaks in the tank and hoses. Make sure the equipment is clean and operating properly.
- Use only clean water in the spray tank. Be sure the pH of the water is within a range suitable for the pesticide(s) being used. Buffers or acidifiers may be required to adjust the pH.
- Measure pesticides carefully, accurately, and safely to be certain the correct amount of pesticide is put into the spray tank.
- When mixing more than one pesticide into the spray tank, add the materials in the following order:

  1. Wettable powders
  2. Flowables and dry flowables
  3. Water-soluble concentrates
  4. Emulsifiable concentrates

Applying Pesticides

To apply pesticides correctly, you must make sure that the correct amount of active ingredient is applied to the area to be treated and that the pesticide is confined just to that area.

Here are some important things that you must do to properly apply pesticides:

- Calibrate the application equipment accurately.
- Use the correct amount of active ingredient. Check the pesticide label for rates of application.
- Measure the area to be treated so that the correct quantity of pesticide mixture can be prepared.
- Check the application site for hazards that might affect the safety of the application. Hazards include electrical outlets and exposed wiring, sources of ignition such as flames or sparks, confined spaces, and improper ventilation. They also include irregular surfaces over which the applicator or equipment must travel.
- Make sure that the weather conditions are suitable for pesticide application. This includes temperature, humidity, and, if making outdoor applications, wind, fog, and rain.
- For liquid sprays, control the droplet size and spray pressure to prevent drift and to keep the spray on target.
- Set up an application pattern that prevents you from having to walk or drive through treated areas.
- Do not apply pesticides in or near air conditioning or heating vents or ducts.
- Keep people and animals away from the area during application and until the treated area is safe to reenter.

Storing Pesticides

Store pesticides in their original, tightly closed containers. Whenever possible, wipe or wash pesticide residue off the outside of containers before they are put into storage. Protect pesticides from extremes in temperature and from becoming wet. A pesticide storage area should be a separate building, away from people, living areas, food, animal feed, and animals. The area must be well ventilated, well lighted, dry, and secure, with lockable doors and windows. Post signs near all primary entrances to warn others that the building contains pesticides.

Some pesticides do not store well for long periods of time. Extended storage, especially after temperature extremes, may cause chemical changes resulting in some products losing their effectiveness or others becoming more toxic. Moisture and air picked up during storage may alter the composition of some pesticides, especially those stored in unsealed containers. Solvents and petroleum-based chemicals can degrade some types of containers after a period of time.

Most pesticide chemicals should not be stored for longer than two years. Before pesticides exceed their shelf-life, use them in an appropriate application or transport them to an approved disposal site.

Pesticide Disposal

Leftover pesticide mixtures are considered hazardous waste unless they can legally be used to control pests in another site. Therefore, whenever possible, mix up only the amount that is required for each job. Excess pesticide must never be indiscriminately dumped; such dumping is a potential source of environmental and groundwater contamination and is illegal. Persons convicted of dumping are subject to large fines and jail terms.

Rinse water from cleaning of equipment is also a hazardous waste and must be treated accordingly.

Hazardous materials such as leftover pesticide residues must be transported to an approved Class 1 dump site, or they may be rendered nontoxic by means of a treatment such as with ultraviolet light and ozone.

Pesticide containers must be triple-rinsed before they can be disposed of in a Class 2 disposal site.

Check with the Florida Department of Agriculture and Consumer Services for methods of disposing of hazardous pesticide wastes and empty pesticide containers.

Pesticide Types

The most common pesticides used in and around structures are insecticides and rodenticides. Table 3-1 compares the toxicity categories of various insecticides used in structures, illustrating that some of the materials are more acutely hazardous than others. Occasionally, fungicides or herbicides are used to control pests near buildings. Wood preservatives are a special class of pesticide used to protect structural and decorative wood, utility poles and marine pilings.

COMMON NAME	PRODUCT NAME	CATEGORY
acephate	Orthene Whitmire	III III
bendiocarb	Ficam "D" Ficam "W" Ficam Plus	III II II
fenvalerate	Pyrid	II
boric acid	Perma-Dust (PT 240)	I
carbaryl	Sevin	III
chlorpyrifos	Dursban LO Dursban 2E Empire Killmaster II	II II II II
cypermethrin	Demon WP Demon EC	II II
cyfluthrin	Tempo	II
diazinon	Diazinon 2D, 4E, and 4S Knox-Out Whitmire PT 260 Diazinon 3 Dust	II II II II
dichlorvos	Vapona Aerosol	I
hydramethylnon	Combat or MaxForce Roach Control	II
hydroprene	Gencor	III
lambdacyhalothrin	Commodore	II
methroprene	Precor	III
proptamphos	Safrotin	III

Table 3-1. Common Materials Used to Control Insects in Structures. Insecticides used for the control of insect pests in structures may belong to any of the three toxicity categories. (Note: Some materials on this list may no longer be registered as insecticides in Florida, or the registration may no longer include structural uses. Before using any pesticide, check the current label to be certain it is registered for the intended use.

Pesticides used for General Household Pest Control are available in several types of formulations (Table 3-2). The following box defines some of the common formulations and describes their advantages and disadvantages. Insecticides and rodenticides can be applied as baits (treated grains, meals or other substances), liquids, granules, gases or dusts. Some insecticidal dusts are used as tracking powders or desiccants. Fungicides and most herbicides are generally applied as liquid sprays, although some herbicides are available in a granular formulation.

MATERIAL	USES	COMMENTS
Wettable powder	Insecticides, fungicides, herbicides.	Require agitation during application. May leave visible residue on treated surfaces after drying. Do not penetrate surfaces well.
Dry flowable	Insecticides, fungicides, herbicides.	Require agitation during application. May leave visible residue on treated surfaces after drying. Do not penetrate surfaces well.
Soluble powder	Insecticides, fungicides, herbicides.	Penetrate better than wettable powder or dry flowable formulations.
Emulsifiable concentrate	Insecticides, fungicides, herbicides.	May damage plants. May cause spotting or staining of treated surfaces.
Flowable	Insecticides, fungicides, herbicides. Limited number of pesticides available in this formulation.	Require agitation during application. May leave visible residue on treated surfaces after drying. Do not penetrate surfaces well.
Water-soluble concentrate	Insecticides, fungicides, herbicides, and rodenticides (as drinking solutions). Limited number of pesticides available in this formulation.	Penetrate better than wettable powder or dry flowable formulations.
Low-concentrate solution	Ready-to-use insecticides.	High cost per unit of active ingredient. Very useful in control of insects in buildings. Usually do not cause stains.
Fumigant	Insecticides, sometimes used for control of rodents.	Must be used in tightly closed area. Requires special certification in application techniques and equipment.
Dust	Insecticides, rodenticides.	Highly visible residues. Must be kept dry. Some types may be used as tracking powder.
Granule/pellet	Insecticides.	Formulated on clay or other carriers. Used outdoors on soil as barrier tratments.
Microencapsulated formulation	Insecticides.	Used for slow, sustained release of active ingredient over time.
Bait	Insecticides, rodenticides, avicides.	May be attractive food substance coated on or impregnated with toxic material. Used in bait stations or bait blocks or scattered in safe location.
Impregnated PVC and paints	Insecticides, fungicides.	Include items such as flea collars, pest strips, and special paints. May also include factory-treated fabrics or carpets.

Table 3-2. Formulation Types and Their Uses

Liquids

Pesticide liquids are mixtures of powdered or liquid active ingredients combined with liquid carriers such as water or oil. Pesticides may dissolve in the carrier to form a solution or may remain suspended in the liquid to form an emulsion or suspension. Suspensions and emulsions require constant agitation to maintain a uniform spray mixture.

Liquid pesticides are applied as spot treatments, crack and crevice treatments, fogs or mists in confined areas, or general sprays to large areas. The common ways to apply liquid sprays are with aerosol dispensers, hand-held compressed-air sprayers, backpack sprayers, or larger, motorized spray units (Figure 3-1). When liquid sprays are applied, a residue of pesticide-active ingredient remains on the treated surfaces and helps to control pests over a period of time. The length of time depends on

Pesticide Formulation Types

Wettable Powder (W or WP). The pesticide is not soluble in water. It is combined with a finely ground material such as clay and combined with other ingredients to improve mixing. Most wettable powders contain between 15 percent and 75 percent active ingredient. When mixed with water, they form a suspension that must be kept agitated during application. Wettable powders may be abrasive to nozzles and pumps, but they are one of the safest formulations for use on plants for insect or disease control. Wettable powders usually leave a visible residue.

Dry Flowables or Water-Dispersible Granules (DF or WDG). This formulation is similar to a wettable powder but is in the form of granules that must be mixed with water before use. These pesticides require agitation during use. Usually there is a higher percentage of active ingredient in this formulation than in wettable powders. These are measured out by volume rather than weight.

Soluble Powders (S or SP). Soluble powders dissolve with water in the spray tank after mixing to form a true solution. These do not require agitation once they have been thoroughly mixed, and they are not abrasive to nozzles or pumps. (Only a few pesticide active ingredients are soluble in water.)

Emulsifiable Concentrates (E or EC). Emulsifiable concentrates are pesticides that are soluble in an organic solvent but not in water. When the undiluted formulation is combined with water, a milky emulsion is formed that must be kept agitated during application. ECs are not abrasive to application equipment, but the solvent may contribute to the deterioration of rubber and plastic seals and hoses of the application equipment. The solvent may also injure plant foliage and may cause damage to certain types of surfaces.

Flowables (F), or Suspension Concentrates (SC). Flowables consist of finely ground pesticide combined with a liquid solvent and emulsifiers. When mixed with water, they form a suspension similar to a wettable powder. Flowable formulations must be agitated during application. These may be abrasive to application equipment components. They leave visible residues on treated surfaces.

Water-Soluble Concentrates, or Solutions (S). Water-soluble concentrates, or solutions, dissolve in water to form a true solution. Once dissolved, they do not require agitation. They are nonabrasive. Only a few pesticide active ingredients are soluble in water.

Figure 3-1. Liquid pesticides can be applied with aerosol dispensers, hand-held compressed-air sprayers, backpack sprayers, or larger, motorized spray units.

the type of pesticide used, the type of formulation, the concentration of active ingredient applied, the type of surface treated and environmental influences such as temperature, humidity or sunlight. Undiluted pesticides contain concentrated amounts of active ingredients that may cause serious injury if inhaled, splashed or blown into the eyes, or spilled on the skin or clothing. Some concentrated pesticides may be flammable.

Applying liquid sprays in certain areas may be extremely hazardous. For example, electric outlets, motors or exposed wiring pose a potential threat of electrical shock to persons applying water-based pesticide sprays. Pilot lights and gas flames from heaters and appliances may ignite flammable petroleum-based pesticides. Sparks from electric motors and switches, and glowing heating elements may also ignite flammable materials (Figure 3-2). Pesticide vapors or fumes in confined areas may injure people if ventilation is inadequate.

Figure 3-2. Many hazards may be found in an area being treated with liquid pesticides. Avoid application near electrical outlets, switches, motors, or heating elements.

Gases

Gases that kill pests are fumigants. Fumigants control certain stored-product insects, drywood termites and wood-destroying beetles, soil-infesting nematodes, soil pathogens and some rodents. The process of applying fumigants, or fumigation, is much different from other forms of pesticide application and requires special training and equipment.

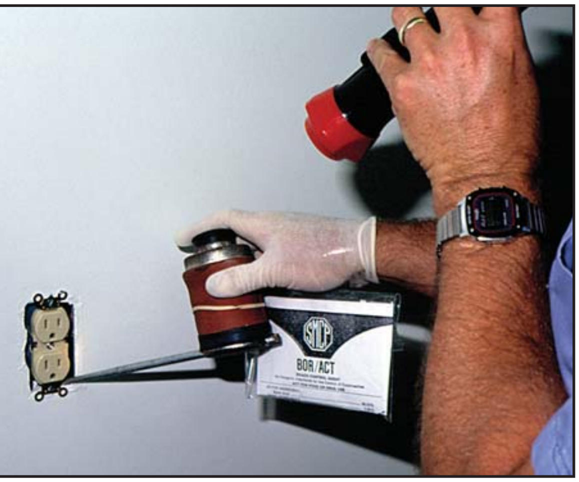

Figure 3-3. Shaker cans can be used to apply dusts to small, confined areas such as electical outlets and cracks and crevices.

Dusts

Dust formulations are finely ground dry powders that contain toxic materials. These are sometimes used to control rodents and certain insects. Most dusts are blown into inaccessible places where pests hide. Dusts do not penetrate surfaces and usually break down slowly. Therefore, the active ingredient in dust formulations remains on the treated surface and is active against pests for a long period of time if the treated area stays dry. Because they do not penetrate, dusts are more effective than liquids on absorptive surfaces such as concrete.

Dusts may be applied in cracks and crevices, under cabinets or appliances and in other areas inaccessible to children and pets. This formulation leaves visible residues on treated surfaces, which often limits its use to areas such as warehouses, attics, crawl spaces and wall voids.

Dusts usually provide better coverage than sprays in inaccessible or hard-to-reach places. In wall voids, they can be dispersed with compressed air to reach all surfaces. During manufacture, dusts are sometimes given an electrical charge or they are combined with an electrically charged powder to make them cling to surfaces better. Puff dusters, shaker cans (Figure 3-3), aerosol cans, and compressed air dusters are used to apply these formulations.

When using dusts, prevent their drift into the airspace of rooms or work areas. Apply dusts only according to the instructions on the pesticide label. Always wear approved respiratory protection to avoid inhaling dust particles.

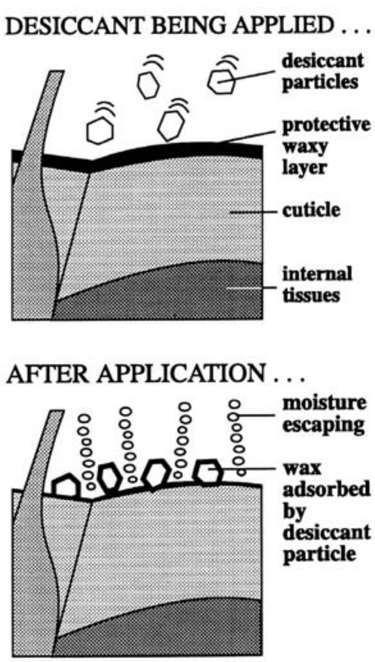

Figure 3-4. Desiccants destroy insects and mites by removing or disrupting the protective outer body covering, as illustrated here. This causes the organism to lose body fluids.

Toxic Tracking Powder. Toxic tracking powder is a dust formulation that may be useful where rodents won't accept bait or there is an abundance of natural food. Target rodents pick up the toxic dust on their body surfaces as they walk through it and later ingest some during grooming. The toxic component of some tracking powders can also be absorbed through the animal's skin.

Apply toxic tracking powder to travelways alongside walls, inside wall voids, and in attics and crawlways. Blow the powder into inaccessible areas where rodents are known to travel. Avoid the use of power blowers in exposed areas to prevent dispersing the powder beyond the treatment site. Once control has been accomplished, remove remaining powder from exposed parts of the treatment site. To remove powder, use a vacuum equipped with an HEPA filter approved for pesticides. Once the area has been cleaned, dispose of the filter and vacuum bag in an approved hazardous-waste disposal site.

Follow label directions for using a toxic tracking powder and carefully select locations where the powder is to be used. Do not put powder where it can be dispersed by air movement or tracked by pests onto food, eating utensils or food-preparation surfaces. Never use toxic tracking powder on shelves, cupboards or ceiling beams overhead in food preparation or eating areas. Because of the hazards, do not use toxic tracking powder in food-processing plants or food-storage warehouses; never apply it in or around homes except inside wall voids or other inaccessible areas. In locations where people or animals may accidentally contact the powder, confine its use to bait stations; the combination of toxic tracking powder and toxic bait can sometimes be very effective.

Toxic tracking powder loses some of its effectiveness in damp areas because moisture causes the powder to cake and not stick to the animal's body; moisture may also speed the breakdown of the toxic material.

Toxic tracking powder formulations are fast-acting poisons; therefore, rodents die quickly. Rodents dying in inaccessible wall voids or other out-of-the-way areas could create odors or attract flies.

Desiccants. Desiccants are dusts or sorptive powders used to control some insect pests found in buildings. The powder abrades or adsorbs the waxy coating that protects insects from losing water (Figure 3-4). Desiccants often last longer than other forms of insecticides; however, insects must move through the dust and pick up some on their bodies for it to be effective. To apply, blow desiccants into wall voids, attics and crawl spaces, and dust them into other areas where insects hide. Some desiccants are highly repellent, which helps exclude insects from treated areas. Avoid breathing dusts during application by wearing respiratory protection.

Granules

Granular formulations are sometimes used to control ants, sowbugs, earwigs, snails and slugs, and occasionally other soil-inhabiting organisms. Usually granules are combined with a food substance or attractant to encourage target pests to feed on them. Do not apply granules in areas where children or pets may find them.

Toxic Bait

Toxic bait may be used to control specific types of insects as well as snails, slugs and rodents. Some birds may be controlled with poisoned bait if you first obtain a special permit from the Florida Fish and Wildlife Conservation Commission.

Most baits are a combination of pesticide and food material. They may be in the form of powders, grains, granules, kibbles or blocks. Baits are usually placed in a bait station or secured in protected places (Figure 3-5). Baits used to control snails or slugs, earwigs or oriental cockroaches are usually broadcast over the soil around the outside of a structure.

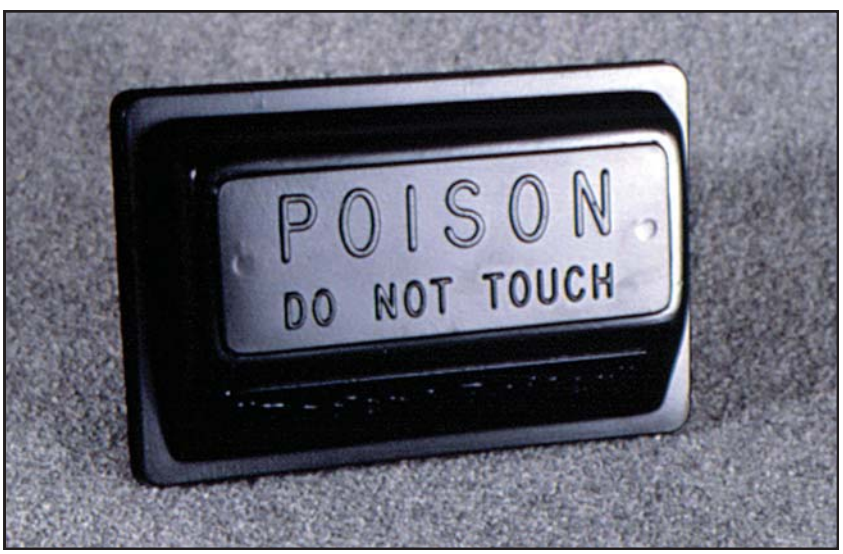

Figure 3-5. Poisoned baits are usually placed in bait stations to prevent children or nontarget animals from being exposed to the toxic material.

Table 3-3 is a guide to selecting bait types. Choose bait types and bait-station styles on the basis of (1) type of pest, (2) history of bait use, and (3) conditions of the baiting location. For example, when baiting for ants, select a bait that foraging workers will carry back to the nest to feed to the colony's reproductives and brood; the toxic substance must be slow-acting so that foraging workers are not killed before they reach the nest. Bait used to control flies, on the other hand, must be fast-acting to stop continued annoyance and prevent further egg laying.

Certain rodent baits contain an anticoagulant, which interferes with the animal's normal blood clotting process. It is important for rodents to feed on some anticoagulant baits over a period of several days so they will consume enough toxic material to be effective. If there is an interruption of feeding for longer than 48 hours, the animal will recover and accumulated toxic effects will be lost. To prevent this from happening, check and refill bait stations regularly. Other anticoagulant baits are effective after a single feeding.

Selecting a bait for rodent or bird control also depends on where it is to be placed. Toxic powders and granular formulations used indoors usually need to be confined to bait stations. Bait blocks can be used without a bait

PEST	TYPE OF ACTIVE INGREDIENT	HOW APPLIED	WHERE USED
Ants	Slow acting so workers can carry bait back to feed others.	Use bait stations such as metal ant stakes, hollow straws, or small containers.	Locate near nests, along trails, inside electrical boxes, and around periphery of buildings.
Birds	Quick acting so poisoned birds will frighten away other birds, minimizing total bird kill. A permit may be required.	Use in bait stations or feeding troughs.	Hang in trees or near roosting sites.
Cockroaches	Quick acting for immediate knockdown; slower acting for continued control.	Use in enclosed bait boxes with many small entrances.	Place under appliances, sinks, cabinets, and other concealed areas where cockroaches are found.
Flies	Quick acting so flies will not reproduce.	Apply as surface spray or use in feeding stations.	Apply sprays to resting surfaces. Locate feeding stations outdoors near garbage cans or other areas where flies congregate.
Rats and mice	Several types including acute toxics and single-and-multiple-feeding anticoagulants. May also be added to drinking water. Vary types if bait shyness develops.	Use in bait stations or as bait blocks. Bait stations must be large enough to accommodate several individuals; should have at least two entrances. Use bait blocks in damp locations.	Locate near runways in protected areas. Choose several locations.
Wasps	Quick acting to reduce number of adults present.	Place in feeding stations.	Locate feeding stations around periphery of outdoor areas used by people.

Table 3-3. How to Select Bait Types. Follow these guidelines when selecting and applying baits.

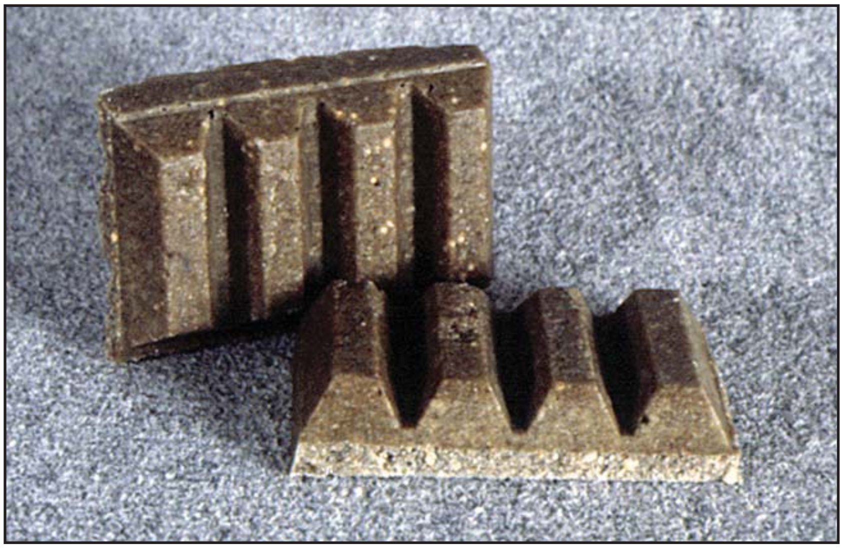

Figure 3-6. Bait blocks can be used without a bait station as long as they are located safely out of reach of children or nontarget animals. Paraffin blocks can be used in damp areas. The wax helps keep the bait fresh and prevents mold.

station, but place them where they can be secured and are out of the reach of children, pets and nontarget animals. In damp areas, use rodent bait in the form of paraffin blocks that can withstand moisture (Figure 3-6); the wax keeps the bait fresh and helps prevent mold. Do not apply powdered or granular baits to shelves or floors in areas where they can be hazardous to children or pets, or cause contamination of food and other items.

Insects may infest rodent bait if it is left in a bait station for a long time, so replace bait frequently. Remove uneaten bait and thoroughly clean bait stations. Dispose of old or unused bait in an approved hazardous-waste disposal area. Contact the local Cooperative Extension office for information on toxic material disposal.

When a toxic material is applied to grains and other materials to make poisoned bait, it must be colored with a dye. Coloring serves several useful purposes: (1) It helps avoid mistaken identification so that grains are not used for human or livestock feed; (2) It is a convenient way of identifying the toxicant because specific colors are generally used for certain types of poisons; (3) It makes bait unrecognizable or unattractive to some nontarget organisms; and (4) It provides a convenient way of ensuring that the bait is uniformly treated with the toxicant.

Rodent Bait. For controlling rodents, place bait near nests and along travelways. Rats usually do not go out of their way to find it and mice confine their activities to small areas most of the time. To improve the chances of it being discovered, place bait in several areas rather than in just one location. Each of the bait locations for mice, for example, should be no more than 10 feet from another source of bait. Whenever possible, put bait under cover of some object so the rodents feel secure while feeding. Secure bait for roof rats in rafters, trees or other elevated areas. For Norway rats, place bait along the bases of walls and near ground burrows. It is also possible to place bait in burrows and put a rock or other heavy object over the burrow opening so children and nontarget animals cannot reach it.

Insect Bait. Put insect bait in areas of greatest activity or in those that cannot be sprayed or dusted. For ants, locate the bait along trails, near

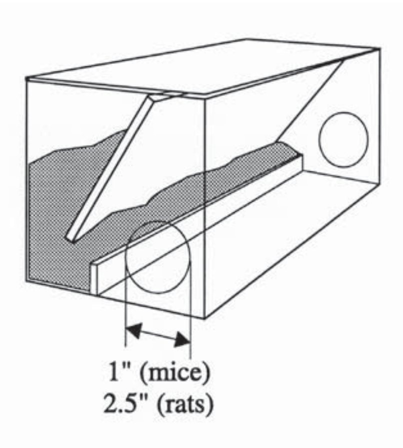

Figure 3-7. Bait stations must be equipped with an internal baffle, as illustrated, to prevent rodents from scattering the bait.

nest entrances, around the foundation of the building, and under sinks and other out-of-the-way locations inside the building. Apply cockroach bait under appliances, under sinks, behind furniture and in hidden areas where these insects have been observed or are suspected to occur; place bait at wall intersections as cockroaches tend to travel along edges. For cockroach species that occur outdoors, place baits around or in woodpiles and in water-meter boxes and other protected locations where these insects are usually found.

Bait Stations. Be sure bait stations are suitably designed for the kind of bait used and the baited pest. For rodents, use stations that comply with the rodenticide label. These should be large enough to accommodate several rats or mice at a time. Provide at least two 1-inch openings into the feeding station for mice and two 2½-inch openings for rats. Multiple small openings are important for an insect bait station.

Use only tamperproof bait stations to prevent children, pets, or non-target animals from gaining access to the bait. Tamperproof refers to a design that blocks access to the bait either through the opening used for filling the station or through the openings that rodents use. Stations must be secured to a surface to prevent them from being tipped or the toxic bait

Tamperproof Bait Boxes

A tamperproof bait box must meet the following criteria to be acceptable for use:

1. Resistant to weather. Placement of the bait station influences weather resistance. If the bait box is placed outside, it needs to be more resistant than if placed indoors or under a shelter.
2. Strong enough to prohibit entry by large, nontarget species. Placement may be a factor if the bait box is inaccessible to nontarget species because it is located inside a building or shelter.
3. Equipped with a locking lid.
4. Equipped with entrances that readily allow target animals access to baits while, at the same time, denying access to larger nontarget species. Access to larger species may be restricted by using baitboxes with baffles, mazes, or small entrances.
5. Capable of being anchored securely so that the bait box cannot be moved or its contents displaced.
6. Equipped with an internal structure for confining the bait. In most boxes, this consists of an arrangement of baffles.
7. Made in such a way so as not to be an “attractive nuisance.”
8. Capable of bearing precautionary statements in a prominent location. The bait box must meet service container labeling requirements.

shaken out. Be sure the word "Poison" is clearly printed on each bait station. Bait stations are considered to be service containers, so they must be labeled with the following information: (1) the name and address of person or firm responsible for the bait station; (2) the identity of the poison being used; and (3) the signal word from the pesticide label. If the bait is a grain or granule, use a bait station equipped with an internal baffle to keep rodents from scattering it (Figure 3-7).

Resistance and Bait Shyness. If baiting has been used before, but control was not successful, the target pest may be developing pesticide resistance or bait shyness.

Pesticide resistance is an acquired condition that gives the target pest population a tolerance or immunity to the toxic substance (Figure 3-8). When resistance is suspected (pests are eating the bait but the population is not declining), switch to another control method such as trapping. Otherwise, use a toxicant that has a different mode of action and augment the baiting program with other control methods. Discontinue the use of bait for several months to reduce chances of further resistance.

Bait shyness develops if an individual animal dislikes the bait or has had a bad experience with it. Bait may be unattractive because it is old, moldy or contaminated. If pest rodents are not feeding on the bait, check to be sure it is fresh and uncontaminated; use another type of attractant and select a toxicant with a different mode of action to see if this improves acceptance. Be sure bait is located in areas where target pests have access to it. Sometimes prebaiting — setting out the same type of bait minus the toxicant — is helpful in overcoming bait shyness. Once the nontoxic bait is taken regularly, switch to the toxic bait.

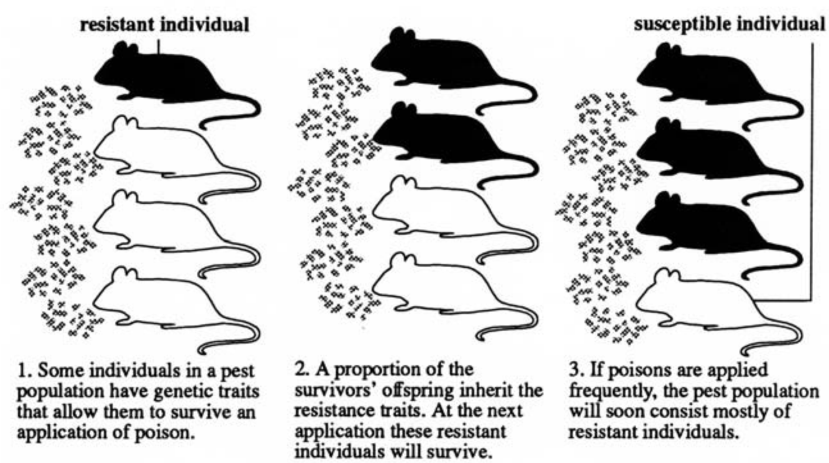

Figure 3-8. This drawing illustrates how pesticide resistance can build up in a pest population. Resistance to pesticides involves a change in the genetic characteristics of pest populations, which are inherited from one generation to the next. Increased or frequent use of a pesticide often hastens resistance.

Human Pesticide Injury

Poisonous chemicals such as pesticides injure or kill people by interfering with the normal functioning of internal organs and systems. The nature and extent of injury depends on the toxicity of the chemical as well as the dose (amount of material) that enters the body's tissues. A person's health and size may also influence the severity of injury.

The ingredients of some pesticides are very potent and are capable of causing poisoning at doses as small as a few drops or a few ounces. Other less-potent pesticides might require that as much as several pounds be

Avoiding Pesticide Exposure

There are many things you can do to avoid pesticide exposure when working around pesticides or applying them. Follow these guidelines:

Wear clean protective clothing whenever you work around pesticides or work on application equipment. Wash thoroughly before eating or drinking, smoking, or using the bathroom. Change clothes and bathe after handling or applying pesticides. Check the pesticide label for protective clothing requirements. See Table 3-5 for guidelines in interpreting label requirements.

Practice safe mixing and application methods. Never walk or drive through freshly treated areas. Clean up leaks and spills as soon as they occur. If any pesticide spills on you, remove contaminated clothing immediately and wash thoroughly with plenty of soap and water.

Whenever possible, select the least hazardous pesticides. Reduce pesticide use by combining chemical control methods with nonchemical control methods. Apply pesticides only as spot treatments, and time the applications to coincide with the most susceptible stage of the target pest.

consumed before signs of illness appear. Regardless of the specific potential hazard, anyone working with pesticides should avoid exposure by using suitable protective clothing and application techniques. Anyone living or working in pesticide-treated areas must be protected from exposure levels that will cause injury.

Poisoning Symptoms

Symptoms are abnormal conditions, feelings or signs that indicate the presence of an injury, disease, or disorder. When a person is exposed to a large enough dose of pesticide to cause injury or poisoning, some type of symptoms will usually appear (Table 3-4). These symptoms may show up immediately or after several days; sometimes they may not appear until after several months or years. It may be difficult to associate the illness or injury with its cause if there has been a lapse of time between exposure and observable effect.

The effect of an exposure can be localized, such as eye or skin irritation, or generalized, when the pesticide is absorbed into the blood and distributed to other parts of the body. A pesticide can affect several different internal systems at the same time. If the person experiences an injury but recovers quickly, or gets worse and dies within a short time, it is known as an acute illness or injury. If the effects last for a long time, and perhaps are irreversible, it is known as a chronic illness. Examples of chronic illnesses usually associated with high or prolonged levels of exposure to certain pesticides include, among others, infertility, birth defects and cancer. Pesticides that are found to cause such disorders or are suspected of causing these problems may lose their federal registration and can then no longer be used in the United States.

Some pesticide poisoning symptoms are similar to symptoms produced by many other chemicals. Symptoms may vary between chemical classes

Possible Symptoms Related To Skin Contact With Pesticide Dust, Liquid, Or Vapors

Staining of the skin
Reddening of skin in area of contact
Mild burning or itching sensation
Painful burning sensation
Blistering of the skin
Cracking and damage to nails
Involvement of internal systems resulting in blurred vision, dizziness, vomiting, or diarrhea
Possible muscle weakness, poor coordination, muscle cramps
Potential chronic problems (see below)

Possible Symptoms Related To Eye Contact With Pesticide Dust, Liquid, Or Vapors

Discomfort, including watering and slight burning
Severe, painful burning (permanent eye damage may occur)
Involvement of internal systems resulting in blurred vision, dizziness, vomiting, or diarrhea
Possible muscle weakness, poor coordination, muscle cramps
Potential chronic problems (see below)

Possible Symptoms Related To Inhaling Or Swallowing Pesticide Dust, Liquid, Or Vapors

Sneezing
Irritation of nose and throat
Nasal stuffiness
Swelling of mouth or throat
Coughing
Breathing difficulties
Shortness of breath
Chest pains
Involvement of internal systems resulting in blurred vision, dizziness, vomiting, or diarrhea
Possible muscle weakness, poor coordination, muscle cramps
Potential chronic problems (see below)

Chronic Problems

Exposure to some types of pesticides may result in chronic problems such as cancer, infertility, birth defects, or genetic disorders to the exposed person or their offspring. Symptoms of these disorders may not appear until years after exposure. Repeated exposure to low doses of certain pesticides over long periods of time may increase the potential for chronic health problems; single incidents of high-level exposure to certain pesticides may also increase the possibility of chronic health problems.

Table 3-4. Common Pesticide Poisoning Symptoms.

of pesticides and may also be different among pesticides within the same chemical class. The presence and severity of symptoms usually are proportional to the amount of pesticide (dosage) entering the tissues of the exposed person. Symptoms may include a skin rash, headache or irritation of the eyes, nose, or throat; these symptoms may go away within a short period of time and sometimes are difficult to distinguish from symptoms of an allergy, cold or the flu. Other symptoms, which might be caused by higher levels of pesticide exposure, include any of the follow-

DuPont

Figure 3-9. Follow the pesticide label use instructions carefully and observe any precautions listed.

ing: blurred vision, dizziness, heavy sweating, weakness, nausea, stomach pain, vomiting, diarrhea, extreme thirst and blistered skin. Poisoning can also result in apprehension, restlessness, anxiety, unusual behavior, shaking, convulsions or unconsciousness. Although these symptoms can indicate pesticide poisoning, they also may be signs of another physical disorder or disease. Whenever the possibility of poisoning exists, consult a physician. Be sure to give the physician a copy of the pesticide label or the name of the pesticide, the manufacturer and the EPA registration number. Diagnosis of a pesticide-caused injury usually requires careful medical examination, laboratory tests, observation and familiarity with a person's medical history.

Individuals commonly vary in their sensitivity to pesticides. Some people show no reaction to a dose that causes severe illness in others. A person's age and body size may influence his/her response to a given dose, thus infants and young children are normally affected by smaller doses than adults. Also, adult women may be affected by smaller doses of some pesticides than adult men. The unborn child carried by a pregnant woman may be highly sensitive to exposure to some pesticides.

Pesticides that are applied in strict accordance with their label instructions with adherence to application rates, reentry intervals, protective equipment requirements, aeration periods, and other listed procedures generally do not leave unsafe levels of pesticide residues (Figure 3-9). Accidents during application may result in a higher, and sometimes unsafe, exposure. An improper application caused by failure to follow label instructions may also result in injury.

Human Protection

Always apply pesticides in strict accordance with label instructions. Furthermore, never use a pesticide in a building or other area unless people living or working there can be protected from exposure. This often requires that they leave the area before an application begins and that they remain away for a period of time after the application. Provide occupants with information about the pesticide application and be sure they understand the safety precautions taken. The type of information they may need includes: (1) the name of the material being used; (2) poisoning symptoms and what to do if they experience such problems, where to get help, and how to get more information; (3) what areas of the building are being treated; (4) what to expect, such as an odor or residue; and (5) the possibility of finding dead insects or rodents and what to do if this happens. Explain ways to reduce personal exposure, such as removing or covering food and utensils before pesticide applications; protecting linens and bedding and similar items; opening windows and doors to increase ventilation and vacuuming carpets and cleaning floors after an application; and keeping children and pets away from treated areas.

Pesticides may be needed to control pests in places where food is stored, prepared, or eaten. If so, special precautions must be taken. For instance, never treat food-preparation surfaces with dusts or liquid sprays and do not allow residues to drift onto food or utensils. If fogs are used, all food preparation surfaces must be thoroughly cleaned after application.

Never make an application near air ducts or ventilation systems unless the system can be shut down for a period of time. Do not apply pesticides inside heating or cooling ducts.

Infants, Children, the Elderly, and People with Medical Conditions

Sometimes the use of pesticides in buildings must be restricted or avoided to protect people living there. Rely on nonchemical control methods as much as possible and use a pesticide only where absolutely necessary. When pesticides are needed, choose the safest formulation available such as a bait or a low-volatility liquid spray. Follow label instructions and precautions carefully. Be extremely careful when using pesticides in areas occupied by infants, children, the elderly or someone who is sick. These areas include hospitals, nursing homes, schools and certain households.

Infants are more vulnerable to pesticide exposure than larger children or adults (Figure 3-10). This is because of their small size and undeveloped immune system responsible for detoxifying hazardous chemicals. Do not apply a pesticide to anything used for infant care, and avoid spraying or dusting carpets, clothing, blankets, towels, or any fabrics that infants or others may contact. When a pesticide is needed in areas where an infant may spend part of the day, use a formulation that will break down completely before the infant returns.

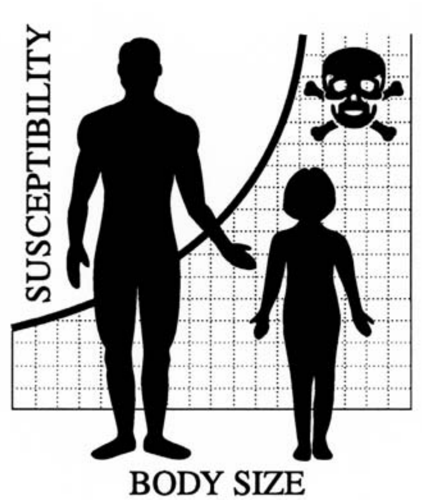

Figure 3-10. Body size may be an important factor in determining an individual's susceptibility to a pesticide. Usually infants and children are more susceptible and may be injured by smaller doses.

Children under the age of six are active and curious. It is difficult to keep them away from places where a pesticide has been used for household-pest control (Figure 3-11). Young children explore a lot and put many objects (including their hands) into their mouths. They also crawl on floors and climb on other surfaces. Therefore, never apply a pesticide to play equipment, toys or any surfaces youngsters normally touch. On carpets, use pesticides that break down rapidly. In all cases, use pesticides having low toxicity and low volatility. If you use bait stations or traps, secure them well out of reach and sight.

stock.xchng

Figure 3-11. It is hard to keep children away from areas where pesticide has been applied.

Elderly people may be susceptible to respiratory illnesses and other disorders that may give them a low tolerance to many airborne dusts and chemicals, including specific pesticides. In some instances, their bodies may not be able to properly degrade or eliminate foreign or toxic materials, such as pesticides. Therefore, use extreme caution when making pesticide applications in rooms where elderly people sleep or spend long periods of time; whenever possible, avoid treating these places. In other areas, use a low toxicity and low volatility pesticide. Apply this as a spot treatment only as necessary. Select alternate methods of control whenever possible, and always augment pesticide use with other pest control techniques so that the amount of pesticide used can be reduced.

People who are acutely ill or suffer from conditions such as diabetes or alcoholism, or have allergies or respiratory disorders including asthma and emphysema may be more sensitive to pesticides. Medications used to treat illnesses may influence the effects of pesticide exposure. Provide persons who are ill or using medications with the name of the pesticide you plan to use and ask them to contact their physicians for advice.

Applicator Safety

Safety risks for applicators working in buildings or enclosed areas are compounded by hazards such as electrical equipment, possibility of explosions and confined work areas. Learn to recognize hazards in the application site that could cause injury. Avoid pesticide exposure by wearing required or recommended protective equipment. Table 3-5 gives examples of suitable protective equipment based on label recommendations.

Maintain, clean and store protective equipment carefully to keep it in good condition and to ensure that it provides optimum protection (Table 3-6).

Figure 3-12. To avoid chances of electrical shock, do not apply water-based sprays around electrical outlets or appliances.

Fire, Explosion, and Electrical Hazards

Fires, explosions, and electrical hazards can be found in residential, industrial and institutional settings and other confined areas. Before using a pesticide, examine the application site for hazards. For example, never apply a pesticide dissolved in oil or petroleum solvent in an enclosed area if there is any source of spark or flame such as functioning electrical motors, wall switches, appliances, or pilot lights; before making an application, shut off electric and gas services to the treatment area. Avoid the use of aerosols in wall voids near hot water pipes; heat from these pipes can ignite solvents and cause a fire. Do not use dust in an enclosed area if there is an ignition source as any airborne dust at the right concentration can explode. Boric acid dust is capable of extinguishing a pilot light, which could create an explosion hazard due to escaping gas (most new gas appliances are equipped with safety shut-off devices or igniters in place of pilot lights).

Do not use a water-based spray around electric appliances, outlets or switches unless the power has been shut off. Water conducts electricity, so you risk electrocution if the spray touches a live power source (Figure 3-12).

Power tools and other electrical equipment that you may use during a pest-control operation can also create hazards. Wiring in older build-

PROTECTIVE CLOTHING AND EQUIPMENT REQUIREMENTS

C A daily change of clean coveralls or clean outer clothing. Wear waterproof pants and jackets if there is any chance of becoming wet with spray. Disposable suits of Tyvek can be used in some, but not all situations. Uncoated Tyvek can be worn in place of coveralls or long sleeved shirt and pants. It will not take the place of waterproof outer clothing. Tyvek that has been coated with polyethylene can be worn in place of waterproof clothing in some situations, but not with organophosphate liquids. The solvents in these pesticides will break down the polyethylene coating. Saranex coated Tyvek suits can be used effectively with organophosphates. Neither uncoated or Saranex coated Tyvek adequately protect against chlorinated hydrocarbons such as methyoxychlor.

A Waterproof apron made from rubber or synthetic material. Use for mixing liquids.

B Waterproof boots or foot coverings made from rubber or synthetic material.

F Face shield, goggles, or full face respirator. Goggles with side shields or a full face respirator is required if handling or applying dusts, wettable powders, or granules or if being exposed to spray mist. Safety glasses with brow and temple protection may be worn if the label does not specify goggles or face shield.

G Waterproof, unlined gloves made from rubber or synthetic material.

H Waterproof, wide-brimmed hat with nonabsorbent headband, or a hood if wearing a waterproof plastic rain suit with hood attached.

R Cartridge type respirator approved for pesticide vapors unless label specifies another type of respirator such as a dust mask, canister type gas mask or self-contained breathing apparatus.

SUMMARIZED LABEL STATEMENT Toxicity Category	MIXER-LOADER I-II	 III	APPLICATOR I-II	 III **
Precautions should be taken to prevent exposure.	A, B, C, F, G, H, R *	A, B, C, F, G, H	A, B, C, F, G, H	C, F, G, H, R *
Protective clothing or protective equipment is to be worn.	A, B, C, F, G, H, R *	B, C, F, G, H, R *	B, C, F, G, H, R *	C, F, G, H, R *
Clean clothing is to be worn.	C	C	C	C
Contact with clothing should be avoided.	A, B, C	B, C	B, C	C
Contact with shoes should be avoided.	B	B	B	B
Rubber boots or rubber food coverings are to be worn.	B	B	B	B
Contact with skin should be avoided.	A, B, C, F, G, H	B, C, F, G, H	B, C, F, G, H	B, C, F, G, H
A cap or hat is to be worn.	H	H	H	H
An apron is to be worn.	A	A		
Rubber gloves are to be worn.	G	G	G	G
Contact with eyes should be avoided.	F	F	F	F
Goggles or face shield is to be worn.	F	F	F	F
Avoid inhalation.	R	R	R *	R *
A respirator is to be worn.	R	R	R *	R *

Table 3-5. Protective Equipment and Clothing Guide.

* Use this equipment when there is a likelihood of exposure to spray mist, dust, or vapors.

** If the Category III pesticide application is being made in an enclosed area such as a greenhouse, or if the application consists of a concentrate spray of 100 gallons-per-acre or less in a grove, orchard, or vineyard, then use the protective equipment guidelines for Category I-II pesticides.

ITEM	USES/PROBLEMS	MAINTENANCE
PROTECTIVE EYEWEAR		
Goggles	Suitable for most mixing and application jobs. Lenses scratch easily. May fog up. Choose goggles with nonabsorptive head band.	Clean daily with soap and water. Replace scratched lenses and worn straps.
Safety glasses	Must have brow and side shields. More comfortable than goggles. Do not provide as much protection as goggles. Available with tinted lenses.	Clean daily with soap and water. Replace when lenses become scratched.
Face shields	Suitable for mixing but not for most application situations. Scratches easily. Must have nonabsorbent headband.	Clean daily with soap and water. Replace when lenses become scratched.
PROTECTIVE HEADWEAR		
Plastic hard hat	Must have nonabsorbent headband.	Clean daily with soap and water.
Hood on waterproof jacket	Should not be removable. Must be unlined.	Clean daily with soap and water.
PROTECTIVE CLOTHING		
Woven long-sleeved shirt and long pants	Minimal protection but should be worn when more protection not required. Avoid wetting with liquid sprays.	Launder daily with hot water and liquid detergent.
Woven coveralls	Minimal protection. Can be removed easily if contaminated. Protects clothing underneath. Avoid wetting with liquid sprays.	Launder daily with hot water and liquid detergent.
Disposable coveralls	Several types offering different types of protection. Unlaminated materials offer similar protection as woven materials. Laminated materials offer protection similar to waterproof materials.	Generally not reused. Throw away after each day or launder with hot waer and liquid detergent.
Waterproof rain suit	Maximum protection. Must have attached hood. Must be unlined or have nonabsorbent lining.	Launder daily with hot water and liquid detergent. Check daily for cracks and tears.
Waterproof gloves and boots	See previous chart for suitable materials. Gloves should be unlined.	Wash gloves daily with mild soap and water. Check daily for holes and cracks.

Table 3-6. Selecting and Maintaining Personal Protective Equipment.

ings may not accommodate heavy-duty electrical equipment. Before connecting equipment, use a circuit tester to make sure the outlet is correctly grounded. Check the wiring size and the fuse or breaker box to be sure that the system can handle the electrical demand of the equipment being used. If the circuit is not protected with the correct size fuse or circuit breaker, or if wiring is too small, an overload could heat the wiring and start a fire. Inadequate grounding can cause a fatal electric shock; prevent this hazard by using a ground fault interrupter (GFI).

Figure 3-13. Reduce exposure hazards when working in confined areas by always wearing personal safety equipment.

Working in Confined Areas

Confined areas present special hazards to persons making a pesticide application. Confined areas may be attics, crawl spaces beneath buildings, storage areas, closets, small rooms and other places that have poor ventilation. Hazards include inhaling the pesticide being applied and coming in contact with treated surfaces. Cramped areas may be uncomfortably hot due to poor air circulation. High temperatures may increase your exposure potential, because sweating and high temperatures accelerate the rate of skin absorption of some pesticides.

Reduce exposure hazards when working in confined areas by wearing personal safety equipment (Figure 3-13). Whenever possible, increase ventilation in the treatment area by opening windows or using a fan to bring in fresh air. Always begin the application from a point furthest from the exit; never walk or crawl through freshly applied pesticide.

To avoid breathing fumes, wear an approved pesticide respirator. Be sure it seals well around your face and is in good working condition. A cartridge or canister type respirator must be worn whenever a Category I or Category II pesticide is being used in confined areas. Applicators with beards or long sideburns must use a powered cartridge respirator, because facial hair prevents adequate sealing of conventional respirator face masks. When atmosphere monitoring equipment indicates that an oxygen deficiency condition exists, or when applying a fumigant, a supplied-air respirator is required.

Prevent skin or eye contact with spray residue or vapor. Always wear a long-sleeved shirt and full-length pants, coveralls or lightweight spray suit when making an application. Protect your hands with waterproof gloves and use a faceshield or goggles to prevent spray or dust from getting into your eyes. Check the pesticide label for the minimum protective clothing requirements.

Technique for Properly Fitting Cartridge Respirators: ISOAMYL ACETATE (banana oil) FIT TEST*

The chemical isoamyl acetate, commonly referred to as "banana oil," is available from major chemical suppliers and is widely used to check respirator fit. Its odor is easy to detect, and the chemical can be used with any pesticide respirator equipped with organic vapor cartridge or canister.

When conducting a fit test, it is important to know that some brands of respirators are available in small, medium, and large sizes. If possible, have several different sizes available during the test to ensure proper fit. Try respirators from different manufacturers since one brand may fit better than others.

If a respirator does not fit properly, the applicator will not be adequately protected. Therefore, be sure to follow the test procedures outlined below:

1. Be sure there is no banana oil odor in the test area that may influence the wearer's ability to detect its presence. Once a respirator is selected, have the wearer adjust it until there is a good face-to-mask seal.
2. Saturate a piece of cotton or cloth with banana oil. The person performing the test should wear rubber gloves and avoid skin contact with the wearer.
3. Pass the saturated material close to the respirator in a clockwise and counter-clockwise motion. Have the wearer stand still and breathe normally and then deeply. If the wearer smells banana oil, readjust the respirator or select a different size or style before starting again.
4. If the odor cannot be detected while the wearer is standing still, have them perform side-to-side and up-and-down head movements. Also have the wearer talk loudly enough to be heard by someone standing nearby. Then have the person make other movements, such as bending over, that may occur during spray application.
5. If the banana oil odor cannot be detected during the above movements, it indicates a satisfactory fit. Seal the respirator in a plastic bag marked with the wearer's name. Keep a record of when the fit test was conducted, along with the size and brand of respirator selected for each user.

*Adapted from A Guide to the Proper Selection and Use of Respirators, Zoecon Corporation.

Protecting Pets and Domestic Animals

Pets housed in or near residences or other buildings include several types of mammals, birds, reptiles, amphibians and fish. Associated with pets and domestic animals are their food and water supplies, bedding, pens, equipment and toys.

Most animals are susceptible to injury by pesticides, even some types that are applied at low doses. Fish and birds are among the most susceptible. Cats are very sensitive because they are metabolically unable to detoxify many types of pesticides. Young animals and older or sick animals may be more affected by lower pesticide doses than adult or healthy animals. Cats and dogs lie and sleep on the ground and other surfaces that may have been treated. They groom and clean themselves by licking, which increases their potential for exposure even when small amounts of pesticide have been used.

To provide protection for pets and domestic animals, remove them from the area before applying a pesticide. Keep animals away until the spray dries and the area is well ventilated. Do not apply pesticides on or near animal food or water. If the animals return to the treated area, remove their flea collars. Discontinue any ectoparasite systemic medications. Pets or domestic animals can be the source of some pest problems. For instance, dogs and cats usually bring fleas inside; dogs may also carry in ticks. Animal manures provide food and breeding sites for several fly species. Pet or livestock food or food left in an animal dish or feeder can attract mice and rats as well as cockroaches, flies and ants. An animal's water dish may provide the water some pests need. Therefore, when performing pest management in an area where pets or livestock are kept, look for these types of conditions. Evaluate and, if necessary, suggest modifications of the feeding routine, housing arrangement and sanitation practices to reduce pests.

Pesticide Drift

If pesticides are not carefully applied, they may drift beyond the treatment site and become deposited as unacceptable residues on surfaces not intended to be treated. These residues can possibly endanger nontarget organisms. Residues from improper application or rinsing of equipment may also result in contamination of surface or groundwater.

Preventing Drift or Unwanted Exposure. Do not use dusts in outdoor locations. To prevent drift when applying liquid sprays, use low pressures and large-nozzle orifices. This prevents formation of small droplets subject to drift. Never make an outdoor application of a liquid spray when the wind is blowing faster than 5 miles per hour. If there is a slight wind, select a formulation or adjuvant that reduces drift. Be especially careful if you are spraying near fruit trees or vegetable gardens, flowers, laundry being air dried, cars, windows, dark surfaces that may spot, pet or livestock food and water containers, fish ponds, bird baths, swimming pools, saunas, spas, or outdoor furniture. Avoid outdoor applications that may drift to children's play areas, sandboxes, swing sets, or lawns and shrubbery that children contact.

Do not apply a pesticide outdoors where residues can be carried into a well, stream, pond or other water source. Never drain or wash application equipment where runoff into sewers, sinks, or sumps can occur.

When applying liquid or dust inside, keep it away from air ducts, fans or blowers to prevent the material from being blown around.

Characteristics Of Treated Surfaces

Treatment sites may have surfaces whose characteristics must be evaluated before applying a pesticide. Depending on the type of surface, a pesticide can be absorbed and rendered ineffective, or the surface may be stained or etched. Concrete, for example, is porous and tends to absorb liquid sprays, reducing the amount of residue on the surface available to control target pests.

Floor coverings such as linoleum, tile and carpeting can be stained or etched by some pesticides or solvents. Certain wallpapers and carpets contain dyes that may run, dissolve or change colors if exposed to some pesticide components. Paint and other finishes used on walls or woodwork may also react with these chemicals to produce spotting or discoloration. Fabrics of all types, and the dyes used for patterns and color, may also react, affecting wear or causing a stain or color change. A soiled fabric may react differently than a clean one. Fabrics also can absorb a liquid pesticide, reducing pest control effectiveness. Dust formulations leave an unsightly residue if applied to surfaces of furniture, woodwork, fabrics, and other items in the treatment area.

Preventing Problems

Stains or color changes may be caused by an excessive dose or by certain application techniques. The formulation type may affect staining or spotting. A soiled or greasy surface may increase staining, spotting or absorption. Paint that has been recently applied and not fully cured has more of a tendency to spot.

Whenever possible, first apply a pesticide to an inconspicuous area, such as a closet, and allow the pesticide to dry for several hours to observe the reaction. Be careful when treating upholstery, furniture, drapes, or lower wall surfaces with a pesticide. Lower wall surfaces are more likely to be soiled, which may enhance staining or bind the pesticide to make it less effective. Read and follow label directions and precautions carefully to avoid staining, spotting, visible residues and pesticide deactivation. Thoroughly clean the application equipment before adding a pesticide to prevent a possible reaction between the pesticide and contaminants in the equipment. These contaminants may cause stains or other adverse effects.

When two or more pesticides are mixed, additional problems associated with pesticide compatibility may appear. Check the compatibility of pesticide mixtures before application.

Odor Problems

Many pesticides have odors that can be detected during and after application. Odors are usually strongest when pesticides are first applied. In confined areas, odors may become overpowering and objectionable. They can cause nausea or headache, initiate asthma or other breathing difficulties, or trigger other medical or anxiety-related symptoms.

An odor may be a chemical characteristic of the pesticide or its solvent or it may be a substance added to the pesticide as a warning agent to reduce chances of injury. Reduce problems associated with odors by (1) using only the application rate stated on the pesticide label, (2) applying the pesticide in localized areas or as a spot treatment whenever possible, (3) using a low-odor formulation if available and if appropriate, (4) increasing ventilation to the application area by opening windows and doors or using fans, and (5) applying the pesticide during periods when the building is not occupied.

An odor may also be caused from a reaction between the pesticide and surfaces that have been treated. Before applying any pesticide in a confined area, read the pesticide label to determine if any of the chemicals in the formulation will react with treated surfaces to produce an odor.

Transporting Pesticides

Pesticides must be transported with special care to prevent spills or accidents that might possibly injure people and animals or damage the environment. A pesticide spill on a roadway can result in serious problems.

Pest-control service vehicles such as pickup trucks or vans are generally used to carry pesticides and application equipment to work sites (Figure 3-14). Some pesticides may be in original containers or service containers; others may be in a spray tank or application device. No matter what form they are in or how they are contained, pesticides transported on public roads are classified by regulatory agencies as hazardous materials. Unused spray material may be classified as a hazardous waste. Classification as a hazardous waste greatly complicates the manner in which pesticide materials can be transported, stored and disposed.

Figure 3-14. Pest-control service vehicle.

CONTAINERS: Use original container. Be sure container is sealed. Use approved service container, tightly sealed. Use application tank or equipment with proper seal.

LABEL: All containers and application equipment must be labeled to show contents of container, signal word, responsible party, and the statement "Keep Out of Reach of Children."

VEHICLE: Transport pesticides in a truck where cargo is separate from passenger area. Do not carry people or animals in cargo area. Do not carry food or animal feed in cargo area. Secure containers and equipment containing pesticides. Do not stack pesticide containers higher than sides of vehicle's cargo area.

PLACARDS: Placards may be required on vehicle. Check with Florida Highway Patrol or Department of Transportation. If required, placards must be placed on all four sides of vehicle and be clearly visible.

SECURING VEHICLE: If vehicle is ever left unattended, pesticides must be secured in a lockable container. Covers on tanks containing pesticides must be locked or equipment must be in a locked part of the vehicle.

ACCIDENTS: Accidents involving pesticide spills on public roads must be reported to local police and fire authorities or the Florida Highway Patrol immediately. Call "911." Never leave the accident site until another responsible party arrives and supervises the cleanup. Keep people away from the spill.

RECORDS: Keep records of all pesticides carried in the vehicle. Have copies of the Material Safety Data Sheets for each pesticide in the vehicle. This information is useful to emergency workers in the event of an accident.

PROTECTIVE CLOTHING AND EQUIPMENT: Do not wear or store contaminated clothing or equipment in the passenger compartment. Store clean clothing and equipment in a separate compartment from the contaminated clothing and equipment.

Table 3-7. Factors to Consider When Transporting Pesticides.

Figure 3-15. Be sure application devices are labeled with the name of the pesticide, its EPA registration number, the name of the active ingredient and its weight or percent in the formulation, the toxicity signal word, and the name, address, and telephone number of the person or company responsible for the container.

Government agencies regulate hazardous material and hazardous-waste transportation on public roads. Under certain conditions, a permit may be required to transport hazardous materials or wastes. Transportation regulations also require that certain vehicles be equipped with placards indicating the class of hazardous material carried. Vehicles may be subject to inspection by the Florida Highway Patrol (FHP). See Table 3-7 for important factors that should be considered when transporting pesticides in a vehicle. Consult with FHP and the Florida Department of Transportation for information on regulations and permits.

During transport, keep undiluted pesticides in their original containers or in approved, labeled service containers. If a container has previously been opened, be sure it is tightly resealed before transporting. Carry diluted pesticides in approved containers and label them according to state and federal regulations. Application equipment or service containers containing pesticides must be labeled with the name of the pesticide, the toxicity signal word from the original container, and the name and address of the person or company responsible for the container (Figure 3-15). It should also bear the statement "KEEP OUT OF THE REACH OF CHILDREN."

During transport, secure all pesticide containers and application equipment to avoid spills or container damage. Use sand bags, blocks, ropes, or straps to prevent movement. The vehicle should be equipped with an emergency spill control kit, including a supply of absorbent material, a special container for holding waste, and a quantity of clean water. If a spill occurs, no matter how small, clean it up immediately. Table 3-8 is a summary of pesticide cleanup.

Lock the area within the vehicle where pesticides are carried to keep children or unauthorized adults out when the vehicle is unattended (Figure 3-16). Also, lock tanks containing diluted pesticides, or store tanks and other equipment containing pesticides in a locked area on the vehicle that is separate from food, feed and passengers.

1. Wear protective equipment, including rubber boots, gloves, waterproof protective clothing, goggles, and respiratory protection.
2. Clear the area and prevent unprotected people from coming near the spill.
3. Administer first aid and obtain medical care for anyone who receives a pesticide exposure.
4. Prevent fires by extinguishing sources of ignition and providing adequate ventilation.
5. Contain the leak. Use sand or other absorbent to keep the pesticide confined. Patch the leaking container or transfer its contents to a sound container.
6. Clean up pesticide and absorbent and any contaminated objects. Place these materials into a sealable holding container.
7. Decontaminate the area contacted by the pesticide, using a suitable decontamination solution. Transfer residues to the holding container.
8. Label containers holding spilled pesticide and contaminated soil and other objects. Include pesticide name, signal word, and name of responsible party.
9. Transport holding containers to approved Class I disposal site.

Table 3-8. Steps to Follow in Cleaning Up a Pesticide Spill

Figure 3-16. Keep pesticides and application equipment locked in a designated part of the vehicle to prevent children or unauthorized adults from gaining access to them.

Study Questions | Chapter 3

1. Most pesticides should not be stored for longer than two years.

    A. True
    B. False

2. Pesticide containers must be _________________ before they can be disposed of in a Class 2 disposal site.

    A. certified
    B. incinerated
    C. inspected
    D. triple rinsed

3. The most common pesticide types used in and around structures are ________________________.

    A. insecticides and rodenticides
    B. insecticides and fungicides
    C. insecticides and nematicides
    D. rodenticides and herbicides

4. Pesticides dissolved in a liquid are called ________________________.

    A. concentrates
    B. solutions
    C. formulations
    D. mixtures

5. Wettable powder formulations can be abrasive to nozzles.

    A. True
    B. False

6. It is rarely necessary to use respiratory protection when applying dusts.

    A. True
    B. False

7. Granules should be applied to ________________________ for control of ants, sowbugs, earwigs and other pests found on the soil.

    A. pavement
    B. turf
    C. foundations
    D. soil

8. Poisoned baits are usually colored with dye.

    A. True
    B. False

For answers refer to Appendix A.

Chapter 4: Pests On or Near Food

Learning Objectives

After completing the study of Pests On or Near Food, the trainee should be able to:

- Given a cockroach specimen, hand lens, and pictorial key, identify the specimen by common name.
- Given a list of common cockroaches, match each with its habitat.
- Cite monitoring strategies for cockroaches.
- Given an actual control situation, apply all elements of cockroach management to include sanitation, proper selection of pesticides, application techniques, and other control methods.
- Identify key features in the life cycle, habitat and appearance of the common species of ants.
- Given a problem situation for each species of ant, select appropriate control and management procedures, including both chemical and nonchemical.
- Describe the life cycle and habits of common urban flies.
- Given a specimen of a common urban pest fly species, identify its common name or group.
- Given a fly management problem, describe pest management procedures needed to suppress it.

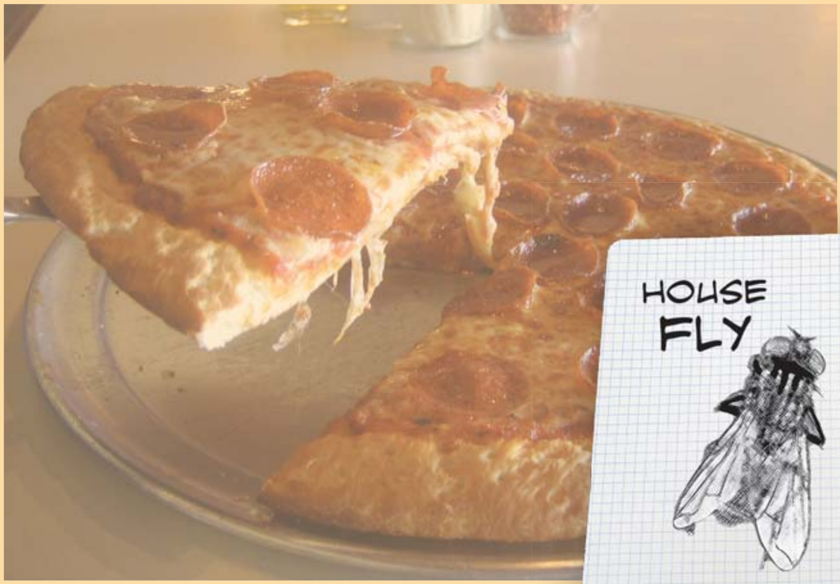

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Figure 4-1. Flies are pests in outdoor eating areas, open-air markets, and home yards.

Cockroaches, ants and flies are some of the most common pests found on or near food in buildings. Successful suppression of these pests is based on understanding their habits so that control methods can be directed to susceptible life stages. To accomplish this, these insects must be correctly identified. General descriptions are included in the following section along with drawings or photographs of some of the more common species. For more complete information on identifying cockroaches, ants, or flies, refer to some of the identification resources listed in the References section at the end of this manual.

Cockroaches

Several species of cockroaches inhabit buildings and may become persistent and troublesome pests. In fact, evidence of their coexistence with people throughout history is testimony to how adaptable cockroaches are to the habits of people. Buildings protect cockroaches from weather and natural enemies and contain sources of food and water as well as many places for them to hide.

There is a difference of opinion on the classification of cockroaches. According to many experts, cockroaches belong to the insect order Orthoptera; other experts consider cockroaches and praying mantids to belong to a separate order known as the Dictyoptera.

Young or immature cockroaches resemble adults (that is, they undergo gradual metamorphosis) and have similar feeding habits. Adults of many species have wings, although many species do not fly; all immature roaches, however, are wingless. Cockroaches are major pests in homes, restaurants, hospitals, warehouses, offices and other structures with food-handling areas. These insects can contaminate food and eating utensils, destroy fabric and paper products, and impart stains and odors to surfaces they contact.

Cockroaches, especially species that live in contact with human feces like the American cockroach, may transmit bacteria responsible for food poisoning, such as *Salmonella* and *Shigella*, and viral hepatitis organisms. German cockroaches are also believed capable of transmitting *Staphylococcus*, *Streptococcus*, and coliform bacteria and are known to be responsible for allergy and asthma problems. In addition, German cockroaches have been implicated in the spread of typhoid, dysentery and leprosy organisms.

Although there are more than 50 described species of cockroaches in the United States and more than 3,500 worldwide, only a few species are major pests (Figure 4-2). These species are the German, brownbanded, Oriental, American, smokybrown, brown, Australian, Florida woods and

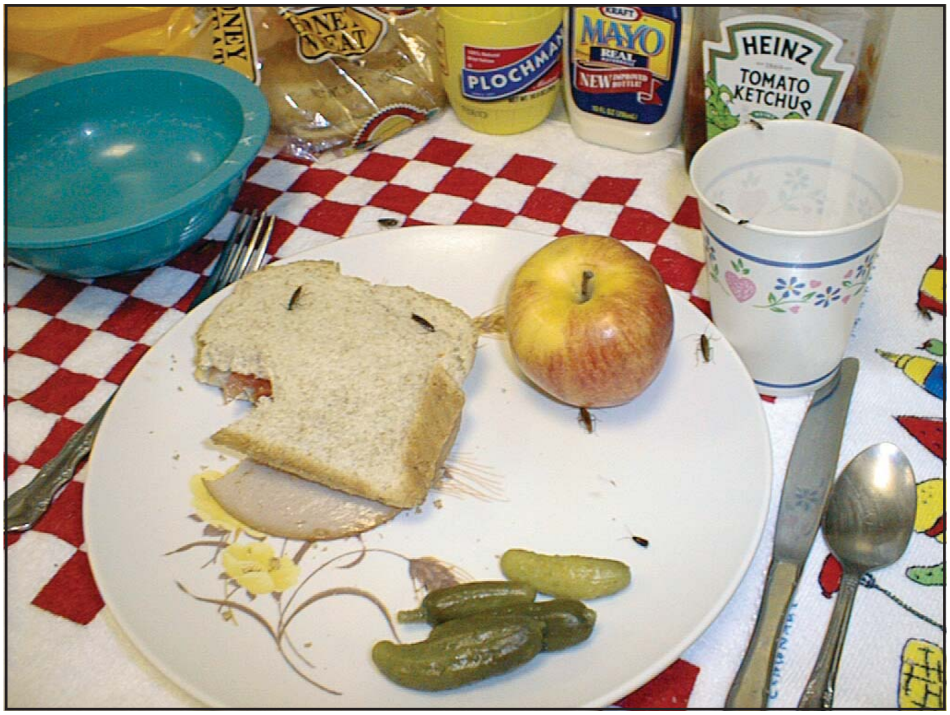

Figure 4-2. There are over 3,500 species of cockroaches throughout the world. However, in Florida only about five species are major pests.

Asian cockroaches. Occasionally other species are introduced into an area and become pests in buildings. Outdoor species often invade buildings.

It is important to be able to identify the species of cockroach causing a problem. You must also be familiar with its behavior, because each species has peculiar habits that influence the type of management methods used and locations where control efforts should be emphasized.

Cockroaches are nocturnal. They hide in dark, warm areas, especially narrow spaces where surfaces touch them on both sides. Cockroaches tend to congregate in corners and generally travel along the edges of walls or other surfaces. Periods of greatest activity differ depending on the species. For instance, brownbanded cockroaches exhibit their peak of activity in the middle of the dark cycle, while German cockroaches begin moving about within one to two hours after lights are out.

German Cockroach
Blattella germanica

German cockroaches are the most common indoor species. They are pests in locations such as homes, hospitals, prisons, zoos and restaurants, and even become pests on ships, planes and buses. In buildings, they are found in food-preparation areas, kitchens, and bathrooms because they favor warm, humid atmospheres; areas where temperatures are around 70° to 75°F are most suitable. With severe infestations, they may occur in other parts of buildings. German cockroaches have been observed migrating in large numbers from areas of high population density to infest other locations.

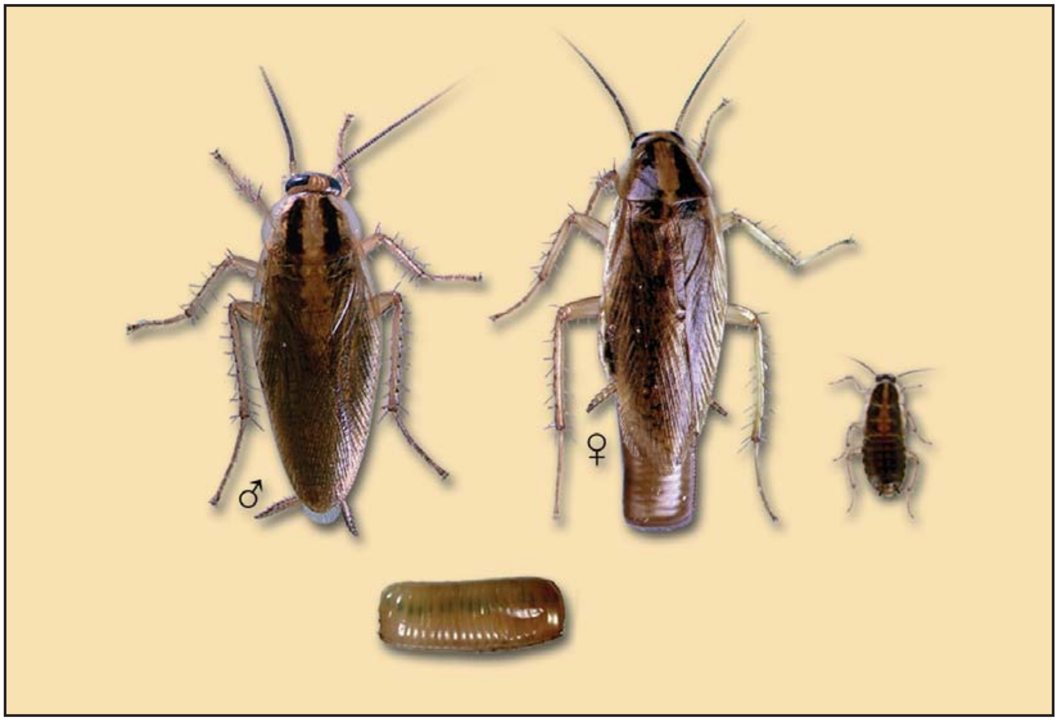

Figure 4-3. German cockroach, *Blattella germanica*.

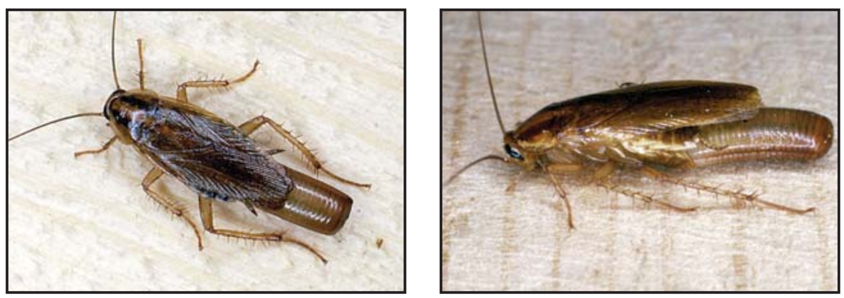

Figure 4-4 and 4-5. As with many species of cockroaches, female German cockroaches lay their eggs into a capsule called an ootheca. German cockroach females carry these egg cases throughout most of the incubation period.

Description and Seasonal Development. Adults are about ½ inch long, brown, and have two darker longitudinal bands or streaks on the top of the thorax. German cockroaches (Figure 4-3) do not normally fly but are capable of gliding flight. This species has the highest reproductive potential of all the common pest cockroaches. Egg laying occurs more frequently during warm weather. Females produce about 30 to 50 eggs at a time, contained in a capsule called an ootheca (Figures 4-4 and 4-5) which is attached to the tip of the abdomen and carried throughout most of the incubation period. Females drop the ootheca about one day before egg hatch. Eggs of this species hatch in about 28 days at room temperature, and the hatchlings reach maturity in about 40 to 125 days after passing through five to seven molts. Adult females live about 200 days, producing six to eight oothecae throughout this time.

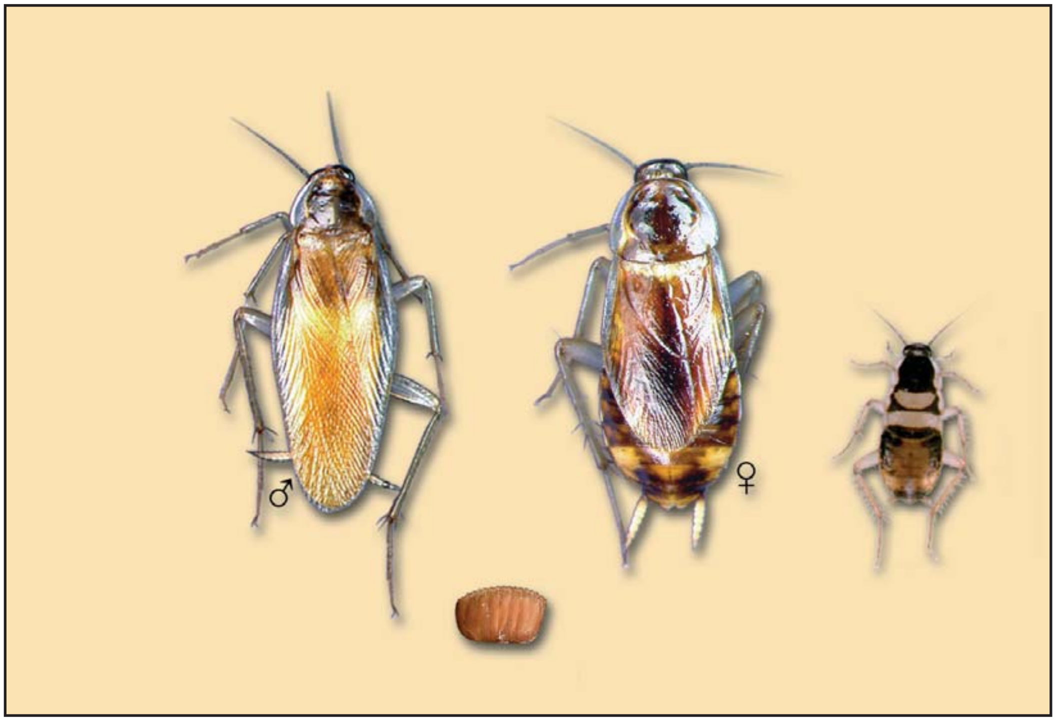

Figure 4-6. Brownbanded cockroach, *Supella longipalpa*.

Brownbanded Cockroach
Supella longipalpa

The brownbanded cockroach is not commonly found in Florida even though it was first introduced into the United States in Miami around the early 1900s. Individuals may be widely distributed throughout a building, hiding behind pictures, beneath furniture, among books and in other drier areas not normally infested by German cockroaches. They seek areas that are warm most of the time such as radios, televisions and refrigerators. They appear to be more common in apartments or homes of the elderly who don't use air conditioning. They are also seen in animal-rearing facilities and are becoming more frequent pests in institutional kitchens, offices and hospitals.

Description and Seasonal Development. Brownbanded cockroaches (Figure 4-6) are about ½ inch long at maturity. Adult males are golden brown and have a narrow body; their wings extend beyond the tip of the abdomen. Female adults are darker chestnut brown, have a teardrop-shaped body, and their wings do not completely cover the abdomen. Both sexes have distinctive horizontal bands of color. Nymphs have two pale bands which run horizontally across the body. Wings on adults have brownish yellow stripes; adult males fly readily when disturbed but females do not fly. Females carry their oothecae for 24 to 36 hours before attaching them to a hidden vertical surface. They often glue their eggs in clusters on furniture or in appliances. Eggs require about 70 days for incubation, and about 160 days to reach maturity. More eggs are produced during summer months. Brownbanded cockroaches prefer warmer temperatures (greater than 80°F) than the German cockroach. Therefore, these two species are rarely found together.

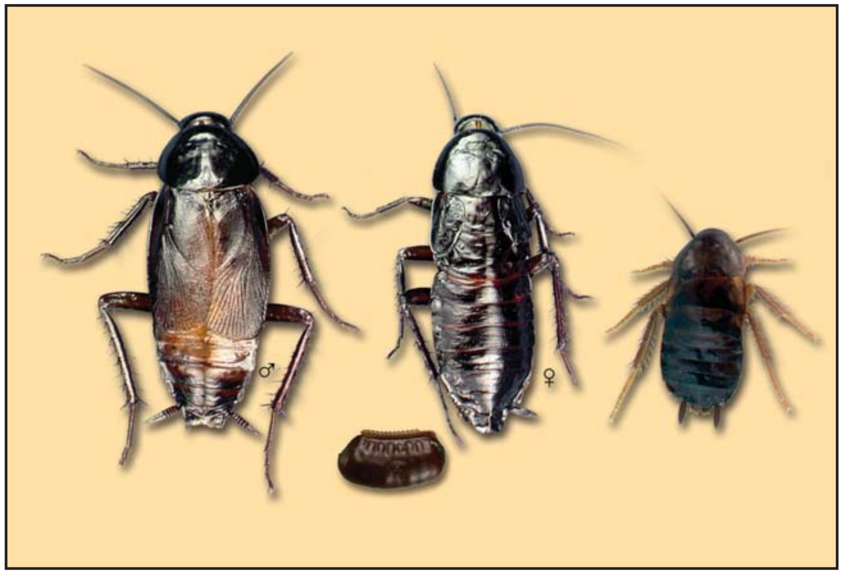

Figure 4-7. Oriental cockroach, *Blatta orientalis.*

Oriental Cockroach
Blatta orientalis

The Oriental cockroach (Figure 4-7) has never been found in Florida, but many pest control operators mistakenly identify Florida woods cockroaches as Orientals. The latter is in most of the U.S. north of Florida and lives in colonies in dark, damp places. Usual places where they are found include indoor and outdoor drains, water-control boxes, woodpiles, basements, garbage chutes, damp areas under houses, and trash cans. They may be found in large numbers outside where people feed their pets. At night, Oriental cockroaches may migrate into buildings in search of food. Migrations may also be observed during periods of adverse weather. They usually remain on the ground floor of buildings and move more slowly than other species. They do not fly and are unable to climb smooth surfaces. Consequently they are commonly found trapped in porcelain tubs or sinks.

Description and Seasonal Development. The adult is about 1 to 1¼ inches long and dark brown, almost black. Males have fully developed wings which are shorter than the body, but don't fly; females have rudimentary wings. Females deposit an average of eight oothecae during their lifetimes; each capsule produces about 16 young. The female carries the oothecae for about a day after formation, then deposits it in a humid location where the eggs complete development. Eggs require about 60 days to hatch. The time for development from egg hatch to adult ranges between 300 and 800 days, depending on environmental conditions. After reaching maturity, adult females live for another 30 to 180 days.

American Cockroach
Periplaneta americana

The American cockroach is a common pest in zoos and animal rearing facilities and also lives in sewers, water meter boxes and steam tunnels. They prefer very warm and humid environments (temperatures in excess of

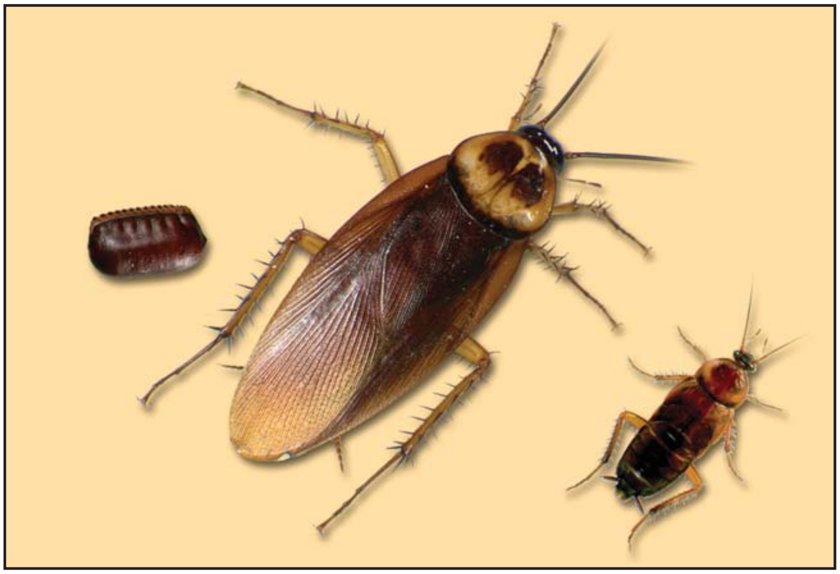

Figure 4-8. American cockroach, *Periplaneta americana.*

82°F) but occasionally forage from sewers and other areas into buildings. Their foraging is confined mostly to the ground floor of buildings unless suitable conditions exist in higher locations.

Description and Seasonal Development. The American cockroach (Figure 4-8) is one of the largest roaches that invade buildings. Adults are about 1¼ to 2 inches long and are reddish brown. Females carry oothecae for a short period before depositing them. Females produce between ten to 60 oothecae, each giving rise to about 14 young. Eggs require about 45 days to incubate. Young mature in as little as 215 days; some studies show that maturation takes up to 400 days. The average life span for an adult female is about 440 days. The greatest numbers of adults are usually seen during late summer months.

American cockroaches can fly and are attracted to street lights at night. They are active throughout the year in temperatures of 70°F or higher.

Brown Cockroach
Periplaneta brunnea

The brown cockroach was first reported in the United States in 1907 in Illinois, but is well established in numerous states throughout the Southeast. While its distribution has grown during this century, it is found mainly in the southeastern states. The brown cockroach occurs mainly outdoors, under the bark of trees and also in sewers.

Description and Seasonal Development. The brown cockroach (Figure 4-9) is often mistaken for an American cockroach. The adults are reddish-brown, but somewhat darker in color. It is 1¼ to 1½ inches (32 to 38mm) long. Males have cerci and styli (structures on the tip of the abdomen) while females have cerci. The cercus of the brown cockroach is stout and triangular in shape, whereas the American cockroach cercus is long and thin.

Figure 4-9. Brown cockroach, *Periplaneta brunnea.*

The life cycle of the brown cockroach requires 339 to 351 days. An average of 24 (21 to 28) eggs are laid in each ootheca and hatch in 35 days. The egg capsules are glued onto surfaces, usually hidden with debris,

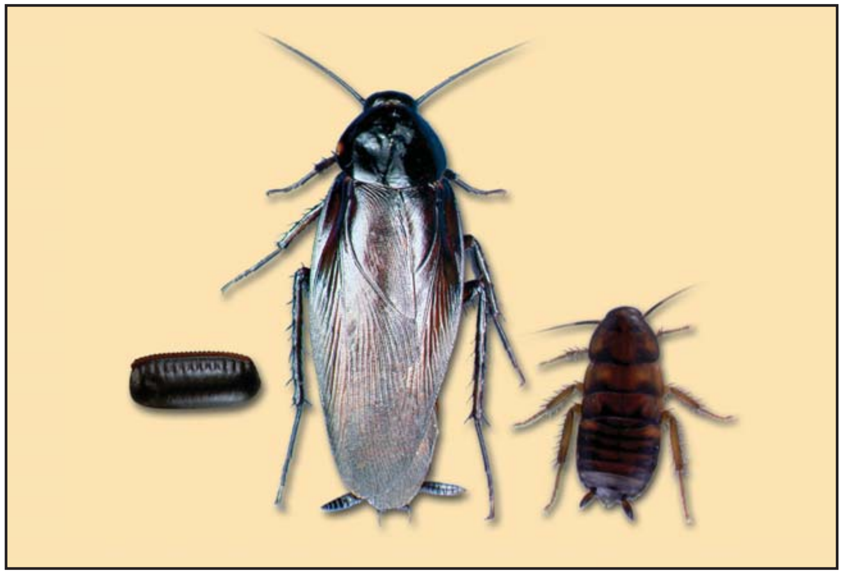

Figure 4-10. Smokybrown cockroach, *Periplaneta fulignosa.*

and may be guarded by the female. Females can produce up to 30 egg capsules in their lifetime. About 14 to 16 nymphs hatch from each ootheca. First-stage nymphs have the first four and last eight segments of the antennae marked with white. The duration of the nymphal stage is 263 to 277 days. Adults can live for 20 months.

Smokybrown Cockroach
Periplaneta fuliginosa

The smokybrown cockroach is usually found in garages, decorative plantings and planter boxes, woodpiles and water-meter boxes; it also occasionally lives in municipal sewers. This species is very visible and is usually seen by building occupants. It can be found in upper parts of buildings, including attics, although it is not specifically attracted to heated areas of buildings where other species are likely to be; it also crawls under shingles or siding and can be found in trees, shrubs and other vegetation during summer.

Description and Seasonal Development. The adult smokybrown cockroach (Figure 4-10) is about 1¼ inches long and uniformly dark brown to mahogany, sometimes almost black. This species has well-developed wings, ordinarily flies, and is known to be attracted to lights at night. The female carries its ootheca for about one day before attaching it to a surface. Eggs hatch on an average of 45 days and about 20 young emerge from each ootheca. Females reach maturity in about 320 days. More adults occur during summer than during any other season.

Australian Cockroach
Periplaneta australasiae
This worldwide species has become established in the southern United States and in many greenhouses. In the United States, it is most abundant in Florida and other southern coastal states.

Like the smokybrown cockroach, it lives outdoors around the perimeter of houses and is the most prevalent cockroach outdoors in south Florida. Australian cockroaches are prevalent in leaf litter, in and around shrubs, flowers and trees, tree holes, wood piles, garages, crawl spaces, attics and greenhouses. It is a pest when it enters homes where it may eat holes in clothing and feed upon book covers. It is apparently more vegetarian than the others, and it has appeared in greenhouses where it has damaged plants.

Figure 4-11. Australian cockroach, *Periplaneta australasiae.*

Description and Seasonal Development. The Australian cockroach (Figure 4-11) closely resembles the American cockroach, but can be separated from it by its slightly smaller size (over one inch), the yellow margin on the thorax, and the light yellow streaks on the sides at the base of the wings or tegmina. It is about 1¼ to 1⅜ inches long and the wings of both sexes cover the abdomen. The female has a broader abdomen than the male and lacks styli. Late instar nymphs possess distinct bright yellow spots along the margins of their abdomen.

The Australian cockroach life cycle requires about one year from egg to adult. The ootheca takes 40 days to hatch. There are 24 eggs per egg capsule, 16 of which hatch. Each female produces 20 to 30 oothecae. The nymphs take about one year to develop. Some of the eggs produced parthenogenetically hatch, but the nymphs do not mature.

Florida Woods Cockroach
Eurycotis floridana

Figure 4-12. Florida woods cockroach, *Eurycotis floridana.*

The Florida woods cockroach is in the West Indies and Florida. It is found in almost any outdoor sheltered location, most often in stacked lumber, firewood, leaf litter and sometimes tree holes. It may occasionally enter houses.

Description and Seasonal Development. The Florida woods cockroach (Figure 4-12) is large, dark brown to almost black, averaging 1½ to 1¾ inches (38 to 44.5 mm) in length. The wings are short and barely extend beyond the mesonotum. Florida woods cockroaches have only one generation per year. Adults may survive for several years.

Asian Cockroach
Blattella asahinai

The Asian cockroach is a more recent introduction into Florida and has spread over at least one-third of the state. The cockroach has been widely publicized and is considered a significant pest by residents in infested areas.

The Asian cockroach was identified as a newly introduced species in 1986 when a heavy infestation was found in Polk County, Florida. The Asian cockroach has spread to infest virtually all counties from Marion County in central Florida to Collier County in southwest Florida. It has the potential to become a major pest in much of the United States.

The Asian cockroach is a rural and suburban pest that mainly infests single-family, suburban houses and yards. It is abundant outdoors, where populations of 30,000 to 250,000 per acre have been found. The adults are strong fliers and readily enter the houses.

The Asian cockroach (Figure 4-13) is both a feral (wild) and peridomestic species. Adults take flight even during the day if disturbed; they are readily seen in an infested lawn, because their flight is similar to that of moths and leafhoppers. At dusk there is a frenzy of activity, when adults are very active in the grass and mulch. They climb to the tips of grass and leaves and take flight. They are attracted to light-colored or brightly lit surfaces, where they settle. Numerous adults have been seen at all heights on single- and two-story homes.

Asian cockroaches invade any opening in a house, such as a lighted doorway or window. Once inside, they crawl on illuminated television screens and on walls while the lights are on during the evening. Because the peak activity period of Asian roaches coincides with our leisure time, the presence of the cockroach is obvious and annoying.

Asian cockroaches are abundant in shaded areas with leaf litter or where there is ground cover. In feral habitats, the Asian cockroach is found in shaded areas of pastures, along shaded road sides in leaf mulch, in shaded areas of thick grass, and in the ground cover of abandoned citrus groves. The adults have been found feeding on the honeydew of aphids on citrus trees, and on the flowers of other plants during the night.

Figure 4-13. Asian cockroach, *Blatella asahinai.*

Description and Seasonal Development. The Asian cockroach is almost identical in appearance to the German cockroach. In fact, entomologists once believed it was an outdoor strain of the German cockroach in Asia. The main morphological differences between the Asian and German cockroaches are the shape of a groove in one segment (eighth) of the abdomen and a small gland in the males. The wings of the Asian cockroach are usually longer and narrower than those of the German cockroach. The wings extend beyond the tip of the abdomen and cover the egg capsule in the females. Asian cockroaches are lighter in color than most German cockroaches.

The Asian cockroach can be identified by gas chromatography of the waxes found in the exoskeleton. Any part or stage of the cockroach can be identified with this procedure. (This roach should not be preserved in alcohol; dry, dead specimens should be sent to a cooperative extension office for analysis.)

The female Asian cockroach produces an egg capsule with about 40 eggs and carries it until the young are ready to hatch. The nymphs mature to adults in about six to seven weeks. From late May through early August, nymphs predominate and adults are rarely encountered. However, adults are abundant during the spring months (February through May) and again mid-August to October.

The feeding behavior of the Asian cockroach appears to be similar to other cockroaches, in that they are omnivorous. Thus, they may be capable of carrying the same pathogenic organisms as the other peridomestic and domestic species of cockroaches. Considering their ability to produce large populations and their likelihood of entering homes, these cockroaches will carry along pathogens associated with animal droppings and soil microorganisms when they enter the home. People sensitive to allergens of German cockroaches are also sensitive to those of Asian cockroaches.

The Asian cockroach is very susceptible to all pesticides; however, acceptable control is difficult. Toxic baits applied to infested areas outdoors provide the most reliable control. Some Asian cockroach baits have been registered for outdoor use. Because the Asian cockroach can fly 120 feet or more in a single flight, large areas around a home require treatment. Even so, cockroaches in surrounding untreated areas may result in reinfestation.

Residual sprays around the perimeter of structures are usually ineffective because there are numerous infested areas in lawns, mulch and wooded areas. Adults enter homes through windows and doorways, and immediately fly to walls, avoiding baseboards and typical German cockroach harborages that are normally treated with pesticides.

Surinam Cockroach
Pycnoscelus surinamensis

Figure 4-14. Surinam cockroach, *Pycnoscelus surinamensis.*

The Surinam cockroach (Figure 4-14) is reported around the world in the humid tropics and in the U.S. from Texas and Louisiana to Florida. It is a burrowing insect which is capable of destroying various plants and is often brought into homes, shopping malls and restaurants in potted plants. Although this cockroach is not in the strict sense a household pest, it is nevertheless a source of much annoyance in related structures such as greenhouses.

The cockroach hides during the day under the soil in the benches, on the sides of the benches, under boards, barrels, in holes and crevices in the walls of buildings and wherever it is dark and possible for them to conceal themselves. At night, they come out in great numbers and gnaw plant stems.

Description and Seasonal Development. The Surinam cockroach is about ¾ inch long and is shining brown to black in color. The front edge of the pronotum has a pale white band.

The egg capsule is retained within the abdomen and the roach gives birth to live young. The number of eggs in each capsule varies from 14 to 42, with an average of 24. No males of this species are found in the U.S. and it reproduces parthenogenetically. In Europe and Indo-Malaysia this roach has two sexes.

Because the Surinam cockroach is outdoors, applications of insecticides to foundation plantings, wood piles, mulch and other infested locations are recommended. Treatments placed to intercept cockroaches are both environmentally and entomologically sound. Residual barrier sprays can substantially reduce Surinam cockroach populations around houses. Application of sprays or granules to potted plants will often control indoor infestations.

Management Guidelines for Cockroaches

Although the German cockroach is the most common, more than one cockroach species may inhabit a building. Successful management depends on identifying the species involved and then selecting methods of control that are effective against these species. You must also change the conditions that attracted and favored the infestation in the first place.

Carefully inspect the infested area to locate cockroaches. Nighttime surveys are useful because cockroaches are nocturnal (active at night). Use a flashlight and search in cracks, under counters, around water

Figure 4-15. A flashlight is essential to search for cockroaches in cracks, under counters, and in other dark locations.

heaters, and in other dark locations (Figure 4-15). Look for alive and dead cockroaches, cast skins, egg capsules and droppings, all of which aid in identification. Use sticky traps (Figure 4-16) or jar traps to monitor cockroach activity and capture specimens for identification; place traps along walls and other areas where cockroaches are known to travel. Traps must be placed right next to walls or other objects or in intersections for maximum effectiveness. If a thorough inspection fails to produce results, an aerosol flushing agent may help to dislodge hiding roaches so they can be captured and identified. Aerosol flushing causes rapid paralysis of cockroaches. However, although extremely useful as flushing agents, aerosols are less effective for the control of cockroaches than other insecticides because they do not have residual action; some cockroaches may recover from the toxic effects of an aerosol knockdown spray. Canned air often is substituted for aerosol flushing of cockroaches.

Once you identify the species, plan your control strategy. Map locations of suspected or actual infestation and concentrate control measures on these areas. Your management program should include nonchemical methods such as sanitation and exclusion whenever possible, because chemical control applied without attention to sanitation may not always be successful.

Sanitation. Eliminate sources of food and water wherever possible. Food should be stored in roachproof containers such as glass jars or sealable plastic dishes. Keep garbage and trash in containers with tight-fitting lids. Remove trash, newspapers, rags, boxes and other items that provide hiding places and harborage. Eliminate plumbing leaks and correct other sources of free moisture. Increase ventilation where condensation is a problem. Vacuum all cracks and crevices to remove debris and food. Be sure surfaces where food or beverage spills have taken place are cleaned up immediately. Trim shrubbery around buildings to increase light and air circulation, especially near vents. Remove trash and stored items around the outside of buildings that provide hiding places for cockroaches.

False-bottom cupboards, hollow walls and similar areas are common refuges for cockroaches. In locations where these conditions exist, and where cockroach populations are high and difficult to control, remodeling may be warranted to eliminate infestations. Commercial areas where food is prepared, stored, or sold would most benefit from remodeling to eliminate cockroach hiding places. If remodeling is too costly or impractical, treat these areas with inorganic dusts such as silica gel or boric acid powder.

Exclusion. If roaches are migrating into a building from outdoors, seal cracks and other openings to the outside. Look for other methods of entry, such as from items being brought into the building. Look for oothecae glued to undersides of furniture, in refrigerator and other appliance motors, boxes, and other items. Locate cracks inside the treatment area where cockroaches can hide; seal these with caulking.

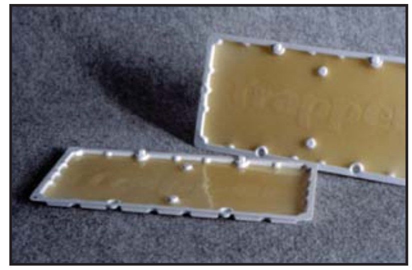

Figure 4-16. Sticky traps are helpful for monitoring cockroach populations. These are most effective if an attractant is placed in the trap.

Chemical Control. Insecticides are usually very effective in controlling cockroaches. However, when infestations occur in food storage, preparation, or serving areas, it is important that insecticides be used with extreme care. Use only materials that are registered for use in food-preparation areas. Combine chemical controls with nonchemical methods whenever possible. In all areas, use only registered insecticides and follow the label directions carefully.

Baits are the most common formulation used to control cockroaches. They can be applied as gel baits or solid baits in bait stations. For control of roaches outdoors, a granular bait may be used. Gel baits may be applied as spot or crack and crevice treatments for the indoor and outdoor (adjacent to homes and structures) for control of cockroaches in residential areas and the nonfood/nonfeed areas of institutional, warehousing and commercial establishments.

For roach gels, application rates are dependent on level of infestation and species to be controlled. Bait can be applied as spots or as a bead in cracks and crevices. Gel placements should be at or near harborages or aggregation areas, such as corners, areas of movement or cracks and crevices. Numerous smaller placements will provide faster control than fewer larger spots, especially for German cockroach control. Do not treat food preparation surfaces. Do not apply bait gel to areas that have been recently sprayed with insecticide, and do not spray insecticide over gel, as it may cause the bait to become repellent.

If contact activity or rapid control is needed, use a quick-acting, low-residual insecticide. These insecticides are usually applied as a liquid spray covering general areas or as a mist in enclosed areas.

Bait stations are manufactured as plastic or cardboard units that contain an attractant. Cockroaches enter the bait station or trap through small openings. Traps and bait stations have the advantage that insecticides can be confined to a small area rather than being dispersed.

To control cockroaches that will be hatching from eggs, have been missed by other treatments, or are migrating in from outside the treatment area, use an insecticide with residual activity. Residual materials may be formulated as liquid sprays, dusts, desiccants (inert dusts or sorptive powders), or impregnates such as lacquers and paints. One possibility for residual control is an insect growth regulator (IGR), which sterilizes or kills immature nymphs. Although highly effective, it may take many months to control a cockroach population with IGR. For this reason, it is common practice to combine IGR with an insecticide having more rapid action to provide an effective long-term control program.

Residual insecticides may be formulated as dusts, liquid sprays, paints or baited traps. Dusts may have desiccant action, such as silica gel, or be internal or contact poisons, such as boric acid. Blow dusts into cracks and crevices or lightly spread them in areas where visible residues are not a problem and where people will not contact them. Do not use boric acid dust in areas subject to repeated moisture followed by drying as the dust will cake and lose its effectiveness. Boric acid is effective but slow acting, killing the pests several days after ingestion or contact. Cockroaches pick

Use of Boric Acid as an Insecticide for Cockroaches

Boric acid is an effective insecticide for the control of cockroaches in buildings and does not appear to present serious health hazards to building occupants, in part because it is a nonorganic chemical which does not penetrate the skin. Boric acid powder is slow acting and may take seven days or more to begin having a significant effect on a cockroach population. Any commercial use of boric acid as an insecticide must be as a registered pesticide, and the use must be strictly according to the label. Formulations usually contain about 1% of an additive which prevents caking and improves dusting properties. Boric acid does not decompose. Therefore it retains its effectiveness as long as it stays dry.

Where to Use: Dust boric acid powder into out-of-the-way places where cockroaches hide. Remove the kick panels from the front of appliances and apply boric acid powder to the entire area underneath. Drill 1/2-inch holes at the top of kick panels beneath cabinets and blow liberal amounts of dust into these areas. Dust spaces under sinks and in dead spaces between sinks and walls. Also dust areas where utility pipes pass through walls. Sprinkle dusts in intersections and in corners of shelves in cupboards.

Method of Application: Boric acid powder can be applied with a bulb duster, hand-operated or power blower, or sprinkled from a small container. Be sure the application method is consistent with label instructions. Avoid dispersing the powder into air ducts or food, eating utensils, food preparation surfaces, and other locations where people or pets might come in contact with it.

Application Rates: Follow label information for application rates. An apartment will usually require one to two pounds of material; an average size house may need two to four pounds. Commercial establishments such as restaurants, cafeterias, hotels and hospitals may require 30 to 40 pounds.

Precautions: Wear gloves and goggles while applying boric acid powder to avoid the powder contacting your skin or eyes. Do not inhale the dust. This material is highly irritating to the eyes and respiratory system. Avoid application in areas where children or pets may come in contact with the powder. Do not apply to plants or to soil where plants are growing.

up this dust on their bodies as they walk through a treated area, then ingest small amounts when they groom themselves.

Apply liquid pesticide sprays to cracks and crevices where roaches spend most of their time and to wall and floor surfaces and other areas where cockroaches travel; use encapsulated formulations for slow release of the active ingredient. Lacquer paints containing residual insecticides are sometimes applied to wall surfaces in areas of cockroach infestation to provide long-term, slow release of the insecticide.

Cockroaches may avoid certain deposits of residual insecticides. For this reason, it is important to use materials that do not repel them; otherwise you must have thorough coverage to ensure that the cockroaches will contact treated areas. Cockroach populations may develop resistance to the insecticides. Populations of cockroaches migrating in from another area may already be resistant to insecticides that were used against them elsewhere. Methods that may help to reduce resistance problems include:

1. use of alternate, nonchemical control methods, such as biological control and good sanitation,
2. lowering the frequency of insecticide application,
3. alternating the types of active ingredient and formulation, and
4. using insecticides that do not repel cockroaches.

Sometimes cross-resistance develops in cockroach populations. This is a condition where the resistance to one type or class of insecticide makes the insect resistant to one or more other types or classes of insecticides.

Monitor and Evaluate. After a cockroach control program begins, evaluate the effectiveness of the methods. Use traps or visual inspections to help determine if treatment is necessary. If populations persist, reevaluate the situation. Look for other sources of infestations, make sure that all possible entryways are blocked, be certain that food and water sources are eliminated as much as possible, and continue sealing and eliminating hiding places. Repeat insecticide applications if necessary. However, if insecticides appear to be less effective, resistance may be occurring. Overuse of insecticides and indiscriminate application may cause resistance.

If cockroach populations are controlled, continue monitoring with baited traps to check for reinfestation. Maintain sanitation and exclusion techniques to avoid encouraging a new infestation. If severe reinfestation continues, consider having the areas modified or remodeled to reduce the amount of suitable cockroach habitat.

Management of Outdoor Cockroaches. Because some cockroaches are primarily outdoors and migrate indoors, applications of insecticides to foundation plantings, wood piles, mulch, and other infested locations are recommended. Treatments placed to intercept cockroaches are both environmentally — and entomologically — sound. Residual-barrier sprays have been shown to provide substantial reductions of cockroach populations around houses. Power dusting of sewage lines, crawl spaces, false ceilings, wall voids and trash chutes is an effective control method. Space sprays, ULV treatment or contact aerosols and sprays can be used in basements and utility rooms. Loose baits and other formulations better suited for damp locations can provide effective control in basements and similar areas.

Ants

Ants are among the most prevalent pests in households. They are also found in restaurants, hospitals, offices, warehouses and other buildings where they find food and water. Most ants can bite with their pincerlike jaws (few actually do) and some have venomous stings. However, they are annoying pests primarily because they appear in large numbers and may nest in wall voids or other parts of structures (Figure 4-17). Ants contaminate and destroy some agricultural products and stored foods. Certain species stain or cause feeding damage to textiles. On outdoor plants, ants protect and care for honeydew-producing insects (aphids, soft scales and mealybugs), which may interfere with the natural biological control of these pests. In nature, ants may perform beneficial functions by preying on certain species of insect pests and aerating soils.

Throughout the world there are over 12,000 species of ants. Less than a dozen species are important pests in buildings, and a similar number cause problems in agricultural and landscape areas.

Ants belong to the insect order Hymenoptera and are close relatives of bees and wasps. These insects undergo complete metamorphosis, passing through egg, larval, pupal, and adult stages. Larvae are immobile and wormlike and do not resemble adults. Ants, like many other hymenopterans, are social insects with duties divided among different types, or castes, of adult individuals. Queens conduct the reproductive functions of a colony, laying eggs and participating in large feeding and grooming. Sterile female workers gather food, feed and care for the larvae, build tunnels, and defend the colony. Males do not participate in colony activities; their only apparent purpose is to mate with the queens. Few in number, males are fed and cared for by the workers.

Ants that invade homes and buildings include the acrobat, Argentine, odorous house, pharaoh, thief, ghost and carpenter ants. Other species such as imported fire ants may be occasional indoor pests. Harvester and velvety tree ants, and other species nest outdoors but also occasionally invade structures.

Figure 4-17. Ants are among the most prevalent household pests; they also are found in restaurants, hospitals, offices, warehouses, and other buildings.

Acrobat Ant
***Crematogaster* spp.**

The slow-moving acrobat ants (Figure 4-18) are found throughout the United States, where they live beneath stones, in old stumps, and in similar areas. Their peculiar habit of raising the abdomen over the head and thorax has given rise to the name “acrobat ant.”

These ants will invade homes for food. They may use tree limbs or power lines as entrances. The various species of *Crematogaster* often live in decaying tree stumps outside and can exist in woodwork, door frames or window frames inside the home. They will also take over areas hollowed out by other insects. Where the colonies are large, the ants sting and bite, but where the colonies are small, the members are timid.

Figure 4-18. Acrobat ant, *Crematogaster* sp.

Description, Development and Habits. Acrobat ant workers are 0.1 to 0.17 inch (2.5 to 4mm) long. The antennae are eleven-segmented and the pedicel is two-segmented and attached to the upper side of the abdomen. The body color of these ants varies from light brown through black and is sometimes multi-colored.

Argentine Ant
Linepithema humile

The Argentine ant (Figure 4-19) forages in restaurants, grocery stores, offices, schools, warehouses and any other location where suitable food and water are available. This persistent pest is difficult to control once it has established a colony inside or near a building. This ant is not a native species, but was introduced into the United States around 1890.

Figure 4-19. Argentine ant, *Linepithema humile*.

Description, Development and Habits. The adult worker is about 1⁄12 inch long and is light to dark brown. Queens are lighter colored and are from 3⁄16 to 1⁄4 inch long; several hundred queens may live in a single, large colony. Argentine ants usually nest in the soil and are often next to buildings or along sidewalks. They also construct nests under boards and plants and sometimes under buildings. They occasionally make nests in wall voids or in soil of house plants if conditions are satisfactory. When foraging, thousands of workers form long trails from the nest to the food location. Ants can be seen traveling in both directions along these trails. Workers all share food with each other and with the colony’s queens.

The queens lay tiny white eggs throughout the year; the maximum production, between 20 and 30 eggs per day per queen, occurs during warm months. The average incubation period is 28 days under favorable weather conditions. After hatching, larvae remain in the nest and are fed, groomed and protected by adult workers. The larval stage lasts approximately 31 days and pupation takes about two weeks. During warm weather, colonies usually break up into smaller groups and migrate closer to food supplies. In the winter they again aggregate into larger colonies. Mating most often takes place in the nest rather than on a mating flight. Queens can live as long as 15 years.

Inside a building, the Argentine ant feeds on sugars, syrups, honey, fruit juice and meat. Outdoors it is attracted to the sweet, sticky secretions called honeydew produced by soft scales and aphids; it also feeds on dead insects and other arthropods and decomposing tissues from dead animals. This diversified diet aids colony survival and success because there is usually always some food available. The Argentine ant's high reproductive potential (a result of the large number of queens in each colony) and the ability of a colony to rapidly adapt and settle into nest sites in a great variety of buildings and natural locations also contribute to this species' success. New colonies can be set up quickly and grow rapidly because queens mate in the nest and participate in the feeding and grooming of larvae. The Argentine ant has no important natural enemies.

Figure 4-20. Bigheaded ants, *Pheidole* sp.

Bigheaded Ants
***Pheidole* spp.**

The so-called "bigheaded ant" is actually a very large group of related ant species. However, *P. megacephala* is certainly the most important pest ant in the group. The bigheaded ant *Pheidole megacephala* is native to southern Africa. It forms very large infestations and is polygynous, i.e., has multiple queens in the nests. They are capable of forming "super colonies" that occupy large areas and are hard to control.

Bigheaded ants (Figure 4-20) nest in and around the house and become pests by foraging indoors. These ants are found in the warmer and more arid regions of the United States and the Hawaiian Islands. Certain *Pheidole* species are important predators of fire ant queens. This genus is remarkable for the large heads of the soldiers. In some species of *Pheidole*, the huge heads of the soldiers are removed by the workers before the winter season. Apparently this is because it is easier to breed new soldiers than feed old ones. These ants may enter homes, contaminating a wide variety of foods. In the wild, they feed on live and dead insects, seeds and plant louse honeydew.

Description, Development and Habits. Bigheaded ant colonies are characterized by having two distinct worker forms. Depending upon the species, small bigheaded ant workers are 1/16 to 1/10 inch (1.5 to 2.4 mm) in length. Large workers (soldiers) are 1/10 to 1/7 inch (2.6 to 3.8 mm) in length and have a head that is disproportionately large for the size of the body. The large worker (soldier) head is divided in two lobes by a well-defined indentation on the back of the head. Bigheaded ants have two nodes in their petiole, and workers and reproductive have two spines pointing up from the back of the thorax. The antenna has a distinct three-segmented club. The body color is light brown to dark brown.

Carpenter Ant
Campanotus floridanus

These long-legged, swift insects are among our largest ants that may occasionally invade homes for food foraging or nest building. Carpenter ants are capable of inflicting a painful bite.

Description. These ants are large, reddish-brown to black insects about 1/4 to 1/2 inch long. The abdominal pedicel of the carpenter ant consists of one segment. In the northeastern states, the black carpenter ant, *Camponotus pennsylvanicus*, is the most common carpenter ant. It is dull black with the abdomen covered with long, yellowish hairs pressed against the body surface. Other common eastern species include the red carpenter ant, *C. ferrugineus*, and the Florida carpenter ant, *C. floridanus* (Figure

4-21), the species commonly found in Florida. *C. rasilis* is probably one of the most common species encountered in the Gulf Coast states. Its head, thorax and petiole are reddish and the abdomen is black. Worker size varies from 0.16 to 0.35 inches (4 mm to 9 mm) long. A species found throughout most of the United States is *C. nearcticus*, which is smaller with the workers being 0.17 to 0.29 inches (4.5 to 7.5mm) long. The abdomen of this ant is black, but the thorax and legs are red. Foraging workers may be from ⅕ to ½ inch (5 mm to 12 mm) in length.

Importance. Carpenter ants prefer to nest in wood that has been damaged by termites or decay. These ants do not eat wood (as is the case with termites) but excavate galleries in it to rear their young. They feed on honeydew from sucking insects and household food scraps. They feed on wood that has been softened by decay or by the other insects' attacks. They remove the wood in the form of a coarse sawdust. They usually do not tunnel in sound wood, but can. Carpenter ant galleries are kept smooth and clean and have a sandpapered appearance. Other wood-infesting insects do not keep theirs as clean.

Figure 4-21. Carpenter ants, *Camponotus floridanus.*

Habits. Carpenter ants establish nests in a variety of locations: in or beneath rotten logs and stumps, dead limbs of trees, or under rocks and in buildings. In and around buildings, nests are constructed in roofs, gutters, paneling, flashing and siding, columns and posts, subflooring, porches, window sills, hollow doors, firewood, fireplaces, under shingles, or in hollow pipes or other naturally hollow areas. The galleries are usually excavated in moist or unsound wood that is decayed or damaged. However, these ants can damage sound wood.

Carpenter ants feed on a variety of plant and animal materials: small insects, both dead and live; honeydew from mealybugs, aphids, and scale insects; sweets found in the home such as sugar, syrup, honey, jelly; and also fats, greasy foods, meats and liver. Termites may supply food for these ants, as they often colonize the same type of wood. Carpenter ants forage up to 100 yards in search of food. They wander individually and may be active both day and night but most are more so at dusk through dawn. Dusk is the best time to look for nests.

Detection. Carpenter ant control is often difficult because of problems locating nests and galleries, eliminating high-moisture conditions, and applying insecticide in the proper locations. Before beginning inspection, it is useful to have information on where the ants have been seen and where they have been most prevalent. A thorough inspection must be made both indoors and out, particularly in areas of high moisture, places where wood contacts the soil, improperly ventilated areas, and previously listed nesting sites.

The ants often enter buildings on firewood. Houses near wooded areas or brush-covered vacant lots are most likely to become infested, although it is by no means uncommon for carpenter ants to invade dwellings in populated city districts. Ants from a neighboring colony may move into a house when seriously disturbed, as often happens in the clearing of building sites. They may enter the home by crawling on branches that contact the roof and other parts of the house.

On warm spring days, people first become aware of carpenter ants in their homes when swarms of large winged ants emerge from the walls and try to escape through the windows. This is a certain sign of continued trouble, for the main part of the colony remains behind and continues to develop. A faint, rustling sound in walls, floors and woodwork is another common clue to the presence of carpenter ants. Often the workers make slitlike openings in the surface of infested wood, through which they expel their borings, which accumulate beneath in characteristic piles of fibrous "sawdust." Frass piles may indicate areas of infestation.

Figure 4-22. Crazy ant, *Paratrechina longicornis.*

Crazy Ant
Paratrechina longicornis

The name "crazy ant" arises from its characteristic erratic and rapid movement. It is in tropical cities worldwide and occurs from Florida to South Carolina and west to Texas in the United States. It also is found sporadically in residences and warehouses over much of the eastern United States, California and Arizona. This ant is highly adaptable, living in both very dry and rather moist habitats. In cold climates, the ants nest in apartments and other buildings where they are potential year-round pests.

Workers are omnivorous, feeding on both live and dead insects, seeds, honeydew, fruits, plant exudates and many household foods. They obtain honeydew by tending aphids, mealybugs and soft scales. The workers are known to gather small seeds of such crops as lettuce and tobacco from seed beds. They apparently have a seasonal preference for a high-protein diet and during the summer months may refuse honey or sugar baits. Colonies are moderate to very populous. They may raise sexuals at any time of the year in warmer regions.

Description and Habits. The crazy ant (Figure 4-22) has a 12-segmented antenna, one-segmented pedicel and is extremely long. The workers are approximately 1⁄10 inch (2.3 to 3 mm) long. The head, thorax, pedicel and abdomen are dark brown to blackish, and the body often has a faint bluish iridescence. The slender-bodied, long-legged worker is capable of extremely rapid movement. The crazy ant is extremely easy to identify on sight by its rapid and erratic movements. Confirmation may be made with the aid of a hand lens, through which the extremely long antennal scape, long legs, and erect setae are very apparent.

Figure 4-23. Caribbean crazy ants, *Paratrechina pubens.*

Caribbean Crazy Ant
Paratrechina pubens

The Caribbean crazy ant (Figure 4-24) is native to the Caribbean islands, but has been in Florida since at least the early 1950s. The Caribbean crazy ant belongs to a genus of ants collectively called "crazy ants" due to their rapid and apparently random movement when disturbed. Upon opening a nest site, one can observe the brown worker ants and light tan brood containing the immature stages: eggs, larvae, and pupae (Figure 4-24). With some luck one should be able to see queens, since several occur in each nest. The queens look like the workers but are two to three times bigger.

Description and Habits. The Caribbean crazy ant is a one-noded, medium-sized ant about 1⁄8 inch long, with all worker ants in the nest of the same size. The workers and queens (several per colony) are reddish-

Figure 4-24. Caribbean crazy ants, *Paratrechina pubens,* nest under a log. White forms are immature individuals (eggs, larvae and pupae), and brownish red forms are adults.

brown. The antennae are 12-segmented without a club, with the first segment out of the head almost twice as long as the head width. Typically, the Caribbean crazy ant forms foraging trails that are more than three ants wide, unlike other ants that seem to follow in a single file.

Native Fire Ant
Solenopsis geminata

Figure 4-25. Native fire ant, *Solenopsis geminata.*

This fire ant (Figure 4-25) is a native species occurring throughout most of the South. However, it is now absent from many areas where it was once abundant because of pressure from the imported fire ant species.

This species is an outdoor ant that nests in the ground. The ground nests are as large as those of the imported species, but are more flattened out. Nests of imported fire ant species are more conical. However, this varies considerably with soil type and moisture conditions.

Description, Development and Habits. The workers are 1⁄10 to 1⁄5 inch (2.4 mm to 6 mm) in length. The head of large workers is greatly enlarged and the pedicel is two-segmented. The first segment of the pedicel is narrow in profile with a sharp, bladelike summit. The disproportionately large head in large workers is a key characteristic used to separate it from the other fire ant (*Solenopsis*) species. The thorax of the worker is heavily sculptured with many ridges. Color varies from red to black.

Importance. This fire ant is an important predator of all ants. As such, it should not be eliminated without good reason, especially since it is not as aggressive as imported fire ants. Typically, once it is eliminated from an area, the imported fire ant species moves into the vacated niche. However, the sting of the “native” fire ant is painful, and enough stings may result in the death of young birds and poultry.

Figure 4-26. Imported fire ants, *Solenopsis invicta.*

Imported Fire Ant
Solenopsis richteri* and *Solenopsis invicta

There are two species of imported fire ants. The black imported fire ant, *Solenopsis richteri*, entered the United States in 1918 or earlier. This ant now occupies only a small area in Alabama, northern Mississippi, and southern Tennessee. The red imported fire ant, *Solenopsis invicta* (Figure 4-26), did not come until about 1940, and has spread rapidly. This ant presently infests more than 300 million acres in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Oklahoma, and California. Small infestations occur in other southern states.

Description, Development and Habits. Imported fire ants are ⅛ to ¼ inch (3.2 mm to 6.4 mm) in length and are reddish brown to black. They are social insects and live in colonies that may have more than 200,000 individuals. Fire ant colonies are made up of a queen ant, winged males and females (virgin queens), workers and brood (eggs, larvae and pupae).

Since it is not necessary or desirable to treat for native fire ants, it is important to know the difference between the native fire ant, *Solenopsis geminata*, and the red imported fire ant. The head of the imported fire ant large worker is not wider than the abdomen, whereas the head of the native fire ant large worker is wider than the abdomen. Imported fire ant nests are rounded and conical; nests of native fire ants are irregular in shape. However, in sandy soil the mound does not maintain its shape.

Biology. The winged reproductives mainly leave the fire ant colony on mating flights in late spring and summer, although swarming may occur at any time of the year. The ants mate during flight, and the females land

Figure 4-27. Imported fire ant nest.

to begin a new colony. Most of the females fly or are blown less than one mile from the nest, but some may travel a distance of 12 miles or more. Fire ant nests are normally prevalent in open, sunny areas. Pastures and other farm lands, roadsides, and home yards are often infested.

In heavy soils, each mature colony of imported fire ants can build a mound that is sometimes as much as 2 feet tall and 3 feet in diameter (Figure 4-27). In many heavily infested areas there are as many as 50 mature colonies per acre. Infestations of 20 to 30 colonies per acre are common. In freshly invaded areas, and in areas with a multi-queen variety of the red imported fire ant, there may be several hundred small nests per acre. Imported fire ants achieve their greatest density in high-maintenance areas such as lawns, parks, roadsides, pastures and areas disturbed by flooding, draining, mowing or plowing.

Importance. The imported fire ant is a small, aggressive ant that causes damage difficult to measure in dollars. In landscaped areas, its large mounds are unsightly. Its painful, burning sting results in pustules that may take up to ten days to heal. If broken, the pustule may become infected. Some people have allergic reactions to fire ant stings. Such a reaction may cause seizure or heart attack. A few individuals have died as a result of allergic responses to fire ant stings, but this is rare. More people die from bee stings than fire ant stings.

Fire ant mounds in yards, playgrounds and recreational areas are a hazard to children and pets. On farms, mounds may cause damage to machinery used to harvest crops. In addition, farm laborers may refuse to work on land where ants are prevalent because of the potential for numerous stings. Fire ants sometimes reduce the yield of farm crops by feeding on germinating seeds and seedlings.

Little Fire Ant
Wasmannia auropunctata

This ant is fairly well distributed throughout the peninsular portion of Florida. The little fire ant (Figure 4-28) requires tropical and subtropical conditions and appears to be susceptible to cold temperatures. This ant does not appear in the spring until the weather has become quite warm.

The worker is distinctive and is not likely to be confused with native ants. The workers are 1⁄16 inch (1.5 mm) long with eleven-segmented antennae, which have two- or three-segmented clubs. There is one pair of spines on the posterior dorsal part of the thorax. The erect body hairs are long, coarse and very sparse. The body of the ant ranges from light brown to golden brown, and the abdomen is slightly darkened.

Figure 4-28. Little fire ant, *Wasmannia auropunctata.*

Unlike most other ants, the little fire ant has no central nest. It may nest under leaf debris, rotten limbs, stones and in the crotches of trees and clumps of grass. The species is highly adaptable in that it nests in both open and shaded situations. A true colony is connected by worker movement between the nests within an area.

This ant moves very slowly, but is especially noted for its painful and long lasting sting. The ant is also a serious household pest because it contaminates food. Although this species attends honeydew-secreting insects, in the home it is attracted to fats, peanut butter, cooked meats and oily materials, especially in the kitchen. The ant may infest clothing, beds and other furniture.

Southern Fire Ant
Solenopsis xyloni

This ant is found from South Carolina south and westward to southern California. This ant is not known to occur in Florida. The nests occur under boards, stones, at the base of plants, in rotten wood, cracks in concrete and beneath houses. The nest consists of loose soil with many craters scattered over extensive areas.

Description, Development and Habits. Southern fire ant workers are about 1⁄16 to ¼ inch (1.6 mm to 5.8 mm) long. The antennae are ten-segmented with a two-segmented club. The body color is yellowish to reddish with a darkened abdomen.

The ant attacks and stings people. It is an omnivorous feeder and eats meats, grease, grains, seeds, vegetables and fruits. The workers may attend aphids, scales and mealy bugs on ornamental plants and fruit trees.

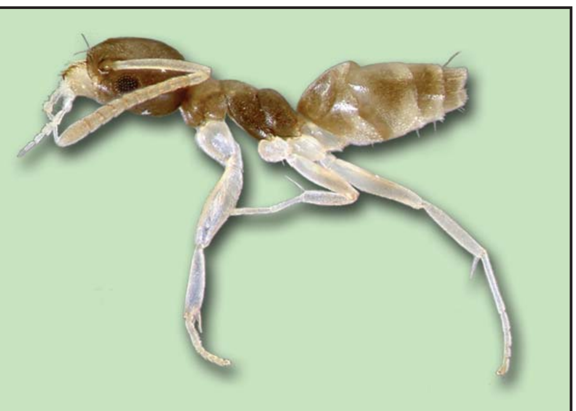

Figure 4-29. Ghost ant, *Tapinoma melanocephalum*.

Ghost Ant
Tapinoma melanocephalum

While the ghost ant (Figure 4-29) can be an important pest in kitchens and other areas of the home, it is not considered a major pest in most of the United States due to its limited distribution.

Description, Development and Habits. Ghost ant workers are extremely small, only 1⁄20 of an inch (1.3 mm to 1.5 mm) long. The antenna has 12 segments. The head is usually darker than the rest of the body, and the thorax and abdomen commonly have light and dark areas of varying sizes. The appendages are pale or milky white in color. The unusual color and small size are the best identifying characteristics as this is one of the smallest ant species.

The ghost ant is a widely distributed species in semi-tropical or tropical areas. Unless it can find shelter in heated structures it does not seem to establish itself in the colder climates of the north. As such it is mostly found in southern Florida, although it has become an important pest in heated structures in central Florida and other areas.

Figure 4-30. Harvester ant large worker, *Pogonomyrmex* sp.

Harvester Ant
***Pogonomyrmex* spp.**

The harvester ant (Figure 4-30) is most commonly found in parking lots, sidewalks, lawns, and landscaped areas. It is an occasional invader of buildings. Individuals of this species are capable of inflicting a painful sting and are aggressive and usually attack when disturbed.

Description and Habits. The worker is about 3⁄16 to ¼ inch long and light rusty red with lighter-colored legs. Males are black and red. Nest openings are characterized by a fan-shaped mound. Harvester ants forage during the day for small seeds and grains. They readily sting people or animals.

Little Black Ant
Monomorium minimum

The little black ant is distributed widely throughout the United States. The nests are found under tree bark and in old termite galleries, beneath rocks, in lawns, or in areas free of vegetation. Nests in the ground may be detected by the very small craters of fine soil. This ant may also establish its nests in the woodwork or masonry of buildings.

Description, Development and Habits. Little black ant workers are 1⁄16 inch (1.5 mm to 2 mm) long. The antennae are 12-segmented with a three-segmented club. The body is shiny black.

The natural food of this ant is honeydew and the sweet secretions of plants. At times it invades homes and feeds on food. The colonies are large and each contains a number of queens.

Odorous House Ant
Tapinoma sessile

The odorous house ant (Figure 4-31) gets its name from the foul, musty odor emitted when is crushed. Like other ant pests, the odorous house ant sometimes invades houses and other buildings in great numbers. It is rarely found in Florida.

Description, Development and Habits. Workers are approximately 1⁄8 inch long, slightly longer and broader than Argentine ants, and are a dark, uniform brown or black. They forage from their nests in long trails, but are slightly slower moving than Argentine ants. Food consists primarily of sugars; the honeydew of aphids and scale insects is their natural food source. Numerous queens are found in each colony, although colonies do not join together. Mating usually takes place outside the colony. Nests are made outdoors in sandy soils, pastures, wooded areas, under stones and logs, in trees and tree stumps and occasionally in bird and mammal nests. Nests are also under building foundations, in wall voids or around water pipes and water heaters.

In locations where the Argentine ant is also a pest, the odorous house ant is usually driven off or out-competed for food.

Figure 4-31. Odorous house ant, *Tapinoma sessile*.

Pavement Ant
Tetramorium caespitum

The pavement ant is found in New England, occasionally in the Midwest, and in California in the San Joaquin and Sacramento valleys. The pavement ant is of interest since it invades homes for food. This ant forages in the home throughout the year, but is observed in greatest numbers during summer. The nests are outdoors under stones, along edges of curbing and in cracks in the pavement, especially when the latter is next to the lawn. Sometimes the nest openings are surrounded by small craters. During the winter, the ants often nest in the home in a crevice near a heat source such as a radiator. Although the workers can bite and sting, they are not as aggressive or painful as the fire ants.

Description, Development and Habits. Pavement ant workers are 0.1 to 0.12 inch (2.5 mm to 3 mm) long. The antennae are 12-segmented with a three-segmented club. The head and thorax are highly sculptured with numerous parallel ridges running lengthwise. There is a second pair of spines on the posterior dorsum of the thorax. The body is light brown to black, but the appendages are lighter. Hairs are thickly distributed over the entire body. This species is not very common in Florida.

Figure 4-32. Pharaoh ant, *Monomorium pharaonis.*

Pharaoh Ant
Monomorium pharaonis

The pharaoh ant (Figure 4-32) is one of the most difficult ant pests to control. Although it occurs in all types of buildings, its presence in hospitals is particularly a problem because it may infest open wounds and is known to carry *Streptococcus, Pseudomonas* and *Staphyloccus* bacteria. The pharaoh ant has had limited distribution in the United States, but its populations are expanding.

Description, Development and Habits. Workers are small, approximately $\frac{1}{16}$ inch long, and range in color from yellowish to light brown to reddish. It can be distinguished from the similar-appearing thief ant by the three segments in its antennal club; the thief ant has two (Figure 4-33). Use a hand lens to examine the ant's antennae to assist in your identification. Queens produce four to 12 eggs per day throughout the year and are most productive during warmer seasons. Under average weather conditions, eggs hatch after seven days. The larval stage lasts 18 days, followed by a three-day prepupal period and a nine-day pupation. Queens live approximately 39 weeks. Their diet includes sweets and fatty foods, although fats are preferred. Workers also feed on live and dead insects. Food is carried back to the nest for queens and larvae.

Pharaoh ants enter buildings through cracks and other openings. They can also be transported into buildings on packages, supplies and furnishings. These ants nest in buildings, preferring warm places such as hot water pipes and heating systems. They colonize in wall voids, behind baseboards, between layers of flooring and under furniture. They also build nests in odd places such as in linens, appliances and paper products. Pharaoh ants travel great distances from nest sites to food and do not always follow the same path, making it difficult to find their nests.

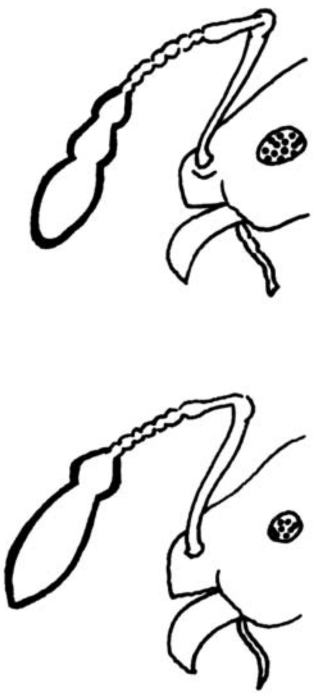

Figure 4-33. The Pharaoh ant (top) can be distinguished from the thief ant by the three segments in its antennal club.

Thief Ant
Solenopsis molesta

Thief ants are pests in homes and other buildings. Their name is derived from the habit of building nests near colonies of other ant species and stealing food from these. They also kill and eat larvae of larger ants. Thief ants are small, light-colored ants that may be difficult to see, especially in some parts of buildings or poorly lighted areas. They are attracted to greasy foods, cheese and animal feces. Because of their size, they can get into almost any type of container where food is stored. Their omnivorous feeding habits make it possible for them to transmit disease organisms to food items. They are persistent and difficult to control once they have invaded a building.

Description, Development and Habits. Thief ants are the smallest of the ant pests to invade buildings. Workers are about $\frac{1}{16}$ inch long and yellowish. This species resembles pharaoh ants, but individuals are smaller. They have a two-segmented antennal club whereas the pharaoh's antennal club is three-segmented (see Figure 4-33). Workers are capable of inflicting stings if they are disturbed, although they are not very aggressive.

Eggs incubate for about 22 days. The larval stage lasts 21 or more days, the prepupal period two to eleven days, and pupation 20 days. When thief ants nest outside, their colonies are usually found under rocks or boards near nests of other ant species. They build small tunnels into the nests of larger ants, providing them access to food as well as the larvae of their host. Thief ants may also build nests in wall voids and other secure locations inside buildings.

Rover Ant
***Brachymyrmex* spp.**

Rover ants, *Brachymyrmex* spp., are nuisance pest ants in some locations. They readily invade homes and other structures in search of sugary food. Although these ants do not sting, their presence may cause concern and the need for control. Nests of these ants are generally outside buildings, but the foragers can be found trailing both outdoors and indoors. Nests are hard to locate, although the ants can be observed coming in and out of small holes in the soil.

Worker rover ants are all similar in size. They are very small (1⁄16 to 1⁄12 inch long) and brown to dark brown. The genus can be recognized by the antennae, which are nine-segmented. The ant waist is formed by a one-segmented node. These ants do not have a stinger and, therefore, cannot sting. Queens are not much bigger than the workers, and male alates are quite a bit smaller. Large number of alates can sometimes be found in swimming pools during mating season in the spring and summer.

Pyramid Ant
***Dorymyrmex* spp.**

The pyramid ants (Figure 4-34) represent a group of related ants. This group can be recognized by the distinct pyramid-shaped bump on the thorax. Ants are usually small (about 1⁄8 inch or 3.5 mm in length) and have a one-node pedicel. Pyramid ant colonies have only on size of workers. The antennae have 12 segments with no club.

Figure 4-34. Pyramid ants, *Dorymyrmex* sp.

The pyramid ants usually construct nests in soil, depositing excavated soil around the nest entrance to form a small crater or mound. In heavy infestation, several of these craters or mounds can be found in a small area of soil. Pyramid ants feed on insects, honeydew produced by sucking insects (aphids, mealybugs, and scales), nectar and other sweet foods. They may be found trailing up trees and shrubs, where they can obtain food from insects or other nectar sources. For unknown reasons, some pyramid ants seem to be attracted to some petroleum products.

Several pyramid ant species are found throughout the United States but are more common in the southern states. In Florida, a dark brown to black species can build up populations to enormous numbers, causing great concern to business and homeowners. These ants do not sting, but when they swarm over a person some of the ants may bite, producing some discomfort. In some cases, these infestations have reached levels very hard to control.

Small infestations can be treated easily once the nests are identified. In these cases, direct application of insecticides to the nests and nest areas may be sufficient. However, very high populations may require a strategy consisting of the application of several products including barrier sprays, other residual insecticides, and toxic bait. Some baits labeled for general ant control may work well against these ants.

Management Guidelines for Ants

Most ants enter buildings seeking food and water, warmth and shelter, or a refuge from dry, hot weather. They may appear suddenly in buildings if other food sources become unavailable. For example, rainfall may wash away honeydew from nearby aphid- or scale-infested plants, forcing workers to search out a new food source.

Ant management requires diligent efforts and the combined use of mechanical, cultural, sanitation, and chemical methods of control. Emphasis should be on excluding ants from buildings and eliminating food and water sources.

To keep ants out of buildings, caulk cracks and crevices around foundations. Trees and shrubs located near buildings may attract ants if they have aphid or soft-scale infestations and foliage is coated with honeydew. Honeydew is an attractive food for ants; ants protect colonies of aphids or soft scales from natural enemies and may even move the insects to other plants to maintain the honeydew production. Plants such as bamboo, cherry laurel and fruit trees, which are especially attractive to ants because of their aphid or soft-scale populations, should not be planted near buildings. Develop a program to control aphids and scale insects if infested trees or shrubs cannot be removed. A sticky resin or petrolatum can be applied in a band around the lower part of the trunk of a plant to provide a barrier to the ants (Figure 4-35). Systemic insecticides can sometimes be used to control sucking insects and subsequently the ants that tend the sucking insects. When ants are excluded, natural enemies of aphids or scales are more effective.

Indoors, eliminate cracks and crevices wherever possible, especially in kitchens and other food preparation and storage areas. Attractive food items such as sugar, syrup, honey and other sweets should be stored in closed containers that have been washed to remove residues from outer surfaces. Rinse empty soft drink containers or remove them from the building. Thoroughly clean up grease and spills. Do not store garbage

Figure 4-35. A sticky paste works as a barrier to keep ants from entering an area or from reaching honeydew in plants infested with aphids or scale insects.

indoors. Look for indoor nesting sites, such as potted plants. If ants are found, remove the containers from the building, then treat the soil with an insecticide or submerge the pots for 20 minutes in standing water that contains a few drops of liquid soap.

An insecticide labeled for ant control can provide immediate knockdown of foraging ants, if necessary, while sanitation and exclusion measures are being taken. However, if ants can be thoroughly washed away and excluded from an area, an insecticide is probably not necessary. Soapy water, as an alternative to insecticides, may be effective in controlling foraging ants in a building.

Chemical control of ants is most successful when the insecticide treatment is focused on queens and larvae inside nests. Killing workers does little to control the colony because as few as one percent of the workers are able to provide sufficient food for nestbound queens and larvae. Follow the insecticide label carefully. Insecticides used indoors usually do not provide long-term control, so combine their use with other practices whenever possible. Outdoors, spray around foundations with a material having a long residual to create a chemical ant barrier. Apply spray to sidewalk or pavement cracks around the perimeter of the building. If structures are on a raised foundation, treat the crawl spaces with dust formulations to provide long-term control.

Baits are the most effective way to get toxicant into the nest (Figure 4-36). Bait can be used most effectively when ant colonies are dispersing in search of food. For instance, set out bait in the early spring, before flowering plants begin to bloom, as ants will begin feeding on nectar as soon as it is available. In the fall, use bait when other food supplies become scarce. Have bait available after rains when honeydew is washed off plants. Place bait next to nests whenever possible, but avoid placing bait in areas where it can be found by small children. Bait is most successful if it does not compete with other food sources in or around buildings, so combine baiting with sanitation practices.

Figure 4-36. Bait used for the control of ants should contain a slow-acting pesticide so workers will carry it back to the nest. This will provide control of larvae as well as adults.

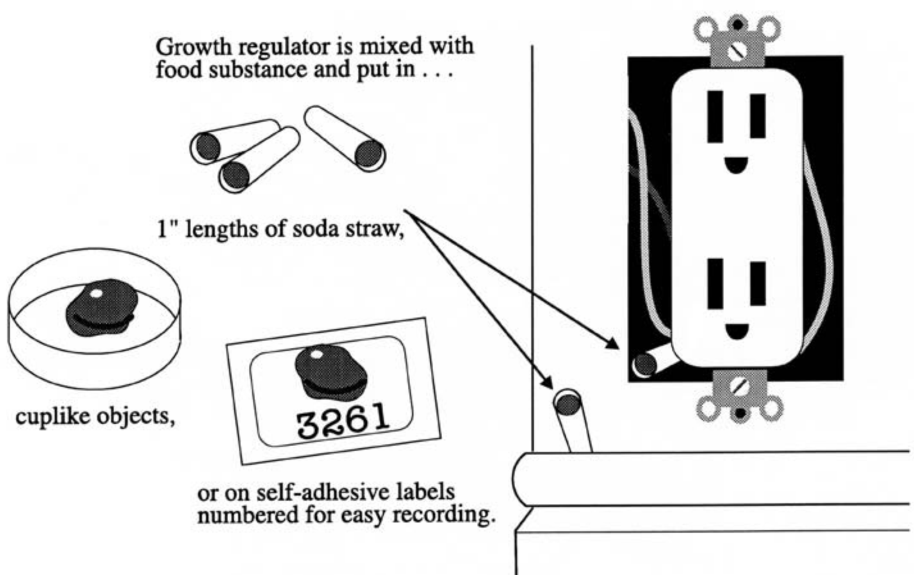

Figure 4-37. Bait stations for controlling ants can be simple devices such as pieces of soda straw.

Management Guidelines for Thief, Ghost and Other Indoor- and Outdoor-Nesting Ants. Because some ants tend to nest indoors and out, begin management by blocking their access into buildings. Seal cracks and openings around the perimeter of the building. Where openings cannot be sealed, use a sticky resin or petrolatum as a barrier to keep ants from entering. Specific long-residual insecticides serve as chemical barriers when sprayed around foundations or other structures that ants must cross to enter a building. Search out nests under stones, boards and similar objects located near buildings and physically destroy them or, if destruction is not possible, treat them with a registered insecticide according to label instructions.

Remove attractive food sources or seal them in antproof containers. Thief ants, however, are capable of finding food almost anywhere, so sanitation alone will not control them. If thief ant colonies are nesting inside a building, use a poison bait that will be carried back to the nest and fed to queens and larvae. Sugar-based bait is not very effective with thief ants because they prefer greasy foods, meats, cheeses and similar animal products.

Management Guidelines for Bigheaded Ants. Bigheaded ants invade homes and business structures and can be found in large numbers in landscapes. In urban areas, they can form large colonies under pavement and sidewalks, which may cause these structures to collapse due to the removal of large amounts of soils by the ants while building their nests. Bigheaded ants can be a problem in hospitals, causing physical damage and serving as the vector of pathogens in patient areas. Around structures, the bigheaded ant may construct "mud tubes" very similar to termite tubes.

Much like the red imported fire ant, the bigheaded ant can be an important ecological pest. When the bigheaded ant invades and gets established in an area, there can be a significant change in the ant population, and in the population of other insects and arthropods. This is due to predation or competition by the bigheaded ant. Because of the changes brought by the bigheaded ant to the arthropod population and direct predation of vertebrate populations, these ants can indirectly bring about changes in the abundance of larger animals. However, similarly to the fire ants, the bigheaded ants also have direct effects on vertebrate animals, especially birds, turtles, and other ground-nesting animals that are easily attacked. Bigheaded ants tend sap-sucking insects and are indirectly responsible for pest problems on plants. Bigheaded ants attack beneficial insects, chew on irrigation pipes and electrical wires, and cause other damage.

Bigheaded ants have been described as immune to detrimental effects of fipronil insecticides. This may be due to behavioral factors related to their tunneling and foraging. Understanding these behavioral factors and other aspects that affect super colony development in bigheaded and other ants may be the key to improved control of these invading ants.

Management Guidelines for Pharaoh Ants. Adequate management requires that you exterminate pharaoh ant colonies from inside buildings. However, this can be difficult, time consuming and expensive. Large buildings, such as hospitals, contain many areas where colonies can exist, and many of these locations are inaccessible to pest control efforts. Sometimes control methods such as applying sprays may appear to be working when actually they are only fragmenting the colonies into smaller, more dispersed groups. As long as food is available, smaller colonies will continue to grow and persist, and the infestation may become worse after treatment due to this dispersion.

Before attempting to control an infestation of pharaoh ants, study the building carefully to find the colonies. A few dabs of peanut butter as an attractant can aid in identifying colonies; however, the great distances between colonies and food sources may make this task difficult or impossible. Look for nests in linen closets, in electrical outlets, in and around appliances, near water pipes, in heating ducts, under furniture and in drawers and cabinets.

Use sanitation practices to restrict ants' access to food and water. Because of their small size, pharaoh ants can get into many small places, including lidded jars without rubber seals. Spills must be thoroughly cleaned up, and garbage, soiled materials, and other items that serve as food should be removed from the building. If possible, seal off cracks and crevices to restrict the colony's travel to food or water.

Treat the perimeter of the building with a persistent insecticide to control ants foraging outside for food. This will also help to stop reinfestation. Be sure to look for trees, shrubs, wiring, or other items that provide bridges to the building.

The principal chemical control method for pharaoh ants inside a building involves the use of a growth regulator or slow-acting insecticide combined with bait that can be taken back to the nest to be fed to queens and larvae. Locate bait stations (Figure 4-35) near nests, next to ant trails, under appliances, around trash storage areas, inside cabinets, inside wall-mounted electrical outlets, and in other areas where ants are seen or suspected. Keep all bait out of reach of pets and children. Once bait-application areas are established, avoid moving or disturbing them so as not to disrupt feeding patterns. Within one week after placing bait, check and refill bait containers if necessary. Continue rechecking and replacing bait for up to six weeks or until there is no further activity. After destroying colonies with a baiting program, prevent reinfestation by applying a residual insecticide in indoor areas where ants gain access to food or water. Use an insecticide in this manner only if entryways cannot be blocked; follow the insecticide label carefully.

Management Guidelines for the Harvester Ant. Control of the harvester ant requires finding nests and physically destroying them or applying insecticides to openings. Destroy nests by digging them up with a shovel or using a mechanical cultivator. Once nests have been opened and exposed, thoroughly saturate the area with soapy water to stop survivors from rebuilding. Removing food supplies is nearly impossible unless all seed-producing plants are eliminated in the area where the colony forages. When working around ant nests, take precautions to avoid being stung by workers. Harvester ant venom usually causes a painful reaction which has been known to persist for over 30 days.

Management Guidelines for Caribbean Crazy Ants. Because these ants usually have several nest sites and seem to be everywhere, control is very difficult. Control must rely on several methods and different products. The first line of defense must be the elimination of nesting sites and entry points. Trimming of trees and shrubs, elimination of litter, logs and other materials serving as nesting sites, and caulking for elimination of penetrations into houses and buildings are essential for control of the Caribbean crazy ant. The elimination of food incentives that bring foraging ants to garbage containers and dumpsters should also be part of the plan.

The use of sweet baits around the perimeter of structures may prevent ants from entering homes and other structures. Barrier treatments and other perimeter treatment with products labeled for ant control may provide some relief. However, according to information from workers in the pest management industry, best Caribbean crazy ant control can be obtained by broadcast application of pesticides to the entire landscape. Because the Caribbean crazy ants travel all over the landscape, this provides plenty of opportunity for contact with a killing dose of the pesticides.

Management Guidelines for Fire Ants. Fire ant control can be achieved by individual mound treatment or by area treatment. Individual mound treatment can be accomplished by several methods:

Applications for nonagricultural land are:

1. Insecticide mound drenches. Dilute insecticide concentrates in water according to label instructions and apply (with a sprinkling can) one gallon or more of solution per mound. Thoroughly wet the mound and surrounding area. Best results are achieved when mound drenches are applied in cool weather (when soil surface temperatures are 60° to 80°F) or after a rainfall. Check treated mounds seven days after application and retreat as necessary.

2. Boiling-water mound drenches. Heat ½ gallon of water to boiling. Apply hot water directly to the mound and surface surrounding the fire ant mound when the brood is near the surface of the soil (on cool days after 10 A.M. when the sun is shining). **CAUTION:** Boiling water is quite dangerous since it is easily spilled onto the skin. Extreme caution must be taken to prevent burns during application.

3. Bait. Apply five tablespoons of bait per fire ant mound, following label instructions. Distribute the bait uniformly three to four feet around the base of the mound. Do not contaminate kitchen utensils during application or storage.

Area treatment may be accomplished by broadcasting bait at 1.0 to 1.5 pounds of formulated bait per acre or more, as required by the product label. Treatments may be required at least annually because fire ants reinvade treated areas.

Baits are registered for fire ant control in pasture, range grass, lawns, turf and nonagricultural lands. The formulations are composed of a corn carrier and soybean oil. The soybean oil may become rancid after the bag is opened. Fire ants do not feed on rancid bat.

An effective fire ant bait must be slow acting, so that it can be passed by the workers throughout the ant colony and eventually to the queen. These slow-acting baits require two to four weeks to kill or sterilize the queen. Within four to eight weeks a significant number of ants should die, and the amount of activity in the mound should decrease. Live worker ants may be found in mounds for four to six months, even though the queen is dead. Retreat these mounds in four months if they are still a nuisance.

To insure ant activity, all bait treatments for fire ants should be made when soil surface temperatures are above 60°F or after a rainfall. Applications during the hot times of day, when soil surface temperatures are above 80°F, are undesirable.

Individual mound treatments should be used when only a few mounds need to be treated, such as in yards and lawns. When portions of a large tract of land have a particularly heavy population, those infested areas should be treated either by air or by ground application. The purpose of the control program is to maintain the fire ant population below a damaging level. Repeat applications may be necessary to keep the fire ant population suppressed.

Proper application of control measures for fire ants will result in suppressing the fire ant populations as well as safeguarding the environment.

Quarantine programs, aimed at preventing the spread of fire ants to other states, restrict the movement of infested articles. Soil, potted plants, plants with soil attached, grass sod, hay and used soil-moving equipment cannot be moved from Florida to uninfested parts of the country without an inspection. Once APHIS certifies these items are free from infestation, the articles may be moved.

Flies

Flies belong to the insect order Diptera and are related to mosquitoes and gnats. These insects undergo complete metamorphosis. Fly larvae, called maggots, have a wide range of feeding habits depending on the species. Some larvae are plant-feeders and can be serious agricultural pests. Others feed on rotting or decaying remains of plants or animals, or on animal excrement. Maggots of some species are internal parasites of arthropods or vertebrates. Most adult flies are winged and fly readily. Flies and all other dipterans have one pair of wings, as opposed to other orders of winged insects which have two pairs. In place of the second pair, dipterans have knobbed balance organs called halteres (Figure 4-38).

Flies are serious pests in and around buildings because they can transmit disease organisms and filth. They also leave deposits of regurgitated food and excrement on walls, furniture, draperies, paintings and other

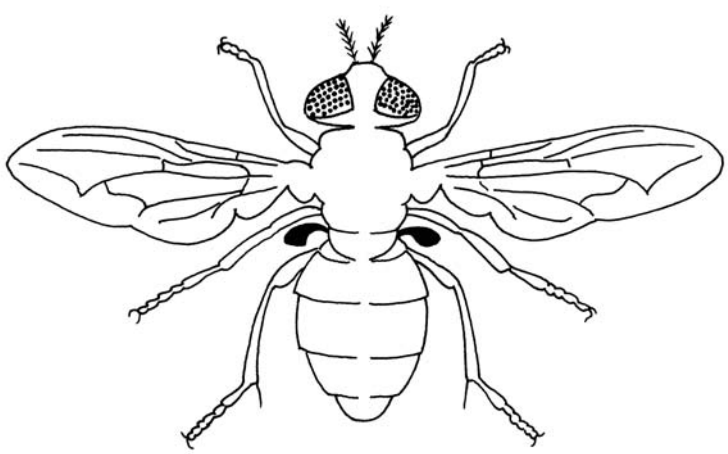

Figure 4-38. Flies and all other dipterans have one pair of wings, while all other winged insects have two pairs. In place of the second pair, flies have knobbed balance organs called halteres (illustrated in black).

belongings. They are annoying due to their flying, buzzing, and landing on food, walls windows, and furnishings. In general, they interfere with people's comfort. Flies are also pests in outdoor eating areas, open-air markets and home yards.

Although there are several thousand species of flies, only a few are persistent pests in or around buildings. These include the house fly, the little house fly, vinegar or fruit fly, and blow flies.

Figure 4-39. Eye gnat, *Hippelates pusio.*

Eye Gnat
Hippelates pusio

Eye gnats are very common pests in the southeastern United States. They are strongly attracted to moisture around the eyes and noses of people outdoors. In mid-summer large numbers of eye gnats hover around the face, causing considerable annoyance. Often eye gnats enter homes through open doors or windows. They are strongly attracted to light and observed mainly on windows in large numbers. Eye gnats are very annoying and persistent pests. If brushed off, they quickly return. Though they are primarily an annoyance, eye gnats do spread disease organisms that cause conjunctivitis (pink eye), anaplasmosis and bovine mastitis.

The major economic damage they cause is to the recreation and tourist industry. Eye gnats also can be extremely annoying on golf courses.

Eye Gnat Description, Development and Habits. These clear-winged, nonbiting flies have dark gray to shiny black bodies and are about 1⁄25 inch (1.2 mm) long (Figure 4-39). Eye gnats are readily attracted to man and most animals. Gnats feed on mucous or sebaceous secretions, pus and blood. These insects do not pierce the skin of the host.

Eye gnats may be present all year if the weather is mild. However, adults are most numerous from June to November. After mating among shrubs and brush, females deposit an average of 26 eggs over an 18-day period. Eggs laid on or below the surface of soil that is moist, and that had fresh vegetation turned in, hatch in about three days. Eye gnats breed in soil containing considerable organic matter, decaying vegetation and animal excrement.

The small larvae burrow into the soil, where they feed on decomposing organic matter. The larval stage lasts about 11 to 17 days under normal conditions but may require several months during cool weather. Mature larvae pupate near the surface of the soil. Adult eye gnats emerge six to 10 days later. Females begin depositing eggs within five to eight days. A complete life cycle (from egg to egg) requires about 28 days under optimal conditions. Adult eye gnats are persistent fliers and have been carried by the wind more than a mile from their breeding site.

Management Guidelines for Eye Gnats. Management of eye gnat populations is difficult because it is often hard to destroy breeding sites over the many acres where eye gnats breed. For personal protection outdoor repellents may be applied to the skin. Indoors, space sprays will kill adults trapped in the house. Repellents, such as those recommended for mosquitoes, provide temporary relief from eye gnats. Application of ULV insecticide sprays on a community-wide basis may provide temporary control of adults, but more adults invade the treated area after the insecticide has dissipated.

Fungus Gnat
Family Sciaridae

Fungus gnats (Figure 4-40) are all members of the family Sciaridae. There are several hundred different species in North America alone.

Description. These slender, mosquitolike flies have long legs. Like humpbacked flies, they are in areas with decaying vegetation. Most of these flies are about the same size as mosquitoes ($\frac{1}{10}$ to $\frac{1}{8}$ inch, or 2.5 mm to 3.2 mm), but some may be as large as $\frac{1}{2}$ inch (13mm). The adults are sooty gray or black.

Figure 4-40. Dark-winged fungus gnat, family Sciaridae.

Biology and Habits. The larvae of these flies inhabit many niches. Most live on fungi or in decaying vegetation, but some are predaceous on other insects. Some species are called mushroom flies, as they are a problem in mushroom cellars.

The larvae of these flies can be pests in greenhouses because they attack the bulbs and roots of many ornamental plants. They are often a problem in potted plants with wet soil and are often found in indoor plantings. The adults are attracted to light. It takes about 10 to 20 days for the fly to go from an egg to adult, which lives about one week.

Management Guidelines. One way to control these flies is to dry out the soil without injuring the plants. Turning over the top 2 or 3 inches helps in drying. However, this does not always completely control the flies. Drenching soil with liquid residual insecticides is recommended for chemical control. Electric light traps are effective because the flies are attracted to light.

Humpbacked Fly
Family Phoridae

Humpbacked flies are all in the family Phoridae. There are hundreds of species. They usually live outdoors but can be a problem indoors as well.

Description. The adult humpbacked fly (Figure 4-41) is rather small — only $\frac{1}{20}$ to $\frac{1}{6}$ inch (1.3 mm to 4.6 mm) in length for the more common species — and is easily recognized by its humpbacked appearance. The third segment of the antenna is so much larger in respect to the other segments that it appears to be the only one. There is a long, hairlike bristle on the end of this segment.

Figure 4-41. Humpbacked fly, family Phoridae.

Biology and Habits. Humpbacked adults are fairly common in many areas, but are especially found around decaying vegetation. The larvae are in many different habitats such as decaying plant and animal matter, fungi, or parasites of other insects, or in the nests of ants or termites.

Management Guidelines. The best way to control these flies is by proper screening and sealing of building entrances. Another way is to remove or dry out the decaying matter upon which most of the larvae live.

Baits, traps, and residual sprays are recommended for chemical control.

Filth-Breeding Flies

Several kinds of nonbiting filth flies can be found in and around farms, residences and food-handling establishments. These flies can be harmful to health, causing annoyance and discomfort. All filth flies have an egg, larva (maggot), pupa and adult stage. The adult fly has two wings (the hind pair is reduced to a knobbed balancing organ).

Filth flies are usually scavengers in nature and many can transmit diseases to man. These flies can usually be grouped according to their habits and appearance as: filter, soldier, and vinegar (fruit) flies; blow, bottle and flesh flies; and house flies and their relatives.

Management Guidelines for Filth Flies. Regardless of advancements in chemical control, sanitation is still the best method of controlling filth flies in and around the home and on the farm. Flies seek breeding places where garbage, animal droppings or vegetation residues accumulate. Locate and thoroughly clean such places. Dry, spread or somehow dispose of dog, cat or other animal excrement. Do not let garbage accumulate in the open and make sure garbage cans have sound bottoms and tight-fitting lids.

Good-fitting screens on windows and doors are essential in barring flies from homes, dairy barns, milk rooms, and food-processing areas. Try to make all screen doors open outward. In areas with high humidity such as exists in Florida, screens last longer when made of copper, aluminum or plastic. Galvanized screens deteriorate rapidly.

To kill flies inside the home use a space spray or aerosol. Release the mist from the aerosol for a few seconds around the room and keep the room closed for 10 to 15 minutes. Outside the house apply a residual or surface spray containing dimethoate or naled. Follow dosage and application directions on the container label.

To kill flies in and around farm buildings apply a residual spray, an insecticide bait or a larvicide to the breeding areas.

Filter Fly
Family Psychodidae

Figure 4-42. Filter fly, family Psychodidae.

Filter flies (drain flies) belong to the family of flies called moth flies (Psychodidae). Filter flies (Figure 4-42) usually feed on slime in trickling filters of sewage treatment plants or in drains of sinks. Usually filter flies breed in houses in the bathroom or kitchen area. Adult filter flies' bodies and wings are covered with dense, long hairs. Filter flies lay eggs where moist decaying organic matter occurs (water traps in plumbing fixtures, dirty garbage containers and around built-in sinks). Larvae and pupae live in the decomposing film. The life cycle from egg to adult is usually one to three weeks.

Filter flies can be effectively controlled by locating and eliminating the source of moisture. Timed aerosol space treatments can break the life cycle of these flies.

Soldier Fly
Hermatia illucens

Figure 4-43. Soldier fly, *Hermatia illucens.*

The soldier fly (Figure 4-43) is a widespread pest that occasionally becomes a problem in homes. The adult is a large fly about one inch long with two translucent areas on the abdomen. The fly behaves like a wasp and is similar in appearance to a mud dauber wasp. The larvae prefer to feed on human or animal excrement, although they have also been known to breed in honey bee colonies killed in walls of houses.

Most frequently the larvae are found in bathrooms, migrating from the septic tank or sewer line. The presence of the maggot under such circumstances indicates the septic tank or sewage line is not working properly.

Fruit, Vinegar or Pomace Fly
***Drosophila* spp.**

Fruit flies (Figure 4-44) are worldwide and are important pests of fruits and uncooked food.

Figure 4-44. Fruit fly, *Drosophila* sp.

Description. The adult fruit fly varies some in description according to species. *Drosophila melanogaster* is common in the home and will be used as an example here. *D. melanogaster* is approximately ⅛ inch (3 mm) long as an adult. It has bright red eyes and a tan-colored head and thorax, with a black abdomen. The larvae are typical of maggots as they are small, legless, eyeless and pointed at the head end.

Biology and Habits. Larvae emerge from eggs approximately 30 hours after being laid. The period from larva to pupa is about five to six days. Pupation occurs in the drier part of the rotting fruit. Newly emerged adults become sexually active within two days. The entire life cycle may be completed within eight days.

The fruit fly is commonly seen wherever fruit and other food items rot or ferment. The fly actually feeds upon the yeasts associated with the fermentation. Fruit or other materials infected by bacteria are not as attractive as food or oviposition sites.

Management Guidelines. Rotting fruits and other materials should be disposed of. If it is not possible to dispose of them in sealed containers, they should be burned. This will prevent the development of a nearby infestation source. For small quantities, such as those in the home, homeowners may wish to add these materials to their compost heaps. Open jars and containers of fruits and vegetables should be resealed and refrigerated. Sanitation is the key to the control of these stored-product pests because they are small enough to penetrate even fine mesh screens.

Thorough, daily cleanup must include the removal of any food items accidentally swept beneath appliances, tables, counters or other equipment. Clean up spilled liquids thoroughly to prevent vinegar flies from breeding in dried residues. Remove liquids and food particles from cracks and crevices. Place garbage in plastic bags and keep it in covered trash cans well away from buildings. Dispose of dishwater, water from floor moppings, and garbage-laden water from sinks. Rinse mops in bleach and hang them to dry.

Use a knockdown spray registered for this purpose to reduce populations of flying adults in enclosed areas. Apply the spray as a fine mist, but be sure to avoid contact with food or food preparation and handling equipment; confine this spray to areas that cannot be cleaned thoroughly on a regular basis, such as under and behind appliances or fixtures.

Aerosolized insecticides used as knockdown sprays have a short residual life, so these should be used along with a thorough sanitation program. Use traps baited with fruits and yeast to collect adults in enclosed areas, but combine trapping with careful sanitation methods.

In areas around packing houses and food processing plants, where large volumes of culled produce or food wastes attract high populations of vinegar flies, spray insecticides directly on the waste to repel adults and retard egg deposition and larval development. Insecticides used this way provide about 24 hours of protection, allowing time for wastes to be collected and disposed.

Figure 4-45. Top to bottom: secondary screwworm fly, *Cochliomyia macellaria,* green bottle fly, *Phaenicia sericata,* and blue bottle fly, *Calliphora vicina.*

Black Blow Fly
Phormia regina

Secondary Screwworm Fly
Phaenicia sericata

Green Bottle Fly
Phaenicia sericata

Blue Bottle Fly
Calliphora vicina

The blow flies (Figure 4-45), including the black blow, the secondary screwworm, the green bottle, and the blue bottle flies, are occasional pests in buildings. They are usually seen flying up against window glass or screens and make audible buzzing sounds. Typically these flies emerge from rotting meat or carcasses of dead animals, so their sudden appearance in large numbers in a building could indicate the presence of a dead animal in a wall void, attic, crawl space or other inaccessible area. Smaller numbers of blow flies in a building may indicate that a dead animal or rotting meat may be present in the neighborhood. Adult blow flies readily deposit eggs in exposed meat or fish in kitchens, markets or other food-handling establishments and can transmit disease organisms to food this way.

These flies are most active during warm, sunny periods and usually enter buildings in the spring and fall, seeking shelter from cool nighttime temperatures. Because they are strongly attracted to flesh, they attack an animal soon after death or begin depositing eggs into fresh meat a few minutes after exposure. Blow flies also deposit eggs into wounds of animals and people, resulting in a condition known as myiasis — the invading and consuming of living tissue by fly larvae.

Description, Development and Habits. Blow flies are larger than the common house fly. Adults range between ⅜ inch and ½ inch in length. The black blow fly is a blue-green, dark blue or greenish black. The green bottle fly is brilliant metallic bluish green. The blue bottle fly has a metallic blue abdomen with a dark grayish thorax and large red eyes. These flies have four to eight broods per year. Females produce up to 600 eggs, laid in batches of 100 to 200. Eggs are laid in decomposing animal flesh or garbage containing some animal matter. Blow flies also deposit eggs into dog feces or any decaying organic matter with a high crude protein content, such as dry cat food. The usual larval stage lasts two to 10 days; pupation takes place in the soil. Full-grown larvae can hibernate in the soil over the winter. Occasionally, "migrating" mature larvae can be a problem during their search for a pupation site.

Management Guidelines for Blow Flies. The most important control for blow flies in buildings is exclusion. Use screens on windows and doors and seal up other openings where they might enter. Dispose of spoiled meat, animal by-products, dog feces, and other waste products in and around buildings to avoid attracting blow flies. The sudden appearance of large numbers of blow flies inside a building usually indicates the presence of a dead animal, perhaps as a result of pest control activities directed toward rodents or other vertebrate pests. The dead animals should be removed if possible. Apply a labeled aerosol spray as a fine mist in a lightly closed room for rapid knockdown of adult flies if population numbers are high.

Several traps are commercially available for trapping blow flies. These use an attractant and have an escape-proof entrance.

A simple way to reduce problems in noncommercial structures where blow flies are persistent pests, and larval sources cannot be located, is to make a small, pencil-sized opening at the top corner of each window screen so flies can exit; blow flies are attracted by the light coming in a window and habitually crawl to the top of window screens. Small holes such as these should not allow other pests to enter.

Flesh Fly
Family Sarcophagidae

As a group, flesh flies occur throughout most areas of the world, although species distribution varies. Flesh flies are found in urban and rural communities but, fortunately, are relatively uncommon in houses or restaurants. They breed in excrement, decaying vegetable matter, and animal flesh or meat. Though they can carry leprosy bacilli, flesh flies usually are not problems as disease carriers or even as nuisances and pose little threat to human welfare or to livestock. Some species can cause intestinal pseudomyiasis (infection by fly larvae) in humans who consume food contaminated with larvae.

Figure 4-46. Flesh fly, family Sarcophagidae.

Description. Flesh flies (Figure 4-46) are medium to large flies and usually have three dark thoracic stripes and mottled abdomens. Many of the common species have a red tip on the abdomen. Though some species may be smaller than house flies, most flesh flies are about ⅓ to ½ inch (10 mm to 13 mm) long.

Biology. Flesh flies retain their eggs within the body of the female until they are ready to hatch. The larvae are deposited directly onto the food that the immature will be eating. The life cycle for the common species can be completed in eight to 21 days.

The preferred breeding media around residences are decayed flesh, spoiling meat, and manure. Usually garbage-can meat scraps and dog food left outside are abundant sources of flesh fly breeding. Flesh flies can breed in dead rodents and birds in attics or wall voids of houses.

Adult flies do not bite but feed on a wide range of liquid substances. Most larvae infest wounds, carrion or excrement. The larvae of some species of flesh flies are beneficial in that they prey on eggs, nymphs or larvae of more harmful insects. Lesser house fly and blow fly larvae and grasshopper nymphs are common hosts of flesh flies.

Flesh fly life histories vary with species and location. They overwinter as pupae in temperate climates. Rarely very numerous, the flies emerge in spring and mate. Eggs are laid only under very unusual circumstances. As a rule, eggs hatch within the body of the adult. Females of most species deposit 20 to 40 larvae directly onto the host or substrate. As many as 325 larvae have been known to be born by a single female.

Flesh fly maggots feed for three or four days and develop through three instars. Soon afterward, these mature maggots enter the pupal stage. Adult flies emerge in 10 to 14 days, and the life cycle is repeated. Several generations are produced each year.

Management Guidelines. Flesh flies rarely require chemical control. The burial or destruction of carcasses, manure heaps, and mounds of decaying organic matter eliminates many favorable breeding sites. Proper treatment of wounds also helps to prevent flesh fly harm to animals.

House Fly
Musca domestica

Little House Fly
Fannia canicularis

Figure 4-47. House fly, *Musca domestica.*

The adult stages of the house fly and little house fly are typically found in buildings such as restaurants, homes, offices, hospitals and grocery stores. They seek out these locations for shelter, food and suitable breeding sites. Besides their annoyance, these two species are capable of carrying disease-causing organisms on their bodies. Flies can contaminate food, eating utensils and other items with these organisms and transmit salmonella, dysentery, typhoid fever, cholera, anthrax, leprosy, yaws and infectious hepatitis. In addition to disease organisms, these flies can carry eggs of pinworms, whipworms, hookworms, *Ascaris*, and tapeworms, which may occasionally infect people. House flies are claimed by some to be the greatest threat to people's health of any species of insect due to their ability to transmit so many disease and parasite organisms.

House Fly Description, Development and Habits. The adult house fly (Figure 4-47) is about ¼ inch long and dark gray with four darker longitudinal stripes on the top of the thorax. The abdomen may be gray or yellowish with a darker median line and an irregular, pale yellowish spot on each side near the thorax. When at rest, the wings of the house fly fold back and are held slightly away from the body but do not overlap. Larvae, or maggots, of the house fly are cream-colored, pointed at the front end, and blunt at the rear end.

Females lay eggs in bunches of 75 to 100 in moist animal manure or garbage. Each female may, under ideal conditions, lay up to 1,000 eggs. Eggs usually hatch in eight to 12 hours. Larvae feed for three to five days, then enter a prepupal stage for an average of two to four days. Pupation usually takes four to five days before adults emerge. In total, it requires from seven to 45 days from egg laying to adult emergence under a normal temperature range of 60° to 95°F. Below 55°F, development usually stops.

During warm weather, two to three generations occurring per month are typical.

Adult house flies are present throughout the year but are most abundant in late summer and early fall. An adult house fly lives from 30 to 60 days and can fly as far as 20 miles, but usually confines its activities within a one- to four-mile range. This fly remains within the confines of a small area if food is plentiful. During the adult stage, house flies feed on many substances including feces, decaying organic matter, and a variety of liquid foods. They are attracted to indoor food preparation and serving areas. House flies leave straw-colored spots of regurgitated food and dark spots of fecal matter on surfaces where they feed or rest.

Little House Fly Description, Development and Habits. The little house fly is a smaller and more slender species than the common house fly. It is dull gray with three darker longitudinal stripes on the top of the thorax. When at rest, the wings of the little house fly are partly folded over each other and are held parallel to the long axis of the body. There are also distinct, obvious differences in the pattern of wing veins that distinguish this fly from the house fly.

At a temperature of 75°F, eggs of the little house fly hatch in about three days, and the larval period lasts about eleven days. Pupation takes approximately 10 days. After emerging as adults, female little house flies are reported to live an average of 24 days. Larvae (maggots) are flattened with prominent lateral spines. They are light cream-colored when first hatched and become darker brown as they mature. Like the common house fly, little house fly larvae feed on decaying animal and vegetable matter and excrement. Adult females usually do not enter buildings, but males often become abundant indoors and hover about aimlessly in the middle of rooms and in shaded outdoor areas. They can be found throughout a building rather than just in food-serving and preparation areas. These flies can transmit similar disease and parasite organisms as the common house fly.

Management Guidelines for House Flies and Little House Flies

Successful control of the common house fly and the little house fly requires an integrated management approach. Insecticides, exclusion techniques and traps reduce the number of adult flies inside buildings. In addition, sanitation, exclusion, insecticides and natural enemies can be used outdoors to reduce egg production and control developing larvae.

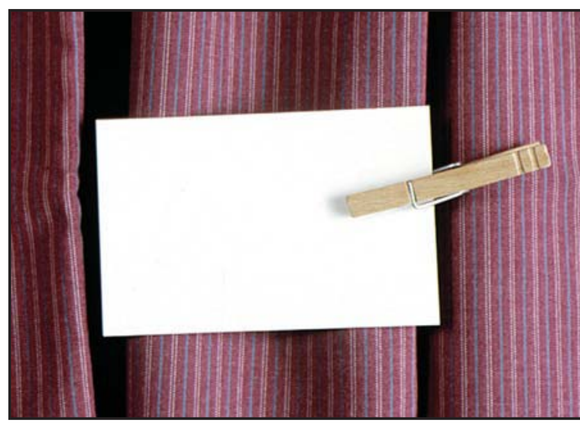

Figure 4-48. A simple way to monitor fly activity is to attach a small white card to the flies' resting surface. Activity is noted by the buildup of spots over a period of time.

Before attempting to control flies in buildings, gather some information about the infestation. Correctly identify the fly species first. Find out how the flies are getting into the building and try to locate where they are breeding. Estimate the size of the population so that control measures can be evaluated; traps and sticky tapes are useful techniques for monitoring fly populations and can supplement visual observations. Observe the locations and density of fecal and regurgitated food spots in areas where flies rest. A simple way to monitor fly activity is to attach a small white card to a resting surface and observe the buildup of spots over a period of time (Figure 4-48). Use similar cards to follow up after control measures have been taken to evaluate control effectiveness.

Sanitation. Sanitation is the primary control method used to reduce house fly and little house fly populations. Suitable larval development sites must be eliminated by keeping interior and outside areas free of garbage,

Figure 4-49. Traps baited with an attractant can be used to capture large numbers of house flies in outside areas.

decaying plant material, animal feces, and other food. Garbage cans are one of the main sources of domestic fly production in urban areas — as many as 20,000 fly larvae per week can be produced in a single garbage can in hot weather. Cans should be emptied twice each week and thoroughly cleaned of residues that support maggot growth. Use tight-fitting lids to keep adult flies from getting in to lay eggs.

Another attractive source of fly larvae food is grass clippings allowed to decay in piles. Dispose of grass clippings by composting, or spreading them thinly over an area so they dry rapidly to avoid fly larvae buildup. Compost piles must be maintained and periodically turned for aeration so they will not become breeding sites.

Dog feces should be removed from yards daily and deeply buried or placed in sealed containers to reduce fly-breeding sites. Livestock areas near buildings are also an important source of house flies. Animal manure should be removed from pens several times per week and composted to kill developing larvae.

Exclusion. Exclude flies from buildings by using screens on doors and windows. Air-curtains or fans above entrances to commercial buildings also help prevent fly entry. Store garbage and other refuse in closed containers away from building entries to reduce the number of flies congregating there.

Trapping. Use traps baited with an attractant to capture large numbers of house flies (Figure 4-49). Commercial attractants are available. Fermenting molasses is a good bait for outdoor use; add ammonium carbonate to the bait to increase its attractiveness. Keep traps away from buildings. When traps become filled, bury or otherwise dispose of the dead flies.

Sticky paper traps (Figure 4-50), pheromone traps and electrocutor traps work well indoors and do not emit obnoxious odors. Electrocutor traps use an ultraviolet light to attract flies to an electrically charged grid, killing them on contact (Figure 4-51). Electrocutor traps effectively reduce adult fly populations in enclosed areas. However, do not use these traps outside because they are not selective and may destroy many non-

Figure 4-50. Sticky paper traps are useful for catching flies in confined areas.

target and beneficial insects. See the section on light traps for information on using them in buildings.

Parasites and Predators. Natural and biological controls are very important in fly management around livestock, but are less important in other areas. Several naturally occurring parasitic wasps attack house fly pupae. Parasites can be purchased and released to augment naturally occurring species. Many species of insects, birds (including poultry), reptiles and small mammals feed on fly larvae, pupae, and adults and can be significant predators of these pests.

Chemical Controls. Always combine house fly insecticide use with other control methods. Because of their high reproductive rate, house fly populations can quickly develop insecticide resistance. Therefore, it is important to use any registered insecticide selectively.

The judicious use of poisoned bait in commercial or rural areas is effective in reducing adult flies. Apply bait around the outside of buildings, where garbage is stored near restaurants and other food preparation areas, and near livestock areas. Bait can also be placed in feeding stations; locate bait stations in areas of greatest fly concentration. Most fly baits contain a synthetic pheromone to attract adult house flies; others may contain sugar or molasses as an attractant. Avoid placing bait in areas where it could be a hazard to children or pets. Poisoned bait kills flies rapidly, but its effectiveness is short-lived and requires repeated applications.

If large numbers of adult flies appear in a building, first try to let them out through windows. If this is not successful, use a quick-acting, short-residual synergized aerosolized insecticide for rapid knockdown. (Be sure the insecticide is labeled for the location where it will be used.) Apply the spray as a mist in tightly closed rooms; never do this while food is being prepared or to areas that cannot be thoroughly aired out before people or animals return. In food preparation areas, be sure surfaces are covered and food and utensils are put away first.

Insecticide application only provides temporary control, however, so locate and destroy breeding areas and block the flies' entry into the building. As a last resort, treat breeding sites with an insecticide registered for control of larvae. However, this may enhance insecticide resistance.

Before using any treatment, determine if natural enemies are controlling part of the population. If these are present, they will be destroyed by the insecticide as well, resulting in a possible resurgence of the fly population at even higher levels unless larval food supplies are totally eliminated.

When other methods fail to provide adequate fly reduction, apply a residual insecticide spray to outdoor surfaces to control adult flies. Spray overhead structures such as eaves, beams, wires, and ceilings of porches, patios, carports, garages, and breezeways, according to label instructions. Because house flies rest in these areas at night during warm weather, they will be killed by prolonged contact with the insecticide. During cooler weather, adult house flies and little house flies attempt to enter buildings to rest for the night; therefore, spraying outdoor resting areas is less effective. Do not apply insecticides to outdoor furniture, play equipment, fences, walls or other surfaces that children or adults might touch.

Figure 4-51. Electrocutor traps use an ultraviolet light to attract flies to an electrically charged grid.

Study Questions | Chapter 4

1. The cockroach that requires the most control effort is the ________________________.

   A. Asian
   B. American
   C. German
   D. Australian

2. American cockroaches like an environment that is ________________________.

   A. slightly cool, moist
   B. warm, moist
   C. hot, dry
   D. lukewarm, average humidity

3. Australian cockroaches have ________________________.

   A. light markings on their wings
   B. two bands across their thorax
   C. short wings
   D. light markings on their thorax

4. Cockroaches need ________________________ to be successful.

   A. food, moisture, harborage
   B. food, moisture, open spaces
   C. warmth, food, cracks
   D. cracks, crevices, food

5. Oriental cockroaches prefer a ________________________ environment.

   A. moist
   B. warm
   C. high
   D. small

6. Brownbanded cockroaches prefer a ________________________ environment.

   A. cool
   B. warm
   C. sanitary
   D. very moist

7. Smokybrown cockroaches prefer a ________________________ environment.

   A. open
   B. warm
   C. moist
   D. high

8. German cockroaches have ________________________.

   A. two bands across their thorax
   B. two stripes on their thorax
   C. light markings on their thorax
   D. short wings

9. Ants are closely related to termites.

A. True
B. False

10. The ant species that nests in wood is the ________________________.

A. carpenter ant
B. pharaoh ant
C. fire ant
D. odorous house ant

11. Fire ants nest in wall voids.

A. True
B. False

12. The ant caste system consists of ________________________.

A. workers, drones, soldiers
B. soldiers, workers, reproductives
C. male and female reproductives and workers
D. larvae, pupae, adults

13. Ants found inside a structure always come from a colony that is located inside.

A. True
B. False

14. Ants forage for ________________________ to sustain themselves and the colony.

A. honeydew, greases, sugars and insects
B. wood
C. honeydew alone
D. pheromones

15. Distinguish between *Drosophila*, or fruit flies, and phorid flies.

16. Briefly distinguish among house flies, flesh flies, and blow flies.

17. List at least three pest management procedures for house fly and blow fly infestations.

18. List at least three pest management procedures for fruit fly, or *Drosophila*, infestations.

For answers refer to Appendix A.

Chapter 5: Parasitic, Biting, and Stinging Arthropods

Learning Objectives

After completing the study of Parasitic, Biting, and Stinging Arthropods, the trainee should be able to:

- Identify common biting pests.
- Understand the biology and habits of biting pests.
- Cite integrated pest management options for biting pests.
- Understand the cat flea life cycle and how it contributes to flea problems.
- Discuss habitat alterations and why they are needed.
- Identify pesticide application methods for flea control.
- Understand when, how and why IGRs are helpful.
- Identify common urban stinging insect pests.
- Describe the life cycles of yellowjackets, paper wasps, mud daubers, honeybees, and carpenter bees.
- Given an urban stinging insect problem, describe integrated pest management procedures to suppress it.
- Describe the habitat and life cycles of common types of spiders that cause problems in urban areas.
- List the appearance or characteristics of harmful spiders.
- Understand pest management procedures for urban spider problems.

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Figure 5-1. *Aedes aegypti,* yellow fever mosquito.

Arthropods that bite or sting to defend themselves — or those that feed on the blood of people or domestic animals — are serious, and sometimes dangerous, pests. Bites or stings may result in localized painful itching and swelling which, if scratched, may even lead to a bacterial infection. Some arthropods transmit disease organisms through the wounds they cause. Some stinging and blood-feeding pests inject venoms capable of causing allergic reactions, which can be fatal. Arthropods that feed on the blood of people and their pets include mosquitoes, some heteropterans (the true bugs), fleas, lice, ticks, midges and some mites. Biting or stinging arthropods include bees, wasps, spiders and scorpions in addition to ants, which were discussed in the previous chapter.

This chapter describes those parasitic, biting and stinging pests that are most commonly found in or around homes or other buildings. The ones that may require pest control include mosquitoes, bugs, fleas, bees, wasps, mites and spiders. Medical or health professionals usually supervise control of lice. Ticks in structures are usually associated with pets and are best controlled in cooperation with a veterinarian. Some ticks transmit the organism that causes Lyme disease. Therefore, people suffering tick bites should seek medical attention.

Mosquitoes

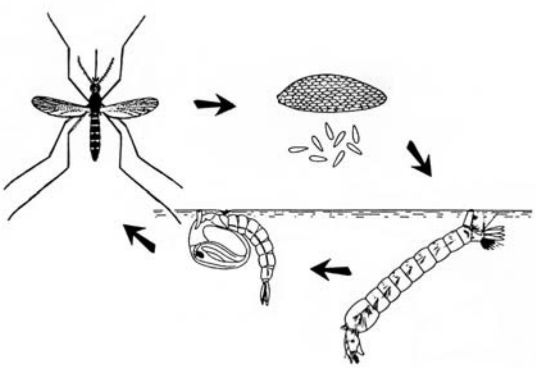

Figure 5-2. Mosquito life cycle.

Mosquitoes are blood-feeding pests of people and animals (Figure 5-2). These insects belong to the order Diptera and are related to house flies, gnats, and midges. Eggs of most mosquitoes are laid in water, usually on raftlike structures made by the adult females. Mosquito larvae are aquatic; they feed on algae, protozoans and minute organic debris. Adult mosquitoes are winged and free living. Males do not take blood as adults, but females of most species require a blood meal before oviposition, using the protein in blood for egg production. Mosquito bites usually result in red, swollen areas called wheals, which itch severely and may persist for several days. Some people develop allergic reactions to proteins injected by mosquitoes and become ill after being bitten. Some species of mosquitoes also vector microorganisms to people or animals. These microorganisms include those that cause malaria, yellow fever, encephalitis, dengue and elephantiasis in humans; and canine heartworm.

Management Guidelines for Mosquitoes. Mosquito control requires area-wide management of breeding sites and is usually the responsibility of public health agencies and mosquito-control districts. Control of mosquitoes in and around buildings depends on sanitation to eliminate breeding sites and exclusion to keep mosquitoes out of buildings.

Sanitation involves draining any standing water and eliminating all objects or containers, such as old tires, cans, bottles, and dishes that contain water where mosquito larvae can develop. Look for blocked rain gutters, for instance, as sources of standing water. Certain mosquitoes develop in water trapped in cavities of trees or basins formed by tree branches. Some species require only small quantities of water for short periods of time to develop.

Livestock and pet water containers should be emptied and cleaned regularly to prevent mosquitoes from using these as breeding sites. Fish ponds and other bodies of water that cannot be drained periodically should be stocked with small mosquito fish (*Gambusia affinis*) that effectively control developing larvae. Quantities of these fish can be obtained through local mosquito control districts.

Sanitation practices may need to be combined with chemical control for some situations. Treat water sources such as swimming pools, fountains, reflection pools and decorative ponds with chlorine, copper sulfate or other algaecides to eliminate conditions favorable to mosquito larvae development. Monomolecular films can control mosquito larvae in small puddles or ponds. Special strains of the bacteria *Bacillus thuringiensis* and *Bacillus sphaericus* are effective as mosquito larvicides when applied to aquatic areas infested by larvae. IGRs like methoprene are also effective for control of mosquito larvae.

To control adult mosquitoes in localized outdoor areas, apply an appropriate insecticide in the form of an aerosol. Be sure the aerosol is dispersed throughout the treated area so it comes in contact with flying and resting adults. Apply aerosols only when the wind is calm to allow the droplets to remain suspended in the atmosphere around the treatment site.

Exclude adult mosquitoes from buildings by using screens over doors, windows and other openings. If necessary, use appropriate insecticides to reduce biting females inside enclosed areas. These reductions will only be temporary, however, unless steps are taken to exclude adult mosquitoes, eliminate breeding sites and destroy larvae.

An insect repellent applied as a lotion or aerosol spray to skin or clothing reduces mosquito attacks on people who must spend time outdoors in areas where mosquitoes are a problem (Figure 5-4). Apply repellents frequently, according to the directions, for best results.

Figure 5-3. Closeup of a larva of *Aedes albopictus,* Asian tiger mosquito. The mosquito lives in water at this stage of development.

Figure 5-4. An insect repellent applied to the skin or clothing usually reduces mosquito attacks on people who must spend time outdoors.

Black Flies

Black flies (*Simuliidae*) are small, dark, stout-bodied flies with a humpbacked appearance (Figure 5-5). The adult females suck blood mainly during daylight hours and are not host specific. They hover about the eyes, ears, and nostrils of man and animals, often alighting and puncturing the skin with an irritating bite. The black fly is a potential disease vector.

The black fly life cycle begins with eggs being deposited on logs, rocks or solid surfaces in swiftly flowing streams. Larvae attach themselves to rocks or vegetation with a posterior sucker. The length of the larval period is variable depending on the species and the larval environment. The adults which emerge after pupation are strong fliers and may fly seven to 10 miles from their breeding sites.

Figure 5-5. Black fly.

Management Guidelines for Black Flies. Chemical control around the home may be accomplished with repellents or space sprays. The most widely used repellent is DEET. DEET is popular for individual protection and is available as a liquid, aerosol, lotion and cream. When applied properly to the neck, face, arms, ankles and other exposed skin surfaces, DEET will provide protection from black fly bites for two to 12 hours. If desired, old clothing may be sprayed with repellent to provide added protection. Care should be taken not to apply any repellent to eyes, lips or other mucous membranes.

Space sprays may be used to kill black flies present at the time of treatment. The major advantage of space treatment is quick application, immediate knockdown and relatively small amounts of materials required for treatment. Space sprays are most effective indoors. Outdoors the insecticide particles disperse rapidly and may not kill many flies.

The major disadvantage of space spraying is that it will not control insects for long periods of time. Best results are obtained if doors and windows are kept closed during spraying and for five to ten minutes after spraying.

Most of the flies that trouble people cannot be eliminated through individual efforts, but instead, must be controlled through organized permanent and temporary measures. Permanent measures include impounding water and ditching and draining swampy breeding areas. Temporary measures include treating breeding areas to kill larvae and space spraying to kill adults.

Insect Repellents

Insect repellents are special chemical compounds that repel biting insects, as well as ticks and chiggers. They do not appear to have an effect on stinging insects such as bees or wasps. To be sold in the United States, insect repellents must have EPA Registration and Establishment numbers.

There are over 15 major insect repellent products on the market. These are available in a variety of forms, the most common being the aerosol spray can. Repellents are also available in lotion form, in squeeze bottles, as rub-on sticks, and in foil-wrapped towelettes.

The major active ingredient used in repellents is N,N-diethyl-meta-toluamide (DEET). The effectiveness of the repellent is usually the result of the concentration of the active ingredient(s) in the ready-to-use formulation. Formulations containing higher percentages of active ingredient (up to 30 percent) are more effective for longer periods of time. DEET appears to be the most effective repellent of common biting insects and ticks, and is the recommended ingredient to protect against the black-legged tick that vectors the spirochete causing Lyme disease.

Some repellents remain effective for less than an hour, and others may last for ten hours. Factors affecting the lasting effect of repellents include sweating, swimming, rain, and general level of activity, the concentration of active ingredient, and other ingredients in the formulation.

True Bugs

Heteropterans, or true bugs, comprise a large order of insects with a few species that occasionally attack people or are household pests. Insects in the order Heteroptera undergo incomplete metamorphosis. Therefore, wingless young resemble winged adults and usually have the same feeding habits. Some true bugs, such as the bed bug and species of conenose, require protein-rich blood from people or animals for development.

Bed Bug
Cimex lectularius

Figure 5-6. Bed bug, *Cimex lectularius.*

Bed bugs feed mainly on the blood of humans, but also suck blood from other animals, birds and bats. Bed bugs usually feed at night when people are asleep. As they feed, they inject a salivary secretion into the wound to prevent coagulation. This fluid often causes the skin to itch and become swollen. Scratching causes sores which may become infected.

The adult bed bug (Figure 5-6) is brown and has no wings. It is about ¼ inch long. The newly hatched bugs are almost colorless and similar to the adult except they are much smaller. When full of blood, the body becomes swollen, and the color changes to dark red.

During the day, bed bugs hide in cracks in the walls, behind baseboards, wallpaper (Figure 5-7) and pictures, where parts of a bed are joined together around slats, around the tufts of mattresses and in bed clothes. They have a bad odor caused by an oily liquid they emit. Bed bugs are carried into homes in clothes, second-hand beds, and bedding, furniture, suitcases, or by people.

Figure 5-7. Loose wallpaper can provide hiding places for bed bugs.

Life Cycle and Habits. Bed bugs lay eggs that are 1⁄25 inch long and are slightly curved. Eggs are fastened with a cement to cracks and crevices or rough surfaces near adult harborages.

The eggs hatch in six to 10 days. The newly hatched nymph is straw colored before feeding. After getting a blood meal, the nymph turns red or purple in color because of the blood in its body. There are five nymphal stages, and it usually takes 35 to 48 days for nymphs to mature.

Female bed bugs deposit ten to 50 eggs at a time. A total of 200 to 500 eggs can be produced per female. The eggs hatch in one to three weeks. Adult bed bugs can survive for six to seven months without a blood meal and have been known to live in abandoned houses for one and one-half years. In some cases they survive without humans by attacking birds and rodents.

Management Guidelines for Bed Bugs. Bed bugs can be extremely difficult to kill with insecticides. Unlike cockroaches, bed bugs do not have sticky pads on their tarsae (feet). When they crawl across residues of insecticide on surfaces, the pesticide does not adhere to their bodies and, therefore, it does not kill them. In order to be effective, most insecticides must be applied directly to the insect. This requires searching for every bed bug in a room and spraying it directly. Of course, this process of finding the bug and spraying it is very labor intensive. Most pest control companies budget about five to ten hours to treat a typical bedroom. Because eggs are not affected by the spray, the treatment must be repeated after about two weeks to kill newly hatched nymphs. Dust formulations provide more residual effectiveness than sprays. The insecticide is more easily transferred from surfaces than for sprays. So dust formulations are usually preferred over sprays for bed bug control.

Bed bugs are known to be resistant to many insecticides, especially pyrethroids. This may be due to cross resistance to DDT. Bed bugs were first reported to be resistant to DDT in the 1950s. It appears from research that the organophosphates and carbamates are still effective. However, they are not registered for use indoors.

Bed bugs also are difficult to control because many of the sites where they occur cannot be treated with residual insecticides. For instance, mattresses, pillows, cushions, clothing, stuffed animals, and other items that may come into contact for long periods of time should not be treated with residual products. There are some nonresidual products that can be applied to these sensitive items, but mattresses and other items should not be drenched with insecticide to control the infestation.

Heat	Temperatures above 113–115°F kill all bed bug stages.
Whole-room or whole-house	Energy requirements are high, and special equipment is needed.
Room contents only	Furniture and other room contents can be contained within a styrofoam box and heated with household oil-filled heaters to 113–115°F, while the room is treated with residual pesticides.
Containerized	Furniture and other infested materials can be placed in an insulated container, which is heated to 113–115°F.
Clothes Dryer	Clothes, bedding materials, and other infested materials can be heated in a clothes dryer to kill bed bugs. Because of the high temperature that can be reached, a few minutes of treatment is sufficient to eliminate infestations.
Steaming	High-temperature steam kills bed bugs immediately without leaving pesticide residues. This treatment is ideal for mattresses and other surfaces having high contact with human skin, or crevices hard to treat with other methods.
Fumigation	Toxic gases (e.g., Sulfuryl fluoride) kill all bed bug stages.
Structure	The structure is tarped to contain the fumigant for a period of time needed to provide adequate lethal cumulative dose of the toxic gas.
Containerized	Furniture and other infested materials can be placed in a sealed container, which is injected with fumigant.
Mattress and pillow encasements	Specially designed encasements can prevent bed bugs from getting established in mattresses and box springs, or prevent established populations from leaving these areas to feed on blood.
Diatomaceous earth / Silica gel	Dust products formulated with these dehydrating and abrasive powders (e.g., in Tri-Die ™) provide long-lasting residual protection against bed bug reinfestation of harborages.
Traps	Because bed bugs are attracted to heat, CO_2, and certain host odors, traps have been developed to monitor the presence of bed bugs. Some traps may be adequate for elimination of infestations.
Bed bug-detecting dogs	Specially trained dogs can detect small, hidden bed bug infestations with > 95% accuracy. A well trained dog will detect only live insects and eggs, and will ignore dead bed bugs, bed bug debris, and other structure-infesting insects.

Table 5-1. New Techniques in Bed Bug Control.

Despite intensive control operations, it is common for bed bugs to reestablish. In most cases, a resident will complain that the bed bugs are back several weeks to months later. In many cases, the resident took clothing or other items out of the infested room during the treatment and later returned them. If those items were infested, the bed bugs would reinfest the room from the infested clothing. Another cause for failure would be the movement of bed bugs through the walls of multiple family housing or in hospitals or nursing homes from infested to neighboring rooms. So it is usually necessary to implement follow-up inspections to find, locate, and destroy these incipient infestations before they reproduce and spread.

Steam cleaning of infested mattresses can effectively kill bed bugs living in seams and buttons. Cracks harboring bed bugs can be treated with residual sprays. Total release aerosols can also be used to treat rooms where bed bugs are located.

Take the bed apart. Spray the bed frames, slats and springs with enough spray to thoroughly wet them. Pay particular attention to the tufts and seams of the mattress. Spray the woodwork and all walls in the bedroom at least two feet above the floor. Brush, vacuum, and steam clean mattress and pillows, then put on clean sheets and pillow cases. Laundering and drying any clothes and other materials will eliminate bed bug eggs, nymphs, and adults.

Spray again if there are any new signs of bed bugs. After two weeks, spray the bed, furniture and walls again. Heat greater than 113° F can be used to eliminate infestations from furniture and other room contents.

Bloodsucking Conenose
Triatoma sanguisuga

Figure 5-8. **Bloodsucking** conenose, *Triatoma sanguisuga.*

The bloodsucking conenose is an occasional pest in homes and other buildings. However, it is more common in rural areas. It occasionally feeds on people, causing severe local skin reactions as well as allergy problems. This bug belongs to the assassin-bug family, *Reduviidae*, and is sometimes referred to as the kissing bug. Conenose bugs feed on blood and are vectors of the trypanosome parasite that causes Chagas disease in people, a serious problem in Central and South America. Some conenose bugs in the United States are infected with this trypanosome organism, but the incidence of Chagas disease in the United States is low, probably because the bugs in this country are a different species.

Description, Development and Habits. The bloodsucking conenose (Figure 5-8) is between ½ and ¾ inch long and tan to brown. This bug passes through five nymphal instars, all of which are usually active throughout the year. Adults live as long as three years and are the life stage usually found in buildings. The bloodsucking conenose normally lives in nests of rats, opossums or other ground-dwelling mammals. Conenose bugs may be attracted to outdoor lights on warm nights, promoting their entry into buildings. The occasional attack on people usually takes place during the night while a person sleeps. Several punctures are made about ¼ inch apart along a straight line at the feeding site. This injury may swell and become painful for several days to a week or more. In buildings, this insect hides in cracks and concealed areas during the day.

Management Guidelines for Conenose Bugs. Control of the bloodsucking conenose involves sanitation around buildings to remove animal nests. Exclude bugs from buildings with screens and by caulking cracks and other openings. To avoid attracting these insects at night, do not use outside lights around doorways. Examine your pets carefully before letting them inside, especially at night, because they may carry bugs into the building. If bloodsucking conenoses are established in a building, follow the control guidelines above for bed bugs.

When conenose bugs invade a building and threaten injury to people, it may be necessary to eliminate the bugs with an insecticide. Use a registered total-release pyrethrin space spray or a registered quick-acting, short-residual fumigant. Be sure to treat all rooms where the bugs may be hiding.

Fleas

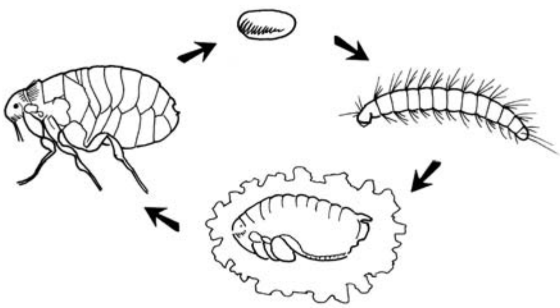

Figure 5-9. Fleas undergo complete metamorphosis through larval, pupal, and adult stages.

Fleas belong to the insect order Siphonaptera. They are tiny, wingless insects that undergo complete metamorphosis with egg, larval, pupal and adult stages (Figure 5-9). Adult fleas are parasites of warm-blooded animals. There are over 1,600 described flea species in the world, 95 percent of these associated with mammals; people are the only primate host. The remaining species parasitize birds. Most flea species have a host preference, but some attack other hosts for blood if necessary.

Some flea species can transmit serious disease organisms, such as bubonic plague or murine typhus, either through bites or feces. The oriental rat flea is the primary vector for the plague-causing bacterium, *Yersinia pestis*. This organism is found in rodent populations throughout temperate areas of the world, including the western United States. Some other flea species can also transmit this bacterium. Murine typhus is caused by a *Rickettsia* microorganism, which occurs in rodent populations and can be vectored to people by fleas. Certain fleas are also intermediate hosts for dog and rodent tapeworms, intestinal parasites which can be transmitted to pets and people through ingestion of infected fleas.

Through feeding, fleas inject a hemorrhagic saliva, which destroys tissues and causes bleeding at the feeding site. The bite produces severe itching, and multiple bites may cause a generalized rash. Some animals and people are more sensitive than others to flea bites and may experience allergic reactions. However, the reactions may be delayed for periods of time, making it difficult to associate the discomfort with the cause. People or animals who suffer from flea allergies are extremely uncomfortable and develop itching and skin rashes, often from just one flea bite.

Several species of fleas may be encountered in the course of pest control in and around buildings. These include the human flea, *Pulex irritans*; the oriental rat flea, *Xenopsylla cheopis*; and the northern rat flea, *Nosopsyllus fasciatus*. The two most common fleas found on pets, however, include the cat flea, *Ctenocephalides felis*, and the sticktight flea, *Echidnophaga gallinacea*. Cat flea, the most troublesome flea pest in buildings and dwellings, is the only species described here.

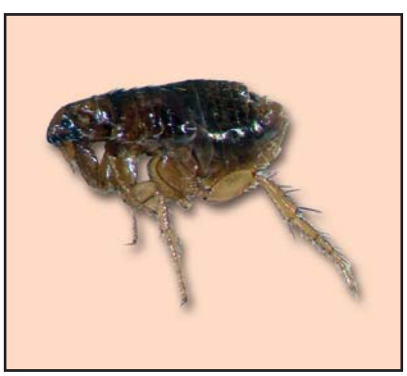

Figure 5-10. Only adult forms of fleas feed on liquid blood. A blood meal from a warm-blooded animal is necessary for females to produce eggs.

Cat Flea
Ctenocephalides felis

The cat flea (Figure 5-10) is the most common flea pest worldwide. This species is a parasite of cats and dogs as well as opossums, foxes, coyotes and other wild animals. It also attacks people. The cat flea is most active during warm summer weather, although it can be a pest throughout the year. Cat fleas have been identified as an occasional vector for the plague bacterium, *Yersinia pestis*, and they can also vector the organism causing murine typhus. Cat fleas are an intermediate host for tapeworms. Treatment for tapeworm, therefore, requires that cat fleas be controlled.

Description, Development and Habits. Adult cat fleas are about 0.08 inch long and dark reddish brown to black. Their laterally compressed bodies are an adaptation that enables them to pass freely through dense hair of host animals. Their smooth cuticle is equipped with short, spine-like hairs directed backward, which help them move forward rapidly through a host's coat. Cat fleas have long, powerful legs and are capable of jumping considerable distances for their small size. They have been observed to jump 8 inches vertically and 15 inches horizontally.

Adult fleas feed only on liquid blood. A blood meal from a warm-blooded animal is necessary for females to produce eggs. However, unlike mosquitoes, both male and female fleas are parasites. Over their lifetime, female cat fleas produce up to 450 eggs, which are laid in batches of three to 18 at a time. Eggs may be deposited in the hair of the host or off the host in debris. Eggs deposited on a host usually drop off before hatching. Depending on environmental conditions, eggs hatch in one to six days; optimum conditions include warm temperatures and high humidity. Eggs hatch into small, hairy, whitish larvae having a distinct brown, eyeless head (Figure 5-11).

Figure 5-11. Larvae of cat fleas are small and hairy with a whitish appearance.

The larvae pass through three instars and grow to about 3⁄16 inch long. Cat flea larvae feed on digested blood in the dried excrement of adult fleas to complete development. Places where the host animal sleeps usually have a high concentration of flea droppings. A protected, moist environment is required for larval development; relative humidity conditions below 75 percent are often fatal.

Carpets provide ideal conditions for cat flea larvae. Carpets installed directly over concrete floors are especially suitable because the cooler temperature of the concrete increases humidity. The sleeping pet provides warmth and also adds to the humidity.

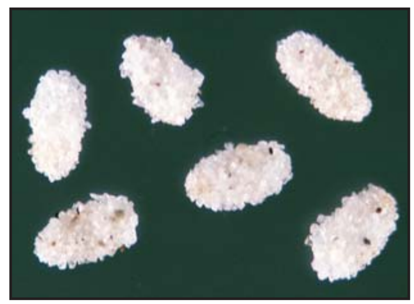

Figure 5-12. When immature fleas complete the larval stage, they pupate inside a silken cocoon. The cocoon becomes covered with debris, making it difficult to distinguish from other debris.

Larval stages under optimum conditions last between seven and 21 days, but during cool weather this period may be longer. Upon completion of the larval stage, immature fleas spin a silken cocoon which becomes covered with debris, camouflaging them from predators (Figure 5-12); they pupate into adults inside this cocoon. The normal pupal period lasts seven to 14 days, although under extreme environmental conditions it may take longer. Once they become adults, fleas may remain inactive in the pupal case for up to a year, protected from enemies and adverse environmental conditions. Increased temperatures and direct physical contact stimulate adult fleas to emerge from the cocoon. Emergence may only take a matter of seconds. Emerged adults generally live for 25 to 60 days.

Management Guidelines for Cat Fleas. Controlling cat fleas in buildings is difficult and requires a multifaceted approach. Control methods must be coordinated with thorough, systematic cleaning of the infested area as well as elimination of fleas on pets.

Before starting a control program, survey the building to determine the sources of infestation (such as pets) and areas where breeding occurs (such as pet sleeping areas). A sudden onset of flea complaints may indicate that a recent change has occurred affecting the flea population; for example, a cat died or is being boarded away from the area. Or the building may have just become occupied after being vacant. Once they become adults, fleas are mobile and search out new hosts when animal sleeping or resting sites are vacated, destroyed or become overpopulated with other fleas. For instance, dogs and cats may crawl under buildings during warm

TECHNIQUE	EFFECT
PET CARE	
Bathe pet on a regular basis (two to four times a month).	Kills some fleas. Dislodges loose hairs and skin debris that serves as food for larvae.
Groom pet daily, using fine-toothed flea comb. Good technique for cats.	Removes adult fleas and eggs. Removes loose hairs and skin debris.
Confine pet to single indoor sleeping area.	Keeps fleas confined to localized area, where control efforts can be concentrated.
Spray pet and sleeping area with flea repellent. (Some repellents last 30 to 60 days, others must be applied as frequently as once each day.	Help to reduce number of fleas attacking pet.
Consult veterinarian for flea control product for use on pet. Many products cannot be used on cats.	Flea control products repel or kill fleas coming in contact with pet.
INTERIOR HOUSEKEEPING	
Vacuum areas where pets sleep or spend time on a regular basis. (Clean at least twice per week, and immediately dispose of the vacuum cleaner bag.	Removes some eggs, larvae, adult fleas, and skin debris. Also removes adult flea excrement and dried blood that provides food for larvae.
Keep pets out of carpeted areas and other hard-to-clean areas (such as closets).	Makes housekeeping functions that reduce fleas easier to perform.
Launder pet bedding on a weekly basis.	Kills eggs and larvae. Eliminates skin debris and hair.
EXTERIOR MAINTENANCE	
Mow grass, destroy weeds, and trim shrubbery. Perform weekly as needed.	Exposes eggs and larvae to more sunlight and kills them.
Irrigate areas surrounding buildings on a regular basis.	Kills eggs and larvae.

Table 5-2. Ways to Reduce Fleas on Pets that Live in Buildings.

weather to rest in the cool dirt; this may be an ideal area for the buildup of a large flea population.

Flea eradication in a building cannot be permanent unless fleas are controlled on animals that spend time in the building. In an infested area, flea populations are highest on rugs and furniture where dogs or cats regularly sleep; however, flea larvae are not usually found in areas of heavy pedestrian traffic, locations that receive exposure to sunlight, or areas where adult flea feces containing dried blood is not present (see Table 5-2).

Areas where adult fleas, flea larvae and flea eggs are must be cleaned thoroughly and periodically. Occupants should vacuum floors, rugs, carpets, upholstered furniture and crevices around baseboards and cabinets at least weekly to remove flea eggs, larvae and food sources. Vacuuming is very effective in picking up adults and stimulating pre-emerged adults to leave their cocoons. Vacuuming must be repeated frequently because disturbed flea larvae quickly attach to carpet fibers, withstanding the pull of the vacuum. Fleas can survive and develop inside vacuum bags and adults may be able to escape into the room, so destroy bags by burning or by sealing them in a plastic trash bag and placing them in a covered trash container. Pet bedding should be laundered in hot, soapy water at least once each week.

Several insecticides are registered for controlling fleas, although some are only for outdoor use. Fleas are known to build up resistance to insecticides, so plan their use carefully and include pesticide use with other methods of control such as thorough, frequent vacuuming. Application techniques are important to ensure adequate coverage. Use the correct volume of spray per unit of treated area so that a lethal dose reaches the adults and larvae; follow label instructions carefully. If immediate control of adult fleas is needed, use a short-residual knockdown spray labeled for this purpose. Spray carpets, pet sleeping areas, baseboards, window sills and other areas harboring adults or larvae. Combine the knockdown spray with an insect growth regulator (IGR) to prevent immature stages from developing into adults; this provides long-term flea control. The IGR should be applied as a diluted space spray or as a residual fog. In some cases the IGR can be applied without the knockdown spray, especially early in the spring or summer. However, elimination of adults may take several weeks. Vacuuming should be used with the IGR treatment program to destroy adults.

Prevent pets from resting in areas under buildings to eliminate these locations as sources of infestation. Once pets are excluded, treat the soil with insecticide to kill adults, larvae, and larvae hatching later from eggs.

Dogs or cats should be treated for fleas at the same time as the building. This will slow down the rate of reinfestation. Pet owners should contact their veterinarians for advice and assistance in controlling fleas. It is important to know the names of insecticides applied in or around the building where pets live. If carbamate or organophosphate insecticides are part of a building flea control program, pet owners should not use similar materials on their animals. Pets treated with organophosphates or carbamates will be more sensitive to these insecticides in their living areas. Pet products that contain organophosphate or carbamate insecticides include some brands of flea spray, flea powder, flea collars, tick-control materials and internal medications given to animals for control of fleas or internal parasites or for protection against dog heartworm. Find out if any of these are being used before making any insecticide treatment.

Once an area has been treated for cat fleas, periodically monitor for reinfestation. Remember to thoroughly vacuum floors, carpets and furnishings regularly. Carpeted areas where pets sleep should be vacuumed daily or at least every other day. Pets must be inspected and treated to remove fleas regularly. Pet bedding should be laundered weekly—more often in warm weather. Thoroughly clean items brought into the building, such as used carpets or upholstered furniture, to prevent these from being flea infestation sources.

Pest Flea Control Products

Several types of products are available to control fleas on dogs and cats. To protect the health of the animal and to ensure adequate control, it is advisable to consult a veterinarian before using any of these products. The effectiveness of most flea-control products usually depends on the thoroughness of application, frequency of application, amount of active ingredient being applied, the concentration of fleas in the animal's living quarters, and sources of reinfestation. Successful flea control on an animal must always involve controlling all life stages of fleas living off the animal as well. Young children and infants should not be allowed to contact pets who have been sprayed, dusted, or dipped with flea control products or who are wearing flea collars.

Soaps and Shampoos: Soaps and shampoos for flea control contain small amounts of insecticide (usually pyrethrins) that kill fleas on the animal. These require that the animal's body be thoroughly coated with a lather, and often it is recommended that the lather be allowed to remain on the animal for up to 15 minutes before rinsing. These products are most suitable for dogs. The bathing process assists in removing dried blood and skin flakes that provide food for flea larvae in the animal's sleeping area. This type of treatment does not usually have any lasting effect on keeping fleas off the animal. Wear rubber gloves to avoid contacting the insecticide while bathing the animal.

Repellents: Repellents are materials that are sprayed or wiped onto the animal's coat to repel fleas. Repellents may be combined with flea sprays or other flea control products. These last for only a short period before they lose their effectiveness through the animal's grooming and other activities and through the natural breakdown of the chemical repellent. They are most useful to protect an animal that will be going into a flea-infested area for a short time.

Dips: Dips are insecticidal liquids that must be diluted with water. The animal is submerged into the water to provide uniform application. Properly applied dips provide immediate control of fleas on the animal and will kill fleas coming in contact with the animal's coat for several days or longer. Avoid contact with the animal's eyes, nose, mouth, or ear canals. Wear waterproof gloves and avoid getting the liquid onto your clothing when handling the animal. Dips can be very hazardous to animals being treated if the insecticide is not properly diluted. This type of treatment should be performed by or under the supervision of a veterinarian.

Powders and Dusts: Powders and dusts are ready-to-use formulations consisting of a small percentage of insecticide active ingredient combined with inert powder. They also include desiccants such as silica aerogel, which may or may not also be combined with a small amount of insecticide active ingredient. Sprinkle the pet with the dust and work it into the coat by brushing. Most powders are available in a shaker can, and some are available as aerosols. Wear rubber gloves when applying the dust. Avoid breathing any dust. Be extremely careful to avoid getting dust into the animal's eyes or nose. Powders and dusts are suitable for flea control on dogs and cats. They usually provide up to one week of control depending on the pet's activities and whether the animal gets wet.

Spray-On Liquids: Spray-on liquids, among the most common type of flea control product for pets, are ready-to-use formulations packaged in aerosol cans, squeeze bottles, or pump-type applicators. They contain a small percentage of one or more insecticides dissolved in a petroleum solvent. The animal's coat must be thoroughly wetted with the spray for it to be effective. For animals with very dense fur, it is necessary to brush the coat up while applying the spray. Wear rubber gloves during application. Avoid contact with the liquid spray. Do not get any spray into the animal's eyes, nose, mouth, or ear canals. Some spray-on products provide flea control for 30 days or more under certain conditions and when properly applied. These impregnate the animal's hair and slowly release the active ingredient.

Flea Collars: The plastic band on a flea collar is impregnated with an insecticidal material that is released slowly as a vapor while the collar is being worn. A collar may be effective for several months as long as it remains dry. Flea collars are suitable for use on dogs and cats; however, some animals are sensitive to the insecticide and may develop a rash or sores on the skin beneath the collar. They should not be used on animals showing any sensitivity.

Systemics: Systemic flea control products are administered on a regular basis in the form of a pill as an internal medication. They contain insecticidal materials that are transported to all skin areas through the animal's blood. The dosage administered to the animal is very critical and is based on the animal's body weight. Systemics should only be prescribed by a veterinarian, and the animal must be regularly monitored by the veterinarian for any adverse effects.

Spot-On Treatments: Spot-on treatments can be very effective against flea infestations on pets. They are easy to apply and can be an important tool in preventing the establishment of a flea infestation and its associated problems to pets, pet owners and the entire household. Spot-on products are applied to a small area on the pet but will spread over the animal's body. It is very important that the right dose for the type and size of pet is used according to the veterinary recommendation. Resistance to some active ingredients used in spot-on products has been suspected in different flea populations throughout the world, so constant monitoring of these treatments is necessary, and rotation of different products may prevent the buildup of resistant populations of fleas. Monitoring is also important in early detection of any allergy or other problems the pet may develop in relation to the flea products.

Ticks

Several species of ticks attack dogs, but cats are rarely infested. Many of the dog ticks are known as wood ticks and infest dogs when they run through the woods or fields. Ticks can also transmit Lyme disease and annoy people, but they are not the preferred host.

Ticks are not insects but are closely related to the spiders. Adult ticks have eight legs. All ticks are parasitic, feeding on the blood of animals.

Of the ticks in Florida, the brown dog tick and the American dog tick are the most troublesome. The brown dog tick rarely bites humans, but infestations are frequently found on dogs and in the home. The American dog tick attacks a wide variety of hosts, including humans, but rarely infests homes.

Figure 5-13. Brown dog tick, *Rhipicephalus sanguineus*.

Brown Dog Tick
Rhipicephalus sanguineus

The brown dog tick seldom attacks animals other than dogs. It is most likely found where dogs are kept in or around the house. The brown dog tick (Figure 5-13) is not known to transmit diseases to humans but may transmit disease among dogs.

The adult female tick lays a mass of 1,000 to 3,000 eggs after engorging on a dog's blood. These eggs are often found in cracks on the roof of kennels or high on the walls or ceilings of buildings. In the house, eggs are laid around baseboards, window and door casings, curtains, furniture, and edges of rugs. The egg-laying females are often seen going up walls to lay eggs.

The eggs hatch in 19 to 60 days into a six-legged, small seed tick. The seed tick takes a blood meal from dogs when they are available. The larvae are so small they won't be noticed on the dog unless a number are together. The seed tick remains attached for three to six days, turns bluish,

Lyme Disease

Symptoms of Lyme disease were described in Europe over 100 years ago. The disease was named in 1975 by a physician studying the symptoms of a group of children living around Old Lyme, Connecticut. This disease appears to be spreading throughout most of the country and has been detected in at least 43 states.

The disease, when left untreated, can involve the brain, the joints, or the heart. It is caused by a corkscrew-shaped bacterium, or spirochete, similar to the one that causes syphilis. This spirochete is transmitted to people and animals through tick bites.

Preventing tick bites is the best way to keep from becoming infected with the spirochete. Anyone going into areas where the tick occurs should do the following:

- Wear light-colored clothing including long pants, a long-sleeved shirt, and a hat. Be sure as much skin area as possible is covered.
- To provide barriers to keep ticks from reaching the skin, pants should be tucked into boots or socks, and shirts should be tucked into pants.
- Spray a repellent containing DEET on any exposed skin. Spray clothing with the repellent or a product registered for use against ticks, such as permethrin.
- If possible, stay on clear paths and avoid trail edges, brush, and grassy areas.
- Examine all body areas for signs of ticks as soon as the clothing is removed. Shower immediately.

then drops to the floor. After dropping from the host, the seed tick hides for six to 23 days before molting into an eight-legged, reddish-brown nymph. It is now ready for another blood meal and again seeks a dog host. The nymphs attach to dogs, drop off, and molt to the adult in twelve to 29 days. As a reddish-brown adult, it again seeks a blood meal, becomes engorged, and is bluish in color, reaching about ⅓ inch in length.

Unengorged larvae, nymphs and adults may live for long periods without a blood meal. Adults have been known to live for as long as 200 days without a blood meal. Indoors, ticks hiding between blood meals may be found behind baseboards, window casings, window curtains, bookcases, inside upholstered furniture and under edges of rugs. Outdoors, ticks hide near foundations of buildings, in crevices of siding, or beneath the porch.

American Dog Tick
Dermacentor variabilis

Figure 5-14. American dog tick *Dermacentor variabilis.*

The American dog tick (Figure 5-14) is also a common pest of pets and humans in Florida. The adult males and females are frequently encountered by sportsmen and people who work outdoors. Dogs are the preferred host, although the American dog tick will feed on other warm-blooded animals. The nymphal stages of the American dog tick usually only attack rodents. For this reason the American dog tick is not considered a household pest.

The female dog tick lays 4,000 to 6,500 eggs and then dies. The eggs hatch into seed ticks in 36 to 57 days. The unfed larvae crawl in search of a host and can live 540 days without food. When a small rodent is found, the larvae attach and feed for approximately five days. The larvae then drop off the host and molt to the nymphal stage. The nymphs crawl about in search of a rodent host, attach to a suitable host, and engorge with blood in three to 11 days. Nymphs can live without food for up to 584 days.

Adults crawl about in search of dogs or large animals for a blood meal but can live for up to two years without food. American dog tick adults and many other species can be found along roads, paths, and trails, on grass and other low vegetation in a "waiting position." As an animal passes by, the tick grasps it firmly and soon starts feeding on its host. The males remain on the host for an indefinite period, alternately feeding and mating. The females feed, mate, become engorged and then drop off to lay their eggs.

The American dog tick requires from three months to three years to complete a life cycle. It is typically an outdoor tick and is dependent on climatic and environmental conditions for its eggs to hatch.

Importance of Ticks. When feeding, ticks make a small hole in the skin, attach themselves with a modification of one of the mouthparts that has teeth that curve backwards, and insert barbed, piercing mouthparts to remove blood.

The presence of ticks is annoying to dogs and humans. Heavy, continuous infestations on dogs cause irritation and loss of vitality. Pulling ticks off the host may leave a running wound, which may become infected because of the ticks' type of attachment.

The brown dog tick is not a vector of human disease, but it is capable of transmitting canine piroplasmosis among dogs. The American dog tick may carry Rocky Mountain spotted fever, tularemia and other diseases from animals to people. Dogs are not affected by these diseases, but people have become infected by picking ticks from dogs. People living in areas where these wood ticks occur should inspect themselves several times a day. Early removal is important since disease organisms are not transferred until the tick has fed for several hours.

The American dog tick is also known to cause paralysis in dogs and children if ticks attach at the base of the skull or along the spinal column. Paralysis is caused by a toxic secretion produced by the feeding tick. When the tick is removed, recovery is rapid, usually within eight hours. Sensitized animals may become paralyzed by tick attachment anywhere on the body.

Lyme disease is transmitted by ticks, but few cases have been reported in Florida to date. Most transmission occurs in the New England states, with the deer ticks. The deer tick is not prevalent in Florida, but species that are close relatives and are capable of transmitting Lyme disease are common throughout the state. The American dog tick and the brown dog tick are not considered important vectors of Lyme disease. In cases of tick bites where Lyme disease is suspected, a physician should be contacted so that appropriate blood tests can be done for the patient.

Management Guidelines for Ticks. Ticks should be removed from pets and humans as soon as they are noticed. Ticks should be removed carefully and slowly. If the attached tick is broken, the mouthparts left in the skin may transmit disease or cause secondary infection. Grasp the tick firmly with tweezers or fingers near the mouthparts and pull evenly and firmly. A small amount of flesh should be seen attached to the mouthparts after the tick is removed.

Pesticidal control of ticks may require both treatment of the pet and the infested area. If a heavy tick infestation occurs, pets, home and yard should be treated at the same time.

Pets should be treated by using dusts, dip or sprays. Rub dusts into the fur to the skin being careful not to allow chemicals to get into the eyes, nose or mouth. Heavy infestations of ticks on the animal should be controlled by spraying or dipping.

Premise sprays are registered for tick control for application to lawns, houses, crawl spaces, kennels, and similar areas. Brown dog tick infestations of homes and yards are frequently difficult to control. Insecticides should be applied inside the house carefully as light, spot treatments to areas where ticks are known to be hiding. Special effort should be given in treating areas frequented by pets. Applications at two- to four-week intervals may be necessary to eliminate the ticks. Pets should be kept off treated surfaces until dry.

People entering tick infested areas should keep clothing buttoned, shirts inside pants and pants inside boots. Do not sit on the ground or on logs in bushy areas. Keep brush cleared or burned along frequently traveled areas. Repellents will protect exposed skin. However, ticks will crawl over treated skin to untreated parts of the body.

Bees and Wasps

Bees and wasps, like ants, belong to the insect order Hymenoptera. They pass through a complete metamorphosis. Adult bees and wasps are nectar feeders, although some adult wasps paralyze insects or spiders as food for their larvae and may consume small amounts of their prey's blood before stocking their nests. These insects are generally considered to be highly beneficial, although bees and wasps can be nuisances around buildings because they forage for food among flowers and around outdoor dining areas. They occasionally wander indoors. Sometimes bees or wasps become nuisances when they build nests in wall voids, attics and other areas in or near buildings. Their nests can also be the source of carpet beetle infestations.

Bees and wasps are most notorious and feared because they defend themselves with a painful, venomous sting. The sting usually produces an intense local reaction accompanied by varying amounts of swelling. In some sensitive people, bee or wasp venoms evoke severe allergic reac-

The Africanized Honey Bee

The Africanized honey bee has made its way into Florida. It is expected to become a permanent resident throughout the coastal regions of the Gulf of Mexico and all of Florida.

The difference between Africanized honey bees and European honey bees is one of degree. Both insects are honey bees; both display all the behaviors associated with these honey bees. However, Africanized bees sting, swarm, and abscond much more than Europeans. Tests have demonstrated that African honey bees become alert to disturbances and prepare for colony defense much quicker than Europeans. Africanized bees also cause six to 10 times more stinging than Europeans, and continue to attack for longer periods of time and at much greater distances from the nest or hive.

Experience suggests that youngsters and elderly people unable to escape when a stinging incident begins are most at risk when stung by a number of honey bees. In addition, small children (low body weight) and persons with high blood pressure and weak hearts are much more likely to succumb to large doses of bee venom. Most older children and adults can survive multiple sting incidents with limited physiological harm.

Serious injury or death from a stinging incident (envenomation) can be prevented. Proper planning and preparation is necessary for agricultural workers, heavy machinery operators, and others likely to encounter Africanized bees out of doors. This precaution extends to homeowners as well. Africanized honey bees nest in many places which would not house Europeans. These include drainage culverts, highway underpasses and other places often exposed to the elements. Exposed nests for Africanized honey bees are common, but are rarely constructed by Europeans.

The following precautions are recommended in areas inhabited by Africanized bees:

1. Have a bee veil handy. Numerous stings can be tolerated on most parts of the body. Facial stings, however, can lead to headaches, fever and in some cases restricted breathing.

2. Be alert for possible shelter if a stinging attack begins. A vehicle or building offers the best protection. Trying to lose the bees by hiding in foliage or walking among trees, often recommended for European honey bees, is futile.

3. In a very few persons, one or two stings can result in an allergic reaction. An injection of epinephrine sold in drug stores as either AnaKit® or Epipen® is the only treatment for someone whose airway has been constricted by swelling or has developed anaphylactic shock. Usually such a reaction is apparent within five minutes of being stung, and the epinephrine then must be used immediately. Before working where there is a likelihood of encountering Africanized honey bees, consult with medical authorities for information on obtaining and using epinephrine and for precautions and hazards associated with its use.

tions, known as anaphylaxis. After being stung a few times, allergic individuals may become hypersensitive to the venom's complex amino acids, proteins and enzymes. Occasionally the reaction is so severe that a sensitized person may die shortly after a sting unless he or she receives drugs to counteract the allergic effects.

Considerable interest and concern is being expressed regarding the migration of the Africanized bee into the United States. This is a much more aggressive strain of honey bee that is more prone to attack people and has been responsible for several human deaths. Victims of Africanized bee attacks have received extremely large doses of venom as a result of hundreds of stings.

Description, Development and Habits. Honey bees, the social wasps, and a few solitary wasps are the pests of this insect group most likely to appear in and around buildings. The social wasps and honey bees are more serious problems because their nests contain hundreds of individuals that may readily become aggressive when they are disturbed.

Figure 5-15. Honey bee, *Apis mellifera.*

Honey Bee
Apis mellifera

Adult honey bees (Figure 5-15) range in length between ½ and ¾ inch and have two pairs of wings. They are black, gray, or brown, intermixed with yellow, sometimes with yellow-banded abdomens. Honey bees have a covering of fine, short hairs on the thorax, legs and abdomen. Several different subspecies, or races, of honey bees exist, each having slightly different colors and other distinguishing physical and behavioral characteristics. Honey bees are social insects and their colonies are divided into three castes of individuals: the queen, the workers and the drones. Queens are the reproductives for a colony (Figure 5-16) and are larger than workers; unlike many of the ant species, honey bee colonies usually have a single dominant queen. Nearly all of the bees in a colony are workers, nonreproductive females that defend a colony, perform housekeeping chores, forage for food and water, and feed and groom

Figure 5-16. Honey bees are social insects that live in colonies, or hives, which may contain thousands of individuals. Queen bees are larger than the workers.

larvae, the queen, and drones. Drones, as the male bees are called, are slightly larger than workers and make more noise when they fly; they do not sting.

The queen lays eggs in individual wax cells constructed by workers. Upon hatching, larvae are fed and groomed by workers throughout that stage. Food consists of honey, produced by workers from nectar collected during foraging flights to flowers, and pollen. When a larva completes its growth, workers cap its cell to prepare it for pupation. Upon completing pupation, the newly emerged adult chews its way out of the cell. Cells are cleaned and reused for subsequent brood.

Honey bee colonies may contain 7,000 to 60,000 individuals. Despite their venom and occasional pest status in or around buildings, honey bees are extremely beneficial because they serve as important pollinators to many agricultural crops. They are kept in hives by beekeepers and rented to growers for crop pollination. Honey and beeswax, both of which are useful commodities, are extracted from hives.

Social Wasps

Many different species of yellowjackets, hornets, and paper wasps are included in the family Vespidae; species range in length from ½ to ¼ inch (Figure 5-17).

Figure 5-17. Paper wasps, of the family Vespidae, are social wasps. Also included in this group are hornets and yellowjackets.

Paper and Umbrella Wasps. Paper wasps or umbrella wasps (belonging to the genus *Polistes*) are black with various yellow, orange, or greenish markings, depending on the species. Mated females overwinter in protected cracks or crevices, often in buildings. In spring they begin constructing paper nests from wood, which they chew into pulp (Figure 5-18) in attics or under eaves, in wall voids, in shrubs and trees, in cavities in the ground and in lumber piles. Eggs are laid in a few cells and tended by the solitary female. When these offspring become adults, the original female assumes the role of queen and continues laying eggs while younger females forage for food and enlarge the nest.

Figure 5-18. Paper wasps construct paper nests from wood, which they chew into a pulp.

Figure 5-19. Yellow jacket, *Vespula* spp.

Yellowjackets and Hornets. Adult yellowjackets and hornets (genus *Vespula*) forage for food, which they consume themselves or carry back to the nest for developing young. These are beneficial insects that contribute to the natural control of many plant pests. They become pests when their foraging brings them too close to people. In addition to capturing insects, they feed on fruit, juice and soft drinks, dead animals, feces and meats. Some species are attracted to homes, buildings and outdoor eating areas for foraging and nest building. Yellowjackets (Figure 5-19) generally construct their nests in holes in the ground or in hollow logs or tree stumps near the ground. Hornets (Figure 5-20) build large globular paper nests suspended from limbs of trees or shrubs or building overhangs. Most colonies die out toward the end of the first year, although some colonies may last for two years. Newly emerged females mate and overwinter to begin fresh colonies the following year.

Removing Bee Nests

Removing honey bee nests from cavities (walls of houses, hollow trees) is a time-consuming, labor-intensive practice that should be undertaken by professionals. Continuous honey bee flight activity to and from a hole in a building is an indication of a nest. Many times, this can be confirmed by listening for bees buzzing inside.

An experienced beekeeper usually can remove bees and combs from easily accessible places like hollow trees, but often bees live in building walls or are tucked away where they are impossible to reach.

Simply killing bees in a cavity with an insecticide can have serious consequences:

- Dead bees and dead brood will decay and produce strong odors.
- Stored honey can absorb moisture and ferment or overheat without adult bees to tend it. This results in burst cappings, producing leaking honey from combs which can penetrate ceilings or walls, causing stains, sticky puddles around doors and windows, and softening of drywall.

The quickest way to remove bees from buildings is to kill them and remove all traces of the nest. In most cases an inner wall or ceiling must be removed, however, calling for the services of a building contractor. It is essential to remove all honeycomb and to plug all holes to be certain there is no way for bees to reenter the area. Any remaining bits of beeswax emit highly attractive odors to swarming bees.

There are a number of ways to kill bees. It is important to exterminate a colony when all bees are on the nest (dusk or dawn). This reduces the number that might be in the field and return to cause problems. Many persons use commercially available wasp and hornet spray for killing the bees. This knocks down the insects quickly and can be used from a distance. Dust formulations of labeled pesticides may also be pumped onto an enclosed nest. There is more and more evidence that soapy water is also a very good material to use that is inexpensive and relatively environmentally benign. How the bees are killed will depend on the particular situation.

Management Guidelines for Bees and Social Wasps. Destroying or removing bee and wasp nests is a delicate operation. It requires special equipment, protective clothing, and skill to prevent stings. Swarms of bees, which are most common in the spring, may appear on or near buildings and create a hazard to people. Because they are beneficial, bees should be removed rather than destroyed, if they are accessible. Whenever possible, obtain the assistance of a beekeeper or specialized bee-removing professional for removing a hive in or near a building because they have the skills and equipment necessary to do a safe and thorough job. Remove the colony as soon as possible. Colonies that are located in wall voids or other inaccessible places are more difficult to deal with. The box "Removing Bee Nests" describes one method that can be used if time allows. To destroy a bee colony in a wall void or inaccessible location, use a fast-acting insecticide labeled for this purpose. Be sure all openings to the outside or interior of the building are sealed except the one used to apply the insecticide. Once the colony is killed, it must be removed from the building to prevent odors of dead bees and fermenting honey from permeating the building and to keep from attracting other insects such as ants to the nest. Old nesting sites are extremely attractive to new bee swarms, so all potential entrances ¼ inch or larger in the area of a building where a nest is removed must be sealed. Naphthalene (moth balls) may be useful in repelling bees from areas where nests once existed.

Figure 5-20. Baldfaced hornet, *Dolichovespula maculata.*

Managing social wasps in and around buildings requires skills similar to those used for honey bees. A few additional techniques are available. One is to use traps baited with an attractant, with the hopes of reducing the numbers of foraging adults that are pests in specific locations (Figure 5-21). When traps become sufficiently full they can be submerged in water to destroy the wasps. This control method may not work well when yellowjacket wasp populations are high. Poisonous bait will be taken back to the nest and destroy the entire colony. This method is slow and may require time before results can be seen. One way of removing adults from a ground nest is by vacuuming them up as they emerge from the nest opening. If you have never removed a nest in this manner, work with someone who has in order to gain experience. Be sure to wear protective clothing to prevent getting stung (heavy coveralls with leg and sleeve openings sealed with tape, gloves, boots and a hat with a bee veil). Seal all but one opening before beginning (it may be difficult to locate and seal all openings). Two people are required to successfully destroy a nest: one opens the nest while the other operates the vacuum. Destroy adults picked up in the vacuum as well as larvae removed from the nest by freezing them.

Figure 5-21. Traps baited with attractants may reduce the numbers of foraging adult wasps in specific locations. Common attractants include raw beef or tunafish.

It is also possible to use a quick-acting liquid insecticide to destroy social wasp nests in the ground, wall voids or other locations. This is done the same way as for control of honey bees. Be sure to seal off all openings except the one used to apply the insecticide. Pour or spray a large quantity of material directly into the nest to prevent any adults from escaping.

Certain insecticide dusts can also be used for control of social wasps. Seal off all but one nest opening, then blow the dust into the nest. This method works well if some of the nest population is away from the area. They will brush against the dust upon return and be killed.

If you must destroy or remove hornet or yellowjacket nests, do so at night, when all individuals are in the nest rather than out foraging. At night, too, cool temperatures inhibit wasps from flying. When using a flashlight, cover the lens with red cellophane to make the light invisible to the insects.

Figure 5-22. Mud dauber wasp (family Sphecidae).

Umbrella wasps (genus *Polistes*) are beneficial and generally not aggressive. They have much smaller colonies than the hornets and yellowjackets, usually up to 200 individuals per nest. Nests have a single layer of exposed cells and are found in protected places such as under eaves or roof tiles. Nests can be removed with a pole or stick.

Solitary Wasps

Figure 5-23. Female mud daubers construct mud cells, which they provision with spiders or insects as food for their young.

Solitary wasps, of the family Sphecidae, include several species of mud daubers that range in length from ½ inch to over 1¼ inches. Some of these wasps are distinctive, having the abdomen separated from the thorax by a long, slender waist, or petiole.

As implied by their name, female mud dauber wasps construct cells of mud (Figure 5-22). They stock these with spiders or insects as larval food for their offspring (Figure 5-23). When the cells are full, a single egg is deposited and the cell is sealed. An adult wasp assembles several cells together in one nest. Nests are located in protected places among trees and rocks in nature, but the wasps also construct them under eaves of buildings and in attics and other out-of-the-way areas.

Mud daubers serve as beneficial insects because they contribute to the control of spiders, including black widow spiders, around buildings and in attics. These wasps are usually few, and they are not aggressive like bees or yellowjackets. Their mud nests may be unsightly and may occasionally attract carpet beetles.

Management Guidelines for Solitary Wasps. Control mud dauber wasps by physically destroying the mud cells and blocking access to attics or other areas inside buildings. Use a spatula, pole or broom to dislodge mud nests from walls, ceilings or eaves. In outdoor areas, the nests can also be removed with a high-pressure stream of water. Cells that have an external opening in them are empty — the opening was made by a newly emerged adult. These cells should be removed, however, because they contain food that may attract other household pests such as carpet beetles.

Scorpions

Figure 5-24. Scorpion.

Scorpions are flattened, crablike animals with 10 legs and a fleshy tail ending in an enlarged, upturned tip, which bears a stinger. They vary in size from 1 to 4 inches long. They normally live outdoors, though they will invade homes and buildings.

Scorpions have a long life cycle. Three to five years may be normal. Males and females go through a courtship ritual prior to mating. Scorpions do not lay eggs and the young are born alive. After birth the young scorpions climb on the back of the mother and remain there until after their first molt. Scorpions are cannibalistic and will readily eat other species or smaller individuals of their own. Females will often eat their own young.

Scorpions (Figure 5-24) sting, but usually only when provoked or disturbed. Scorpion venom is a neurotoxin, but the dose injected usually is insufficient to prove fatal to an adult human. However, the site of the sting may be sore and swollen for some time. Scorpions are most active at night. They hide under boards, rubbish or similar debris which provide shelter and protection. Places commonly infested in a home are under the house or in the attic. They feed on insects, spiders, or similar small animal life.

Management Guidelines for Scorpions. Mechanically destroy any scorpions found indoors by swatting or crushing. Clean out all possible hiding places. Treat hiding or breeding areas with residual sprays or dusts. During dry weather scorpions can be attracted and trapped by spreading moist burlap on the ground around infested areas.

Spiders

Figure 5-25. Beneficial spiders, such as Paykull's jumping spider *(Plexippus paykulli),* commonly occur in and around buildings.

Spiders (Figure 5-25) are typically seen in buildings, attics and crawl spaces, under eaves, around windows and outside in shrubbery. Many different species of spiders may be there. Some make webs to snare their prey; others are hunters that walk across floors or climb walls searching for food. All spiders are predators that depend mostly on live insects for food. Spiders are highly beneficial because they consume many pest insects such as flies, cockroaches and mosquitoes. Spiders never feed on plants or any type of nonliving material such as grains or fabrics. They are pests primarily because they leave unattractive, dust-catching webbing in corners of rooms, around windows and on the outside of buildings and plants. Dense webbing filled with dust and insect remains is also in basements, crawl spaces, garages and other dark places. This debris attracts other pests such as carpet beetles.

Some spider species are capable of inflicting painful venomous bites, but rarely do. The black widow is the most notorious biting spider, although large garden spiders have occasionally been known to injure people who accidentally come too close. The brown recluse or violin spider is not common in Florida. Despite the rarity of their bites, spiders have a frightful reputation to the point where many people cannot tolerate their presence.

Description, Development and Habits. Several species of spiders may be in buildings. Each has unique habits, food preferences and life spans, although it is possible to generalize on some aspects of their biology.

Most spiders lay eggs into a sac constructed of special webbing. Egg sacs usually contain several hundred eggs, and most female spiders construct two or more of these during their adult life. Females of some species carry the egg sac with them attached to the end of their abdomen, under their body, or in their jaws. Other species position the sac in their web and stand guard over it. Generally, female spiders are very protective of their eggs and newly hatched young.

Eggs hatch in two to three weeks, but young spiderlings of most species remain in the egg sac for several more days. The total time between egg laying and the appearance of young spiderlings outside the egg sac is usually three to four weeks. Newly hatched spiders resemble adults but are much smaller. Usually they are light-colored and have few distinctive markings.

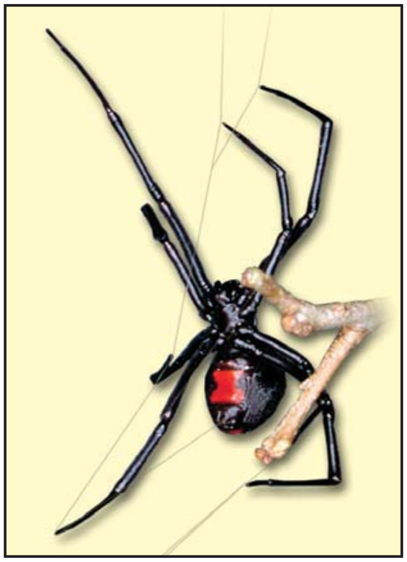

Figure 5-26. Black widow spiders are usually found in dark locations inside or around the outside of buildings.

As spiderlings grow, they shed their outer body covering, a process known as molting. Shed "skins" are called exuviae. The first molt takes place before spiderlings emerge from the egg sac. Spiders usually undergo six or seven molts before reaching maturity; most species found in and around buildings mature within six months. With the onset of the winter season, however, immature spiders do not complete their final molt until spring. Spiders grow larger with each successive molt and their coloration and markings gradually resemble those of adults.

Adult females are larger and more robust than males and usually live longer. Adult females generally live for six or eight months, although some species, for example large female tarantulas, may live for more than 30 years. As adults, males of all species cease feeding and concentrate their efforts on finding females for mating — their adult lifespan only lasts a few months.

Spiders produce several types of silklike webbing from glands in their abdomens. Webbing is emitted through external structures at the end of the abdomen called spinnerets. Most young spiders disperse from their hatching area by letting out a long strand of webbing, or gossamer, which carries them aloft on air currents. Spiderlings can travel a distance of hundreds of miles by "ballooning" in this manner.

One characteristic of some spiders is the web they build to catch prey. Some are symmetrical orbs constructed between supporting structures, such as those made by garden spiders. Others are irregular jumbles known as cobwebs; these are constructed by such species as the black widow. Other species make sheet or funnel webs to entice and capture prey. Not all spider species build webs; many roam in search of food or hide among flowers or foliage and are adept at jumping on and overpowering prey.

All spiders inject paralytic venom into their prey through hypodermiclike fangs. Spiders also use their fangs to defend themselves from enemies or danger, and this is the source of spider bites.

Widow Spiders
Latrodectus spp.

These spiders have a bad reputation and are often found in inconspicuous areas such as wood piles, garages, and under houses, hanging upside down in their strong webs. They are poisonous, and their bite can be dangerous not only to small children but also to adults.

All these species are rather long, about 1½ inches with the legs extended. The female black widow is readily recognized by its glossy, jet-black color, large bulbous abdomen and, of course, the familiar red "hour glass" marking on the ventral side of the abdomen (Figure 5-26). The black widow is actually two separate species.

The southern black widow is most widely spread and quite common in the southeast and southwest United States. Occasionally the female may have more markings, as its immature forms may have a series of dots on the dorsal side of the abdomen.

The northern black widow has a row of red spots down the middle of its back and two reddish triangles resembling an hourglass on the underside of the abdomen.

The brown widow spider varies in color from gray to light brown or black. The abdomen has variable markings of black, white, red and yellow. Under the abdomen it has an orange or yellowish-red hourglass.

The red widow spider has a reddish orange head-thorax and legs with a black abdomen. The abdomen may have a dorsal row of red spots with a yellow border. The red widow lacks a complete hourglass under the abdomen but may have one or two red spots.

The female lays her eggs in late spring. After the nymphs emerge, they become adults in three months.

Widow spiders are found throughout North America except northern Canada. The northern black widow is mainly in forests with irregular, loosely woven webs three to 20 feet off the ground.

The southern black widow is most frequently outdoors in protected places such as in piles of grass, stump hollows, discarded pipe or building materials, rodent burrows, storm sewers, and under park benches and tables. Around houses, the southern black widow lives in garages, storage sheds, crawl spaces under buildings, furniture, ventilators and rain spouts.

The red widow spider makes its web off the ground in palmettos. It has only been found in sand-pine scrub areas. The web retreat is characterized by the rolled palmetto frond with the web spread over the fronds.

The brown widow is commonly on buildings in well-lighted areas.

Brown Recluse Spider
Loxosceles reclusa

The brown recluse spider is recognized by its dark, violin-shaped mark behind the eyes (Figure 5-27). There are three pairs of eyes on this species, while most spiders have four pairs. The brown recluse is a medium-sized spider, about ¼ to ½ inch (6.4 mm to 12.7 mm) in length.

The brown recluse spider lives mainly in the eastern United States. Because of its tendency to live in old boxes, furniture, houses and farm buildings, it is inadvertently transported by man. Specimens of brown recluse spiders have been found in Florida, but there is no indication that it can survive and reproduce in this state.

The brown recluse spider is a shy species that bites humans when trapped in clothing or rolled onto in bed. Persons bitten by the brown recluse do not usually feel pain for two to three hours. A sensitive person may feel pain immediately. A blister arises around the bite area. The local pain is intense, with the wound sloughing tissue, often down to the bone. Healing takes place slowly, usually requiring six to eight weeks.

The brown recluse spider is one specimen in a group called Loxocelids. Other spiders in this group are also of major medical concern. All these spiders have the same markings. If the bite of a brown recluse spider is suspected, collect the spider and consult a physician immediately.

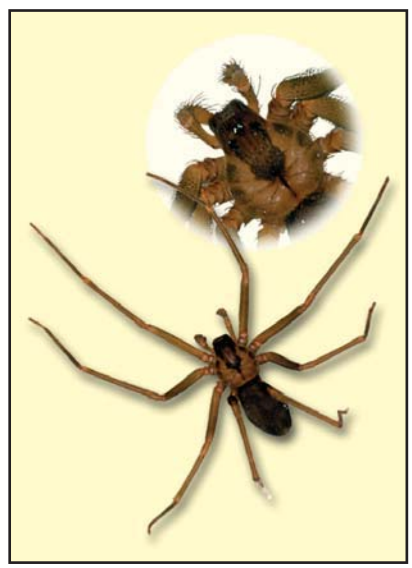

Figure 5-27. Brown recluse spider and closeup.

Management Guidelines for Spiders. Most spiders found indoors and around the outside of buildings are harmless to people and are often beneficial but are nevertheless controlled because they or their webs are nuisances. Spiders depend on live insects or other small arthropods for food, but they can survive for long periods without food. They are most numerous in locations where insects occur. Because of the innocuous nature of most spiders, control may not be needed. In most situations, control should be nonchemical; reserve pesticide use to destroy black widow or other occasionally harmful species.

Satisfactory management of spiders inside buildings begins by eliminating food sources and by keeping spiders out. Items such as firewood, cut flowers and nursery plants should be thoroughly inspected for spiders or spider eggs before being brought indoors. Eliminate the spiders' food by keeping flying insects such as flies and mosquitoes out of buildings. Use door and window screens and insect traps, and caulk or fill small cracks and other openings. These techniques also help exclude spiders, although most young spiderlings are so small they can pass through the openings of window screening and small gaps in poorly fitted doors and windows. If food is not available, however, spiders will not survive. Whenever possible, use a vacuum cleaner to remove spiders and webbing from ceilings, corners, and behind and under furniture and appliances. Be sure to remove egg cases.

Black widow spiders (Figure 5-26) usually are found only in dark locations. Look for them behind or under furniture, in closets, basements, attics, crawl spaces and storage rooms. When controlling poisonous spiders in inaccessible locations, apply an insecticide as an aerosol or fine mist. The spray must actually contact the spider or its webbing to be effective because these spiders are not mobile and do not usually walk over sprayed surfaces; they may even avoid treated areas. Use only pesticides specifically registered for indoor spider control.

Apply desiccants (inert dusts or sorptive powders) in basements, attics, wall voids, crawl spaces, store rooms, garages and other similar areas where spiders are found. Before applying a desiccant, clean the area to remove spiders, eggs and webbing. Apply dusts to surfaces where spiders attach their webs. Desiccants are effective in providing relatively safe, long-term control as long as they remain dry. A pesticide dust or liquid residual spray can also be used in these areas for control of spiders, although control may not last as long.

Remove spiders from building exteriors by vacuuming, sweeping or washing with a high-pressure stream of water. Insects are attracted to lights; therefore, spiders congregate in these areas, too. If possible, relocate exterior lights to attract insects away from buildings or use lights that are less attractive to insects, such as sodium vapor lights or yellow incandescent "bug" bulbs. To eliminate suitable habitats, shrubbery should be trimmed away from buildings, and debris and items stored next to buildings should be removed. Periodic cleaning of building exteriors is usually sufficient to prevent excessive spider problems and eliminate the need for chemical controls. If further treatment is necessary, apply a liquid residual pesticide spray labeled for control of spiders to surfaces where they congregate, such as under eaves and around windows and doors. Also apply this type of spray around building foundations where spiders must pass to gain access to walls or eaves. This application may help keep spiders out of buildings as well.

Study Questions | Chapter 5

1. What two diseases are commonly transmitted by ticks in the United States?

2. What diseases are transmitted to dogs or humans by the brown dog tick in the United States?

3. What diseases are transmitted by bed bugs in the United States?

4. The food of flea larvae is principally ________________________.

   A. blood they suck from the host
   B. dried blood from the female flea
   C. fur from the host
   D. starch

5. Adult fleas obtain blood by ________________________.

   A. sucking
   B. chewing
   C. absorbing
   D. lapping

6. Pets that are flea hosts sleep and loaf in particular places rather than randomly lying down when they are tired.

   A. True
   B. False

7. During treatments for fleas, it is important for the pet owner to ________________________.

   A. remove the pet
   B. vacuum pet's resting spots
   C. treat the pet
   D. clean pet bedding

8. Application of an IGR will ________________________.

   A. kill adults
   B. immunize the pet
   C. keep pupae from developing
   D. keep eggs from hatching

9. Dogs can become allergic to flea bites.

   A. True
   B. False

10. Describe the two types of nesting habits of yellowjackets.

11. Describe the nesting habits of the paper wasps, Polistes.

12. Describe the nesting habits of mud dauber wasps.

13. What makes an insect a "social insect?"

14. Describe pest management procedures for a stinging insect problem where stings and specimens were the only clues provided by the client.

15. Describe three distinguishing characteristics of the black widow spider.

16. Describe three distinguishing characteristics of the brown recluse spider.

17. Describe inspection procedures for black widow spiders.

18. Describe inspection procedures for the brown recluse spiders.

19. Discuss pest management methods for controlling spiders indoors.

For answers refer to Appendix A.

Chapter 6: Fabric Pests

Learning Objectives

After completing the study of Fabric Pests, the trainee should be able to:

- Identify common fabric pest groups.
- List the key features in the life cycle and habitat of some common fabric pests.
- Discuss inspection and prevention techniques for fabric pests.
- Discuss pest management procedures for fabric pests.

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Fabric pests include insects that feed on natural fibers, synthetics and animal by-products. They damage clothing, upholstery, carpeting, draperies and other fabrics. Some of these pests are able to digest the animal protein keratin and, therefore, feed on hides, furs, hair, feathers, animal horns, and preserved insects and other museum specimens. Several fabric pests are also important stored-product pests (such as black carpet beetles, silverfish, and firebrats).

Four orders of insects have species considered to be fabric pests: the Coleoptera (carpet beetles); the Lepidoptera (clothes and webbing moths); the Thysanura (silverfish and bristletails); and the Orthoptera (crickets).

Carpet Beetles

Beetles make up the very large insect order known as Coleoptera. All beetles undergo complete metamorphosis and in the immature stage have several larval instars (stages between molts). They pass through a pupal stage before becoming adults. Adults are winged, and many species are good fliers. Adult beetles are distinctive among adult insects because their front pair of wings is modified into hard body coverings known as elytra. When a beetle flies, the elytra are raised to expose the hind wings. Elytra are shiny and brightly colored in some species of beetles; other species have a covering of fine hairs or scales.

Carpet beetles belong to the coleopteran family Dermestidae. Three species of carpet beetles cause serious damage to fabrics, carpets, furs, stored foods and preserved specimens. These insects are pests in warehouses, homes, museums and other locations where suitable food exists.

Figure 6-1. Varied carpet beetle, *Anthrenus verbasci.*

Varied Carpet Beetle
Anthrenus verbasci

The adult varied carpet beetle is about $1/10$ inch long. It is black with an irregular pattern of white, brown and dark yellow scales on its elytra. Older adults, however, may have lost the scales that form this pattern, so they appear solid brown or black. Figures 6-1 and 6-2 illustrate the characteristics that distinguish the varied carpet beetle from the furniture carpet beetle.

Female beetles search out nests of bees, wasps, birds and spiders in which to lay their eggs because these contain dead insects, beeswax, pollen, feathers or other nest debris that can serve as larval food. These nests may be a source of infestation of varied carpet beetles into a building. Once inside, beetles deposit eggs on or near wool carpets and oriental rugs, woolen goods, animal skins, furs, stuffed animals, leather book bindings, feathers, horns, whalebone, hair, silk, dried plant products, and other materials that can be used as larval food.

Each female lays about 40 eggs; eggs hatch in about 18 days. Larvae pass through five to 16 instars depending on temperature, humidity and food quality. Mature larvae are about the same length as adults and are covered with dense tufts of hairs, which they can extend to form a round plume if disturbed. Larvae have a series of transverse stripes alternating between light and dark brown, and are distinguishable from other carpet beetle larvae because they are broader in the rear and narrower in front. The larval stage may be completed in 220 to 320 days, or may extend for as long as 630 days, depending on environmental conditions and food sources. Pupation takes 10 to 13 days. Adults usually appear in spring or early summer. Adult males live for two to four weeks and females live for two to six weeks. Outdoors, adults feed on flower pollen. Indoors, adults are usually near windows in the spring.

Furniture Carpet Beetle
Anthrenus flavipes

Adults of the furniture carpet beetle are slightly larger and rounder than the varied carpet beetle when viewed from above (Figure 6-2). Adults have a mottled appearance due to white and dark-yellow to orange scales interspersed with black spots on their elytra. Their undersides are white. Adults may appear solid black if these scales are rubbed off. Coloration and markings are highly variable.

Females lay a total of about 60 eggs in one to three clutches on surfaces of upholstered furniture, clothing, and in cracks and crevices. Hatching begins in nine to 16 days. Larvae are white at first but darken to dark red or chestnut brown as they mature. In contrast to larvae of the varied carpet beetle, larvae of the furniture carpet beetle are broader in front and narrower at the rear. The larval period lasts 70 to 94 days, and pupation

Figure 6-2. Furniture carpet beetle, *Anthrenus flavipes.*

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Figure 6-3. Black carpet beetle, *Attagenus megatoma.*

takes from 14 to 17 days. Adults live four to eight weeks. Feeding habits of larvae are similar to those of the varied carpet beetle.

Black Carpet Beetle
Attagenus megatoma

Larvae and adults of the black carpet beetle are distinctly different from the other carpet beetles described above. In the United States, the black carpet beetle is a more serious stored-product pest than a fabric pest.

Adult black carpet beetles (Figure 6-3) range from ⅛ to 3⁄16 inch in length. They are shiny black and dark brown with brownish legs. Full-sized larvae may be as long as 5⁄16 inch. Larvae range in color from light brown to almost black. Larvae are shiny, smooth, hard, and covered with short, stiff hairs, resembling larvae of wireworms. Their body tapers toward the rear and terminates in a tuft of long hairs.

Females produce about 90 eggs, which are usually deposited in dark, protected places. Black carpet beetles develop from eggs to adults in 180 to 360 days. The egg stage usually lasts from six to 16 days. The larval period takes from 166 to 330 days, and pupation lasts from eight to 14 days. These insects usually pass through five to 11 instars; however, under certain conditions, 20 instars have been observed. Adults live for about 30 to 60 days.

Management Guidelines for Carpet Beetles. Carpet beetles are among the most difficult building pests to control because of their ability to find food in obscure places and to disperse widely. Control success depends on integrating the use of sanitation, exclusion and, where necessary, insecticides.

Monitor for adult carpet beetles using sticky traps baited with an appropriate pheromone. Several traps throughout a building can show from what area the beetles are coming. These traps are also useful for monitoring the effectiveness of control applications. Pheromone traps can also be used to augment other control methods when used to attract adult males in small, confined areas. Check all traps once or twice a week.

Eliminate accumulations of lint, hair, dead insects, and other debris that serves as food for carpet beetles. Destroy any badly infested clothing, rugs or other items. Bird, rodent or bee and wasp nests may harbor infestations, as may spider webs with their accumulation of dead insects. Cut flowers brought into a building may harbor adult beetles.

Regular and thorough cleaning of rugs, draperies, upholstered furniture, closets and other locations where carpet beetles congregate is an important preventive and control technique. Frequent, thorough vacuuming is an effective way of removing food sources as well as carpet beetle eggs, larvae and adults. Fabrics can be protected by keeping them cleaned, because food and perspiration stains on fabrics attract carpet beetles that feed in these areas. Mounted animal specimens, such as museum specimens or trophies, should be regularly cleaned or periodically placed in a freezer for several hours. Stored woolens, linens and furs should be periodically inspected then aired, brushed and hung in light. If infestations are found, launder or dry clean these items before storing to destroy carpet beetle adults, larvae and eggs. Be sure cleaned items are sealed in a protective plastic bag or other suitable container.

Apply residual insecticides as spot applications. Confine insecticide applications to the edges of floor coverings, under rugs and furniture, on the floors and walls of closets, on shelving where susceptible fabrics are stored, and in cracks, crevices and other lint-accumulating areas. Use dust formulations, including desiccants, in attics and wall voids and other inaccessible places. Fumigation may be necessary when infestations are extensive, although success can be limited by the ability of the fumigant to penetrate all of the areas in which carpet beetles hide. Fumigants such as moth balls or flakes can be used in small, tightly closed containers. Infested furniture or similar objects can be removed from the building and treated in fumigation vaults.

Some insecticides may cause staining or cause fabric dyes to run, so when in doubt, test the chemical on an inconspicuous part of the fabric before making a complete application.

Clothes Moths

The webbing clothes moth and the casemaking clothes moth are occasional fabric pests. Clothes moths belong to the insect order Lepidoptera, family Tineidae. They undergo complete metamorphosis from larvae to pupae then adults. Although many adult moths are attracted to lights, clothes moths are not. They hide when disturbed, and adults are rarely seen close to the source of infestation. Larvae of clothes moths spin silken webs, which may be the only sign of the pest's presence.

In years past sheep, treated with chlorinated hydrocarbon insecticides such as endrin, toxaphene, or DDT to protect them against external parasites, supplied insect-resistant wool. However, newly produced woolen items are more susceptible to clothes moth infestation because these persistent insecticides are no longer being used on sheep. As a result, there has been an increase in clothes moth problems, requiring other types of protective measures. Heavy reliance on synthetic fibers has helped reduce the clothes-moth problem.

Webbing Clothes Moth
Tineola bisselliella

The webbing clothes moth (Figure 6-4) is the most common fabric moth. Adults are golden colored with reddish golden hairs on top of the head. Wings, with a wingspan of about ½ inch, are fringed with a row of golden hairs. Adult moths are not attracted to lights, but are usually found very close to the source of infestation such as in dark areas of closets.

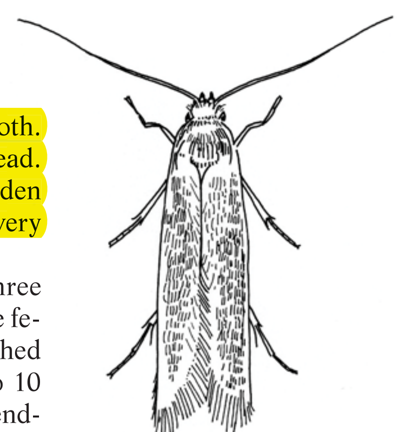

Figure 6-4. Webbing clothes moth, *Tineola bisselliella.*

Females lay an average of 40 to 50 eggs over a period of two to three weeks and die once egg laying has been completed. Adult males outlive females and continue mating throughout their adult life. Eggs are attached to threads of fabric with an adhesive secretion; they hatch in four to 10 days during warm weather. Larvae molt from five to 41 times depending on indoor temperatures and type of food available. The larval period lasts from 35 days to two and one-half years. Larvae are shiny white with a dark head capsule. They spin webbing as they feed and may partially enclose themselves in a webbing cover or feeding tube. Feeding tubes are usually extended along floor cracks under carpets. Excrement of the webbing clothes moth may contain dyes from the cloth fibers being consumed and thus be the color of the fabric they are infesting; this same color appears as a median streak seen through the outer parts of the larvae.

Pupation lasts from eight to 10 days in summer, three to four weeks in winter. Heated buildings enable webbing clothes moths to pass through their life stages more rapidly during winter months.

Larvae feed on wool clothing, carpets, rugs, upholstered furniture, furs, stored wool, animal bristles in brushes and even wool felts in pianos. Larvae also eat synthetics, especially if blended with wool. Larvae may use cotton fibers to make their pupal cases. Damage generally appears in hidden locations such as under collars or cuffs of clothing, in crevices of upholstered furniture, and in areas of carpeting covered by furniture. Fabrics stained by foods, perspiration or urine are more subject to damage.

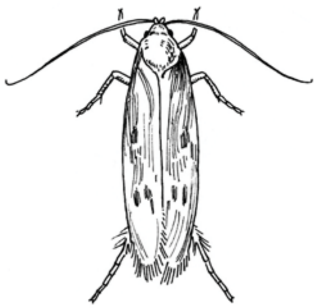

Figure 6-5. Casemaking clothes moth, *Tinea pellionella.*

Casemaking Clothes Moth
Tinea pellionella

Adults of the casemaking clothes moth are roughly the same size or slightly smaller than the webbing clothes moth but are similar in appearance (Figure 6-5). They are distinguished from the webbing clothes moth by their wings, which are more brownish, and their forewings, which are dimly spotted with a darker color. Also, head hairs are lighter colored than those of the webbing clothes moth. Larvae of both species are nearly identical, except that larvae of the casemaking clothes moth always carry a silken case with them as they feed. They never leave this silken tube, but enlarge it as they grow. They feed from either end and retreat into it when disturbed. This case takes on the coloration of the fabric that larvae feed on. Pupation also takes place inside the case.

In its food preferences and biological development, the casemaking clothes moth is very similar to the webbing clothes moth.

Management Guidelines for Clothes Moths. Control of clothes moths depends on preventing infestation, protecting fabrics, and selectively using insecticides when necessary. Low humidity inside creates an environment unsuitable for clothes-moth development. Building construction free of many tiny cracks and crevices also helps limit clothes-moth problems.

Regular, thorough cleaning of susceptible clothing, carpets, closets and storage areas is an important factor in clothes-moth control. Strong vacuums should be used to remove eggs and larvae. Clothing and other fabrics should be periodically shaken and brushed to remove these insects or their eggs with special attention given to seams, collars and cuffs. To avoid attracting moths, launder or dry clean soiled fabrics before they are stored or hung in a closet. Whenever possible store garments, blankets, linens and rugs in tightly sealed boxes or containers. Cold storage at temperatures between 40°F and 42°F can further protect expensive clothing and furs. This is also effective in killing moths if they are first exposed to rapid changes of temperature: for example, a sudden change from 50°F to 18°F, before storage at 40°F to 42°F.

Aerosolized insecticides provide quick knockdown of clothes moths and most can be sprayed directly on fabrics if needed (in situations where fabrics cannot be laundered or dry cleaned). Some insecticides do not leave persistent toxic residues and, therefore, are especially suitable for clothes moth control. Use a residual spray along baseboards, margins of carpets, in closets and in storage areas. Also spray under furniture and other areas where moths occur. Before treating any fabric with an insecticide, test a small, inconspicuous part of the fabric to be certain the spray will not cause staining or running of dyes.

Study Questions | Chapter 6

1. The most important element in a pest management program for fabric pests would be ________________.

    A. fogging
    B. monitoring
    C. dusting
    D. spraying

2. Two groups of insects feed on stored woolens, furs and feathers. They are ________________________.

    A. clothes moths and carpet beetles
    B. carpet moths and blanket beetles
    C. blanket beetles and clothes moths
    D. clothes moths and tapestry moths

3. Clothes moths usually feed on ________________________.

    A. synthetic fibers
    B. wool
    C. cotton
    D. leather

4. Insecticides applied for control of fabric pests never cause staining.

    A. True
    B. False

5. Carpet beetles can also infest dried flowers.

    A. True
    B. False

For answers refer to Appendix A.

Chapter 7: Stored Product Pests

Learning Objectives

After completing the study of Stored Product Pests, the trainee should be able to:

- Identify common stored product pests.
- Identify factors that contribute to pest infestations in stored products.
- List the key features in the life cycle and habitat of common stored product pests.
- Discuss monitoring and survey techniques for stored product pests, including pheromone use.

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Many species of pests infest and damage stored cereals, grains, nuts, dried fruit, and other food products. These include birds, rodents, fungi and other microorganisms, mites, and certain insects such as weevils, beetles, moths, silverfish and firebrats. Stored product pests are widespread and cause serious economic losses to grain producers, food processors and consumers. They attack stored products on farms and in processing plants, warehouses, grocery stores, restaurants, homes and virtually any other location where food is stored or prepared.

Contamination of food products by pests or pest excrement cannot be tolerated, even at low levels. Contaminated food may contain disease-causing organisms or toxins that can cause human illness.

Some types of pest infestation destroy or damage the food's nutritional value or change its physical properties. Even if the contaminated food remains healthful, it lacks aesthetic appeal. Some contaminated grains may require special cleaning and screening to remove the pest and its damage; nuts and dried fruit may need to be hand sorted. The added expense of these processes increases food-production costs.

To control losses from stored product pests, (1) use management methods that prevent pest infestation, (2) eradicate existing infestations, and (3) stop the spread of the pests or contamination to other food items. Establish an integrated approach that includes periodic inspection and monitoring, sanitation, exclusion, and appropriate chemical and nonchemical controls. Use mechanical techniques such as aerating the stored products for moisture control, controlling storage temperature to reduce moisture condensation or uptake and to prevent development of insects, and rotating or turning the stored products to stop localized pest outbreaks. Never store pest-free items near infested products or in contaminated or infested containers or buildings.

Use pesticides as one management tool to stop the buildup of pests and to supplement other controls. Follow pesticide label directions carefully and be certain that application equipment is properly calibrated.

Birds

Birds can consume large quantities of grain and other items, and they may also contaminate stored food with their feces and feathers. Bird feces may contain *Salmonella* bacteria and fungal spores that can produce serious intestinal poisoning of people.

The most important way to prevent bird damage is to exclude them from storage areas. Areas where birds are most apt to be a problem are warehouses with large doors kept open. If doors cannot be closed, install

Figure 7-1. Pigeons should be released far from where they are caught.

nets or strips of plastic or fabric at the entrances. These barriers enable people and vehicles to pass through freely but keep birds out. In all storage facilities, seal cracks and openings that are large enough for birds to enter. Close off vents and other high-level openings with wire screen having a mesh of ¼ inch or smaller. Remove or modify ledges that serve as roosting sites, or install nets or other barriers to keep birds from roosting in or on the storage facility. Other attractive nearby roosting sites, such as large trees, may also need to be eliminated.

Maintain good sanitation so storage areas do not attract birds. Clean up grains or other items spilled during loading, transfer and handling. Be sure that conveyors, railings, ledges and other parts of the storage facility are kept clean and free of food residues. Dispose of spoiled or contaminated products in covered containers, and remove these promptly from the area.

With persistence, certain species such as pigeons can be trapped. Trapped birds are generally released in an area distant from where they are caught.

Avicides are not generally effective in controlling birds when there is an abundance of other food in the area. If you use avicides, place them in locations where there is no risk of contaminating any stored food products. Whenever possible, use materials that repel pest birds rather than killing them.

Trapping, repelling or poisoning pest birds requires considerable experience and expertise. Permits may be required from the Florida Fish and Wildlife Conservation Commission for some species. Extreme care is required to prevent injury of protected nontarget species. See Chapter 9 for more information on bird control.

Rodents

Rodents such as rats and mice are troublesome pests of stored food. Rodents can chew through wood and other materials to get to food

sources. They are good climbers and can squeeze through small openings. Rats and mice can rapidly build up their populations and then consume or contaminate large quantities of stored food. They contaminate stored products and storage facilities with their urine, feces and hair. They also damage cloth, plastic and paper bags or cardboard boxes used to package stored products. Rodents within a storage facility may also chew on electrical wiring and cause serious fire hazards or equipment malfunction.

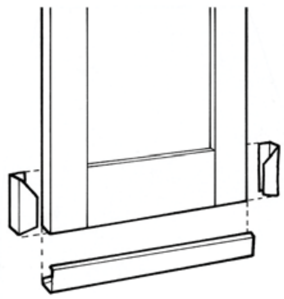

Figure 7-2. Attach metal plates to bottoms of doors to reduce the gap and prevent rodents from chewing through and gaining entrance into buildings.

Exclusion. The most important control method for rodents is rodent-proofing. To exclude rodents from storage areas, seal openings with heavy-gauge sheet metal, heavy wire screen with a mesh of ¼ inch or less, or concrete with heavy wire screening embedded in it. Attach metal plates to the bottoms of doors, as shown in Figure 7-2, to reduce the gap to ¼ inch or less and prevent rodents from entering. Modify foundations of buildings with concrete or metal barriers to stop rodents from digging their way in. Eliminate dead spaces inside the storage area to restrict areas where rodents may hide. Dead spaces include double walls, false ceilings, enclosed staircases, boxed plumbing and voids under cabinets.

Sanitation. Sanitation is important in preventing rodent buildup. Spilled grains and other food items around the periphery of a building attract rodents and encourage them to nest nearby. Be sure all spills are cleaned up quickly and placed in rodent-proof containers or promptly destroyed. Sanitation must also include keeping all storage areas and adjacent spaces well lighted, clean and orderly. Eliminate weeds, shrubs and vines that provide shelter and hiding places for rodents. Rodent activity can be more quickly spotted in clean, orderly areas, enabling early control.

Figure 7-3. Periodically replace baits used in traps.

Trapping, Baiting and Fumigation. Rodents infesting a storage facility are controlled by trapping, use of poison baits (rodenticides), fumigation, or combinations of these methods. See the following chapter for complete information on ways to control rodents with traps and rodenticides. When controlling rodents in food storage areas, consider the following points:

1. Trapping requires daily checking for trapped animals and servicing of the equipment. If traps are baited, the bait must be kept fresh by periodic replacement (Figure 7-3).
2. Poisonous baits must be kept fresh to be attractive. Therefore, bait stations need to be checked and refilled frequently. If baits are the multiple-feeding, anticoagulant type, rodents must feed on them continually over a period of several days.
3. Once started, bait stations must not be allowed to become empty; otherwise, rodents may recover from the toxic effects.
4. Use of rodenticides such as poison baits within storage facilities creates the risk of product contamination and may not be allowed in some situations.
5. Baits may not be very effective as long as the rodents have access to the stored food product.
6. Poisoned animals may wander off and die, making them difficult to find. Dead animals create smells and attract insects such as flies.
7. Fumigation may leave dead animals inaccessible.

When using rodenticides for control of rats or mice inside or around a food-storage facility, it is very important to identify the rodent species. You need this identification to understand the rodent's habits so you can select the right rodenticide and use it properly. Mice, for instance, tend to restrict their activities to a small area, probably no more than 30 feet from their nest, and never move beyond this area unless food or shelter is eliminated. Bait placed only a few feet away from a mouse nest will have no effect if the mouse never travels near it. Different species of rodents may inhabit different levels of a storage structure, or different colonies of the same species may even be at different levels. An effective rodenticide or trapping program requires locating all of the rodent colonies and placing control agents within the reach of each. See Chapter 9 for more information on rodent control.

Fungi and Other Microorganisms

Figure 7-4. Stored corn damaged by *Aspergillus flavus,* a filamentous fungus.

Many microorganisms may attack and damage stored food products, including bacteria, protozoa, slime molds, yeasts and filamentous fungi. A large number of these require free water to grow and reproduce. Therefore, these are only problems if the stored products become wet or are wet when they are put into storage. The most serious problem of stored grains and other products, however, comes from filamentous fungi adapted to conditions without free moisture. Fungi damage includes reduced germination of grain seeds, discoloration of grains and other products, microbiological heating of the stored material, caking, decay, and musty odors. Some fungi produce toxic materials that contaminate stored food products and can cause poisoning if ingested. The most serious of these are the aflatoxins produced by the fungi *Aspergillus flavus* (Figure 7-4) and *Aspergillus parasiticus*.

Many conditions promote fungal development in stored foods. These include high moisture, low temperature, insect or mite presence, damage to the grain or other stored products, degree of fungal invasion before items are put into storage, and the amount of foreign material present with the stored product. The length of time items are in storage and the amount and type of air circulation in the area also influence fungal development.

Several things should be done to reduce problems with microorganisms in stored foods. Moisture control is very important. The length of time items are to be stored influences the amount of moisture that must be removed before storing. For example, grains held for long-term storage (greater than two years) usually must have no more than 13.5 percent moisture content. On the other hand, grains may usually be stored for four or five months at moisture levels of 18 percent without fungus problems. Differences in temperature between the stored product and the surrounding area may cause condensation of water vapor, thereby producing wet spots, which favor fungal growth. To control temperature and condensation in storage containers, provide air circulation, occasionally turn the material, or transfer it from one container to another.

Bulk grains usually contain debris, dust and broken grain known as fines. If conveyor belts or augers fill bulk containers, fines will accumulate in one area near the spout. A concentration of fines in the stored product impairs air circulation and may promote localized fungal development. Fines are also attractive to certain stored product insects and may increase insect damage. To prevent accumulation of fines, keep the spout moving while filling the storage container to distribute them evenly throughout the stored material.

Some stored product insects carry in on their bodies fungal spores that may infest stored food. Moreover, insect-feeding damage makes some items more susceptible to feeding by other insects and fungal invasion. Large accumulations of insects may alter the temperature and moisture content of a stored product and may provide more ideal conditions for fungi. Therefore, controlling stored product insects can help reduce fungal problems.

Figure 7-5. Sawtoothed grain beetle, *Oryzaephilus surinamensis*.

Insects

Stored product insects are small and often difficult to detect. Eggs or larvae commonly pass unnoticed from one part of the food-handling system to the next. These are important economic pests that contaminate stored food with their excrement, cast skins, dead bodies, and webbing. They consume or damage large quantities of food, and in damaging packaging materials they cause indirect food damage and further economic loss.

Several species of beetles, weevils and moths are common stored product insects. Descriptions of some of these follow. Management guidelines for these insects are included together, following the descriptions, as the control principles are the same.

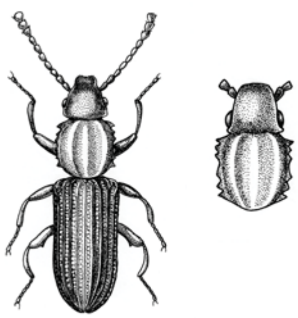

Figure 7-6. Sawtoothed grain beetle, *Oryzaephilus surinamensis* (left), and merchant grain beetle, *Oryzaephilus mercator* (right).

Beetles

Sawtoothed Grain Beetle
Oryzaephilus surinamensis

Merchant Grain Beetle
Oryzaephilus mercator

The sawtoothed grain beetle (Figure 7-5) and the merchant grain beetle are similar in appearance and easy to confuse (Figure 7-6). Adults are about 1⁄10 inch long and reddish brown to dark brown. Lateral margins of the thorax contain six sawtoothed projections on each side. These are long, narrow beetles with characteristic flattened bodies, giving them access to small cracks and crevices. Both species have well developed wings, but the sawtoothed grain beetle has not been seen flying. Adults of both species are usually seen running rapidly over stored food. Larvae have brown heads, and their bodies are yellowish, elongated, and segmented, with three pairs of legs. They crawl actively during feeding.

Adult females lay between 45 and 285 eggs singly or in small batches in or around suitable larval food sources. Eggs hatch in about eight days. Larvae pass through two to four instars over an average of 37 days, and pupation takes another six days. Temperature and humidity affect the development time and the number of larval instars.

Sawtoothed grain beetle larvae feed on items such as rice, wheat and nutmeats. These insects probably cannot attack whole, undamaged grains, so may be associated with other whole-grain pests and feed on the kernels damaged by the other pests. The merchant grain beetle is not a major pest of grains or cereals, preferring seeds and nuts.

Confused Flour Beetle
Tribolium confusum

Red Flour Beetle
Tribolium castaneum

The confused flour beetle and the red flour beetle (Figure 7-7) are the most common and serious pests of flour, cereal and broken grains. They are closely related, similar in appearance and often occur together. Flour beetles are members of the large coleopteran family Tenebrionidae, commonly known as the darkling beetles. They emit a foul-smelling, gaseous secretion when disturbed. Adults are about 1 inch long, flattened, and shiny reddish brown. Antennae of the confused flour beetle terminate in four segments that gradually enlarge to form a clublike shape, whereas antennae of the red flour beetle abruptly terminate in three larger, clublike segments (Figure 7-8).

Adult flour beetles live up to two years. Females produce 400 to 500 eggs in their lifetime, laying two or three per day; eggs hatch in five to twelve days. Larvae pass through five to 18 instars, typically seven or eight, over a period ranging from one to four months. Larvae are slender, wirelike, and whitish with yellow tinges. They are distinguished from other stored product insect larvae by the prominent, two-pointed termination of the last body segment.

Like grain beetles, flour beetles usually do not attack whole grains. They feed on damaged grains, flour, cereals and other stored products. Their small size provides them access to closed containers that would normally be insect-proof. Adult beetles run quickly when disturbed. In addition to feeding damage, they produce secretions that contaminate the material they feed on, giving it a disagreeable odor and taste.

Figure 7-7. Red flour beetle, *Tribolium castaneum,* above, is easily mistaken for confused flour beetle, *Tribolium confusum.*

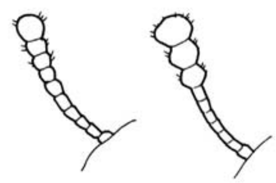

Figure 7-8. Antennae of the confused flour beetle terminate in four segments that gradually enlarge to form a clublike shape, left. Antennae of the red flour beetle abruptly terminate in three larger, clublike segments.

Granary Weevil
Sitophilus granarius

Rice Weevil
Sitophilus oryzae

Weevils are distinguished from other beetles by the slender elongation of their heads, a feature responsible for the common name of snout beetles. Two, the granary and rice weevils, are serious grain pests (Figure 7-9).

Several features distinguish the granary weevil from the rice weevil. The granary weevil is about ⅛ inch long and shiny dark brown or black. The top central area of its thorax is covered with elongated depressions or punctures. Adults have nonfunctional, vestigial wings. By contrast, the rice weevil is a good flyer and is slightly smaller. It is reddish brown to black, and usually has four reddish or yellowish spots on its elytra. The top-central area of the thorax of the rice weevil is covered with round punctures.

Both species bore holes into grain kernels to deposit their eggs. Larvae feed and pupate inside kernels and also feed on caked flour and tightly compressed cereals. Granary weevils have become adapted to living entirely in stored grains and never forage in the wild for food, hence their lack of wings. Rice weevils, however, fly to fields and infest grains such as corn, rice and wheat. After harvest, infested grain mixed with clean grain causes widespread contamination during storage.

Figure 7-9. Granary weevil, *Sitophilus granarious* (left), and rice weevil, *Sitophilus oryzae* (right).

Females lay approximately 200 to 300 eggs during their lives. (Rice weevils produce more eggs than granary weevils.) Larvae of both species pass through four larval instars over a period of three to five weeks and usually have four generations per year. Adults of the granary weevil live from seven to eight months when food is abundant. Adults of the rice weevil live three to six months.

Figure 7-10. Bean weevil (left) and cowpea weevil.

Bean Weevil
Acanthoscelides obtectus

Cowpea Weevil
Callosobruchus maculatus

Bean weevils and cowpea weevils (Figure 7-10) are not weevils but belong to the seed beetle family Bruchidae. Larvae bore into seeds, where they feed and pupate. After pupation, adults bore an emergence hole in the seed. Often more than one larva infest a single seed. Bean weevils are about ½ inch long and are light olive brown with darker brown and gray markings and reddish legs. Eggs are laid on pods of legumes such as beans, peas and lentils in the field or on the surface of stored legumes. Grains, cereals and other stored food products are not infested by bean weevils. Infestation of stored legumes can easily occur from harvested products being brought in from the field.

Females lay about 75 eggs during their lifetime; these are deposited singly on or near host seeds and hatch after five to 20 days. Larvae feed for four to six weeks before pupating. Adults hibernate during the winter, but if temperatures rise, they emerge and females begin egg laying again.

Figure 7-11. Cigarette beetle (left) and drugstore beetle.

Cigarette Beetle
Lasioderma serricorne

Drugstore Beetle
Stegobium paniceum

Cigarette and drugstore beetles (Figure 7-11) are members of the Anobiidae family, which also includes deathwatch beetles. Adults can be distinguished by their humped appearance due to their downward-bent head and prothorax. The cigarette beetle is reddish yellow to brownish red. Adults are about ⅛ inch long and have the distinctive humped appearance characteristic of this group. Females produce about 30 eggs over a three-week period; these usually hatch within one week. Eggs are attached to sources of stored food such as tobacco, rice, raisins, grains, pepper and many other stored products. Larvae are curved, plump, and hairy; they are yellowish with a light brown head. The larval stage lasts from five to 10 weeks, and three to six broods are produced in a year.

Adults of the drugstore beetle are almost the same size as the cigarette beetle. They are reddish brown and can be distinguished from the latter by the longitudinal striations, or ridges, on their elytra. They are also less humped.

Drugstore beetles usually have one to four generations per year. They complete a life cycle in about two months. Larvae, which resemble those of the cigarette beetle, feed on practically every type of stored product as well as spices, drugs, books and wood. They can survive on items with low food value because of yeastlike organisms in their digestive systems that produce some essential vitamins.

Black Carpet Beetle
Attagenus megatoma

The black carpet beetle is described in the previous chapter as a fabric pest. This insect is widespread and feeds on a large variety of dried foods including beans, peas, corn, wheat, rice, and many types of seeds.

Moths

Moths belong to the insect order Lepidoptera. Larvae of moths infesting stored food products may be confused with beetle or weevil larvae because of their wormlike shape. Unlike beetles and weevils, only the moth's larval stage causes damage. A telltale sign of infestation is the appearance of small-to-medium moths in food containers and packaging, or flying around or clinging to walls in a room or storage area.

Indianmeal Moth
Plodia interpunctella

The Indianmeal moth (Figure 7-12) is the most common pest of coarsely ground flours (such as whole wheat flour) and cornmeal. It is widespread in grocery stores, warehouses and kitchens. The Indianmeal moth also infests shelled or ear corn, broken grains, dried fruit, seeds, peas, beans, crackers, biscuits, nuts, powdered milk, chocolate, candy, red peppers, dry dog food, and other commodities. Unlike weevils and other beetle larvae, Indianmeal moths spin large amounts of webbing, further contaminating food products.

Adults of this moth have a wingspan of about ¾ inch. Wings are pale gray with the outer two-thirds of the forewing colored reddish brown with a coppery luster.

Egg laying usually begins in April. Females lay eggs at night, either in masses or singly, and produce 200 to 400 eggs. Larvae are dirty-white but may take on different hues, depending on the food ingested. The larva's head and prothoracic shield are brown. Pupation takes place in a silken cocoon. The larval period varies greatly between one and 10 months, depending on environmental conditions and available food. The normal complete life cycle of this pest takes about six to eight weeks.

Figure 7-12. Indianmeal moth, *Plodia interpunctella.*

Almond Moth
Cadra cautella

The almond moth (Figure 7-13) is a pest of lesser importance than the Indianmeal moth. However, it is capable of causing considerable damage to cereals, dried fruits, flour, grain, seeds and shelled nuts. Adults are slightly smaller than the Indianmeal moth, with a wingspan of about 1 inch. They are mottled gray and may have a fawn-colored pattern on the forewing. Larvae are dirty-white tinged with brown or purple dots, giving them a striped appearance. They leave matted webbing as they feed.

Females lay an average of 100 eggs, which hatch in about a week. The larval period usually continues for two months.

Figure 7-13. Almond moth, *Cadra cautella.*

Management Guidelines for Stored Product Insects

Stored product insects are tiny and difficult to detect in bulk or packaged food products. Therefore, they can be freely transported from processing plants to warehouses to grocery stores to restaurants and household and institutional kitchens. Even under the most carefully controlled conditions, some of these pests, in egg, larval, or adult forms, probably will pass from one level of the food handling system to another.

Eradication at any one level is virtually impossible due to the size and complexity of the food-distribution industry. Once an infestation occurs in one commodity, it can quickly spread to others unless appropriate and timely control measures are taken. Each entity in the complex maze of food distribution, from the producer on up to the consumer, must assume a role in the management of stored product insects.

Detection and control methods for stored product insects have to be ongoing, not sporadic. Management relies on inspection and monitoring to detect and identify pests, followed by an integrated program of control that includes sanitation practices, exclusion techniques, habitat modification, and careful insecticide use.

Beetle or moth infestation of a box of cereal or bag of flour in the home is an annoyance. The infestation may result in the loss of the cost of the product and perhaps spread of the pest to other similar products stored in the pantry or cupboard. Control can be as simple as throwing away the infested materials (or returning them to the grocery store for a refund) and storing uncontaminated food products in insect-proof containers.

Similar infestations occurring in grocery stores, warehouses, or packaging and processing plants can result in considerable loss of investment and revenue. Pest control efforts, therefore, should be proportional to the potential for loss. Major efforts involving sanitation practices, exclusion techniques, habitat modifications, and insecticide applications are usually required to eliminate damage. Early detection simplifies the management program, reduces control costs, and prevents extensive damage to stored food. Monitoring is used to detect, locate and identify pests, determine the proper time to apply control techniques, and evaluate the success of the management program.

Inspection and Detection. Inspection and detection are necessary parts of a stored product pest management program. They provide information, evaluate control methods used, and monitor for reinfestation.

Make a complete and thorough inspection of the premises to locate potential infestation sources. Carefully examine stored food such as grains, dried fruit, flour, dog food and seeds. Check around buildings because some stored product insects are attracted to certain flowers, shrubs, and outdoor lighting.

Use pheromone traps inside a building or structure to monitor pest activity; pheromones are available for most of the insects that damage stored food. Traps using mating pheromones generally catch individuals of one sex, usually males. For other stored product insects, traps containing aggregating pheromones are available that attract both sexes. The attractiveness of monitoring systems for some insect species is enhanced by incorporating food attractants with pheromones. Food attractants can lure larvae and adults of both sexes. With some species, food attractants are used alone.

When using pheromones or food attractants for monitoring, place one trap per 250 to 500 square feet of storage space. For monitoring flying insects, locate traps near storage containers. Put traps inside containers for insects that do not normally fly.

Sometimes the use of more than one type of pheromone in an enclosed area may prevent target insects from efficiently locating traps. Before installing traps for other insect species in an area where one type of pheromone trap is already being used, check with the manufacturer or supplier to determine the effectiveness of such a combination.

Flying insects locate pheromone traps by following a trail of pheromone scent upwind, detecting its increasing concentration in the air. Enclosed areas where traps are located, therefore, should have some air movement so the atmosphere does not become saturated with pheromone. Keep traps away from bright lights that may repel target insects.

Check traps regularly — daily if there is a low tolerance to stored product insects on the commodity or weekly under normal conditions. At each inspection, record the number of pest insects caught and remove them from the traps. Replace pheromones according to manufacturer's instructions. Change sticky parts of the traps whenever they become coated with debris and ineffective.

Pheromones or attractants can sometimes be used in traps for control of stored product insects. Trapping may be a preferable control method over insecticides because foods are not exposed to their residues. Put traps close to the infestation source for maximum control, and increase the density of traps to about one to each 25 to 50 square feet of storage space.

For stored bulk grains, use pheromones with specially designed probes positioned at different levels inside storage bins. Check probes periodically for insect pests, and use catch data to find areas of infestation. This monitoring should also be used to evaluate the effectiveness of other control measures.

Exclusion. Prevent insect entry into the storage facility by inspecting grains, cereals, flour, and other bulk and packaged products as they arrive. Check packages for holes, webbing, insect frass, eggs, living insects, and insect parts. Even new, unused packaging material, such as cardboard, may be an insect source. Immediately return infested materials to the supplier or destroy them. Never store infested materials in the facility unless they can be enclosed in a tight container or refrigerated. Prevent contamination of flour, grains, cereals and dried fruit by keeping them in insect-proof containers. Opened bags or boxes must be resealed securely or their contents transferred to sealable containers. Promptly remove empty boxes and bags from the building.

Keep insects out of buildings by using screens over door and window screens. Close off all other openings with wire screening or caulking. If it is not possible to exclude pests from the entire building, at least make sure the storage area is protected. Locate and close rodent holes as stored product insects can enter through these. If rodent baits are in the area, check them for infestation; even stored or unused bait may harbor insects. To keep from attracting insects into buildings, locate outdoor lighting away from doorways. Use sodium-vapor lights rather than mercury-vapor lights for outdoor lighting around warehouses and grocery stores because insects are less attracted to yellow light.

Sanitation. Sanitation is a critical part of controlling stored product insects in homes, grocery stores, warehouses, and processing facilities.

Clean up spilled materials to eliminate food sources for pests. Seal cracks in shelves and bulk-food containers to eliminate places where pests can hide and to keep grains, flour or other food from accumulating. Keep storage shelves far enough away from walls to leave room for cleaning. Raise shelving in warehouses and other storage areas off the floor to make cleaning underneath possible. Areas where susceptible items are stored should be well lighted for ease in cleaning and spotting pest infestations; moths may be easier to detect during evening hours when they are active. Conveyors, augers and food processing machinery must be thoroughly cleaned regularly to prevent them from harboring pests.

Environmental Modification. Manipulation of storage temperatures or humidity can be used to destroy many stored product pests. Heat treatment kills some pests outright; cold usually blocks their development. For adequate control, it may be necessary to subject products to a prescribed period of high temperatures followed by cold, after which they should be kept stored at a constant, lowered temperature. In general, a temperature of 60°F prevents insect feeding; 40°F kills insects over a period of time. Some products can be frozen to protect them from insect damage.

Desiccants. Dusts, such as silica gel or diatomaceous earth, can be combined with certain stored grains to provide protection against insect damage. These dusts kill target insects by desiccation. Dusts are removed from grain and other stored food before processing by a cleaning operation that also removes other debris. Because sorptive dusts are inert, they do not leave any potentially harmful residues on the food if traces of the desiccant remain.

Insecticides. Insecticides vary according to the pest type and infestation situation. Because food products are involved, residues must never exceed legal tolerances. Apply only those insecticides registered for stored food products and use them in strict accordance with label instructions. Insect resistance to insecticides is an increasing problem, so avoid overusing insecticides, and always employ other control methods along with them. Apply insecticide when insects are most susceptible.

The safest type of insecticides for use on food items are the microbials such as *Bacillus thuringiensis*. Those organisms produce toxins that are fatal to certain species of insects but have no known effect on people. Use only microbial insecticides labeled for control of stored product pests that can be applied directly to the product. Thorough coverage is necessary to ensure that target insects consume some of the microbial organisms.

Insect growth regulators (IGRs) have a low toxicity to humans as compared with other insecticides. IGRs are chemicals that alter an insect's ability to develop normally or pass through developmental stages at the proper time. For instance, some IGRs prevent larvae from becoming adults.

Because of the low toxicity of IGRs, they are usually safe to spray directly onto raw products. (Check the label before application.) Use an IGR where fumigation is not possible or desirable. An IGR is effective only if it contacts the targeted insect pest. Therefore, thorough coverage is necessary. Apply a spray of a labeled IGR to grains, nuts or other foodstuffs during the filling of storage bins. Use enough spray to thoroughly protect all the stored product. Spray when insects are at the correct stage of development as described on the IGR label instructions. Occasionally the application of an IGR extends the larval period and, therefore, larvae of pest insects may feed more before they are destroyed.

Fumigants are used to control stored product insects in bulk containers, truck trailers, railroad cars, warehouses and large storage areas. Fumigants are effective because they penetrate areas where pests occur or might become problems. To be effective, fumigation must take place in a well-sealed area so that its concentration can build up to high enough levels. Other conditions must also be met and specific problems overcome before fumigation. Small quantities of cereals and similar products can be fumigated in containers such as plastic pails or glass jars using dry ice (frozen carbon dioxide). However, if containers are tightly closed immediately after treatment, a vacuum will form that may cause them to implode. Tighten down the lid after the container warms to room temperature.

Short-term residual insecticides can be used for rapid knockdown of some types of stored product insects. Apply these materials in cracks and crevices and on surfaces that stored products contact. These materials can be applied to bulk containers before adding foodstuffs, for example. They are also used in cupboards and on shelves and areas close to where products are stored, but usually require frequent reapplication if infestations are high.

Residual insecticides should be selectively used. Residuals are generally applied to surfaces of empty containers to prevent infestation, but rarely applied directly to foodstuffs. Residual insecticides should be used as a supplement to sanitation measures. They are convenient ways to control stored product pests in inaccessible areas.

There are severe restrictions on pesticide residues on food in food-handling establishments, so be sure residual insecticides are used only according to label instructions and in compliance with federal, state and local regulations.

Booklice

Booklice belong to a group of insects collectively called psocids. The psocids are small, soft-bodied insects, most of which are less than ⅛ inch long (Figure 7-14). They may be either winged or wingless. Psocids have chewing mouthparts.

The majority of psocids are outdoor species with well developed wings. They are most commonly found on bark or foliage of trees and shrubs. These psocids are frequently called "barklice." Most of the species found in buildings are wingless. Because they are often among books or papers, they are called booklice. The term "lice" in the names is somewhat misleading because none of these insects are parasites, and few of them have a louselike appearance.

Psocids feed on molds, fungi, cereals, pollen, fragments of dead insects or other similar materials. They cause little loss of food because they feed chiefly on mold. At times they may become extremely abundant and spread through an entire building. In such situations they may contaminate foods and materials to the point the goods must be discarded. Psocid eggs are laid singly or in clusters and are often covered with silken webs or debris. Most species pass through six nymphal stages. The entire lifespan from egg to adult is between 30 and 60 days.

Figure 7-14. Booklouse, *Liposcelis* spp.

Management Guidelines for Booklice. Moisture reduction, to eliminate mold formation, is a very effective method for booklice control. Infested furniture, bedding or other movable furnishings should be thoroughly cleaned and aired. Clean up spilled food products and keep all stored products tightly sealed.

If required, apply a spot treatment of residual insecticide. Aerosol applications reduce numbers but will not provide long-term reductions.

Mites

Mites occasionally infest stored food. They are known to feed on cheese, flour, grains, dried fruits, dried meats, cereal foods, dog and cat food, and animal feeds. Grains often must first be damaged by insects or fungi before certain mite species invade. There are over 112 species of mites commonly associated with stored foods. Because mites are extremely small their presence goes unnoticed, but the damage they can cause is sometimes very serious. Infested items become contaminated with living and dead mites, cast skins, and fecal materials.

Feeding by some mite species alters the nutritional quality of grains and other food; mites often attack the germ of grains. Flour from mite-damaged grain may become sour and have poor color, and bread made from it does not rise properly.

Some mites are fungus feeders. They invade moldy commodities, bringing spores of certain fungi, and feed on the fungi once they become established. Even after the mites are controlled, the fungi persist and continue to cause damage.

Management Guidelines for Stored Product Mites. The most difficult part of managing stored product mites is detecting infestation. Large populations can develop before they are discovered and may have already done, by that time, considerable damage. The stored food may have an odor variously described as minty, sweetish or musty when it is infested with mites. This odor may be the first indication that mites are present.

Use a microscope or hand lens to inspect stored products for moving mites that are small and colorless or cream-colored. Take several samples throughout the stored product and examine each carefully. Check for moldy areas and for mites associated with the fungus. Avoid attracting mites by using sanitation to eliminate residues around the storage facility. Clean storage containers before their use to remove debris and mites and mite eggs. Inspect materials before they go into the storage facility to be sure they are pest-free. Maintain proper storage conditions, including moisture control and air circulation to prevent fungal growth. Keeping the stored product at or below a moisture content of 12 percent also retards development of many species of mites.

Desiccants, fumigants and some types of residual sprays effectively control mites as long as the commodity has been uniformly treated. Usually treatment of the commodity or storage container for insect control also destroys mites. Periodic retreatment may be necessary afterward because mite eggs may not have been destroyed. Check the label of the pesticide for permitted uses and follow label instructions carefully.

Study Questions | Chapter 7

1. Some common stored product pests that attack whole grains and chew through the seed coat are ________________________.

    A. rice and granary weevils
    B. red and confused flour beetles
    C. psocids and grain mites
    D. sawtoothed and merchant grain beetles

2. Pheromones are used in ________________________.

    A. sprays
    B. traps
    C. dusts
    D. warehouse foggers

3. ________________________ is not commonly a food of stored product pests.

    A. dried fruit
    B. paprika
    C. paper
    D. cornmeal
    E. mung beans

4. Psocids and grain mites need ________________________ to build large populations.

    A. grains
    B. processed meal
    C. high protein grain
    D. high humidity

For answers refer to Appendix A.

Chapter 8: Occasional Invaders

Learning Objectives

After completing the study of Occasional Invaders, the trainee should be able to:

- Identify the key features in the life cycle, habitat and appearance of miscellaneous invaders.
- Discuss integrated pest management procedures for common miscellaneous invaders.

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Figure 8-1. Some occasional invaders make their way indoors after they are attracted to outdoor lights at night.

Occasional invaders are pests that do not usually live and breed inside buildings but can wander or migrate seasonally into structures. Some of these pests are associated with trees, shrubs, mulch or other habitats conducive to pest development. Others are attracted to lights at night (Figure 8-1). Some are dislodged from preferred habitats by management procedures that make the environment unsatisfactory. Environmental extremes, such as excessive rainfall, drought, temperature changes or poor drainage around a building, may stimulate pest movement indoors.

Many of these pests can be managed by eliminating conditions near the structure that allow them to build up to large numbers. Generally, sanitation or basic landscaping will help eliminate pest-infested sites near structures. Also, pest exclusion, using caulking, weatherstripping, screening of vents, and lighting location can solve many problems with occasional invaders.

Mites

Mites are small arthropods with two body regions, sucking mouthparts, no antennae, and four pairs of legs as adults. A mite's life cycle is generally composed of four active stages: egg, larva, nymph and adult. Completion of the life cycle requires one to four weeks. Favorable conditions may result in huge populations. Mites are occasionally found in or near homes and attack humans in the absence of their normal hosts — birds, rodents or insects. Bites from these mites may be painful and cause severe skin irritation.

Bird Mites

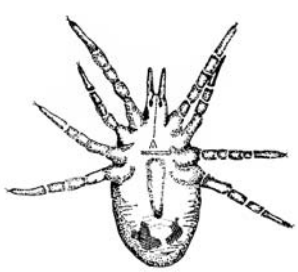

Figure 8-2. Northern fowl mite, *Ornithonyssus sylviarum*.

The northern fowl, tropical fowl, and chicken mites are the major bird mite species in Florida. The northern fowl mite (Figure 8-2) is the most important as a problem to birds in the state. The adult female fowl mite lays eggs on the host bird. The eggs hatch in one to two days into the six-legged larval stage, which does not feed. The larvae molt to the nymphal stage in about eight hours. The nymphs and adults have piercing mouthparts and seek blood meals. The complete life cycle from egg to egg-laying adult can take from five to seven days or longer, depending on the type of environment.

Bird mites enter homes when they migrate from bird nests in eaves, rafters or gutters. They prefer to feed on fledglings in the nest, but when these leave, the mites will migrate to other areas in search of a blood meal. Many times infestation of buildings occurs when bird roosts and nests are disrupted or destroyed.

Insect Mites

The almost-invisible straw itch mite (Figure 8-3) is the most prevalent insect parasite that also attacks humans. Infestations from alfalfa, hay and barley can produce irritation.

The mites are parasitic on the larvae of insects such as the angoumois grain moth, wheat jointworm, and furniture beetles. The female mite retains up to 300 eggs in her body, where the immature stages develop to adults. Upon emerging they search for hosts to parasitize.

The bites of the straw itch mite are located almost entirely on the clothed portions of the body. Dermatitis results from bite reactions within 24 hours. Humans become infested when they come in contact with straw, grain or wood. Houses may become infested when the insect hosts of the mites are present.

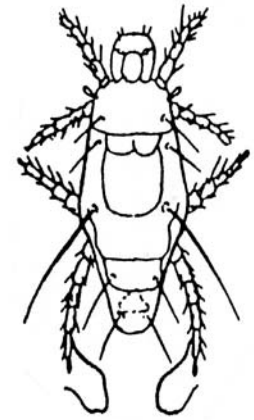

Figure 8-3. Straw itch mite, *Pyemotes tritici*.

Rodent Mites

The two most abundant rodent mites in buildings are the tropical rat mite and the house mouse mite. Rodent mites are primarily external parasites of rats and house mice, but they will also feed on humans. The life cycle of rodent mites is similar to the bird mites and usually takes 10 to 12 days.

Rodent mites can cause severe irritation and dermatitis in humans. Areas bitten by mites may remain swollen for several days and leave red spots. Scratching of bites often can result in secondary infection.

Management Guidelines for Household Mites. Management of household mites is best accomplished by eliminating nests and roosting areas for birds, and controlling rodents or insect hosts. Insecticide total release or mechanical aerosols and foggers are effective in killing mites but do not prevent reinfestation. Application may need to be repeated in two to three weeks.

Bites should be treated with antiseptic, and a local anesthetic may be applied to ease the irritation. Persons with severe dermatitis caused by mites should consult their physicians for treatment.

House Dust Mites

The house dust mites, or floor mites (Figure 8-4), are a little known and rarely mentioned group of mites of medical significance to humans. Pieces of the mites in house dust may produce allergic reactions when humans inhale them. At present approximately 8 percent of the human population has a house dust allergy.

The adult female house dust mite is approximately 1⁄64 inch long, and the males are even smaller. Because of their small size these mites are often overlooked in a house. The adult female lays about an egg a day for 30 days. The eggs hatch and develop to adults in about one month.

House dust mites feed on the shed human skin. It has been estimated that a normal person sheds five grams of skin per week. One gram of skin will feed thousands of mites for months. The house dust mite is found commonly in houses and schools throughout the United States. It is believed that dust near the bed and in mattresses is the most common habitat for the mite.

House dust mites or their fragments, excretory or secretory products are the most important allergens in house dust. Asthmatic symptoms after exposure to house dust have long been known, and only recently has it

Figure 8-4. House dust mite, *Dermatophagoides* spp.

been shown that house dust mites, like pollen, can be the potential producers of allergic responses upon inhalation.

Symptoms of asthmatics are often aggravated when they go to bed because of increased exposure to house dust mites. Hospitalized patients often dramatically improve from decreased exposure.

Management Guidelines for House Dust Mites. There is no chemical control of house dust mites now. Frequent changes of bedding and use of nonfibrous bedding reduces mites. Frequent vacuum cleaning and correction of excess humidity also aids mite control.

Insects

Booklice

Figure 8-5. Booklouse, *Liposcelis* spp.

Booklice belong to a group of insects collectively called psocids. The psocids are small, soft-bodied insects, most of which are less than ⅛ inch long (Figure 8-5). They may be either winged or wingless. Psocids have chewing mouthparts.

The majority of psocids are outdoor species with well developed wings. They are most commonly found on bark or foliage of trees and shrubs. These psocids are frequently called "barklice." Most of the species found in buildings are wingless. Because they are often among books or papers, they are called booklice. The term "lice" in the names is somewhat misleading because none of these insects are parasites, and few of them have a louselike appearance.

Psocid eggs are laid singly or in clusters and are often covered with silken webs or debris. Most species pass through six nymphal stages. The entire lifespan from egg to adult is between 30 and 60 days.

Management Guidelines for Booklice. Reduction of moisture to eliminate formation of mold is a very effective method for controlling booklice. Infested furniture, bedding, or other movable furnishings should be throughly cleaned and aired. Clean up spilled food products, and keep all stored products tightly sealed.

If an insecticide is required, apply a spot treatment or crack and crevice treatment according to label directions.

Silverfish and Firebrats

Figure 8-6. Silverfish, *Lepisma* sp.

Silverfish and firebrats make up the insect order Thysanura, which includes some of the most primitive insects. There are about 13 species of silverfish and firebrats in the United States. These small, wingless pests (Figure 8-6) do not undergo complete metamorphosis; hatchlings look like adults but are smaller. All life stages have similar feeding habits. Immature forms may molt as many as 50 times before becoming adults. Silverfish and firebrats continue to molt during the adult stage. These insects are long-lived, taking up to two years to reach maturity and then continuing to live for several years as adults. Under optimum conditions, the immature stage lasts two to three months.

Adults range from ¼ to ¾ inch in length, depending on the species. Silverfish are tapered in the back, giving rise to their fishlike appearance. Most are silver; firebrats are gray with darker markings. Both silverfish and firebrats have long antennae and three long bristles, known as cerci, arising from the tip of the abdomen — because of this they are sometimes called bristletails. Females lay approximately 100 eggs during a lifetime and deposit them as small batches, usually in cracks or obscure places. Eggs require two to eight weeks to hatch.

Silverfish and firebrats gain entry inside through openings in foundations or around pipes or wires passing through walls. They can also be carried into buildings in boxes, books, papers or other items brought from infested areas. These insects are attracted to buildings and survive if areas have a warm, moist environment and suitable food. They live in most indoor locations including attics, basements and wall voids. Firebrats require warmer areas than silverfish and can tolerate drier conditions. Both silverfish and firebrats are nocturnal and are not attracted to light; thus, they are rarely seen in well lighted locations.

Silverfish and firebrats feed on fabrics such as linen, rayon and cotton. They are attracted to starched fabrics and also feed on paper, paper sizing, book bindings and dead animals. They feed on any type of human food, but appear to be especially attracted to flour and starches. They may also be found in breakfast cereals. They do not feed on wool, hair or other animal fibers but may damage some synthetics. Silverfish and firebrats are voracious eaters, but are also capable of going without food for long periods. Besides damaging objects by feeding, silverfish and firebrats leave yellow stains and dark-colored feces on items they touch.

Figure 8-7. Eliminate hiding places of silverfish and firebrats by caulking.

Management Guidelines for Silverfish and Firebrats. Due to their nocturnal habits, silverfish and firebrats are difficult to see. If possible, make observations or surveys of silverfish or firebrats during the night using a flashlight. They may also be monitored with sticky traps. These insects may go unnoticed until populations get large or damage becomes severe. Control may be difficult because it is hard to locate the infestation sources.

Keep silverfish and firebrats from entering buildings by caulking or otherwise closing outside openings (Figure 8-7). Caulk cracks and fill other openings inside to eliminate hiding places. Moisture attracts these insects, so it is important to repair leaking pipes and drains and insulate water pipes to prevent water condensation. Wherever possible, eliminate sources of food; store flour, cereals, and similar items in tightly sealed containers.

Chemical control methods for firebrats and silverfish are similar to those used for other crawling pests. Insecticides may be sprayed around building foundations; desiccant dusts may be applied to attics, crawl spaces, and voids in walls and beneath cabinets. Insecticides used in this manner create barriers that keep silverfish and firebrats out of building interiors when openings cannot be blocked or located.

Apply a liquid insecticide having residual activity to locations where silverfish or firebrats are most concentrated. Inject the spray into cracks and crevices. Dust formulations may be preferred in dry areas where visible residues are not objectionable. Blow dusts into wall voids, attics, and into cracks and crevices. Do not apply liquid or dust formulations to books or papers or other objects that might be stained, or with which people come into close contact.

Figure 8-8. Field cricket, *Gryllus* spp.

Crickets

Crickets are sometimes nuisances in buildings, and they may also damage fabrics or other materials. They are especially destructive to silks and woolens. They are attracted to perspiration and other stains on clothing and fabrics. Occasionally crickets invade a structure in large numbers. They are often attracted to lights around a building at night. Besides damage, they produce chirping that may become annoying to building inhabitants.

Crickets belong to the insect order Orthoptera and are related to grasshoppers. These insects do not undergo a complete metamorphosis. Therefore, the young resemble adults except they do not have functional wings. Young and adults both have similar feeding habits.

The most common crickets to invade buildings include the house cricket, *Acheta domesticus*, and the field cricket, *Gryllus* spp. (Figure 8-8), which are very similar in appearance.

House cricket adults range in length between ½ and ¾ inch. They may be light yellowish brown with three dark bands on the head, or solid shiny black. This species has long, slender antennae. The field cricket is slightly larger, up to 1 inch in length, and usually brown or black. Females of both species have a long, thin ovipositor projecting from the tip of the abdomen.

Management Guidelines for Crickets. The key to managing crickets inside is exclusion. Seal cracks and other openings from the outside that provide access. Caulk or otherwise seal cracks and crevices inside the building that provide hiding places. Behind or under heavy furniture and appliances or in other inaccessible areas, try removing crickets using a strong vacuum cleaner. Weeds and debris around the outside of the building should be removed to eliminate attractive habitats. Change outside lighting to sodium vapor lights or yellow incandescent lights that are less attractive to crickets (and other insects). Garbage and other refuse that serves as food should be stored in containers with tight lids and elevated off the ground on platforms or bricks.

Insecticides should be used only when exclusion and sanitation cannot accomplish control quickly enough to stop the damage within a reasonable time. Use liquid sprays of an insecticide registered for indoor use as a spot spray in cracks and crevices and other areas where crickets may hide. Sorptive powders may also be blown into inaccessible areas. Apply liquid sprays around the perimeter of the building or in other outdoor areas if crickets cannot be controlled through sanitation. Avoid using outdoor spray materials in indoor areas unless the label states this is permissible. Insecticide-impregnated baits or granular formulations of certain materials may also be used outdoors. Granules are suitable in lawns and other areas subject to moisture or frequent watering. Avoid the use of baits or granules if children or pets can gain access to them.

Cricket infestations are usually seasonal. Most often, problems occur during the fall as evenings become cooler and the insects seek buildings for warmth and shelter. Because of this, applications of long-residual insecticides are not usually needed indoors for adequate control.

Springtails

Springtails are extremely small insects (Figure 8-9) that become problems in homes and other structures when they invade in enormous numbers.

They are very common outside as soil insects. As a result, they fulfill an important role in soil development and enrichment. There may be as many as 50,000 springtails per cubic foot in forest litter. They can also be indoors in potted plants and decaying bulbs.

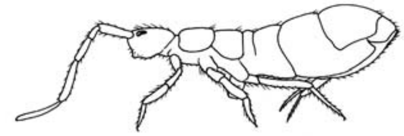

Figure 8-9. Springtail.

Description and Habits. These insects are white or gray. They have a forked appendage to the rear and bottom of the abdomen. This appendage, used as a lever, allows these insects to jump or spring into the air, which is how these insects got their name.

They infest buildings that have constant high humidity. This is usually in the basement, but may be in other areas with water leaks. As a result, the best method of control is to stop the leak or decrease the humidity. Fans may be used to dry out wet areas quickly.

Springtails are attracted to light and may enter homes or other structures under doors. They are a particular problem in newly built buildings with wet materials.

Plaster Bagworms

Plaster bagworms are similar in appearance and closely related to clothes moths. Bagworm larvae (Figure 8-10) live in a flattened, gray, watermelon seed-shaped case about ½ inch long. The case is made of silken fiber and sand particles, lint, paint fragments, and other debris. The case has a slitlike opening at each end so the larva is able to move around and feed from either end.

Figure 8-10. Plaster bagworm, *Phereoeca* sp.

Plaster bagworms are easily seen on light-colored walls. Close examination of the house may reveal bagworms attached to the underside of chairs, bookcases and other furniture. They are often found along rug edges, near baseboards or on the lower edges of walls. Bagworms are quite common in garages and underneath buildings. The larvae mainly feed on spider and other webs; however, they also eat fabrics made of natural fiber.

Control of plaster bagworms is similar to that of clothes moths. Good housekeeping is important, especially the removal of spider webs. Sweep down and remove any spider webs and visible bagworm cases.

Earwigs

Earwigs are beetlelike, short-winged, fast-moving insects (Figure 8-11). They are about ½ to 1 inch in length. They are usually dark brown and have a pair of pincerlike appendages at the tip of the abdomen. They have chewing mouthparts and a gradual type of development.

Figure 8-11. Earwig, *Forficula* spp.

Earwigs are active at night. They usually hide in cracks, crevices, under bark, or in similar places during the day. They are usually scavengers in their feeding habits, but occasionally feed on plants.

The name earwig is derived from an old superstition that these insects enter peoples' ears. This idea is entirely unfounded since earwigs are harmless to man. Some species have scent glands from which they can squirt a foul-smelling liquid. This is probably used for protection from predators.

The striped earwig adults are dark brown with light tan markings. The males are large and robust with stout pincers. The females are somewhat smaller and lighter in color than the males. This earwig lives in subterranean burrows or under debris in areas with sandy or clay soils. They are usually outside unless populations are large or other conditions are adverse. They enter structures in search of food, a more suitable environment, or accidentally.

Because they are nocturnal, they remain in the soil or under debris during the day. Heavily thatched lawns or mulched flower beds are among their preferred daytime habitats. At night they collect in large numbers around street lights, neon lights, lighted windows or similar locations where they search for food. Favorite foods include armyworms, aphids, mites and scales. They also forage on food scraps or dead insects.

The female lays about 50 tiny eggs in a subterranean burrow. The eggs hatch into nymphs in about seven days and the nymphs feed on their egg case. The female continues to care for the young, grooming and manipulating them in the burrow throughout the first nymphal stage. The young nymphs are about ⅛ inch long and could be very easily confused with termites.

In about seven days, the nymphs molt into the second stage and are released from the burrow by the female. At this time the female loses her maternal instincts and many times will devour the nymphs before they can hide. During later stages, the nymphs tend to be cannibalistic. After passing through six nymphal stages, lasting an average of 56 days, the earwig becomes an adult.

Management Guidelines for Earwigs. Earwigs are difficult to control with chemicals. Many times the most effective control for an errant earwig or two in the home is purely mechanical. A folded newspaper, fly swatter, broom and dust pan provide quick and inexpensive control. For severe indoor infestations, insecticide sprays should be used only for spot treatment.

Proper scheduling of outdoor applications may increase the efficiency of control. Application of residual insecticides should be made late in the afternoon or early evening because earwigs are active at night. The material should be applied in a band treatment at least ten feet wide around the entire perimeter of a structure. It may also be necessary to treat the base of mulched shrubbery or flower beds. Because of the high reproductive potential and habitat of earwigs, it is likely that insecticide applications will have to be repeated regularly to achieve a satisfactory degree of control.

Glass jars or tin cans baited with fish or cat food can be buried level with the ground line for use as pit-fall traps. The earwigs cannot climb the sides of the container and are trapped. The trap can be cleaned periodically and the trapped earwigs destroyed.

Figure 8-11. Sowbug.

Sowbugs and Pillbugs

Sowbugs and pillbugs are common crustacea, belonging to a group of animals called Isopods, and are found throughout Florida. They are wingless, oval or slightly elongated arthropods about ½ inch in length, and slate-gray with the body segments appearing as armored plates.

Both pillbugs and sowbugs feed primarily on decaying organic matter, although occasionally they damage the roots of green plants. Their normal habitat is outside but they occasionally wander indoors, where they do no damage.

Sowbugs (Figure 8-11) are often called woodlice and possess two tail-like appendages, seven pairs of legs, and well developed eyes. They are incapable of rolling into a tight ball. Pillbugs, or "roly-polies," lack the taillike appendages and can roll into a tight ball.

The habits, biology and control of sowbugs and pillbugs (Figure 8-12) are similar. Both animals are slow-moving, crawling arthropods. They require high moisture and are most active at night. When resting during the day, they may be found under trash, rocks, boards and decaying vegetation or just beneath the soil surface. A heavy infestation indoors usually indicates a large population outdoors. Mulches, grass clippings and leaf litter often provide the decaying organic matter these bugs need to survive.

Figure 8-12. Pillbug.

Breeding occurs throughout the year in Florida. The female carries the eggs in a brood pouch on the underside of her body. Often there are seven to 200 eggs per brood. The eggs hatch in three to seven weeks, and the young remain in the pouch another six to seven weeks. Once the young leave the pouch, they never return. Some species produce only one brood per year, but others may produce two or more. Individuals may live up to three years.

Management Guidelines for Sowbugs and Pillbugs. Sowbugs and pillbugs cause no damage inside the home. Simple mechanical control such as a broom and dustpan or a fly swatter may be adequate. If they become a serious nuisance, elimination of hiding places, food and moisture sources will reduce the infestation. Source reduction outdoors helps considerably. Piles of leaves, grass clippings and fallen fruit should be removed. Boxes or boards and other debris should be stored off the ground to eliminate a moist shelter.

Indoor treatment with residual insecticides may kill pillbugs and sowbugs that wander inside. Complete control is difficult to achieve and treatments may not last more than one month.

Usually, outdoor treatments are necessary to control sowbugs. Treatments should be to and near foundation walls, around steps or damp areas surrounding the structure. Cracks between sidewalks and the foundation require thorough treatment. Granules or dusts are also useful for treating around foundations and crawl spaces.

Centipedes and Millipedes

Centipedes and millipedes are commonly seen in yards and occasionally enter homes. Neither centipedes nor millipedes damage furnishings, home or food. Their only importance is that they annoy or frighten individuals.

Centipedes are many-legged animals and belong to a group of animals called Chilopods. They are usually brownish, flattened animals with many body segments (Figure 8-13). Most of the body segments have one pair of legs. Centipedes are fast runners and may vary in length from 1 to 6 inches. They have one pair of antennae that are easily seen.

Figure 8-13. Centipede.

Centipedes have poorly developed eyes and are most active at night. They are active predators and feed mainly on insects and spiders. All centipedes have venom glands to immobilize their prey. The jaws of the smaller local species cannot penetrate human skin. However, the larger species may inflict painful bites.

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Figure 8-14. Millipede.

Centipedes are usually associated with damp, dark places such as under stones, leaf litter, logs, bark or soil crevices. Indoors they may be found in closets and bathrooms where there is high humidity.

Centipedes usually lay 15 to 55 eggs clustered together in the soil, although the eggs of some species are laid singly. The eggs hatch soon after they are deposited. The female will usually guard the eggs and the newly hatched young. Young centipedes closely resemble the adults and require three years to mature. Centipedes are rather long-lived, and individuals may live up to six years.

Millipedes (Figure 8-14) are commonly known as "thousand leggers" and belong to a group of arthropods called Diplopods. Millipedes are wormlike, cylindrical animals with many body segments. Most of their body segments bear two pairs of legs. Millipedes tend to coil up tightly when disturbed, and some species can secrete a foul-smelling fluid.

Millipedes feed on decaying vegetable matter and are often found under stones, flower pots, boards or similar debris where there is abundant moisture. Occasionally after rains or during cold weather, large numbers of millipedes may migrate into buildings. They can climb foundation walls and enter homes through any small opening. These pests are generally more troublesome in wooded or newly developed areas where decaying vegetation provides excellent food and breeding conditions.

Female millipedes can lay from 20 to 300 eggs singularly or in clusters in the soil. The eggs hatch in a few weeks, and the young go through seven to eight stages before maturing to adults.

Management Guidelines for Millipedes and Centipedes. Indoor chemical treatment eliminates only the centipedes or millipedes already inside. Spot treatments of residual insecticides to infested areas aids in control. Removal of individuals with a broom or dustpan is sometimes sufficient.

A large indoor population usually indicates large numbers of millipedes or centipedes surrounding the structure. Removal of breeding sites and harborages will aid in control. Compost piles and decaying vegetation should be removed from areas close to the home. Outside treatments of residual sprays should help control outdoor populations. Dusts and granules may be applied to crawl spaces and around foundation walls.

Study Questions | Chapter Eight

1. Describe millipedes and centipedes and discuss their management.

2. Discuss the management of crickets.

3. Mites have ________________________ body region(s).

    A. one
    B. two
    C. three
    D. no

4. Management of household mites is best accomplished by eliminating bird, rodent, or insect hosts.

    A. True
    B. False

5. Dust mites can suck human blood.

    A. True
    B. False

6. Booklice are ________________________.

    A. chicken lice
    B. dust lice
    C. psocids
    D. really lice

7. Silverfish are in the order ________________________.

    A. diptera
    B. thysanura
    C. psocoptera
    D. collembola

8. Bagworms are ________________________.

    A. caterpillars
    B. maggots
    C. nymphs
    D. eggs

For answers refer to Appendix A.

Chapter 9: Vertebrate Pests

Learning Objectives

After completing the study of Vertebrate Pests, the trainee should be able to:

- List the physical characteristics of rats and select those unique to each species.
- Identify the habits and habitat of each.
- Describe the monitoring procedures and tools.
- Describe methods to reduce required resources and carrying capacity.
- Describe physical control methods.
- Discuss the use of rodenticides.
- Describe the habits and habitats of mice.
- Describe the habitats and life cycles of other vertebrates.
- Describe the impact of other vertebrates on household and structural resources.
- Discuss the reasons for and methods of excluding nuisance bats.
- Discuss the nonchemical and chemical alternatives of bird control and management
- Describe the habitats and life cycles of birds.

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Figure 9-1. House mice, shown above, and other rodents are well adapted to human habitats. Rats and mice are among the most common vertebrate pests in and around buildings.

The most common vertebrate pests found in or around buildings are rats, mice, bats and birds. Occasionally other vertebrates such as snakes, lizards, raccoons, opossums, and squirrels enter buildings, although these are usually nuisances rather than destructive pests. Rats and mice, however, are troublesome because they are well adapted to live with people, and they destroy or contaminate food and fabrics, cause structural damage, cause fires by gnawing wires, and are primary or intermediate carriers of transmissible disease organisms (Figure 9-1).

Bats and birds do not live intimately with people, but many species use buildings for roosts or nest sites. They produce smelly and unsightly urine and droppings, are noisy, build messy nests, and may have several insect and mite pests living on their bodies or in their nests. There is also concern that bats can be infected with rabies. Birds may be capable of harboring or contributing to several different diseases, such as histoplasmosis, Psittacosis, Cryptococcosis, and Newcastle disease.

Managing vertebrate pests requires special skills because these animals are larger and more intelligent than invertebrates. Vertebrates may learn to recognize and avoid some control attempts; therefore, an integrated and persistent approach is needed. It is necessary to understand their habits and food preferences in order to monitor and manage population levels effectively and economically; otherwise you may get poor control or even increase the problem.

Rocky Mountain Laboratories, NIAID, NIH

Figure 9-2. Color-enhanced scanning electron micrograph showing *Salmonella typhimurium* (red) invading cultured human cells.

Rats

Rats are destructive building pests. They eat and contaminate food products such as fruit, vegetables, grains, and meat; packaged food or beverages in cardboard, paper, foil, plastic, or cloth containers; and pet food. They also destroy textiles, upholstery, paper, books and insulation by using these materials for nests and staining them with filth. Rats create holes in walls and around doors or windows and gnaw on electrical wiring, water pipes and gas lines. Their gnawing can cause fires and other forms of severe damage. They leave droppings, urine and hairs wherever they wander.

Several human diseases are associated with rat infestations (Figure 9-2). Salmonellosis is a serious intestinal disorder that can be transmitted to people who ingest food contaminated by *salmonella* bacteria in rat urine or feces. Murine typhus, leptospirosis, listeriosis, and trichinosis are other rat-transmitted diseases. The tropical rat mite, an external rat parasite, causes severe itching and skin irritation in people. Rats have oc-

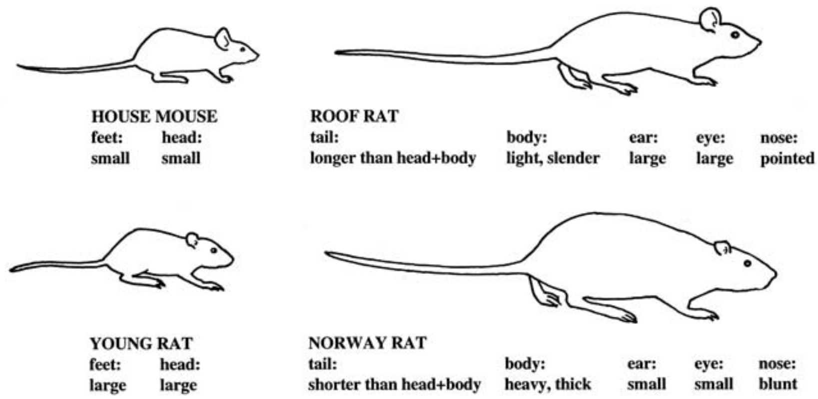

Figure 9-3. The Norway rat and roof rat can be identified by certain physical characteristics including relative body size, shape of nose, size of ears and eyes, and length of tail.

casionally been known to bite sleeping people, which can result in rat-bite fever (RBF), *Streptobacillus moniliformis*. Plague bacteria can be transmitted from rats to people through the bite of rat fleas.

The Norway and roof rats are the principal rat species that may be in buildings. The two species can be distinguished by certain physical characteristics including relative size of body and tail, shape of nose, and size of ears and eyes (Figure 9-3).

Requiring 1 inch or larger openings, rats enter buildings several ways. They may get in through broken windows, poorly screened attic and foundation vents, openings through walls used for passage of electric, gas, water, and sewage services; and through other openings or cracks in foundations, walls, or roofs. They can also chew holes through wooden window or door frames. Dilapidated or poorly maintained buildings usually have many places for rats to enter. Poor building design or construction also contributes to infestations. Buildings serve as sources of food, water, shelter and protection from natural enemies. For roof rats, shrubs and trees growing near buildings, including fruit and nut species, furnish attractive nest areas and abundant food; thick plantings of vines such as ivy make ideal locations for nests. Trash and garbage stored near buildings supply food and nesting sites, encouraging rat populations. Poor housekeeping within buildings also contributes to conditions that favor rat infestations.

Rats sometimes live in sewer systems and use these as travel routes for building access. They get into sewers through poorly covered drains, broken lateral lines and roof vents. Rats have been known to get into toilet bowls after coming up through sewer pipes or climbing down the inside of a vent pipe. The ample food, water and shelter provided by some sewers allows rat populations to build up to large numbers; individuals may then invade buildings for food or in search of new shelters.

Rats have poor vision but highly developed senses of smell, taste, hearing and touch. They use their senses to locate food and avoid danger. Rats forage for food in buildings mostly during the night, thus avoiding encounters with people. Rats are agile and able to run quickly, climb and swim well. They squeeze through small openings to get to food or escape from danger. These rodents are extremely wary of new items or situations and will sometimes take several days to adjust to changes in their environment before they investigate new food or nest items.

Norway Rat

Rattus norvegicus

Figure 9-4. Norway rat, *Rattus norvegicus.*

The Norway rat, also known as the brown rat, house rat, wharf rat and sewer rat, is the larger of the two rat species commonly found in buildings (Figure 9-4). Adults weigh between ¾ and 1¼ pounds; their average length ranges between 7½ and 10 inches, excluding their tail. Tail length is less than head and body length, and ranges between 6 and 8½ inches. Norway rats have coarse brown fur with scattered black hairs. The underside of the body is usually gray, but may also be shades of yellowish white. The almost hairless tail is colored dark brown above, lighter below. This species has small, closely set ears, a blunt muzzle and small eyes.

Norway rats become sexually mature at three to five months of age. They live for an average of nine to 12 months in the wild, although their life span in captivity may be much longer. Females produce four to seven litters of eight to 12 young each.

Outdoors, Norway rats usually nest in the ground. They construct their burrows under cement slabs, in lumber piles and garbage and rubbish heaps, along stream banks, or in other suitable locations. Nests are often no more than 6 to 8 inches below the surface and may be connected to bolt holes, separate exits used for escape when the main tunnel is blocked or endangered. From outdoor nests, Norway rats forage for food, entering buildings at night but returning outside before dawn. During cold or rainy weather, Norway rats tend to move into buildings in search of shelter, warmth and food. Indoors, they nest in secluded areas such as wall voids, behind appliances, beneath floors, and in drawers and closets where they will not be disturbed. When food and shelter requirements are adequate, these rats remain inside throughout their lives; under other conditions, many migrate outdoors and even away from the building as weather improves.

Norway rats generally feed on any type of food, but prefer greasy meat and other animal products as well as fruits, grains and vegetables. When starved, they eat other items such as soiled or stained clothing, snails, cockroaches and other insects, soap, and animal feces. These rats get water inside from leaking pipes or faucets, condensation, pet dishes, sinks and toilet bowls. Norway rats have also gnawed holes in plastic and lead drain pipes to get water.

Roof Rat

Rattus rattus

Figure 9-5. Roof rat, *Rattus rattus.*

Roof rats, also known as black, fruit or citrus rats, (Figure 9-5) are smaller than Norway rats, but have a tail longer than the combined length of the head and body. In adults, head and body length ranges from six to eight and one half inches and tail length is from seven to ten inches. Body weight ranges between ½ and ⅔ pound. Tail color is uniform on both sides rather than being lighter on the underside. There are several color variations in roof rats, ranging from brownish gray with a white underbelly, to gray with a buff belly, to solid black with a gray underbelly. Roof rats have a pointed muzzle and large prominent ears; eyes are larger and more pronounced than those of Norway rats. They become sexually mature at three to five months of age. Females can produce up to six litters having six to eight young per litter. The average life span is nine to twelve months.

Roof rats prefer to eat vegetable matter, including fruits, nuts, grains and vegetables. Under stress, however, they eat a much wider array of foods.

This species less frequently nests in burrows in the ground and, due to its excellent ability to climb, often nests in vines, hollow trees and other types of dense foliage; occasionally they are found in sewers. In buildings, they nest in wall voids, attics, rafters, and other secluded and elevated locations. They can swim and squeeze through openings as small as ½ inch in diameter. Therefore, they can be difficult to exclude from buildings.

Mice

House Mouse

Mus musculus

Figure 9-6. House mouse, *Mus musculus.*

The house mouse (Figure 9-6) occurs throughout the United States. Although they are building pests, they also live outdoors. An adult house mouse is about 3½ inches long with a tail about the same length. They are usually dusky gray but may range from light brown to dark gray and commonly have a lighter underbelly. House mice have large, distinct ears. Adults weigh between ½ and 1 ounce. They reach sexual maturity within 35 days after birth. Gestation takes 18 to 21 days; mature females can produce a litter every 50 days, with an average of six young per litter. After about 15 months of age, females stop having litters. Both males and females may live several years.

House mice cause structural damage to buildings from gnawing and nesting. They can damage attic and wall insulation and may also chew through electrical wiring. If they build nests in large appliances, they may destroy insulation and wiring. Through feeding and nesting, house mice ruin items stored in warehouses, storerooms, attics, basements, and garages, and they can also seriously damage museum collections.

Like rats, house mice are capable of harboring several diseases. Diseases attributed to house mice include salmonellosis, rickettsialpox and leptospirosis.

House mice eat most human food items. They consume meat, grains, cereals, seeds, fruits and vegetables. A single mouse is capable of eating up to eight pounds of food per year, although it destroys much more than this due to fecal and urine contamination or partial eating. Mice also damage food-packaging materials and containers. They can go for long periods without water, although in locations where water is scarce, they are attracted to fruits and other foods with high water content. They require more water when they eat high-protein food.

House mice climb well, are good swimmers, and can jump more than twelve inches. They are capable of crawling through openings as small as ¼ inch wide. They run easily along horizontal pipes, wires, beams and other objects. House mice adjust rapidly to changes in their environment and explore new objects and try new food within a few hours after it is put out. They usually range an average of only 10 to 12 feet from their nest for food and water; at a maximum their travel is usually within a range of 30 feet, although they sometimes travel farther.

Management Guidelines for Rats and Mice

The management of rats and mice is similar. However, it is important to identify the species so that control efforts can be tailored to its particular habits. For more successful management, use several approaches including sanitation, exclusion, mechanical, and chemical control.

Successful rodent control may be followed by an outbreak of secondary pests such as rat fleas or mites. Be sure to look for possible secondary pest problems and be prepared to use control measures for these pests while conducting a rodent control program.

Because rodents may be diseased or infested with parasites such as fleas or mites, wear gloves when handling and disposing of carcasses. Place carcasses in sealable plastic bags and dispose of them by burning or burying. Keep children and pets away from living or dead rodents.

Detecting and Monitoring. Rat and mouse infestations can be detected by their feces and urine odors. Other identifying characteristics are holes and gnaw marks on structural portions of the building, and trails and greasy markings along runways. Figure 9-7 compares fecal pellets of roof rats, Norway rats and house mice; shape is more characteristic than size, as younger rats produce smaller pellets than adults. Use a black light (ultraviolet light source) to see urine droplets and help locate the areas of greatest and most recent rodent activity. Use these signs to help you determine how the rodents are getting into the building and how they are moving about the premises once inside. Search for areas where nests are located. For rats, stuff paper wadding into burrow entrances and check them in 24 hours to see if wadding has been removed or chewed, indicating active burrows. Determine what type of food is available to the rats or mice and where and how they are getting it. Look for water sources.

Use Table 9-1 to estimate the size of the rodent population. If possible, evaluate the extent of damage and economic loss caused by the rats or mice in order to estimate the degree of effort and amount of money that should be spent to eliminate the infestation. From this information, begin to develop a control strategy. Prepare a sketch of the floor plan of the building and indicate entry points, feeding areas, water supplies, runs and nest sites. Begin by focusing control efforts in areas of greatest and most recent activity.

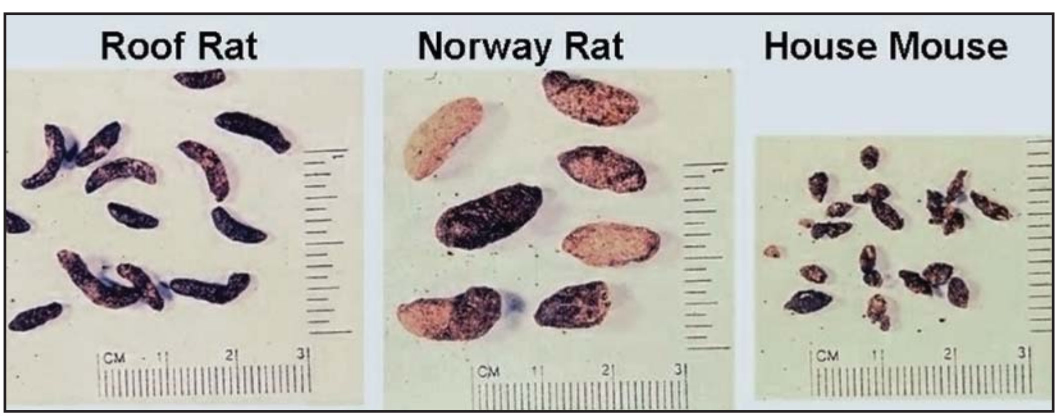

Figure 9-7. The shape of fecal pellets can be helpful in identifying the species of rodent infesting a building. Left to right: roof rat, Norway rat, and house mouse droppings.

Exclusion. Exclude rodents from buildings by sealing or blocking all entry points. Use durable materials such as concrete or metal for blocking holes to make it impossible for rodents to reopen them. Blocking entries should be included with all other methods of control because reinvasion will quickly replace those animals destroyed by control efforts, especially if food and water are still available. See Table 2-4 for information on materials used for excluding rodents. Be careful not to seal rodents into wall spaces or attics as they may die without food or water, causing serious odor and fly problems.

POPULATION SIZE	OBSERVATIONS
Rodents not present or in very low numbers. Any infestation is probably very recent.	None of the signs listed below have been observed.
Medium population	Old droppings present. Signs of gnawing seen. One or more rodents seen at night by flashlight. No rodents reported observed in the day. (There are probably 10 or more rodents in the general area where one is seen at night.
High population	Fresh droppings. Signs of rodent gnawing. Tracks observed in dust. Three or more rodents seen at night by flashlight or one or more seen in daylight.
SIGNS INDICATING PRESENCE OF RODENTS	
When searching for the presence of rodents in a building, look for these signs.	
Sounds	Due to gnawing, feeding, fighting or moving about.
Droppings	Found along runways near nests, in feeding areas.
Urine	May be wet or dry; fluoresces in dark area.
Smudge marks	Found around pipes, beams, and other structural parts of building.
Runs	Found next to walls, along fences, and under shrubbery. In buildings, runs may be dust-free trails on floors, cabinets, and structural parts of building.
Gnawing	Wood chips, torn fabrics, tooth marks. Damage to doors, door frames, window frames, moldings, cabinets, furniture, and other objects.
Sightings	Use flashlight or spotlight at night. Seeing rodents in daylight indicates a high population.
Nests and food caches	Found in attic and undistrubed areas, including dense shrubbery.
Pet excitement	Cats or dogs may be attracted to areas of floors or walls where rodents are nesting.
Odors	Usually can distinguish between rat and mouse odors.

Table 9-1. Ways to Estimate the Size of a Rodent Population.

Figure 9-8. Barriers such as those shown here can be used to keep rats out of trees and adjacent buildings.

Total exclusion may be impossible due to the size or design of a structure. Under these circumstances, use control methods aimed at reducing rodent populations around the outside of the building and reducing entry access. For instance, wrap rat guards (bands of thin sheet metal at least 18 inches wide) around the trunks of all trees adjacent to the building to keep rats from climbing them (Figure 9-8). Trim or remove dense foliage and ivy in contact with the building, and place 18-inch sections of plastic shower curtain rod covers around electrical and telephone wires coming to the building.

Habitat Modification and Sanitation. Modify the environment inside and around the outside of the building to discourage rodents. Start by eliminating food and water supplies whenever possible. Areas where food is prepared or served must be cleaned daily to remove any food traces that can sustain a rodent population. All food must be stored in rodent-proof containers. Establish policies for good housekeeping in other areas of the building to eliminate nests and materials that can be used for nesting. Outdoors, keep shrubbery and grass well trimmed and get rid of weeds and dense foliage that can provide nesting sites. Remove trash heaps and other stored materials that can provide nesting sites. Keep all garbage containers tightly covered. Place hardware cloth screens over the drain holes of large trash bins such as dumpsters.

Trapping. Whenever possible, use mechanical or sticky traps for control of rodents inside a building. Figure 9-9 illustrates the different types of traps available for rat and mouse control; these include snap traps, glue boards, and live traps. Because they are nontoxic, traps are one of the safest methods for eliminating rats and mice. Trapping may produce quicker results than other control methods. Dead animals caught in traps can be located and disposed of more easily than those that are killed by poisons. Some individuals learn to avoid traps and become trap shy.

Figure 9-9. Rodents may be trapped by using snap traps, live traps, or glue boards.

To be most effective, place traps along normal runways with triggers of spring traps placed adjacent to walls or other objects in the line of travel. If traps are used in areas where they are accessible to children or pets, put them in large bait boxes or similar containers. Trapping requires considerably more time than chemical control methods because traps must be checked and serviced daily.

Snap Traps. Snap traps are illustrated in Figure 9-10. In many cases, snap traps provide an effective, humane method of controlling rodents without the need for rodenticides. They are useful in situations where there is a chance that poisoned animals might go into wall voids or other inaccessible

Figure 9-10. Snap traps are often an effective method of controlling rats or mice, eliminating the need for using rodenticides.

Figure 9-11. Place snap traps along walls and inside a trapping station. This will help guide the rodents into the trap.

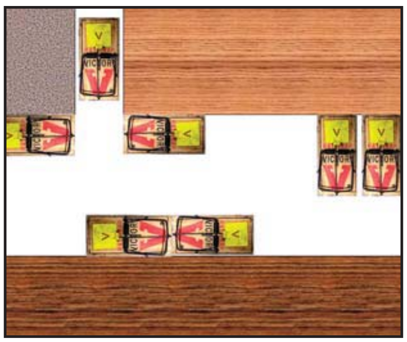

Figure 9-12. For greater effectiveness, place traps in pairs along walls to prevent rodents from jumping over a trap and avoid being caught.

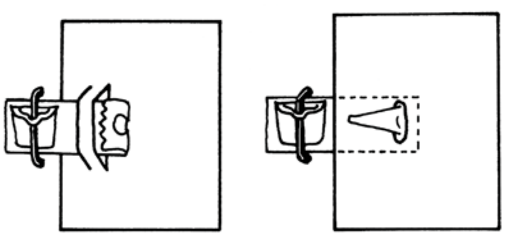

Figure 9-13. Spring traps can be more effective and can be used without bait if the trigger pedal is enlarged using a piece of heavy cardboard. Traps can also be purchased with an enlarged trigger pedal.

areas to die. Other criteria for the use of snap traps include (1) only a few animals are present, (2) people are opposed to the use of toxicants, and (3) there is time available for a successful trapping program.

To increase their effectiveness, snap traps should be put where rats or mice are most likely to encounter them, such as along or near known travel routes on floors, shelves and walls. Place snap traps along walls and inside a trapping station as illustrated in Figure 9-11 to guide the rodents into the trap. Always use many traps to increase chances of catching rodents. Place traps as shown in Figure 9-12 to prevent rodents from jumping over and eluding them. Locate traps in areas inaccessible to children or pets. Also, do not put traps where they might be tripped accidentally. In homes and offices, place traps out of sight so animals caught will not be visible. Check the traps daily to remove captured animals.

Rodent odors from previous catches do not repel other rodents and may even enhance the effectiveness of snap or live traps. Petroleum oils repel rodents, however, so never use these as a lubricant or rust prevention. If rust is a problem, cover metal surfaces with vegetable oil, lard or other animal fat.

To reduce trap shyness, bait the traps for several days without setting them until bait is taken regularly; then set the spring mechanism. Bait snap traps with an attractive food or nesting material. Foods attractive to rodents include peanut butter, sardines, bacon, sausage, whole peanuts, chocolate candy, marshmallows, cheese, dry rolled oats (for mice) and dog or cat kibbles; many people have discovered other materials that work well in their situations. When unsure of which bait to use, try several different types at first, then continue baiting with the one that appears to work best. Tie bait securely to the trigger mechanism so it cannot be removed without springing the trap. Baits that cannot be tied, like peanut butter, have the disadvantage of being easily removed from the trap without setting it off. Therefore, place only small amounts on the trigger plate; the rodent must work harder to remove the bait so its chances of getting caught are increased. Replace old or stale bait frequently to prevent baited traps from losing their effectiveness.

Baits used in traps may attract ants or cockroaches; if these are a problem, use nonbaited traps or bait them with nesting materials. For example, use a small, securely attached cotton ball because mice collect cotton fibers for their nests. Traps are also available with trigger pedals infused with a mouse-attracting scent that does not attract insects.

When using nonbaited traps, enlarge the trigger mechanism with a piece of thin cardboard as illustrated in Figure 9-13. Traps like these are available commercially. Place nonbaited or runway traps directly in rodent pathways, close to walls or other vertical surfaces; position the trigger side toward the wall. Also, nail nonbaited traps to beams and other overhead passageways (Figure 9-14). Be sure the trigger side is positioned in the line of travel.

Trapping rodents is most successful during the first three or four days after traps have been placed, after which, rodent catches usually drop off. Once the initial trapping period has passed, use a nontoxic tracking powder to see where remaining rodent activity is taking place and concentrate trap placement in those areas.

Glue Boards. Use glue boards in the same manner as snap traps to catch mice and rats (Figure 9-15). Glue boards, also called sticky traps, are disposable cardboard or plastic units having one or more surfaces thickly coated with a sticky paste.

Put glue boards in runways and tape them around pipes or other objects traversed by rodents. Once an animal gets caught, dispose of both the trap and pest. Live rodents must be euthanized prior to disposal. Rodents may be killed in a CO_2 chamber, by decapitation, or by cervical dislocation. For mouse control, glue boards have similar advantages to snap traps. Keep them away from children or pets. Use vegetable oil to clean glue from hands or fingers, and mineral spirits to clean surfaces. They do not work well in wet or dusty locations where sticky surfaces become coated with dust and debris. If these conditions exist, place glue boards in protected bait boxes and use nonpoisonous bait to attract rodents.

Check glue board traps daily. Do not reuse traps once a rodent has been caught as some of the sticky substance will be lost and the trap is not as effective. Because they are larger and stronger, rats are more difficult to capture on glue boards; secure traps to a surface with double-sided tape, Velcro strips, or tacks to keep rats from dragging them away.

Live Traps. Live traps can be used to capture rats and mice, as well as capturing birds, skunks, opossums and other small animals (Figure 9-16). Live traps are the only type that can be used for protected wildlife species.

Live trapping requires time and patience. Use a nontoxic food as a bait such as grains, fruits, meat and other items. To increase trapping success, keep unset traps supplied with fresh bait for several days with the doors wired open. Set the trap closing mechanism after food is taken regularly. An animal that has escaped from a trap will probably not go into one again, so do a careful, thorough job of trapping the first time.

Place live traps in areas where they will not be disturbed by children or pets and where the traps will not capture nontarget wildlife. Check traps daily or more frequently to make sure that bait is available and that the trap is still set.

Several styles of live traps are available for catching mice. A simple plastic one has a door that snaps shut because the trap tips as the mouse enters to get the bait. A more complicated mechanical live trap for mice is

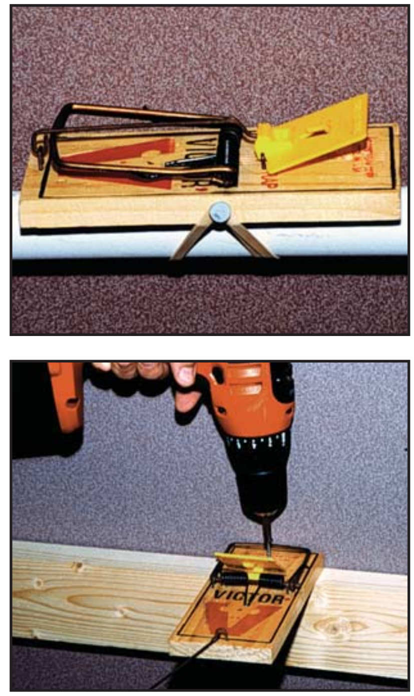

Figure 9-14. Traps for roof rats are often most effective secured to their above-ground travel routs on conduit, pipes, rafters and beams. Heavy rubber bands hold the traps steady and do not spook the rodent when it steps on the trap. Traps can also be screwed or nailed to wooden rafters, beams and stringer boards of fences.

Figure 9-15. Glue boards, also known as sticky traps, are used for trapping mice, rats, and insects such as cockroaches.

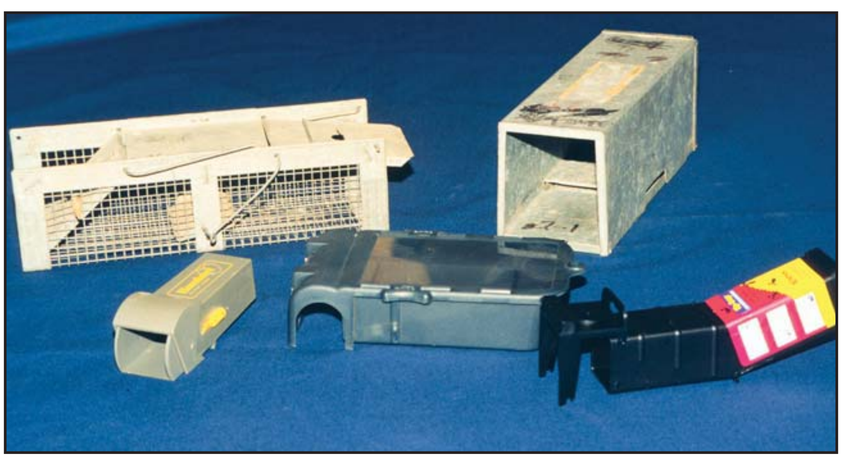

Figure 9-16. Live traps can be used to capture or monitor the presence of small animals such as birds or rodents without injuring the animals.

Figure 9-17. These multi-catch live traps are most effective for infestations of mice. These traps will hold numerous mice each and do not have to be reset each time a mouse is caught.

powered by a spring-wound mechanism; when a mouse enters the baited or unbaited entrance it trips a lever, causing it to be flipped into a holding chamber. Another multiple-catch live trap uses a tipping runway leading into the holding compartment. These last two traps hold several mice and do not have to be reset each time one is caught. Live traps, including multiple-catch traps, (Figure 9-17) must be checked daily.

Rodenticides

Rodenticides are divided into three groups based on their mode of action or application method. These groups are (1) multiple-dose and single-dose anticoagulants, (2) acute single dose non-anticoagulant toxicants, and (3) fumigants. Anticoagulants and acute toxicants may be applied as tracking powders, food baits, or liquid baits.

Bait shyness and resistance problems may be associated with careless use of rodenticides, so keep bait fresh, use it selectively, and only when nonchemical methods are unsuitable. Rodenticide must be carefully placed to ensure that target rodents walk through or consume the toxic material. For instance, placement is different for control of roof rats in rafters than for Norway rats on the ground, because these two species prefer to nest and feed in different environments.

An understanding of the rodents' habits is required for successful rodenticide use. Rats, for example, are wary of new items in their environment and may take several days before investigating or tasting introduced bait. Mice, on the other hand, usually investigate new items within a few hours. A disadvantage of poisons is that rodents may die in inaccessible places, causing odor and fly problems.

Baits. Poisonous baits are effective ways of controlling rodents in a confined area. Use them especially if access to other sources of food or water can be reduced or eliminated. Baits must be attractive to the target rodents, therefore, they should be some form of a natural or acceptable food. Currently available baits are ready to use, so there is no need to add any additional attractants. Adulteration would only increase attractiveness of the bait to nontarget organisms and insects.

Restricted Use Pesticides

In 2008, the Environmental Protection Agency completed a major study on the risks related to brodifacoum, bromadiolone, bromethalin, chlorophacinone, cholecalciferol, difenacoum, difethialone, diphacinone (and its sodium salt), warfarin (and its sodium salt), and zinc phosphide. As a result of this study, EPA issued the following risk mitigation decision:

"To minimize children's exposure to rodenticide products used in homes, EPA is requiring that in the future, all rodenticide bait products available for sale to general consumers be sold only in bait stations. A range of different types of bait stations will meet the new requirements, providing flexibility in cost.

"To reduce wildlife exposures and ecological risks, the Agency intends to prevent general consumers from purchasing bait products containing the rodenticides that pose the greatest risk to wildlife (the second generation anticoagulants – brodifacoum, bromadiolone, difethialone, and difenacoum) by requiring various measures to control sales and distribution. These new requirements support EPA's goal of preventing the sale of the second generation anticoagulants on the general consumer market, but will not change how the livestock industry or other professional applicators use rodenticides." *

To clarify: EPA has classified all bait products containing the active ingredients brodifacoum, bromadiolone, difethialone and difenacoum as restricted use pesticides. This will require much more careful record keeping for the use of these products due to their RUP status.

EPA requires that all outdoor, above-ground placements of bait products containing second-generation anticoagulants be contained in tamper-resistant bait stations. Pest management professionals should have been doing this already.

EPA requires that any rodenticide bait product available for sale to a consumer must be sold in a tamper-resistant bait station, with solid bait blocks as the only permissible bait. This affects only the normal resident or homeowner and does not affect persons with a Restricted Pesticide Applicators license or a Commercial Pest Control License.

* Federal Register, Vol. 73, No. 108, Wednesday, June 4, 2008, Notices 31868-9

Keep baits out of the reach of children or pets. Rodenticides are one of the leading causes of dog poisonings. These materials may also attract ants, stored-product pests or other insects.

Some baits are available as bait blocks, which can be attached to walls or structures in areas where rodents are most active. Most bait blocks incorporate paraffin or other waxy materials to keep them fresh and help protect them against moisture. Dogs may chew on paraffin blocks,

Active Ingredient Name	Trade Names	Mode of Action
Brodifacoum	Talon, Havoc, Klerat Ratak, Finale, Final	Single-dose Anticoagulant **RUP**
Bromadiolone	Maki, Super-Caid, Contrax, Rotox, Contrac, Hawk, Boot Hill	Single-dose Anticoagulant **RUP**
Flocoumafen	Storm, Stratagem	Single-dose Anticoagulant (Not currently registered in the US)
Difenacoum	Difenacoum Rat and Mouse Pellets, Ratak, Roban	Single-dose Anticoagulant **RUP**
Pindone	Pival, Pivalyn Contrax-P	Multi-dose Anticoagulant
Diphacinone (and its sodium salt)	Diphacin, Remik, Diphacinone, Ditrac, Tomcat, Diblock Contrax-D	Multi-dose Anticoagulant
Chlorophacinone	Rozol, Liphadione, Caid, Remac, Patrol, Topgun	Multi-dose Anticoagulant
Warfarin (and its sodium salt)	Warf, d-CON, Warficide	Multi-dose Anticoagulant
Coumafuryl	Fumarin	Multi-dose Anticoagulant
Difethialone	Generation, Hombre, D-cease, BlueMax	Anti-vitamin K agent **RUP**
Bromethalin	Vengeance, Assault, Trounce, Gladiator, Farmgard	Metabolic poison disrupts oxidative phosphorylation in the ATP cycle.
Cholcalciferol (Vitamin D3)	Quintox and Rampage	Causes hypercalcemia
Zinc Phosphide	Ridall-Z, Zinc-Tox, AG Zinphos, Commando, Zinc-Phos	Generates phosphine gas in the stomach **RUP**

RUP = Restricted Use Pesticide license required.

Table 9-2. Rodenticides.

Figure 9-18. Rodenticide bait stations. The inverted-T station and a corner station are some innovative styles.

Figure 9-19. Liquid baits are delivered in watering fountains and are available in styles that fit inside bait stations.

so put them in out-of-reach places or in tamper-resistant bait stations (Figure 9-18).

When using pellet or grain baits, they should always be placed inside an immovable bait station. The stations should be staked, bolted, screwed, or glued to the floor, wall, ground, or concrete pad. This prevents the loose bait from being spilled or scattered if the station is kicked or an animal or child tries to pick it up or turn it over.

Put bait stations along known travel routes and near nests. Record the location of each bait station within a treated area so that each can be properly maintained and so all stations will be removed when the baiting program is over. Be sure bait stations are marked to indicate that they contain poisonous bait; also attach a label that includes the signal word, chemical name, and the name and telephone number of the person responsible for the bait station. The words “KEEP OUT OF REACH OF CHILDREN” should be clearly printed on the bait station.

Prebaiting for several days with untreated bait may be useful as a monitoring technique and may help to determine how much toxic bait to use in a bait station. Once the untreated bait is consumed regularly, switch to a bait with a toxicant. In this way rodents should become accustomed to the bait stations as a food source. Whether using treated or untreated bait, check the stations frequently to be sure there is an ample supply of fresh bait. If bait is not being taken in some stations but is from others, consider relocating those with no activity. If little or no bait is removed from all the bait stations, the bait may not be suitable or there may be another food source that is more attractive.

Bait stations may also be located in the wrong places. First, if possible, eliminate all competing food sources. Be sure bait stations are positioned near nests or known travel routes. If bait acceptance is still poor, switch to another type or brand of bait.

Liquid baits, Figure 9-19, can be very effective in situations where it is impossible to remove competing food sources, but water is limited. Liquid baits are used in chick watering fountains or specialized liquid bait fountains. They should be placed out of the reach of children, pets, and wildlife or inside tamper-resistant bait stations. This is relatively easy because liquid bait fountains are now made to fit inside standard bait stations. Addition of sweetened, powdered fruit drink to the water may increase attractiveness. Tracking powder is used to treat rodent burrows and inaccessible voids used by rodents. Use of a dust mask is advisable because tracking powders contain a high concentration of active ingredient, and care must be taken not to inhale the airborne powder. When considering the use of rodenticide tracking powders, ask yourself if anyone else (plumbers, electricians, your employees, or the occupants) could come into contact with this dust in the next 10 to 20 years. In locations where people could even conceivably come into contact with the tracking powder, it should be confined inside a tracking powder station and removed when the control is achieved. Never use tracking powder in proximity to food, livestock feed, or food preparation areas. Rodents carry the powder on their feet and body, so they can track it anywhere they travel.

Fumigants. The use of fumigants requires a fumigation license. Fumigants are poisonous gases used to kill pests in confined spaces. In Florida, most rodent fumigations involve treating structures for rapid cleanout of rodent populations in restaurants and other food preparation locations. In other parts of the country, fumigants often are used for rodent control by injecting gas or applying metallic phosphide pellets into the burrows of the pest. Fumigation for control of stored product pests in food storage areas such as grain silos, railway cars, ships' holds and transport containers, flour mills, and food warehouses often target rodents in addition to insects. A disadvantage of fumigation is that dead rodents trapped in inaccessible sites may result in serious odor and fly problems.

Fumigation requires that the treated area be evacuated and sealed so that the airborne concentration of toxicant can reach a lethal level. The toxicant concentration must be held at this level for a specific period of time as described on the label. Afterward, the area must be thoroughly ventilated before it is safe to enter.

Nuisance Vertebrate Control Laws

Frequently pest control companies receive requests for help with "nuisance" wildlife problems either from current customers or one-time-only customers. These types of calls are often considered a nuisance because they can be time consuming. Response to nuisance wildlife calls should be considered a service to foster good will and fidelity with current customers or the opportunity to develop relationships with potential new customers for other services.

Limited Certification, 2008. In 2008, the Bureau of Entomology and Pest Control began creating a new limited certification for Commercial Nuisance Wildlife Management personnel. This certification allows nuisance wildlife trappers to exclude, trap, euthanize vertebrate pests and nuisance wildlife, but trappers may not use any chemical products such as rodenticides or avicides. This certification became effective July 1, 2008.

68A-1.004 Definitions.

(55) Nuisance wildlife — Wildlife that causes or is about to cause property damage, presents a threat to public safety, or wildlife causing an annoyance within, under or upon a building.

68A-9.010 Taking Nuisance Wildlife.

Any person owning property may take nuisance wildlife or they may authorize another person to take nuisance wildlife on their behalf except those species listed in subsection (1) below on their property by any method except those methods listed in subsection (2) below. Persons responsible for government owned property are considered "landowners" for the purpose of this rule. The executive director or a designee may authorize the take of additional species of wildlife or additional methods of take for justifiable purposes by permit issued pursuant to 68A-9.002 F.A.C.

(1) Wildlife that may not be taken as nuisance wildlife:

(a) Species listed in Chapter 68A-27 F.A.C. (Endangered, Threatened, and Protected species)

(b) The following mammals:

1. Black bear.

2. Deer.

3. Bats — Except that bats may be taken either when:

a. That take is incidental to the use of an exclusion device, a device which allows escape from and blocks re-entry into a roost site located within a structure (including chemical repellants), at any time from August 15 to April 15 or

b. That take is incidental to permanent repairs which prohibit the egress of bats from a roost site located within a structure provided an exclusion device as described in sub-subparagraph a. above is used for a minimum of four consecutive days/nights for which the low temperature is forecasted by the US National Weather Service to remain above 50°F prior to repairs and during the time-period specified.

(c) The following birds:

1. All birds listed in 50 C.F.R. §10.13 (as protected by the Migratory Bird Treaty Act unless the take is authorized by the U.S. Fish and Wildlife Service by a permit or depredation order.)

2. Bobwhite quail.

3. Wild turkey.

(2) Methods that may not be used to take nuisance wildlife:

(a) Gun and light, except as provided in paragraph (4)(b) below.

(b) Steel traps. (above ground leg-hold and body-gripping traps)

(c) Poison, other than those pesticides that are registered by the Florida Department of Agriculture and Consumer Services without additional authorizations and are only used in a manner consistent with the product labeling.

(d) Bat exclusion devices or any other intentional use of a device or material at a roost site which may prevent or inhibit the free ingress and/or egress of bats from April 16 through August 14.

(e) Any method prohibited pursuant to 828.12, F.S.

(3) Transportation and release of nuisance wildlife.

(a) Live captured nuisance wildlife transported under authority of this section may be done only for the purpose of euthanizing the nuisance wildlife, provided any euthanasia shall be humane as defined by the American Association of Zoo Veterinarians. Euthanasia of those species listed in 68A-6.0022(2) (exotic pet species of mammals, birds, reptiles and amphibians) is not required.

(b) Live captured nuisance wildlife may be released on the property of the landowner provided the release site and capture site are located on one contiguous piece of property.

(4) Take of nuisance wildlife on airport property.

(a) Wildlife listed in Chapter 68A-27, F.A.C., that pose an imminent jeopardy to aircraft safety and human life, may be harassed by persistent, non-injurious disturbance without physical capture or direct handling to disperse wildlife by airport operators or their agents on airport property in order to prevent collisions between aircraft and wildlife.

(b) Airport personnel may take deer or wild turkey on airport property if their presence poses a potential threat to aircraft safety and human life.

NORTHWEST REGION
3911 Highway 2321
Panama City, FL 32409
(850) 265-3676

NORTH CENTRAL REGION
Route 7, Box 440
3377 US Hwy 90 East
Lake City, FL 32055
(386) 758-0525

NORTHEAST REGION
1239 SW 10th Street
Ocala, FL 34471
(352) 732-1225

SOUTHWEST REGION
3900 Drane Field Road
Lakeland, FL 33811
(813) 648-3200

SOUTH REGION
8535 Northlake Boulevard
West Palm Beach, FL 33412
(561) 625-5122

http://myfwc.com

Table 9-3. Locations of Florida Fish and Wildlife Conservation Commission Regional Offices and website address.

Deer may be taken by the use of a gun and light at night. Carcasses of deer or wild turkey taken under this rule shall be buried, incinerated on-site or donated to a charitable, non-profit institution or agency. No deer or wild turkey carcasses taken under this rule shall be retained for use by airport personnel.

Mammals. The roof rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), nine-banded armadillo (*Dasypus novemcinctus*), and coyote (*Canis latrans*) are not protected in the state of Florida. Registered rodenticides may only be used to control house mice, roof rats, Norway rats, field rodents, and pocket gophers, if used according to label instructions.

All other mammals are protected as either native game or native non-game wildlife. Native mammals (except threatened or endangered species, deer, bear, and bats) may be taken by a property owner only in the immediate area where the damage is occurring. Only property owners, tenants, family members, and employees may kill nuisance wildlife without a pest control operator's license or a limited nuisance wildlife management certification. Pest control operators or certified nuisance wildlife trappers may be hired to capture or kill nuisance wildlife on the property of another. Nuisance wildlife permits are available from Regional Offices of the Florida Fish and Wildlife Conservation Commission. Nuisance wildlife may not be taken with steel traps or guns and lights at night without special permits issued by the executive director of the FF&WCC. Poisons registered for use in Florida by the Florida Department of Agriculture and Consumer Services, Bureau of Pesticides may only be used by property owners and Licensed Pest Control Operators if they are used for the target species listed on the label and according to the label instructions. Examples would include mole baits, pocket gopher baits, and field rodent baits labeled for cotton rats in truck crops and sugarcane. Poisons may not be used by those with only a limited nuisance wildlife management certification.

Two common native mammals that are often considered pests in lawns and golf courses are the southeastern pocket gopher, *Geomys pinetis*, (Figure 9-20) and the eastern mole, *Scalopus aquaticus* (Figure 9-21).

Figure 9-20. Mounds produced by southeastern pocket gopher, *Geomys pinetis,* are a common sight in sandy upland habitats.

The pocket gopher is the tan, subterranean rodent that makes large, regularly-spaced mounds. The pocket gopher should not be confused with the protected gopher tortoise. The name pocket gopher comes from the unique fur-lined cheek pouches that these rodents use to carry food from their tunnels to their nest or storage chamber. Pocket gophers are also called "salamanders" or "sandy mounders" in Florida. The eastern mole is not a rodent, but is an insectivore related to shrews and hedgehogs. They feed on earthworms, grubs, caterpillars, and small vertebrates. Most of the damage caused by moles is aeshthetic due to unsightly ridges and mounds. They often are blamed for damage to turf that is actually caused by the insects they eat.

Figure 9-21. The eastern mole, *Scalopus aquaticus,* is common in most Florida habitats. It is recognized by serpentine surface ridges created while foraging and mole hils created by pushing up soil during excavation of nest cavities.

The use of registered poison baits or burrow fumigants for the control of the southeastern pocket gopher or the eastern mole is legal as of July 1, 2008, under Florida Wildlife Code 68A-9.010(2)a. Specialized mole or pocket gopher traps are not considered steel traps because they are set in or under the ground. These traps may be used by property owners, tenants, licensed pest control operators or wildlife management professionals to control moles and gophers without additional permits. Insecticides used to eliminate mole crickets, white grubs, etc., the food of moles, are legal if label instructions for these insect pests are followed. Treating for the turf insects that moles feed on is a commonly recommended method to encourage moles to leave an area. Be prepared for an increase in activity after treatment because the moles have to search more and tunnel more to find enough of the decreasing food supply.

Nine-banded armadillo, *Dasypus novemcinctus,* is a relative of the sloths and anteaters. They made their way into Florida by expanding their range around the Gulf of Mexico from Texas in the 1930s through 1950s. They can cause problems for people by digging burrows under foundations, disrupting termiticide barriers, and tearing up landscapes in their search for worms, grubs, beetles, caterpillars, and small snakes and lizards. They can be physically excluded by fences or other barriers. They are also relatively easy to trap if you follow three rules: 1) Use no bait. That will just attract numerous nontarget creatures. 2) Use a drift fence to guide the armadillo into the trap. In nature they commonly follow logs and other barriers as they forage along the forest floor. 3) Cover the wire on the floor of the trap to prevent the armadillo from feeling it and backing out before stepping on the trigger (Figure 9-22).

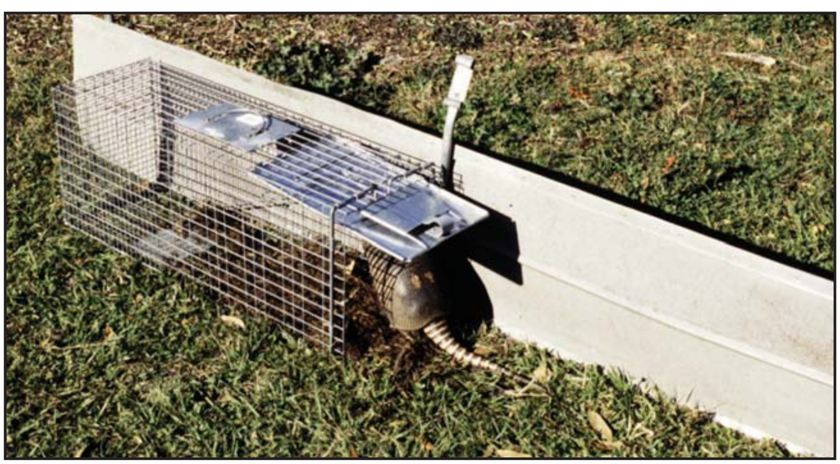

Figure 9-22. Nine-banded armadillos, *Dasypus novemcinctus*, are easily trapped using a drift fence to guide them into the live trap.

Figure 9-23. Racoons, *Procyon lotor,* are common attic invaders.

Figure 9-24. From top: Virginia opposum, *Didelphis virginiana,* eastern gray squirrel, *Sciurus caronlinensis,* and southern flying squirrel, *Glaucomys volans.* All are common attic invaders.

The most common species of nuisance wildlife in suburban environments are raccoons, *Procyon lotor* (Figure 9-23), opossums, *Didelphis virginiana*, gray squirrels, *Sciurus carolinensis*, and southern flying squirrels, *Glaucomys volans* (Figure 9-24). They are usually a problem only when they move into an attic or crawlspace or underneath a shed or deck. Exclusion should always be the first option considered. It is usually the cheapest and simplest solution. Live trapping followed by permanent exclusion is usually the preferred method of control for structural invaders. The animals can then be released back into their natural home range to find suitable den sites in the area they are familiar with. Special effort must be given to prevent trapping young inside the structure. Frantic mothers have been known to do extensive damage while trying to reach their trapped offspring.

Raccoons, otters, skunks, bobcats, coyotes, gray foxes (*Urocyon cinereoargenteus*), and red foxes (*Vulpes vulpes*) are potential rabies vector species. Live-trapped carnivores may not be released on state lands, but these animals may be released back onto the same contiguous property they were trapped on after the nuisance situation is corrected. Live raccoons may only be transported within the state of Florida with a raccoon transportation permit from the FF&WCC. Captured nuisance wildlife may not be released on state properties, such as state parks and state recreation areas. Relocation of nuisance animals is rarely recommended or advisable. These rules are meant to reduce the spread of rabies and other wildlife diseases.

It is illegal to release captured exotic, nonnative species of animals into the wild in Florida. This includes English sparrows, starlings, pigeons, Muscovy ducks, escaped parrots, roof rats, Norway rats, house mice, escaped pets like ferrets, gerbils, hamsters, pythons, iguanas, and giant marine toads (see Table 9-4).

	Common name	Scientific name
Feral Livestock**	**Mammals**	
	Ferret (domestic)	*Mustela putorius*
	Feral Domestic Rabbit	*Oryctolagus cuniculus*
	Feral Dog	*Canis familiaris*
	Feral Cat	*Felis catus*
	Feral Pig (except on Wildlife Management Areas)	*Sus scrofa*
	Birds	
	Feral Chicken	*Gallus gallus*
	Guineafowl	*Numida meleagris*
	Common Peafowl	*Pavo cristatus*
	Muscovy Duck	*Cairina moschata*
	Rock Dove or feral pigeon	*Columba livia*
Exotic Wildlife***	**Mammals**	
	Nine-banded Armadillo	*Dasypus novemcinctus*
	Coyote	*Canis latrans*
	White-nosed Coati	*Nasua narica*
	Mongoose	*Herpestes javanicus*
	Red Fox	*Vulpes vulpes*
	Gambian Pouch Rat	*Cricetomys gambianus*
	Black-tailed Prairie Dog	*Cynomys ludovicianus*
	Capybara	*Hydrochaeris hydrochaeris*
	House mouse	*Mus musculus*
	Nutria	*Myocastor coypus*
	Norway Rat	*Rattus norvegicus*
	Black Rat or Roof rat	*Rattus rattus*
	Mexican Red-bellied Squirrel	*Sciurus aureogaster*
	Black-tailed Jackrabbit	*Lepus californicus*
	Birds	
	Purple Swamphen	*Porphyrio porphyrio*
	Eurasian Collared-Dove	*Streptopelia decaocto*
	Ringed Turtle-Dove	*Streptopelia risoria*
	Budgerigar	*Melopsittacus undulatus*
	Monk Parakeet	*Myiopsitta monachus*
	Myna	*Acridotheres* spp.
	House Finch	*Carpodacus mexicanus*
	Spot-breasted Oriole	*Icterus pectoralis*
	House Sparrow	*Passer domesticus*
	European Starling	*Sturnus vulgaris*

	Common name	Scientific name
Exotic Wildlife***	**Reptiles**	
	Red-eared Slider	*Trachemys scripta elegans*
	Spectacled Caiman	*Caiman crocodilus*
	African Redhead Agama	*Agama agama*
	Giant Ameiva	*Ameiva ameiva*
	Brown Anole	*Anolis sagrei*
	Hispaniolan Green Anole	*Anolis chlorocyanus*
	Puerto Rican Crested Anole	*Anolis cristatellus cristatellus*
	Largehead Anole	*Anolis cybotes*
	Bark Anole	*Anolis distichus*
	Knight Anole	*Anolis equestris equestris*
	Cuban Green Anole	*Anolis porcatus*
	Jamaican Giant Anole	*Anolis garmani*
	Brown Basilisk	*Basiliscus vittatus*
	Oriental Garden Lizard	*Calotes versicolor*
	Rainbow Lizard	*Cnemidophorus lemniscatus*
	Giant Whiptail	*Cnemidophorus motaguae*
	Mexican Spinytail Iguana	*Ctenosaura pectinata*
	Black Spinytail Iguana	*Ctenosaura similis*
	Tokay Gecko	*Gekko gecko*
	Tropical House Gecko	*Hemidactylus mabouia*
	Common House Gecko	*Hemidactylus frenatus*
	Mediterranean Gecko	*Hemidactylus turcicus*
	Indo-Pacific Gecko	*Hemidactylus garnotii*
	Green Iguana	*Iguana iguana*
	Northern Curlytail Lizard	*Leiocephalus carinatus armouri*
	Red-sided Curlytail Lizard	*Leiocephalus schreibersii schreibersii*
	Butterfly Lizard	*Leiolepis belliana belliana*
	Many-lined Grass Skink	*Mabuya multifasciata*
	Giant Day Gecko	*Phelsuma madagascariensis grandis*
	Texas Horned Lizard	*Phrynosoma cornutum*
	Ocellated Gecko	*Sphaerodactylus argus argus*
	Ashy Gecko	*Sphaerodactylus elegans elegans*
	Black and White Tegu	*Tupinambis merianae*
	Nile Monitor	*Varanus niloticus*
	Common Boa	*Boa constrictor*
	Burmese Python	*Python molurus bivittatus*
	Brahminy Blind Snake	*Ramphotyphlops braminus*
	Amphibians	
	Giant Toad	*Bufo marinus*
	Greenhouse Frog	*Eleutherodactylus planirostris*
	Coqui	*Eleutherodactylus coqui*
	Cuban Treefrog	*Osteopilus septentrionalis*

Table 9-4. Unprotected Vertebrates in Florida*. Those species that can be trapped or captured and removed without any special licenses or permits.

* All vertebrates are protected from inhumane treatment, abuse, or cruelty.

** Releasing livestock into the wild constitutes animal abandonment, a form of animal cruelty and a first degree misdemeanor. Florida Statutes Chapter 828 Section 828.13 (3).

*** It is illegal to release any nonnative animal into the wild in Florida without a permit from the Florida Fish and Wildlife Conservation Commission. The release of a nonnative animal is a first degree misdemeanor. Florida Statutes Chapter 372 Section 372.265 (1).


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Figure 9-25. Nuisance alligators must be captured by a state-licensed alligator trapper, and only after the FF&WCC has issued a nuisance alligator warrant.

Reptiles and Amphibians. The use of toxic materials, such as gasoline or fumigants, to flush reptiles from their dens or retreats or to kill them is prohibited. No toxicants are registered for control of any reptile or amphibian. Exotic species are not protected and may be captured or killed without a permit. Native species of amphibians and reptiles are protected from wanton destruction and are generally beneficial.

Native snakes that are not listed as threatened or endangered, but are a nuisance because they frighten people, may be captured and relocated using funnel traps or glue boards. A snake captured on a glue board may be released by pouring room temperature vegetable oil over the snake and glue board. The oil softens the glue and the snake can crawl away. Some frogs and turtles may be harvested for food with a fishing license. Other species are protected as endangered or threatened and may only be taken with a permit from the executive director of the FF&WCC. Current lists of endangered and threatened species and state species checklists are available from the FF&WCC. Nuisance American alligators, *Alligator mississippiensis*, may only be captured and removed or killed by licensed trappers of nuisance alligators (Figure 9-25).

If you are in doubt about any law or whether a species is protected, contact your regional office of the Florida Fish and Wildlife Conservation Commission listed in Table 9-2 for more information, free publications, and nuisance wildlife permits.

Bats

Bats are highly beneficial wild mammals. They are not flying rodents, but belong to a unique order of mammals called the Chiroptera (chiro = hand, ptera = wing). Bats are more closely related to primates (monkeys and humans) than they are to rodents. There are two families and 18 species of bats in the eastern United States. Fourteen species can be found in Florida. All these bats feed on night-flying insects. Each bat eats about its weight in food every night. This means that even a small colony, numbering several hundred individuals, consumes hundreds of pounds of insects every week. These insectivorous bats have tiny sharp teeth for chewing insects. Bats cannot use their teeth to gnaw wood or wires as can rodents with their chisel-like incisors.

During the day bats rest in dark secluded roosts, such as caves, hollow trees, under bridges, crevices, and the attics of buildings. In winter when insects are scarce, some bats migrate like some birds do, while others hibernate in caves, trees, or buildings. Most bats in Florida enter torpor (a form of deep sleep) during the day and on winter nights when it is too cold for their insect food to fly. Most bat species only have one baby per year. So it takes bat populations a long time to recover from human acts of destruction. Bats are long lived animals. The little brown bat from the northern states is known to live up to 30 years. Bats in Florida can probably live ten to twelve years. Bats are creatures of habit and will frequent the same roost year after year, even if they only use it seasonally.

Bats are often feared as carriers of rabies. Bats can become infected with the rabies virus as can dogs, cats, raccoons, and skunks. But unlike these animals, rabies-infected bats do not generally become deranged and attack people or other animals. They usually become paralyzed and die quietly. The infection rate for house-dwelling bats is very low, ranging from one per 2,000 (0.05%) in the southeastern bat to four per 1,130 (0.35%) in the Brazilian free-tailed bat.

Bat Identification. A picture key to the bats of Florida is included in this publication. Table 9-5 summarizes the natural history of Florida bats.

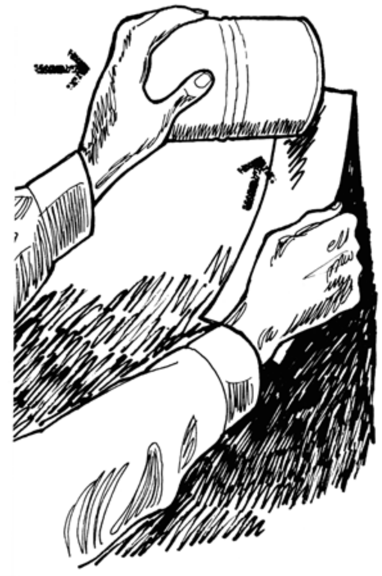


Figure 9-26. Bats can be safely captured with a can and stiff paper and then released outdoors.

Removing Single Bats from a Building. Despite their importance as insect predators, bats can be a nuisance when they choose to live in houses, buildings, or other structures used by people. Problems such as noise, smell, accumulations of feces (guano) and urine, staining and spotting of surfaces, attraction of other pests such as flies or cockroaches, and the general fear of these mammals by the public may require that they be excluded from a structure.

Single bats occasionally enter buildings accidentally. This usually occurs in the spring or fall, when bats move between winter roosts and maternity roosts, or in the late summer when young bats have just learned to fly. Young bats can become confused, get lost, and turn up inside buildings where they don't belong. In most cases, all that is required is that access for escape be provided by opening a door or window. In cases where that is not possible, as in most air conditioned buildings, a bat can be captured by covering the resting individual with an empty coffee can. Then gently slide a piece of cardboard or heavy paper between the container and the surface on which the bat is resting, trapping it inside (Figure 9-26). Groups of bats numbering fewer than 10 individuals can also be removed in this way. If a small bat is resting quietly, it may be possible to pick it up while wearing heavy leather gloves. Never touch a bat with bare hands; it will bite to defend itself, as would any wild animal. Do not try to catch a flying bat; this is almost impossible and usually results in injuring the animal. After the bat is captured, take it outside, away from children and pets and let it fly away or place it high on the side of a tree or wall to fly away on its own. A torpid (cold and sleepy) bat will need to "warm up" before it can fly.

If anyone is bitten, cleanse the wound thoroughly with soap and water and call your county health department for information and instructions.

COMMON NAME	SPECIES	DISTRIBUTION IN FLORIDA	SUMMER HABITAT	WINTER HABITAT	NOTES
Southeastern bat	*Myotis austroriparius*	Northern two-thirds of the state	Caves, trees, buildings	Caves	Common building inhabitant.
Gray bat	*Myotis griscens*	Panhandle	Caves	Caves	Endangered species.
Northern long-eared bat	*Myotis septemtrionalis*	Panhandle	Hollow trees, buildings	Caves	Very rare in Florida.
Indiana bat	*Myotis sodalis*	Panhandle	Hollow trees, under loose bark	Caves	Endangered species. Very rare in Florida.
Little brown bat	*Myotis lucifugus*	Panhandle	Hollow trees, buildings	Caves	Very rare in Florida.
Eastern pipistrelle	*Pipistrellus subflavus*	Northern two-thirds of the state	Trees	Caves	Rarely enters houses.
Big brown bat	*Eptesicus fuscus*	Northern half of the state	Buildings and under bridges	Caves, attics	Uncommon in Florida.
Red bat	*Lasiurus borealis*	Northern third of the state	Trees (foliage)	Trees (foliage)	Tree bat.
Seminole bat	*Lasiurus seminolus*	All of state except the Everglades region	Tree foliage, Spanish moss	Tree foliage, Spanish moss	Tree bat.
Hoary bat	*Lasiurus cinereus*	Migrants found only in N. Florida	Absent	Trees	Migrates through state in fall/spring.
Northern yellow bat	*Lasiurus intermedius*	Entire state	Trees, palms, Spanish moss	Trees, palms, Spanish moss	Tree bat.
Silver-haired bat	*Lasionycteris noctivagans*	Panhandle	Trees	Trees	Very rare in Florida.
Evening bat	*Nycticeius humeralis*	Entire state	Buildings, hollow trees	Hollow trees	Common building inhabitant.
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	Northern two-thirds of the state	Abandoned buildings, hollow trees	Same as summer	Rare in Florida.
Brazilian free-tailed bat	*Tadarida brasilienses*	Entire state except Keys	Buildings, bridges	Same as summer	Common building inhabitant.
Florida bonneted bat	*Eumops floridanus*	Southern quarter of the state	Spanish tile, woodpecker holes	Same as summer	Largest resident in Florida; endangered.
Velvety free-tailed bat	*Molussus molossus*	Florida Keys, Caribbean, and Central America	Buildings	Same as summer	Originally flew from Cuba or carried on ships.

Table 9-5. Natural History of Bats in Florida.

Try to collect the bat so it can be tested for rabies. NEVER pick up a bat you find lying on the ground. Keep children and pets away from it and if necessary move it to an inaccessible spot with a shovel or similar implement. Call the county animal control office to have the bat removed.

Figure 9-27. A typical bat colony entrance often can be recognized by a stain below it.

Confirming the Presence of Bats in a Building. The presence of a bat colony in a building is often confirmed by seeing bats emerge from various openings at dusk. Squeaking and rustling noises coming from ceilings and walls may indicate a bat colony is present. The sounds may also come from mice or flying squirrels. Chirping noises coming from chimneys are usually made by nesting chimney swifts, which are small insect-eating birds. An opening, which can be as narrow as ¼ inch, with a dirty stain below it may be the exit hole for bats. Stains come from urine, feces, and body oils that are deposited around the opening as bats enter or leave the roost (Figure 9-27). Droppings on sidewalks, ledges, patios, or underneath rafters in an attic or barn may indicate bats are present. Bat droppings, which are brown or black and resemble instant rice grains in size and shape, are composed entirely of insect parts. Mouse droppings are similar in size and shape but do not crumble between your fingers to reveal bits of insects. Gecko droppings are similar to bat droppings but the pieces of insects are larger, less chewed up, and have a small white ball of uric acid on one end. Cockroach droppings are usually smaller and have six flattened sides, making them hexagonal in cross section.

Bat Proofing. As with most nuisance animal situations, preventing a problem is much easier and cheaper than correcting one (Figure 9-28). To prevent bats from establishing themselves in a building, all attic and soffit vents should be screened with ¼ inch hardware cloth or screen. Good ventilation of attics discourages bats from roosting and also discourages infestations of large peridomestic cockroaches. Vent holes in Spanish tile roofs should be covered with screen that is held in place with silicon rubber caulk. Gaps in siding, spaces under warped fascia boards, spaces

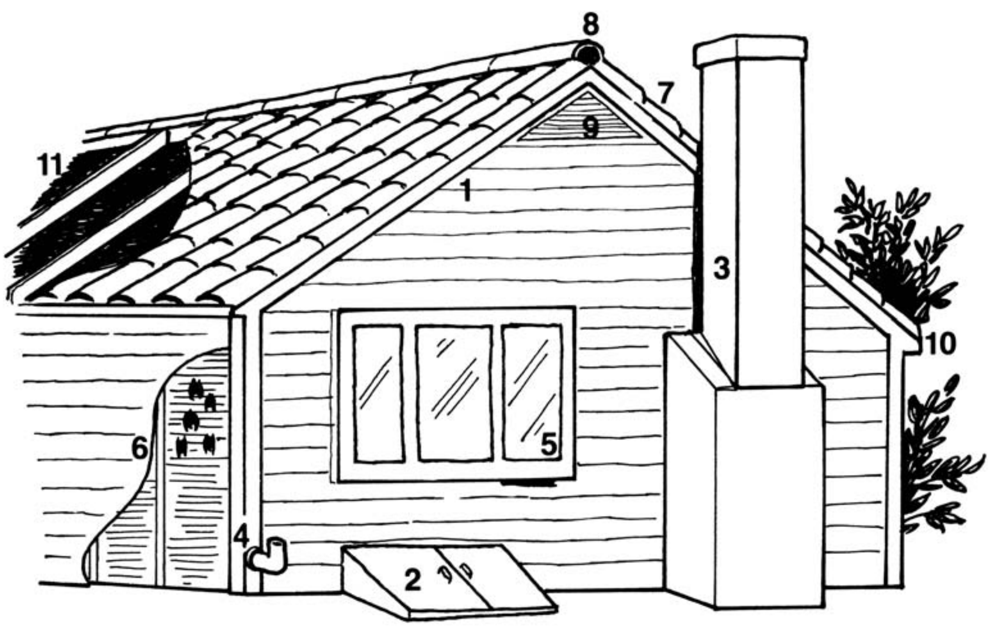


Figure 9-28. Common points of entry and roosting sites of bats in buildings.

between house and chimney, and loose flashing and moldings should be sealed to exclude bats and other invading household pests (Figure 9-29).

Excluding a Bat Colony. When bats do become established in a building where they are not wanted, the best and most permanent solution is exclusion. This is accomplished by the following steps:

1. Observe the building at dusk from all angles on three or four consecutive evenings to identify the entrance and exit openings that the bats are using.
2. Seal and bat-proof all other openings that bats do not use, but might use in the future. Some species of bats can enter through a crack or crevice that is only ¼ inch wide. Sealing materials can include caulking, wood, sheet metal, plaster, cement, ¼ inch hardware cloth, or window screen.
3. Plan to do the exclusions in the spring or fall. Bats give birth in the summer. Exclusions must not be attempted when baby bats are present, as they do not fly with their mothers until they are almost full grown. Baby bats trapped in the roost by an exclusion will die of thirst or starvation and create a serious odor and fly problem. In Florida, exclusions should not be attempted from April 15 through August 14. Wait until the young are flying to exclude the colony. Avoid exclusions during cold weather because bats usually do not fly when temperatures are below 45°F.
4. Exclude the unwanted bats by placing one-way devices on each of the colony's exit points. These devices can be as simple as a plastic "sleeve" (Figure 9-30). Once the bats exit through this, it collapses behind them. They cannot climb or crawl on the smooth plastic. Bat netting works the same way. The top of the netting is attached securely to a wall, beam, or other solid surface above the roost opening and extends over it. The

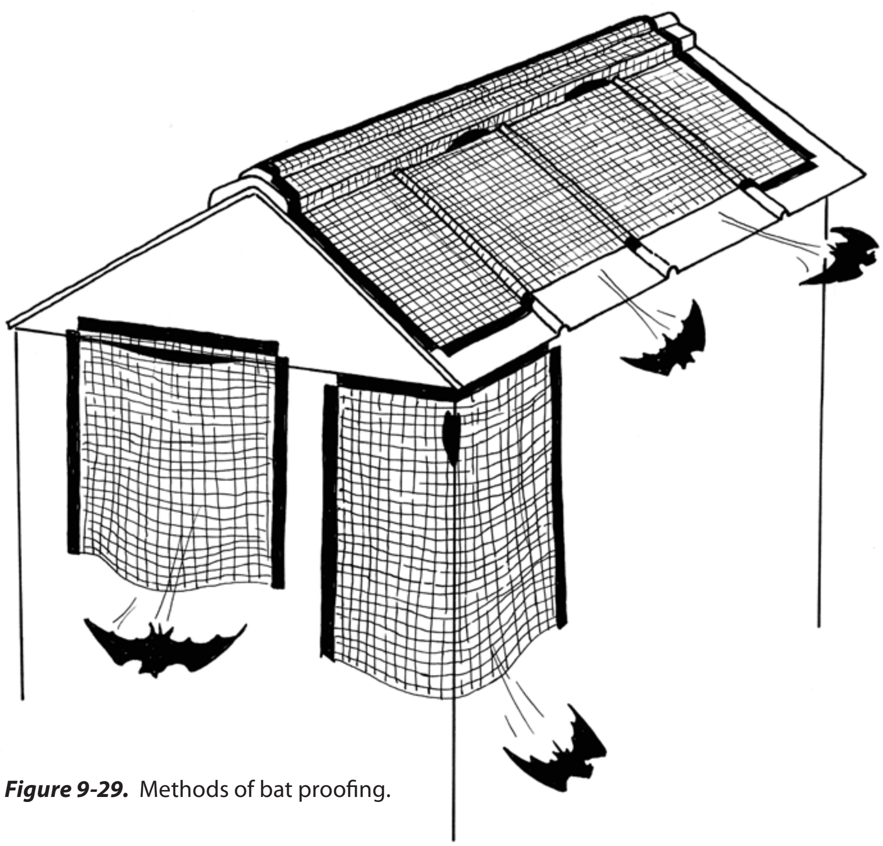


Figure 9-29. Methods of bat proofing.

bottom of the netting is secured at spots along the bottom edge. The netting can be secured with duct tape, staples, Velcro tabs, or silicon rubber caulking. The bats exit the roost, crawl out the bottom of the netting, and escape, but are not able to find the roost opening when they return from feeding, because the netting covers the hole. Professional bat exclusion specialists have developed a variety of exclusion devices for special situations. Colonies in large structures or in high dangerous places should be excluded by experienced professionals. Returning bats may fly around the roost openings, but will disperse within a day or so.

5. Once excluded, a large bat colony may leave behind external parasites such as bat bugs, soft ticks, or mites. Most bat parasites are host specific and will not bite people. Once the bats have been excluded, the application of a desiccant or insecticide dust throughout the roosting site will kill parasites. This is a good precaution to prevent their spread while they look for other hosts.

   Bat guano dries to form a crumbly, powdery substance that can grow a fungus called *Histoplasma capsulatum*. Spores from this fungus become airborne when the guano is disturbed. Inhaled spores develop into a yeastlike infection in the lungs. This produces a systemic disease called histoplasmosis, the effects of which can range from flulike symptoms (in most people) to serious lung abscesses and lesions resembling tuberculosis (in a minority of others). When working in an area where bat guano is present wear protective clothing and a cartridge respirator (capable of filtering particles as small as 0.3 microns) to avoid breathing guano dust. Prior to removing accumulated guano, spray it with water to hold down the dust.

6. Permanently seal roost openings when you are sure that all of the bats have left the roost. Leave the excluder in place for at least three days in warm weather, longer in cool or cold weather.

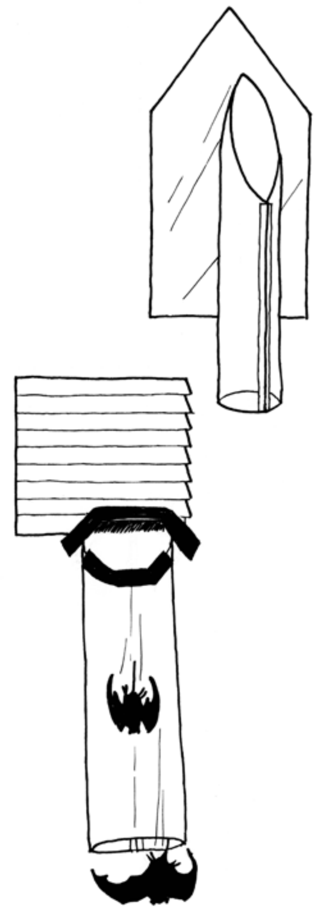


Figure 9-30. Plastic sleeve used as one-way device to exclude bats.

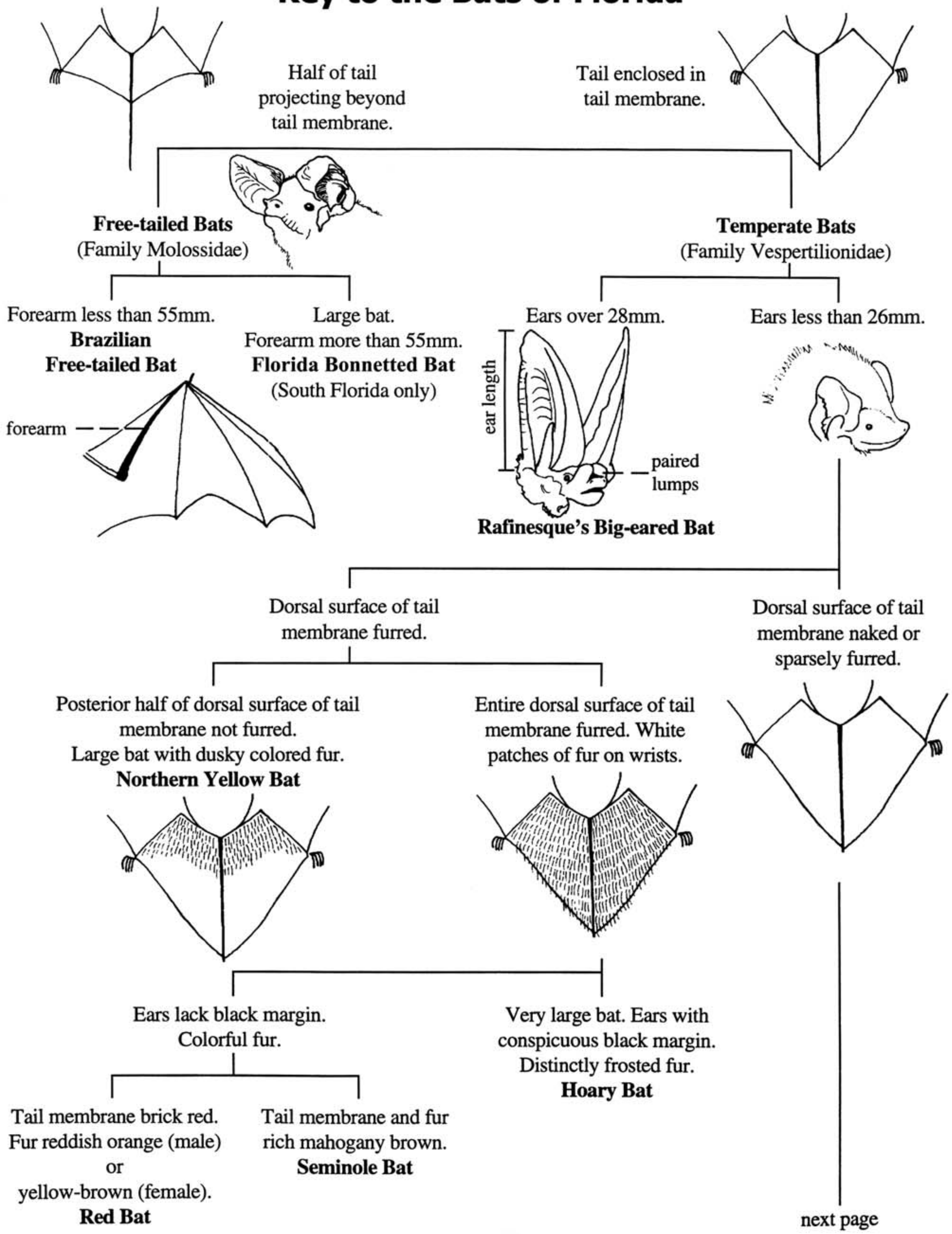
Bats and the Law. Two species in Florida (the Indiana bat and the gray bat, which generally do not occur in buildings) are classified as endangered species by the US Fish and Wildlife Service. In Florida, these and all other bats are classified as native nongame wildlife by the Florida Fish and Wildlife Conservation Commission and are protected by law. Bats may not be taken, captured, or killed unless the death is incidental to 1) the use of an exclusion device, a device which allows escape from and blocks re-entry into a roost site located within a structure at any time from August 15 to April 15, or 2) permanent repairs that prohibit the egress of bats from a roost site located within a structure, provided a one-way exclusion device is used for a minimum of four consecutive days/nights for which the low temperature is forecasted by the US National Weather Service to remain above 50°F prior to repairs and during the time period specified.

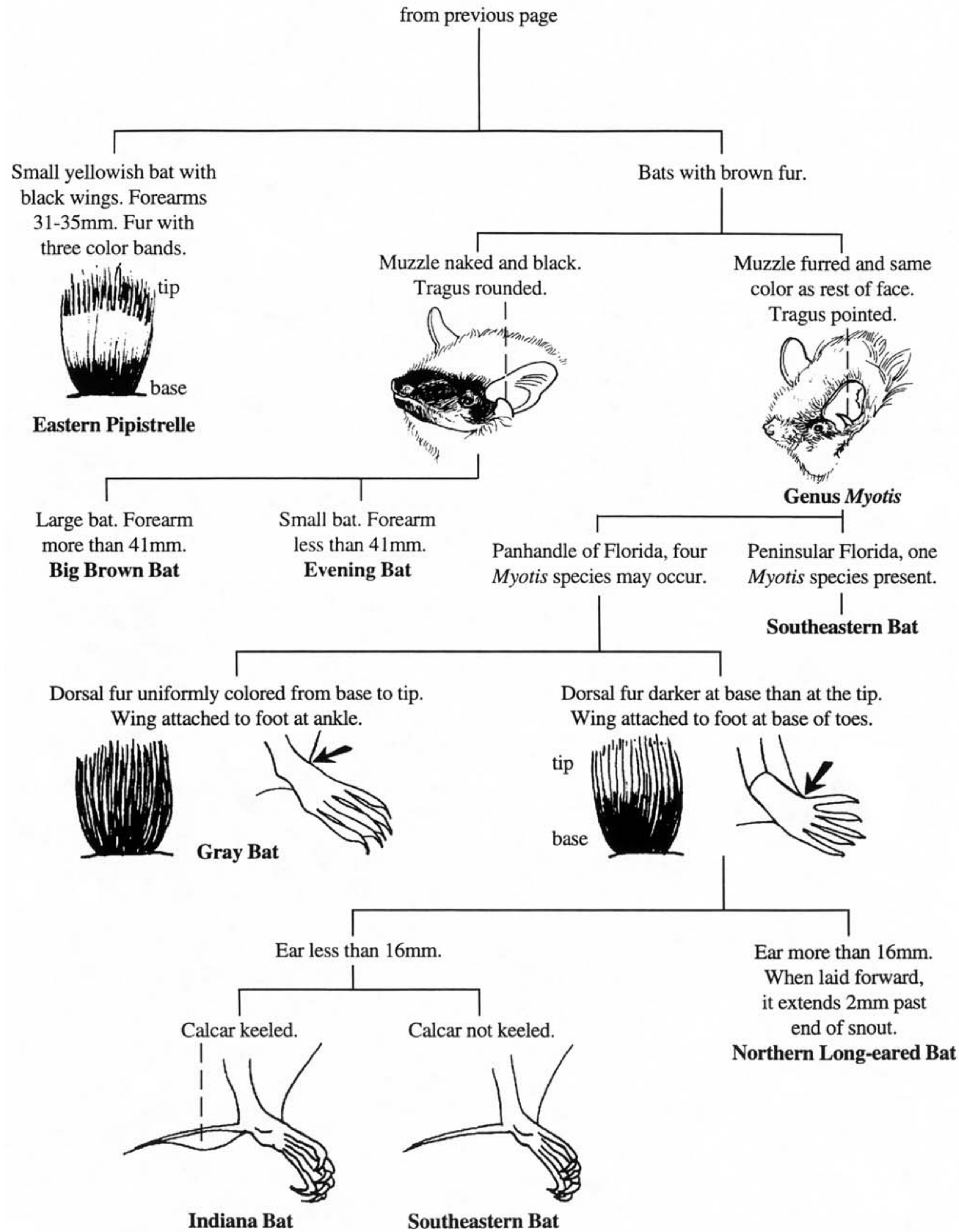
It is illegal to use bat exclusion devices or any other intentional use of a device or material at a roost site that may prevent or inhibit the free ingress and/or egress of bats from April 16 through August 14.

NO POISONS OR FUMIGANTS ARE LEGAL OR REGISTERED FOR CONTROL OF BATS IN FLORIDA. Poisoning a bat colony exposes people, especially children and pets, to large numbers of dead and dying bats, thus increasing the chance of someone being bitten by picking up a sick animal. Exclusion is the only recommended permanent solution to an unwanted bat colony in a building.

Naphthalene repellents are the only registered materials for bat control in Florida. However, use of this substance is not a permanent solution. Naph-

Key to the Bats of Florida





Original drawings by Jane Medley

thalene evaporates and as soon as this occurs, the bats will return unless roost openings have been sealed. There is also the odor and expense of placing several pounds of naphthalene in a building where people live. If people are sensitive to the odor of moth balls, avoid using naphthalene. If naphthalene is used to repel bats from a structure, a general household pest control license is required to use this material. A limited nuisance wildlife certification does not allow the use of chemical repellents.

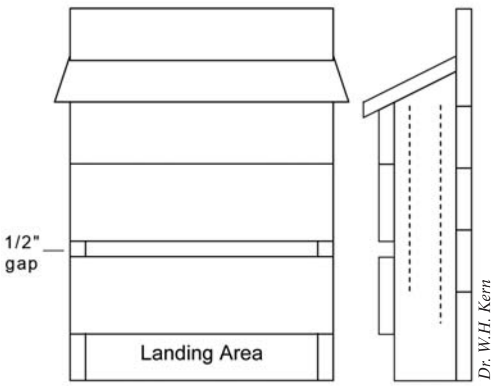


Figure 9-31. Bat house front view and left side view. See instructions below.

Bat Houses. Since bats are beneficial, many people want to keep them in the neighborhood while excluding them from a building. This may be accomplished by putting up one or more commercially available bat houses. Bat houses are similar to bird houses in size and shape. However, they lack a circular entry hole. Bats enter and exit the house from the bottom of the house, which has been left open (Figure 9-31). Bats will not leave a building to move into a bat house. But if a colony is excluded, bats may move into the closest new accommodations. A bat house should be placed high on the east or southeast side of a tree or building (10 to 15 feet from the ground), as far in advance of the exclusion as possible. There should be no branches directly below the bat house to obstruct the entry or exit of bats. Plans for a bat house are available from Bat Conservation International, PO Box 162603, Austin, Texas, 78716-2603; and the Florida Bat Conservancy, PO Box 516, Bay Pines, Florida 33744, phone: (727) 710-BATS, or (727) 710-2287, e-mail: floridabats@aol.com, website: http://www.floridabats.org/BatHouses.htm.

Instructions for Buiding a Three-Chamber Bat House Suitable for Most Florida Bats

MATERIALS

One 8-foot-long 1" × 6"	One 3-foot-long 1" × 8"
One 6-foot-long 1" × 4"	One 4' by 4' sheet of ¼" exterior plywood
Two 3-foot-long 1" × 1"	Plastic mesh or plastic widow screen

INSTRUCTIONS

Step 1. From the 1 × 6, cut six 14" sections to form the front and back panels. From the 1 × 8, cut one additional 14" section for the top panel on the back and one 16" section for the roof. From the 1 × 4, cut one 14" section for the center panel on the back. Cut a 4-foot section of the 1 × 4 in half using a 30-degree diagonal cut to make the two side pieces. From the two 1 × 1s, cut four 17" sections. These will be used to space and secure the partitions.

Step 2. The 16-inch 1 × 8 will need to be beveled to fit flush with the back of the bat house and the top front 1 × 6 will need to be beveled to fit flush with the roof.

Step 3. From the plywood sheet, cut a 16" × 12 ½" section for the front partition and a 17" × 12 ½" section for the back partition.

Step 4. Fasten the back panels to the two side pieces starting from the bottom, with the 8" board at the top. Cut and staple the plastic mesh or screen to the back wall of the bat house including the landing area and also to the front side of each of the two partitions. If window screen is used, it should be wrapped over the top and bottom.

Step 5. Assemble the partitions by fastening one pair of 17" spacers to the back wall and then adding the 17" partition. Repeat for the 16" partition. Add the front panels, spaced to provide the ½" gap. The roof should be caulked where it joins the back wall.

— Plans courtesy of the Florida Bat Conservancy

Birds

Birds are an aesthetically and ecologically valuable part of the environment. Birds are major predators of forest and agricultural insects. Millions of people in the United States derive enjoyment from watching and feeding birds each year. Because of their beauty and enjoyment value, the public wants birds protected. All native bird species are protected by state and federal law and international treaty. Some local communities have additional ordinances that protect all birds, both native and exotic species.

Problems. Birds can become nuisances when their activities conflict with human needs. The most common problem involves birds nesting in or on buildings (Figure 9-32). Their feeding, roosting, and flocking behaviors can also cause problems in specific situations. Such situations include English sparrows and starlings defecating on materials stored in a warehouse to the extent that the receiving store refuses to accept the materials; pigeons nesting, loafing, and defecating on buildings; chimney swifts nesting inside chimneys and their twittering song annoying people; and flocks of blackbirds, grackles, or ring-billed gulls living in parking lots and parks and becoming a nuisance due to the accumulation of their guano or simply due to their numbers (Table 9-6). Other problem situations include birds eating commercial fruits, such as blueberries; fish-eating birds in fish hatcheries; feral Muscovy ducks defecating on parking lots and sidewalks near ponds, lakes, and canals; and birds striking aircraft or being sucked into jet engines at airports, damaging planes and potentially causing accidents during takeoffs and landings.

Few birds regularly cause problems. Table 9-7 on pages 208 and 209 gives descriptions of those species that are most often nuisances and explains their behaviors that cause problems.

Figure 9-32. Birds can sometimes be pests in and aroung buidings because they create messes, as shown above. They can also make noise and harbor parasites that may attack people.

Exotic Nuisance Birds No State or Federal protection. Some local governments may have passed protection ordinances.	**European starling** **English or house sparrow** **Common mynah** *Monk parrots*
Feral Livestock No State or Federal protection. Some local governments may have passed protection ordinances.	**Feral rock dove (pigeon)** **Peafowl** *Feral chickens* *Feral guinea fowl* *Muscovy ducks* *Other feral domestic waterfowl*
Native Protected Migratory Birds Birds, eggs, and nests may not be taken or disturbed without Federal and State permits.	**Carolina wren** **Barn swallow** **Chimney swift** **Barn owl** **Vultures (in winter)** **Woodpeckers** **Least terns**

Structure-infesting birds *Landscape pests*

Table 9-6. Birds in Florida That Often Require Professional Management.

	SPECIES	DESCRIPTION	BEHAVIOR	DAMAGE
	**BLACKBIRDS***	Many species; 6 to 16 inches; females smaller bodied; sharp, pointed bills; plumage iridescent black; some species have brightly colored areas of red or orange on wings; female plumage brownish, often with streaked breast.	Gregarious; flock ranges from few birds to thousands; some species congregate in huge winter roosts.	Eats vegetables (lettuce, peppers, tomatoes, sweet corn), and nuts (sunflowers, almonds).
	**ENGLISH or HOUSE SPARROW**	5.75 to 6.25 inches; male has black bib and bill, white cheeks and gray cap; female is dull brown above and dingy whitish below without black bib, bill, or gray cap.	Abundant on farms, in cites and suburbs; lives in loose flocks; often nests in building eaves, vents, or other openings and cavities.	Eats emerging seedlings, fruit, buds; damages flowers, newly seeded lawns, and ripening fruit; droppings deface buildings and contaminate goods in warehouses.
	**PIGEON or ROCK DOVE**	14 to 15 inches; plump-bodied, short-billed; usually blue-gray with whitish rump and red feet, but white, brown, or other-colored plumage not uncommon.	Found in cities and suburbs; feeds on seeds, grain, fruits, insects; coos intermittently while perched; roosts in large flocks.	Deposits droppings on buildings and cars, contaminates foodstuffs; nests on buildings, may clog drain pipes; transmits disease to humans and domestic animals.
	**SCRUB JAY**	10 to 12 inches; head, wings and tail blue; underparts and back gray; white throat; no crest.	Found in scrub habitats in peninsular Florida.	An important protected species in Florida.
	**STARLING**	7.5 to 8.5 inches; short tail; long, slender, yellow bill in spring and summer, dark bill in winter; plumage black to purplish-black; heavily speckled in winter.	Abundant in city parks, suburbs, and on farms; gregarious; uses large communal roosts from late summer until spring; flies swiftly and directly; primarily a ground feeder.	Pulls small plants; damages fruit (grapes, cherries, strawberries, and others); nests in building eaves and other openings; droppings deface buildings and contaminate goods.
	**WRENS**	Small, brownish bird; holds tail vertically. Carolina wren has white stripe over the eye and a buff-colored breast. House wren is a plain, small, brown bird.	Friendly, vocal bird found in suburban and rural areas.	Tends to nest in and around buildings (garage shelves, mail boxes, etc.), especially the Carolina wren. Wrens are protected song birds.

*Includes common grackle (winter), boat-tailed grackle (summer and winter), red-winged and dusty blackbirds, and cowbird.

Table 9-7. Identification and Management of Pest Birds and Native Birds that Create Nuisance Situations. Protected birds in shaded areas.

SPECIES	DESCRIPTION	BEHAVIOR	DAMAGE
HERRING GULL	20 inches long, 55-inch wingspan. White head and tail (adult), gray wings with black tips.	Lives in coastal areas; most common full found at dumps in summer.	General nuisance; soils structures with feces.
LAUGHING GULL	13 inches long, 41 inch wingspan. Adult head black in the summer.	Named for its raucous call. Lives in coastal Florida all year.	General nuisance; congregate near buildings and harbors.
RING-BILLED GULL	16 inches long, 49 inch wingspan. White head and tail; black vertical stripe on the bill.	Spends summer months at lakes in central North America; winters in Florida and other Gulf Coast states.	Congregate in parking lots; cause nuisance at tourist attractions.
LEAST TERN	Smallish bird, about 8 inches; forked tail; light-colored body.	Normally nests on sandy beaches. Feeds on small fish. Only occurs in coastal areas.	Nests on flat-top tar and gravel roofs. Defecates on people and cars below.
DOWNY WOODPECKER/ HAIRY WOODPECKER	Downy is 5.75 inches; the hairy is 7.5 inches. Both are black and white; white back; black cap and nape of neck, black strip through the eye; white spots on black wings.	These and all woodpeckers nest in holes of their own construction. They all feed on insects that swell in dead wood.	Woodpeckers are primarily a nuisance by territorially drumming on buildings, destroying wood siding and fascia boards while looking for insects and, rarely, constructing nests in buildings.
PILEATED WOODPECKER	15 inches; black with large white patches on underside of wings. The only crested woodpecker in Florida.		
RED-BELLIED WOODPECKER	8.5 inches; horizontal black and white stripes on back and wings. Red only on back of neck and cap.	Very common in suburban neighborhoods. Occasionally pecks a series of regular holes in living trees. Like sapsuckers.	
REDHEADED WOODPECKER	7.5 inches; black and white with a red head.		
YELLOW-SHAFTED FLICKER	10.5 inches; grayish with a black chevron on breast. Yellow shafts on wing and tail feathers.	Feeds more on the ground than any of our other woodpeckers.	
RED-COCKADED WOODPECKER	7.25 inches; horizontal black and white stripes on back, white cheek patch, black nape/cap.	Found in longleaf pine woods. Nest holes recognized by a white coating of pine resin.	Endangered species; fully protected.
YELLOW-BELLIED SAPSUCKER	7.75 inches; white stripe on wing; male black and white, female mottled brown, both with yellow-tan belly.	Pecks a series of regular holes in living trees. Feeds on sap and small insects caught in sap.	May injure living trees by exposing them to boring insects.

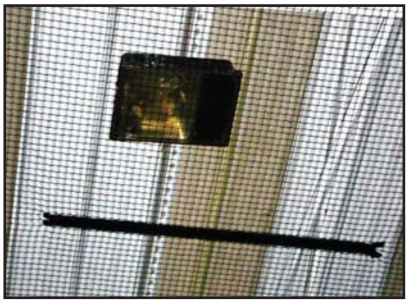


Figure 9-33. Industrial bird netting used to seal off areas from birds. The zipper secured into the netting allows access to lights and other components that may need maintenance.

Solutions. The first step in solving a bird problem is identification of the bird. This is very important because most birds are protected by law. A key to common nuisance birds is included in this publication. Other good color identification field guides to birds are available at your public library or local book store.

Determine the type and extent of the problem. If birds are nesting in buildings, how are they entering the structure? If they are roosting on ledges, which ledges and what portion of the surfaces? Where are the food and water sources that support the nuisance population?

The best solution is always exclusion (Figure 9-33). Close off openings with bird netting, screen, hardware cloth, wood, or sheet metal to eliminate entrances and nesting cavities. Special chimney caps are available to keep birds and other wildlife out of the flue. Large openings to warehouses and other buildings can be excluded using air curtains, a wall of air blown downward in front of the door, or heavy plastic strips covering the doorway. Protect fruit plants by covering them with plastic bird netting.

In some situations it is not possible to exclude the birds because the area is too large or not suited to exclusion (Figure 9-34). Porcupine wire (Nixalite®, Cat Claw®, etc.), electrified wires (Avi-Away), and tactile roost repellents (sticky substances, usually polybutenes) are often used to keep birds from nesting or loafing on ledges, pipes, and duct work. These materials will remain effective as long as they are clean and free of debris.

Flight interrupters are used to deter large birds like gulls, wading birds, and waterfowl, from large areas such as over ponds or in large open buildings. Flight interrupters are sections of fine cable or heavy monofilament line strung to interfere with normal flight. The birds hit the lines while trying to land, take off, or fly through an area, and this make flying difficult. While some birds will avoid the area, others learn to avoid the lines. Therefore, flight interrupter lines must be moved frequently for continued effectiveness.

Frightening devices, such as propane cannons (automatic gas exploders), electronic alarms, recorded distress calls, flashing lights, pyrotechnic devices (fireworks, shellcrackers, whistle bombs, etc.), kites,

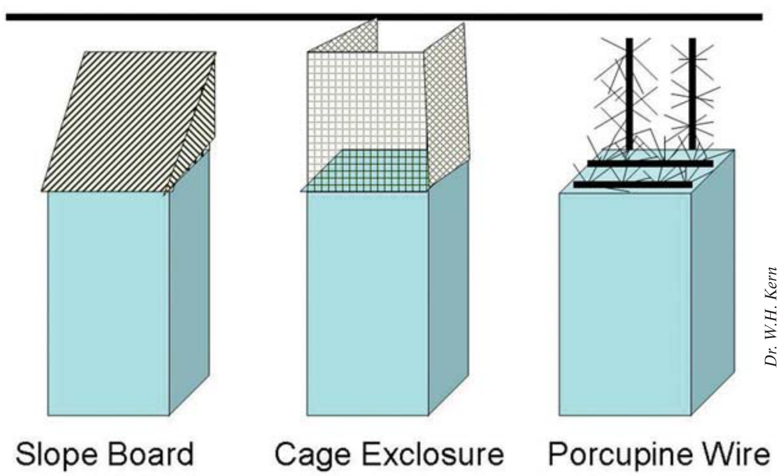


Figure 9-34. Methods of deterring perching and nesting on structures.

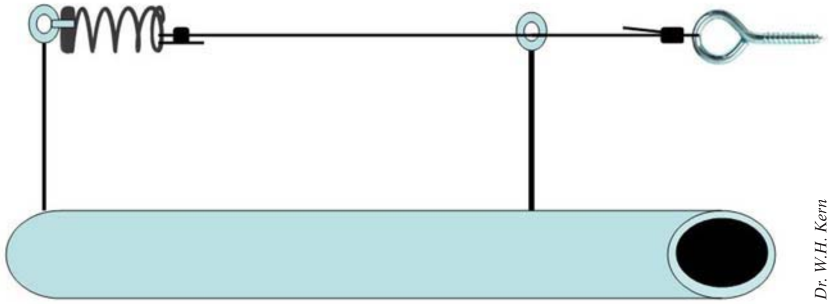


Figure 9-35. A method of safely deterring perching on handrails and overhead pipes and conduit. A monofilament line or wire is stretched over the center of the rail. This prevents the bird from centering its body on the pipe, and it must struggle to contine perching there.

balloons, artificial snakes, models of hawks or owls, etc., are of limited use because birds grow accustomed to them quickly, and noisy startle device disturb people as well as birds. These devices are better suited to agricultural situations than urban settings. The greater the unpredictability and irregularity of the sound, the more effective these devices become. There fore, use multiple devices with different timing intervals for maximum effectiveness. Ultrasonic devices have been used because they operate above the normal hearing range of human beings. Again, birds quickly get used to the sound and ignore it, and high frequency sounds bounce, creating sound shadows where the birds can escape the sound.

Figure 9-36. Pictured from top: 15 mm screamer and bird bomb launcher.

Figure 9-37. Pyrotechnic devices like 15 mm screamers, bird bomb launchers, and 12-gauge shellcrackers are useful flock-harassing tools. Always wear eye and hearing protection and gloves to protect your hands from the rocket exhaust when using the 15 mm launchers.

Figure 9-38. Under some circumstances, crows and some other birds may be taken by a property owner without a permit.

Figure 9-39. Gulls, pigeons, and sparrows are just three of the bird species that may become a nuisance in areas where humans live, work or play.

A variety of bird live traps are manufactured for English sparrows, starlings, and pigeons. Two types of entrances are used: funnel-type and bob-type. The funnel type traps work using the same concept as a minnow trap: It is easy for them to find their way in, but difficult to find their way out. The bob type trap uses vertically hanging rods, called bobs, that can be easily pushed in to let the bird into the trap, but cannot be pushed out. Prebaiting is important for the success of either type of trap. Funnel trap locations are baited for several days prior to setting out the trap. Prebaiting of bob type traps involves securing the bobs out of the way and placing bait inside the trap for up to a week prior to setting the trap by releasing the bobs. Some birds, especially cavity nesting birds like English sparrows and starlings, can learn how to escape from funnel traps. These educated birds frequently enter traps to feed, then exit them as easily as a person goes out their front door. Live traps will never remove all nuisance birds if used alone.

Chemosterilants are chemical agents that temporarily sterilize nuisance birds. Azacosterol, the active ingredient in Ornitrol®, interfered with cholesterol production, essential for the production of viable eggs. Ornitrol was withdrawn from the market in the fall of 1993. Currently, only OvoControl P® for pigeons and OvoControl G® for ducks and geese are the only chemosterilants registered in Florida and most other states, but not US territories. OvoControl contains the active ingredient nicarbazin, which interferes with the hatchability of eggs produced by birds that regularly feed on this bait. It is a Restricted Use Pesticide due to the reproductive risk to all birds, but is essentially nontoxic to the adult birds.

Avicides are bird poisons. The only avicide currently registered for use in Florida is 4-aminopyridine, Avitrol®. This material is toxic to all vertebrates and has fairly rapid knockdown when used on birds. Poisoned birds often give distress calls, which scare other members of the nuisance flock away, thus limiting the number of nuisance birds that are killed while relieving the nuisance situation. Pigeons do not produce these distress calls, and this material should be considered strictly as an avicide in pigeon control.

The Law. English or house sparrows (*Passer domesticus*), starlings (*Sturnus vulgaris*), rock doves or domestic pigeons (*Columba livia*), and the Muscovy duck (*Cairina moschata*) are unprotected exotic birds. They may be shot, live trapped, snared, or captured by hand without a permit or license. Local ordinances usually prohibit the discharge of firearms and may protect all species of birds from being killed or harassed. Check your local ordinances. The use of the avicide Avitrol is currently only allowed for pigeon control and requires a Florida Avitrol Permit. This permit is available from the Division of Wildlife, Florida Fish and Wildlife Conservation Commission (FF&WCC), 620 South Meridian Street, Tallahassee, FL 32399-1600, phone (850) 488-4676, or online at http://myfwc.com. Care must be taken to prevent accidental poisoning of nontarget native birds, all of which are protected.

The red-winged blackbird (*Agelaius phoeniceus*), rusty and Brewer's blackbirds (*Euphagus* spp.), grackles (*Quiscalus* spp.), brown-headed cowbirds (*Molothrus ater*), and crows (*Corvus* spp.) may be taken by a property owner without a permit when they are in the act of damaging or about to damage ornamental trees, agricultural crops, wildlife, livestock, or are concentrated so as to be a threat to human health (Figure 9-38). These birds are protected when not causing damage. When crows are not causing damage, they may only be taken during the legal crow hunting seasons, at which time a hunting license is required. If pest control operators or others are hired by a property owner to remove these bird species that are causing a nuisance, they must have either a pest control operator's license or a limited nuisance wildlife management certification.

All other species of birds are protected under the Migratory Bird Treaty Act, 16 USC 703-711. These protected birds include all other species of wild birds not previously mentioned. When protected birds become a nuisance, permits from the FF&WCC and United States Fish and Wildlife Service are required prior to taking or attempting to take these birds or their nests. Situations that fall in this category include the following: chimney swifts nesting inside chimneys, barn swallows nesting inside buildings, Carolina wrens nesting inside buildings and mailboxes, woodpeckers pecking on or nesting in buildings, vultures roosting on buildings, least terns nesting on roofs, and gulls flocking around garbage dumps, airports, warehouses, and parking lots. For advice or recommendations on dealing with nuisance migratory birds contact USDA-APHIS, Wildlife Services, 2820 East University Avenue, Gainesville, Florida 32601, phone (352) 377-5556.

Birds and Public Health. Birds may act as hosts for ectoparasites that can also attack people. These ectoparasites include bedbugs, soft ticks, mites, and some species of fleas, such as the sticktight flea. Lice are very species specific, and bird lice will not live on humans or mammalian pets. Ectoparasites that leave birds or bird nests must be treated with a product labeled for these pests; see appropriate sections in this manual.

The accumulation of bird droppings may provide a medium for the growth of fungi harmful to human health. The fungus *Cryptococcus neoformans* (Figure 9-40) grows in pigeon droppings, and the yeastlike cells that can infect people are inhaled with the dust when they are disturbed.

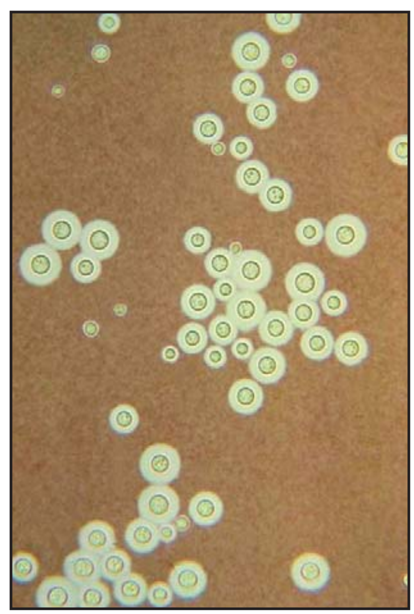
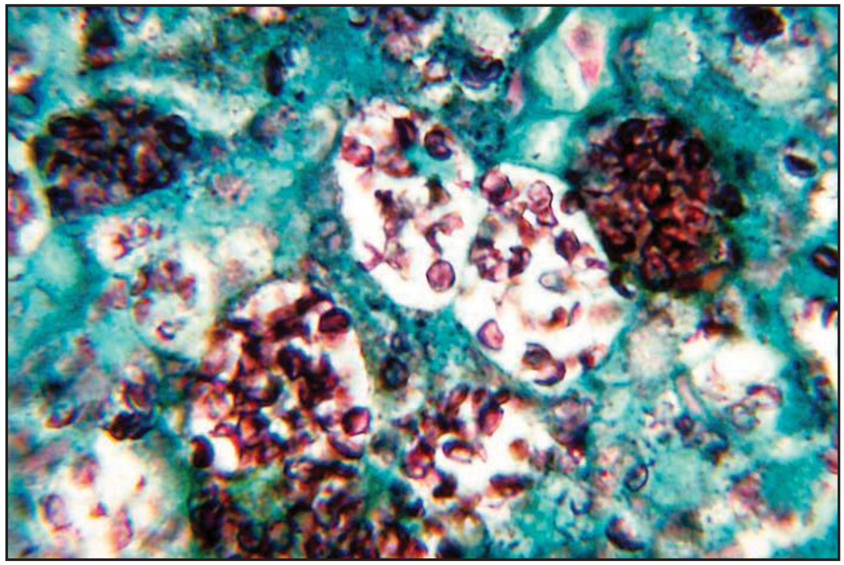


Figure 9-40. The fungus *Cryptococcus neoformans.*



CDC / Dr. Libero Ajello

Figure 9-41. The fungus *Histoplasma capsulatum*. Wear adequate protection when cleaning up bird guano to avoid a fungal infection.

Cryptococcal infections may result in respiratory symptoms or no symptoms at all. Most cases go undiagnosed because no serious complications develop. However, if cryptococcal meningitis (an inflammation of the membranes covering the brain) develops, it can be fatal if not diagnosed and treated. Prior to cleaning up pigeon roosts, the guano or accumulated feces should be sprayed with an alkaline disinfecting solution. *Cryptococcus neoformans* is sensitive to alkali, so disinfecting solutions should contain sodium hydroxide (lye) or ammonium hydroxide (ammonia).

The fungus *Histoplasma capsulatum* (Figure 9-41) is often associated with guano-enriched soil under bird roosts that are three or more years old. Although the fungus grows well in guano, it does not produce the infectious spores under the acid conditions found in fresh guano. Fresh guano contains large amounts of uric acid, the white "urine" in bird feces. The soil under roost trees used annually by flocks of breeding or migrating birds are the most common sources of *Histoplasma* spores. This fungus is uncommon in pigeon roosts. Histoplasmosis usually produces no symptoms or only mild flulike respiratory symptoms. Once infected, most people are immune from further histoplasmosis infections. People with weak immune systems may develop pneumonia with lung damage, blindness, or systemic involvement of the spleen and other organs. Droppings can only be decontaminated with a formalin solution, but the formaldehyde fumes are a greater health risk than the possibility of histoplasmosis, and its use is not recommended unless absolutely necessary.

When cleaning up bird guano, workers should wear a high-efficiency particulate air (HEPA) filter that removes particles as small as 0.3 microns, or supplied air respirator with full faceplate, disposable coveralls, rubber gloves, boots, and hat for adequate protection.

Figure 9-42. The tropical fowl mite, shown, and other bird ectoparasites often enter homes looking for a blood meal after the baby birds fledge from the nest in attics and soffits. These bites are extremely irritating, but these parasites cannot reproduce on humans or our pets.

Study Questions | Chapter 9

1. A roof rat can compress its body and squeeze through an opening as small as ________________.

   A. ¼ inch diameter
   B. ½ inch diameter
   C. 1 inch diameter
   D. 2 inches diameter

2. Rats are a major carrier of rabies.

   A. True
   B. False

3. Mice commonly travel a distance of __________________ from their nest looking for food and water and patrolling their territory.

   A. 10 to 30 feet
   B. 100 to 150 feet
   C. 1 to 2 miles
   D. None of the above

4. When applying rodenticides, they should be placed __________.

   A. in locations not accessible to children, pets, wildlife, and domestic animals
   B. in tamper-proof bait boxes
   C. only outdoors
   D. all of the above
   E. 'A' or 'B'

5. Roof rats prefer to live under debris and in burrows; Norway rats prefer to live high in trees and attics.

   A. True
   B. False

6. The house mouse can be responsible for transmitting which disease?

   A. Musculitis
   B. Measles
   C. Chicken pox
   D. Salmonellosis

7. When mice infest food, the greatest loss is not what mice eat, but what is thrown out because of contamination.

   A. True
   B. False

8. Mouse control is difficult because ________________.

A. they can squeeze through openings slightly larger than ¼ inch
B. there can be many nests in an infested building
C. they have a very high reproductive potential
D. all of the above

9. The key difference in baiting mice in contrast to rats is ________________.

A. you need to apply many small bait placements
B. you must use water baits
C. you need to wait weeks for mice to stop avoiding the "new" bait
D. baits are not effective against mice

10. Mouse traps should be placed ________________.

A. about 6 inches away from a wall
B. every 30 feet
C. along walls, behind objects, and in dark corners
D. in the center of infested rooms

11. Which of the following is true about bats?

A. They are usually beneficial to the environment.
B. Most feed on animal blood.
C. Most feed on insects.
D. 'A' and 'C'

12. Exclusion is the recommended method of bat control because ________________.

A. no poisons are registered for bat control
B. it avoids the odor and insect problems caused by dead bats
C. it reduces human and pet exposure to dying bats
D. all of the above

13. It is illegal to release live trapped raccoons or foxes on state lands.

A. True
B. False

14. Which of the following birds is not exotic and, therefore, is protected by state and federal law?

A. House sparrow
B. Chimney swift
C. Starling
D. Muscovy duck

15. The little bird making a nest in your garage holds its tail straight up in the air. It is ________________.

A. a house sparrow
B. a wren
C. an English sparrow
D. a starling

For answers refer to Appendix A.

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Glossary

A

abiotic • Nonliving factors, such as wind, water, temperature, or soil type or texture.

absorb • To soak up or take in a liquid or powder.

absorption • The movement of a chemical into plants, animals (including humans) and microorganisms.

acaricide • A pesticide used to control mites.

accumulate • To increase in quantity within an area, such as the soil or tissues of a plant or animal.

active ingredient (a.i.) • The material in the pesticide formulation that actually destroys the target pest or performs the desired function.

acute toxicity • The capacity of a pesticide to cause injury within 24 hours following exposure. LD_{50} and LC_{50} are common indicators of the degree of acute toxicity. (See also chronic toxicity.)

adjuvant • A substance added to a pesticide to improve its effectiveness or safety; same as additive. Examples: penetrants, spreader-stickers, and wetting agents.

adsorb • To take up and hold on surface.

adsorption • The process by which chemicals are held or bound to a surface by physical or chemical attraction. Clay and high organic soils tend to adsorb pesticides.

aerosol • Very fine liquid droplets or dust particles often emitted from a pressurized can or aerosol-generating device.

agitator • A mechanical or hydraulic device that stirs the liquid in a spray tank to prevent the mixture from separating or settling.

anti-siphoning device • A device attached to the filling hose that prevents backflow or backsiphoning from a spray tank into a water source.

antibiotic • A substance produced by a living organism, such as a fungus, that is toxic to other types of living organisms; sometimes used as a pesticide.

anticoagulant • A type of rodenticide that causes death by preventing normal blood clotting.

antidote • A treatment used to counteract the effects of pesticide poisoning or some other poison in the body.

arachnid • A wingless arthropod with two body regions and four pairs of jointed legs. Spiders, ticks and mites are in the class Arachnida.

arthropod • An animal having jointed appendages and an external skeleton, such as an insect, a spider, mite, crab, or centipede.

attractant • A substance that attracts a specific species of animal. When manufactured to attract pests to traps or poisoned bait, attractants are considered pesticides.

attractant trap • A device used to monitor pests and pest activity. These usually contain a pheromone or food substance that attracts the pests and a sticky surface or some other method to trap the pest.

avicide • A pesticide used to control pest birds.

B

bacterium (plural: **bacteria**) • A unicellular, microscopic, plantlike organism that lives in soil, water, organic matter, or the bodies of plants and animals. Some bacteria cause plant or animal diseases.

bactericide • Chemical used to control bacteria.

bait • A food or foodlike substance that is used to attract and often poison pest animals.

band application • Application of a pesticide in a strip alongside or around a structure, a portion of a structure or any object.

barrier application • See band application.

beneficial insect • An insect that is useful or helpful to humans. Usually insect parasites, predators, pollinators, etc.

biochemical • Pertaining to a chemical reaction that takes place within the cells or tissues of living organisms.

biological control • The action of parasites, predators, pathogens or competitors in maintaining another organism's density at a lower average than would occur in their absence. Biological control may occur naturally in the field or be the result of human manipulation or introduction of biological control agents.

biomagnification • The process where one organism accumulates chemical residues in higher concentrations from organisms it consumes.

biotic • Pertaining to living organisms, such as the influences living organisms have on pest populations.

blacklight trap • A monitoring or control device for certain flying insects; insects are attracted to the ultraviolet light source built into the trap.

botanical pesticide • A pesticide produced from chemicals found in plants, such as nicotine, pyrethrins, rotenone and strychnine.

brand name • The name, or designation of a specific pesticide product or device made by a manufacturer or formulator; marketing name.

broad-spectrum pesticide • A pesticide that is capable of controlling many different species or types of pests.

buffer area • A part of a pest-infested area that is not treated with a pesticide to protect adjoining areas from pesticide hazards.

C

calibration • Measurement of the output of pesticide-application equipment so that the proper amount of pesticide can be applied to a given area.

carbamates (N-Methyl Carbamates) • A group of pesticides containing nitrogen, formulated as insecticides, fungicides and herbicides. The N-Methyl Carbamates are insecticides and inhibit cholinesterase in animals.

carcinogenic • Cancer producing.

carrier • The liquid or powdered inert substance that is combined with the active ingredient in a pesticide formulation. May also apply to the water or oil that a pesticide is mixed with before application.

carrying capacity • The capacity a certain defined area has for supporting a population of pests; factors influencing a carrying capacity include food, water, temperature, light, humidity, and shelter or hiding places.

certified applicators • Individuals who are certified to use or supervise the use of any restricted-use pesticide covered by their certification.

chemical name • The scientific name of the active ingredient(s) found in the formulated product. This complex name is derived from the chemical structure of the active ingredient.

chemical control • Pesticide application to kill pests.

chemosterilant • A chemical compound capable of preventing animal reproduction.

CHEMTREC • Chemical Transportation Emergency Center; center has a toll-free number that provides 24-hour information for chemical emergencies such as a spill, leak, fire, or accident. (800) 262-8200.

chlorinated hydrocarbon • A pesticide containing chlorine, carbon and hydrogen of which many are persistent in the environment. Examples: chlordane, DDT, methoxychlor.

cholinesterase, acetylcholinesterase • An enzyme in animals that helps regulate nerve impulses. This enzyme is depressed by N-Methyl carbamate and organophosphate pesticides.

chronic • Pertaining to long duration or frequent recurrence.

chronic onset • Symptoms of pesticide poisoning that occur days, weeks, or months after the actual exposure.

chronic toxicity • The ability of a material to cause injury or illness (beyond 24 hours following exposure) from repeated, prolonged exposure to small amounts. (See also acute toxicity).

commercial applicator • A certified applicator who, for compensation, uses or supervises the use of any pesticide classified for restricted use for any purpose or on any property other than that producing an agricultural commodity.

common name • The recognized, nonscientific name given to plants or animals. The Weed Science Society of America and the Entomological Society of America publish lists of recognized common names. Many pesticides also have common names.

community • The different populations of animal species (or plants) that exist together in an ecosystem (See also population and ecosystem).

compatible • The condition in which two or more pesticides mix without unsatisfactory chemical or physical changes.

competent • Individuals properly qualified to perform functions associated with pesticide application. Degree of competency (capability) required is directly related to the nature of the activity and the associated responsibility.

concentration • Refers to the amount of active ingredient in a give volume or weight of formulated product.

confined area • Enclosed spaces such as attics, crawl spaces, closed rooms, warehouses, greenhouses, holds of ships and other areas that may be treated with pesticides.

contact poison • A pesticide that provides control when target pests come in physical contact with it.

contamination • The presence of an unwanted substance (sometimes pesticides) in or on a plant, animal, soil, water, air or structure.

coverage • The degree to which a pesticide is distributed over a target surface.

cultural control • Pest control method that includes changing human habits, e.g. sanitation, work practices, cleaning and garbage pick-up schedules, etc.

D

danger • Signal word used on labels of pesticides in toxicity Category I - those pesticides with an oral LD_{50} less than 50 or a dermal LD_{50} less than 200 or those having specific, serious health or environmental hazards.

deactivation • The process by which the toxic action of a pesticide is reduced or eliminated by impurities in the spray tank, water being used for mixing, or biotic or abiotic factors in the environment.

decontaminate • To remove or break down a pesticidal chemical from a surface or substance.

degradation • The breakdown of a pesticide into an inactive or less active form. Environmental conditions, impurities, or microorganisms can contribute to the pesticide degradation.

deposition • The placement of pesticides on target surfaces.

dermal • Pertaining to the skin. One of the major ways pesticides can enter the body to possibly cause poisoning.

desiccant • A pesticide that destroys target pests by causing them to lose body moisture.

detoxify • To render a pesticide's active ingredient or other poisonous chemical harmless.

diagnosis • The positive identification of a problem and its cause.

diluent • Any liquid or solid material used to dilute or weaken a concentrated pesticide.

disease • A condition, caused by biotic or abiotic factors, that impairs some or all of the normal functions of a living organism.

disinfectant • A chemical or other agent that kills or inactivates disease-producing microorganisms. Chemicals used to clean or surface-sterilize inanimate objects.

dissolve • To pass into solution.

dose • The measured quantity of a pesticide. Often the size of the dose determines the degree of effectiveness, or, in the case of poisoning of nontarget organisms, the degree of injury.

drift • The movement of pesticide dust, spray or vapor away from the application site.

dust • Finely ground pesticide particles, sometimes combined with inert materials. Dusts are applied without mixing with water or other liquid.

E

economic damage • Damage caused by pests to plants, animals, or other items resulting in loss of income or a reduction of value.

economic threshold • The point at which the value of the damage caused by a pest exceeds the cost of controlling the pest; therefore, it becomes practical to use the control method.

ecosystem • The pest management unit. It includes a community (of populations) with the necessary physical (harborage, moisture, temperature) and biotic (food, hosts) supporting factors that allow a pest infestation to persist.

efficacy • The ability of a pesticide to produce a desired effect on a target organism.

emulsifiable concentrate • A pesticide formulation consisting of a petroleum-based liquid and emulsifiers that enable it to be mixed with water for application.

emulsifying agent (emulsifier) • A chemical that aids in the suspension of one liquid in another that normally would not mix together.

emulsion • A mixture of two liquids which are not soluble in one another. One is suspended as very small droplets in the other with the aid of an emulsifying agent.

encapsulated formulation • A pesticide formulation with the active ingredient enclosed in capsules of polyvinyl or other materials; principally used for slow release. The enclosed active ingredient moves out to the capsule surface as pesticide on the surface is removed (volatilizes, rubs off, etc.).

endangered species • Rare or unusual living organisms whose existence is threatened by people's activities, including the use of some types of pesticides.

entry interval • See re-entry interval.

environment • All of the living organisms and nonliving features of a defined area.

Environmental Protection Agency (EPA) • The federal agency responsible for regulating pesticide use in the United States.

EPA establishment number • A number assigned to each pesticide-production plant by EPA. The number indicates the plant at which the pesticide product was produced and must appear on all labels of that product.

EPA registration number • An identification number assigned to a pesticide product when the product is registered by EPA for use. The number must appear on all labels for particular product.

eradication • The pest-management strategy that attempts to eliminate all members of a pest species from a defined area.

evaporate • The process of a liquid turning into a gas or vapor.

exclusion • Pest management technique that uses physical or chemical barriers to prevent certain pests from getting into a defined area.

exposure • Coming in contact with a pesticide.

F

FIFRA • Federal Insecticide, Fungicide, and Rodenticide Act; a federal law and its amendments that control pesticide registration and use.

flowable • A pesticide formulation of finely ground particles of insoluble active ingredient suspended in a petroleum-based liquid combined with emulsifiers; flowables are mixed with water for final application.

flypaper • Strips of paper coated with a sticky substance and sometimes a pheromone attractant hung in areas inside buildings where flies are a problem. Flies become entangled in the sticky substance.

fog • A spray of very small pesticide-laden droplets that remain suspended in the air.

formulation • A mixture of active ingredients combined during manufacture with inert materials. Inert materials are added to improve the mixing and handling qualities of a pesticide.

fumigant • Vapor or gas form of a pesticide used to penetrate porous surfaces for control of soil-dwelling pests or pests in enclosed areas or storage.

fungicide • A pesticide used for control of fungi.

fungus (plural: **fungi**) • A group of small, often microscopic, organisms in the plant kingdom which cause rot, mold and disease. Fungi need moisture or a damp environment (wood rots require at least 19 percent moisture). Fungi are extremely important in the diet of many insects.

G

general use (unclassified) pesticide • A pesticide which can be purchased and used by the general public. (see also restricted-use pesticide).

glue board • A small cardboard sheet or boxlike apparatus having one or more surfaces coated with a thick, sticky paste. This is placed on surfaces to capture pest insects or small rodents.

granule • A dry formulation of pesticide active ingredient and inert materials compressed into small, pebblelike shapes.

groundwater • Fresh water trapped in aquifers beneath the surface of the soil; one of the primary sources of water for drinking, irrigation, and manufacturing.

H

habitat • The place where plants or animals live and grow.

habitat modification • A pest management practice that involves modifying certain physical aspects of a building or structure to make it less suitable for pests to live.

haltere • A knoblike organ replacing the second pair of wings on flies, mosquitoes, and other insects in the order Diptera; this organ is believed to assist in balance.

hazard • See risk.

host • A plant or animal species that provides sustenance for another organism.

host resistance • The ability of a host plant or animal to ward off or resist attack by pests or to be able to tolerate damage caused by pests.

I

impregnate • An item, such as a flea collar, that has been manufactured with a certain pesticide in it; impregnates usually emit small, localized quantities of pesticide over an extended period of time.

incompatibility • A condition in which two or more pesticides are unable to mix properly or one of the materials chemically alters the other to reduce its effectiveness or produce undesirable effects on the target.

incorporate • To move a pesticide below the surface of the soil by discing, tilling or irrigation; to combine one pesticide with another.

inert dust • A finely ground clay or other powder used to control certain types of insects by desiccation.

inert ingredients • Materials in the pesticide formulation that are not the active ingredient. Some inert ingredients may be toxic or hazardous to people.

ingredient statement • The portion of the label on a pesticide container that gives the name and amount of each active ingredient and the total amount of inert ingredients in the formulation.

inhalation • The method of entry of pesticides through the nose or mouth into the lungs.

inhibit • To prevent something from happening, such as a biochemical reaction within the tissues of a plant or animal.

insect growth regulator (IGR) • A type of pesticide used for control of certain insects. IGRs disrupt the normal process of development from immature to mature life stages.

insecticide • A pesticide used for the control of insects. Some insecticides are also labeled for control of ticks, mites, spiders and other arthropods.

insects, Insecta • A class in the phylum Arthropoda characterized by a body composed of three segments and three pairs of legs.

inspection • The thorough checking of items for the presence of pests or pest eggs before bringing the items into a pest-free area.

integrated pest management (IPM) • A pest management program that uses life-history information and extensive monitoring to understand a pest and its potential for causing economic damage. Control is achieved through multiple approaches including prevention, cultural practices, pesticide applications, exclusion, natural enemies and host resistance. The goal is to achieve long-term suppression of target pests with minimal impact on nontarget organisms and the environment.

interactive effect • Interaction when two or more pesticides are mixed, producing greater or lesser toxicity to the target pests or changing the mode of action.

invertebrate • Any animal having an external skeleton or shell, such as insects, spiders, mites, worms, nematodes, and snails and slugs.

J

juvenile hormone • A hormone produced by an insect that inhibits change or molting. As long as the juvenile hormone is present the insect does not develop into an adult but remains immature.

K

knock down • An insecticide that has a rapid, although sometimes temporary, immobilizing effect on target insects; some knock-down materials have rapid killing abilities.

L

label • All printed material attached to or on a pesticide container.

labeling • The pesticide product label and other accompanying materials that contain directions that pesticide users are legally required to follow.

larva • The immature form of insects that undergo metamorphosis (plural: larvae).

LC_{50} • The lethal concentration of a pesticide in the air or body of water that will kill half of a test animal population. LC_{50} values are given in micrograms per milliliter of air or water.

LD_{50} • The lethal dose of a pesticide that will kill half of a test-animal population. LD_{50} values are given in milligrams per kilogram of test animal body weight.

leaching • The process by which some pesticides move down through the soil, usually by being dissolved in water, with the possibility of reaching groundwater.

legal threshold • A mandate to begin control of a particular pest. A legal threshold is usually based on a very low pest population and sets limits on the amount of pest damage or contamination allowed in food products offered for sale, or endangering public buildings.

lethal • Capable of causing death.

M

material safety data sheet (MSDS) • An information sheet provided by a pesticide manufacturer describing chemical qualities, hazards, safety precautions, and emergency procedures to be followed in case of a spill, fire or other emergency.

metabolism • The total chemical process that takes place in a living organism to use food and manage wastes, provide for growth and reproduction and accomplish all other life functions.

metamorphosis • The more or less sudden physical transformation undergone by insects (and some other animals) during their development; the change of an insect from larva to pupa to adult.

microbial degradation • Breakdown of a chemical by microorganisms.

microbial pesticide • Pertaining to pesticides that consist of bacteria, fungi or viruses used for control of weeds, invertebrates or (rarely) vertebrates.

microorganism • An organism of microscopic size, such as a bacterium, virus, fungus viroid or mycoplasma.

mimic • Relating to insect pheromones, the ability of a synthetic chemical to produce the same or similar effect on a target insect as a pheromone produced by that species of insect.

miticide • A pesticide used to control mites (see acaricide).

mode of action • The way a pesticide reacts with a pest organism to destroy it.

molluscicide • A chemical used to control snails and slugs.

monitoring • The process of carefully watching the activities, growth and development of pest organisms over a period of time, often using very specific procedures.

MSDS • Material safety data sheet.

multiple catch trap • A special type of live trap designed to catch mice. Traps of this type can catch several mice without having to be reset after each capture.

mutagenic • A chemical that is capable of causing deformities in living organisms.

mycelium • The vegetative body of a fungus, consisting of a mass of slender filaments called hyphae (plural: mycelia).

N

natural enemy • An organism that causes premature death of a pest organism; includes predators pathogens, parasites and competitors.

necrosis • Death of plant or animal tissues which results in the formation of discolored, sunken or necrotic (dead) areas.

nonselective • A pesticide that has an action against many species of pests rather than just a few.

nontarget organism • Animals or plants within a pesticide-treated area that are not intended to be controlled by the pesticide application.

nymph • The developmental stage of insects with gradual metamorphosis that hatches from the egg. Nymphs become adults.

O

ocular • Pertaining to the eye; one of the routes of entry of pesticides into the body.

ootheca • A capsule, constructed by female cockroaches, into which they deposit many eggs; some species carry an ootheca attached to the body, while others will deposit the ootheca in a hidden place. (plural: oothecae).

oral • Through the mouth; one entry route of pesticides into the body.

oral toxicity • The ability of a pesticide to cause injury or acute illness when taken by mouth. One of the common exposure routes.

organism • Any living thing

organophosphates • A large group of pesticides that contain the element phosphorus and inhibit cholinesterase in animals.

P

parasite • A plant or animal that derives all its nutrients from another organism. Parasites often attach themselves to their host or invade the host's tissues. Parasitism may result in injury or death of the host.

pathogen • A microorganism that causes a disease.

penetrate • To pass through a surface such as skin, protective clothing, plant cuticle, or insect cuticle. Also refers to the ability of an applied spray to pass through dense foliage.

persistent pesticide • A pesticide that remains active in the environment for long periods of time because it is not easily broken down by microorganisms or environmental factors.

personal protective equipment • Devices and clothing intended to protect a person from exposure to pesticides. Includes such items as long-sleeved shirts, long trousers, coveralls, suitable hats, gloves, shoes, respirators, and other safety items as needed.

pest • An undesirable organism: (1) any insect, rodent, nematode, fungus, weed, or (2) any other form of terrestrial or aquatic plant or animal life or virus, bacteria or other micro-organism (except viruses, bacteria, or other micro-organisms on or in living man or other living animals) which the administrator declares to be a pest under FIFRA, Section 25(c)(1).

pesticide • Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any insects, rodents, nematodes, fungi, or weeds, or any other forms of life declared to be pests; and any other substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

pesticide formulation • The pesticide as it comes from its original container, consisting of the active ingredient blended with inert materials.

pesticide resistance • Genetic qualities of a pest population that enable individuals to resist the effects of certain types of pesticides that are toxic to other members of that species.

pH • A measure of the acidity/alkalinity of a liquid: acid below pH7; basic or alkaline above pH7 (up to 144). A pH of 7 is neutral.

pheromone • A chemical produced by an animal to attract other animals of the same species.

photodegradation • Breakdown of chemicals by the action of light (photolysis).

physical control • Habitat alteration or changing the infested physical structure; e.g., caulking holes, cracks, tightening around doors, windows, moisture reduction, ventilation, etc.

physiological • Pertaining to the functions and activities of living tissues.

phytotoxicity • Injury to plants caused by a chemical or other agent.

point of runoff • The point at which a spray starts to run or drip from the surface to which it is applied.

Poison Control Center • A local agency, generally a hospital, which has current information as to the proper first aid techniques and antidotes for poisoning emergencies. Centers are listed in telephone directories.

population • Individuals of the same species. The populations in an area make up a community (see ecosystem).

potency • Pertaining to the toxicity of a pesticide.

powder • A finely ground dust containing active ingredient and inert materials. This powder is mixed with water before application as a liquid spray.

prebaiting • Placing nontoxic bait in a trap to overcome bait or trap shyness on the part of the target pest; once the target pest becomes used to feeding from the trap, the nontoxic bait is replaced with toxic bait.

precipitate • A solid substance that forms in a liquid and settles to the bottom of a container. A material that no longer remains in suspension.

predator • An animal that attacks, kills, and feeds on other animals. Examples of predaceous animals are hawks, owls, snakes and many insects.

prepupa • The resting life stage between larval and adult forms in insects having complete metamorphosis.

professional • One who is able to make judgments based on training, experience and an available data base.

propellant • The inert ingredient in pressurized products that forces the active ingredient from the container.

pupa (plural: **pupae**) • The developmental stage of insects with complete metamorphosis where major changes from the larval to the adult form occur.

pyrethrins • The active ingredients of pyrethrum insecticides.

pyrethroid • A synthetic pesticide that mimics pyrethrin, a botanical pesticide derived from certain species of chrysanthemum flowers.

R

rate • The quantity or volume of liquid spray, dust or granules applied to an area over a specified period of time.

re-entry interval • The length of time following a pesticide application when entry into the treated area is restricted.

registered pesticides • Pesticide products which have been registered by the Environmental Protection Agency for the uses listed on the label.

repellent • A pesticide used to keep target pests away from a treated area by saturating the area with an odor that is disagreeable to the pest.

residual pesticides • A pesticide that continues to remain effective on a treated surface or area for an extended period following application.

residue • Traces of pesticide that remain on treated surfaces after a period of time.

restricted-use pesticide • A pesticide that can only be used by or under the supervision of a licensed or certified pesticide applicator.

resistance • See pesticide resistance or host resistance.

risk • A probability that a given pesticide will have an adverse effect on man or the environment in a given situation.

rodenticide • A pesticide used for control of rats, mice, gophers, squirrels and other rodents.

runoff • The liquid spray material that drips from the foliage of treated plants or from other treated surfaces. Also, the rainwater or irrigation water that leaves an area - this water may contain trace amounts of pesticide.

S

sanitation • A pest-management practice that involves removing desirable food and habitat that could be used by and promote particular pests.

secondary pest • An organism that becomes a pest only after a natural enemy, competitor or primary pest has been eliminated through some type of pest control method.

selective pesticide • A pesticide that has a mode of action against only a single or small number of pest species.

service container • Any container designed to hold concentrated or diluted pesticide mixtures, including the sprayer tank, but not the original pesticide container.

signal word • The word "Danger," "Warning," or "Caution" appearing on a pesticide label that signifies how toxic the pesticide is and to what toxicity category it belongs.

site of action • The location within the tissues of the target organism where a pesticide acts.

soluble • A material that dissolves completely in a liquid.

soil drench • To soak or wet the ground surface with a pesticide. Large volumes of the pesticide mixture are usually needed to saturate the soil to any depth.

soluble powder • A pesticide formulation where the active ingredient and all inert ingredients completely dissolve in water to form a true solution.

solution • A liquid that contains dissolved substances, such as a soluble pesticide.

solvent • A liquid capable of dissolving certain chemicals.

sorptive dust (or powder) • A fine powder used to destroy arthropods by removing the protective wax coating that prevents water loss.

space spray • A pesticide which is applied as a fine spray or mist to a confined area.

spot treatment • A method of applying pesticides only in small, localized areas where pests congregate rather than treating a larger, general area.

spring trap • A spring-loaded trap used to capture mice and rats.

stomach poison • A pesticide that kills target animals who ingest it.

suppress • To lower the level of a pest population.

surface water • Water found in ponds, lakes, reservoirs, streams, and rivers.

suspension • Fine particles of solid material distributed evenly throughout a liquid such as water or oil.

symptom • A sign which indicates the presence of a disease or disorder.

systemic pesticide • A pesticide that is taken into the tissues of the organisms and transported to other locations where it affects pests.

T

target • Either the pest that is being controlled or surfaces within an area that the pest will contact.

technical material • The pesticide active ingredient in pure form, as it is manufactured by a chemical company. It is combined with inert ingredients or additives in formulations such as wettable powders, dusts, emulsifiable concentrates or granules.

teratogenic • A chemical that is capable of causing birth deformities.

threshold • A level of pest density. The number of pests observed, trapped, counted, etc., that can be tolerated without an economic loss or aesthetic injury. Pest thresholds in urban pest management may be site specific, for example, different numbers of cockroaches may be tolerated at different sites (e.g., hospitals and garbage rooms). A threshold may be set at zero (e.g., termites in a wooden structure, flies in an operatory).

tolerable levels of pests • The presence of pests at certain levels is tolerable in many situations. Totally eliminating pests in certain areas is sometimes not achievable without major structural alterations, excessive control measures, unacceptable disruption, unacceptable cost, etc. Pest levels that depend on pest observations vary. The tolerable level in some situations will be zero (e.g. termites). Urban pest management programs usually have lower tolerable levels of pests than agricultural programs.

tolerance • The ability to endure the effects of a pesticide or pest without exhibiting any adverse effects.

total release • A pressurized insecticide dispenser that will release its entire contents into an area once it has been triggered.

toxic • Poisonous to living organisms.

toxicant • A poisonous substance such as the active ingredient in a pesticide formulation.

toxicity • The potential a pesticide has for causing harm.

toxic tracking powder • Tracking powder that contains a poisonous material that can be absorbed through the skin or outer body covering of pests or ingested through grooming.

toxin • A naturally occurring poison produced by plants, animals or microorganisms. Examples: The poison produced by the black widow spider, the venom produced by snakes, the botulism toxin.

tracking powder • A fine powder that is dusted over a surface to detect or control certain pests such as cockroaches or rodents. For control, the inert powder is combined with a pesticide; the animal ingests this powder and becomes poisoned when it cleans itself.

U

ultraviolet • Pertaining to light having a wavelength just beyond the violet end of the visible spectrum; such light is invisible to people, hence it is known as black light.

unclassified pesticide • See general-use pesticide.

urban • A standard metropolitan area (SMA) or a town of 2,500(+) occupants.

urban pest management • Management of pest infestation that are normally problems in urban areas. Urban pest management involves reducing pest populations to tolerable numbers in and around homes, and structures, and those pests that cause health-related problems. Urban pest management may or may not focus on reducing economic injury but it always deals with health or aesthetic injuries.

use • The performance of pesticide-related activities requiring certification include: application, mixing, loading, transport, storage or handling after the manufacturing seal is broken; care and maintenance of application and handling equipment; and disposal of pesticides and their containers in accordance with label requirements. Uses not needing certification are: long-distance transport, long-term storage, and ultimate disposal.

V

vapor pressure • The property which causes a chemical to evaporate. The higher the vapor pressure, the more volatile the chemical or the easier it will evaporate.

vaporize • Able to pass from liquid into a gaseous stage readily at low temperatures.

vector • A carrier, an animal (e.g. insect, nematode, mite) that can carry and transmit a pathogen from one host to another.

vertebrate • Animal characterized by a segmented backbone or spinal column.

virus • Ultramicroscopic parasites composed of proteins. Viruses can only multiply in living tissues and cause many animal and plant diseases.

volatility • The degree to which a substance changes from a liquid or solid state to a gas at ordinary temperatures when exposed to air.

W

water-soluble concentrate • A liquid pesticide formulation that dissolves in water to form a true solution.

water table • The upper level of the water saturated zone in the ground.

wettable powder • Pesticide formulation consisting of an active ingredient that will not dissolve in water combined with a mineral clay and other inert ingredients, and ground into a fine powder.

Z

zone • The management unit, an area of potential pest infestation made up of infested sites. Zones will contain pest food, water and harborage. A kitchen-bathroom arrangement in adjoining apartments might make up a zone; a kitchen, storeroom, waiters station and loading dock at a restaurant may make up another. Zones may also be established by eliminating areas with little likelihood of infestation and treating the remainder as a zone. A zone is an ecosystem.

Index

A

acrobat ant 82. *See also ant: acrobat*
action threshold 19–20
aerosol can 46
aerosol 32–33, 44, 45, 79, 81, 102, 104, 105, 109
Africanized honey bee 129, 130
almond moth 16, 157
ambrosia beetle 16
American alligator 198
American cockroach 68. *See also cockroach: American*
American dog tick 125. *See also tick: American dog*
anaphylaxis 129–130
anaplasmosis 100
angoumois grain moth 16, 167
ant 24–27, 48, 68, 82, 114
  acrobat 82, 83
  Argentine 82, 83–84, 90
  bigheaded 84
  carpenter 24–27, 82, 84–86
  Caribbean crazy 86–87, 96
  crazy 86
  fire 82, 84, 87, 89, 90, 96
    black imported 88
    imported 87, 88–89
    little 89
    native 87
    quarantine 99
    red imported 88–89, 96
    southern 90
  ghost 82, 90, 96
  harvester 82, 90, 97
  little black 91
  odorous house 82, 91
  pavement 91, 95, 96
  pharaoh 82, 92, 96, 97
  thief 82, 92–93, 96
  velvety tree 82
ant bait 86, 93, 95, 96, 97–98, 101
ant management guidelines
  bigheaded ant 96
  Caribbean crazy ant 97–98
  fire ant 98–99
  general 94–95
  harvester ant 97
  indoor/outdoor ant 96
  pharaoh ant 96
ant mound drench 98
anthrax 106
aphid 76, 82, 83, 85, 86, 90, 91, 93, 94
applicator safety 40, 55–61
  equipment requirement 56–59
  respirator fit test 60
  fire, explosion and electrical hazard 56–58
  protective clothing 56–58
  working in confined area 59
  applying pesticide 40
Argentine ant 82. *See also ant: Argentine*
Ascaris 106
Asian cockroach 69. *See also cockroach: Asian*
Asian tiger mosquito 115
attractant
  fly 109
  insect and rodent 16–19
  pheromone 16, 27, 35, 109, 144, 158–159
Australian cockroach 68. *See also cockroach: Australian*
avicide 150, 199

B

Bacillus sphaericus 115
Bacillus thuringiensis 115, 160
backpack sprayer 44
bacteria 68, 106, 120, 149, 153
  coliform 68
  Salmonella 68, 106, 149, 150
  Staphylococcus 68
  Streptococcus 68
  Yersinia pestis 120
bagworm, plaster 171
bait box. *See bait station*
bait shyness 48, 51
bait station 35, 43, 46–51, 55, 79, 97, 109, 191–192
barklouse 161–162, 168
barn swallow 207, 213
bat house 206
bat 24–26, 198–206
  chemical control 193, 206
  confirming presence in a building 201
  exclusion 201–203
  identification 199, 204–205
  key to the bats of Florida 204–205
  legal aspect 203, 206
  removing single bat 199–203
bean weevil 156
bed bug 27, 117–120
bee 24, 26, 114, 128–131, 132, 133
  Africanized honey 129, 130
  carpenter 26
  honey 130–131, 132, 133
bee allergy problem 129–130
bee management guidelines 132–133
beetle 142–145, 154–157. *See also carpet beetle; stored product insect*
  ambrosia 16
  bean weevil 156
  black carpet 142, 144
  cigarette 156
  confused flour 155, 157
  cowpea weevil 156
  drugstore 156–157
  furniture carpet 142, 143

granary weevil 154
merchant grain 155–156
red flour 16, 24, 155
rice weevil 155–156
sawtoothed grain 154
varied carpet 142–143, 144
wood-boring 24, 27
bigheaded ant 84, 96
biting bug problem 24
bird 24–26, 48, 149–150, 207–214
chemical control 151, 212–213
exclusion 150–151, 210–211
identification 208–209
legal aspects 213
problem, solution 207, 210–213
sanitation 151
black blow fly 104, 106
black carpet beetle 142, 144
black fly 115–116
black imported fire ant 88
black rat. *See roof rat*
black widow spider 135. *See also spider: black widow*
black-legged tick 116
blackbird 207, 208, 213
bloodsucking conenose 117, 119–120
blow fly 100, 104, 106
blue bottle fly 104
booklouse 161–162, 168
boric acid 79–80
bovine mastitis 100
Brazilian free-tailed bat 199, 200
brown cockroach 73. *See also cockroach: brown*
brown dog tick 125. *See also tick: brown dog*
brown rat. *See Norway rat*
brown recluse spider 135. *See also spider: brown recluse*
brown widow spider 137
brown-headed cowbird 213
brownbanded cockroach 68 *See also cockroach: brownbanded*
bubonic plague 120
bulb applicator 33–34

C

canine heartworm 114, 123
carbamate 123
Carolina wren 207, 208, 213
carpenter ant 24–27, 82. *See also ant: carpenter*
carpenter bee 26
carpet beetle 24, 26–27, 129, 134, 135, 142
black 142, 144
furniture 142, 143
varied 142–143, 144
carpet beetle management guidelines 144–145
Caribbean crazy ant 86–87, 96
carrying capacity 20–21
casemaking clothes moth 145–146
cat flea 120–125
centipede 173–174
certificate renewal 7
certified operator 7
Chagas disease 119
characteristic of treated surface 61–62
odor problem 62
preventing application problem 62
chicken mite 166
chimney swift 201, 207, 208, 213
cholera 106
cigarette beetle 16, 156
citrus rat. *See roof rat*
clothes moth 24, 27
casemaking 145, 146
webbing 142, 145–146
cockroach 24–27, 30, 48, 68
American 68, 72–73, 75
Asian 69, 75–77
Australian 68, 74–75
brown 73
brownbanded 68, 69, 71
Florida woods 72, 75
German 68, 69–70, 71, 76, 77, 79
Oriental 68, 72
smokybrown 68, 74–75
Surinam 77
cockroach allergy problems 68
cockroach asthma problems 68
cockroach management guidelines
chemical control 79
exclusion 79
general 77
monitoring 81
outdoors 81
sanitation 78
compressed air duster 46
confused flour beetle 16, 155, 157
conjunctivitis (pink eye) 100
cowpea weevil 156
crazy ant 86
crazy ant, Caribbean 86–87, 96
cricket
field 170
house 170
crow 212, 213
cryptococcal meningitis 214

D

darkling beetle 155
DDT 145
deathwatch beetle 156
deer tick 128
DEET 116, 126
dengue 115
dessicant 47, 138, 159
detection and monitoring device 16–19
dimethoate 102
dog heartworm 114, 123
dog tick 125
drain fly. *See fly: filter*
drugstore beetle 16, 156–157
Dursban 42
dust 28, 33, 46
duster 33–35
dysentery 68, 106

E

earwig 171–172
eastern mole 194, 195
economic threshold 20
electric light trap 101, 109
elephantiasis 115
encephalitis 115
endrin 145
enforcement of pest control regulations 4–6
English sparrow 196, 207, 212
envenomation 129
environmental hazard 3, 38, 41, 63

pesticide drift 54, 61
equipment 28–35
aerosol and fog generators 32–33
bellows 33–34
bulb 33–34
calibration 31
cold fogger 32
duster, hand 33–34
duster, power 34–35
duster, puff 46
hand-held compressed air sprayer 29–30
plunger 33–34
power sprayer 30
thermal fogger 32
equipment maintenance 28–31
eye gnat 100

F

field cricket 170
filter fly 103
filth-breeding flies 102–109
fire ant 82. *See also ant, fire*
firebrat 24, 27, 149, 168–169
flea 24, 27, 114, 120–125
cat 120–125
human 120
northern rat 120
Oriental rat 120
sticktight 120
flea allergy problem 120
flea control product 124–125
dip 124
flea collar 125
powder, dust 124
repellent 124
soap, shampoo 124
spot-on treatment 125
spray-on liquid 124–125
systemic 125
flea life cycle 120
flea management guidelines 121–125
chemical control 122
sanitation 122–123
flesh fly 105–106
floor mite 167–168
Florida woods cockroach 72. *See also cockroach: Florida woods*
flour beetle 24
fly 24, 27, 48, 68, 99
black 115–116
black blow 104, 106
blue bottle 104
drain. See fly: filter
eye gnat 100
filter 103
flesh 105–106
fruit 16, 24, 100, 102, 103–104
fungus gnat 101
green bottle 104
house 16, 100, 104, 106–109
humpbacked 101
little house 100, 106–108
moth fly *See fly: filter*
pomace. *See fly: fruit*
secondary screwworm 104
soldier 102, 103
vinegar *See fly: fruit*
fly management guidelines
blow fly 105
eye gnat 100
filter fly 101
filth fly 101
flesh fly 106
fruit fly 103–104
fungus gnat 101
house fly 107–109
humpbacked fly 101
little house fly 107–109
flypaper 19
frogs 197, 198
fruit rat. *See roof rat*
fruit fly 16, 24, 100, 102, 103–104
fumigation 45, 145
fungi 24, 150, 153–154, 161, 162
control 154
Cryptococcus neoformans 213–214
damage 152–153
Histoplasma capsulatum 194, 203, 214
fungus gnat 101
furniture beetle 167
furniture carpet beetle 142–143

G

garden spider 135, 136
German cockroach 68. *See also cockroach: German*
ghost ant 82, 90, 96
glue board and trap 19
gopher tortoise 195
gnat
eye 100
fungus 101
grackle 207, 208, 213
grain moth 24
granary weevil 24, 155–156
granule 47
gray bat 200, 203
gray fox 196
gray squirrel 196
green bottle fly 104
gull 207, 208, 210, 212, 213

H

habitat modification 22
hand-held compressed air sprayer 45
handling pesticide 38
harvester ant 82. *See also ant: harvester*
hazardous waste 64
transportation 63–65
health and safety threshold 20
hepatitis, viral 68
heteropteran 114, 117. *See also true bug*
histoplasmosis 178, 203, 214
honey bee 130–131, 132, 133
honey bee nest removal 132
honeydew 76, 82, 83, 84, 85, 86, 88, 91, 93, 94, 95
hookworm 106
hornet 131. *See also wasps: social*
house cricket 170
house dust mite 167–168
allergy, asthma problems 167
house fly 100. *See also fly: house*
house mouse 181, 182, 194, 197
house mouse mite 167
house rat. *See Norway rat*
house sparrow. *See English sparrow*
human flea 120
humpbacked fly 101

I

identification card 5–7
imported fire ant 87, 88–89. *See also ant: fire ants*
impregnated paint, lacquer 79, 80
Indiana bat 200, 203
Indianmeal moth 16, 157
infectious hepatitis 106
insect bait 49–51
insect growth regulator 79, 97, 161
insect repellent 115–116
insecticides 42–44, 47, 77, 79, 80, 81, 93, 94, 95, 96, 97, 100, 104, 107, 109, 123, 144–145, 160–161
integrated pest management 14
intestinal pseudomyiasis 105

K

khapra beetle 16

L

least tern 207, 209, 213
legal threshold 20
leprosy 68, 105, 107
leptospirosis 178, 181
lesser grain borer 16
lice 114
light trap 18, 101–109
limited certification 10–11
listeriosis 178
little black ant 91
little brown bat 199, 200
little fire ant 89
little house fly 100. *See also fly: little house*
Lyme disease 114, 116, 125, 126, 128

M

malaria 115
Mediterranean flour moth 16
merchant grain beetle 154
midge 114
millipede 173–174
mite 114, 162, 166–168. *See also stored product mite*
  bird
    chicken mite 166
    northern fowl mite 166
    tropical fowl mite 166
  house dust mite 167–168
  insect
    straw itch mite 167
    management guidelines 167
  rodent
    house mouse mite 167
    tropical rat mite 167
mixing pesticide 30
monitoring 14, 15–19, 23, 27, 29, 35, 78, 81, 107
mosquito 114–115
  Asian tiger 115
mosquito life cycle 114
mosquito management guidelines
  Bacillus thuringiensis 115
  chemical control 115
  exclusion 115
  mosquito fish 115
  repellent 115
  sanitation 115
moth fly 103. *See also fly: filter*
moth 24, 149, 157. *See also stored product insect*
motorized spray unit 44
mouse 24–27, 48, 151–153, 181, 182, 194, 197. *See also rodent*
mud dauber wasp 134
murine typhus 120, 178
Muscovy duck 196, 197, 207, 213

N

naled 102
naphthalene 203, 206
native fire ant 87
N,N-diethyl-meta-toluamide 116. *See also DEET*
nontoxic tracking powder 16, 19, 28
northern fowl mite 166
northern rat flea 120
Norway rat 179, 180, 182, 188, 194, 196, 197
nuisance vertebrate control laws 192–198
  mammals 194
  reptiles, amphibians 198
nuisance wildlife permit 194, 198

O

odorous house ant 82, 91. *See also ant: odorous house*
opossum 196
organophosphate 123
Oriental cockroach 68. *See also cockroach: Oriental*
Oriental rat flea 120

P

paper wasp 131
pavement ant 91, 95, 96
pest acceptance threshold 20
pest control certificate 2, 7, 8, 10–11
pest control license 5–10
pest control method 14, 21
  biological control 28
  habitat modification 21–27
  exclusion 23–27
  inspection 26–27
  sanitation 14, 21–23
  pesticide 28
  trapping 16–19, 27, 35
pest control regulation 4–7
  FEPCA 4
  FIFRA 4, 7
pest exclusion material 23–27
pesticide 28, 42, 51, 76, 77, 81, 98, 128, 132, 138. *See also insecticide*
  applicator safety 40, 55–56
  bird 48
  concerns 3
  dessicant 47, 138, 159
  dust 28, 33, 46
  gas 45
  granule 47
  insect 49–50
  liquid 44–45
  pesticide drift 54, 61
  pet and domestic animal 20, 60–61
  poisoned bait 47–50
  rodent 48–49, 152–153, 188–192
  safety 2, 3, 14, 51–65
  toxic tracking powder 19, 46–47
  transporting pesticide 63–64
pesticide certification 2, 7, 8, 10–11

pesticide cross-resistance 81
pesticide disposal 41
pesticide injury
human 51–54
poisoning symptoms 52–54
human protection 54–55
those with higher risk 55
pesticide label 38, 46, 50, 51, 53, 56, 57, 63
pesticide resistance 51, 81, 109
pharaoh ant 82, 92, 96, 97
pheromone 16. *See also attractant*
pigeon 151, 196, 207, 208, 212, 213, 214
pillbug 172–173
management guidelines 173
pink eye (conjunctivitis) 100
pinworm 106
plaster bagworm 170
pomace fly. *See fly: fruit*
population size 21
praying mantid 68
protozoa 153
psocid 161–162, 168
puff duster 46

Q

quarantine 99

R

rabies 178, 196, 199, 201
raccoon 196
raisin moth 16
rat flea 179, 182
rat-bite fever 179
rat 24–27, 48, 150–153, 178–181. *See also rodent*
red flour beetle 16, 24, 155
red fox 196, 197
red imported fire ant 88–89, 96
red widow spider 137
regulatory agencies 4, 7–11
Agricultural Plant & Health Inspection Service 99, 213
Bureau of Entomology and Pest Control 6, 8–11, 18
Environmental Protection Agency 4, 7–8
Office of Pesticide Programs 5
Florida Department of Transportation 61
Florida Department of Agriculture & Consumer Services 5–6, 8, 10
Florida Fish and Wildlife Conservation Commission 47, 194, 196, 198, 213
Florida Highway Patrol 63
United States Fish and Wildlife Service 213
USDA Agricultural Marketing Service 20
residual-barrier spray 77, 81, 93, 95, 96
residual insecticide 77, 78, 79, 80, 81, 93, 95, 96, 97, 101, 102, 109, 144–145
rice weevil 155–156
Rickettsia 120
rickettsialpox 181
ring-billed gull 202, 209
rock dove. *See pigeon*
Rocky Mountain spotted fever 127
rodent bait 46–47, 185–189, 191
rodenticide 188–192
rodent 25–27, 48, 151–153, 179, 182–192
detecting, monitoring 182
exclusion 25–26, 152, 183
habitat modification 184
management guidelines 182–192
sanitation 152, 184
trapping, baiting, fumigation 152–153, 184–188
roof rat 179, 180–181, 182, 187, 188, 194, 196, 197

S

Salmonella 68, 106, 149, 178
salmonellosis 178, 181
sanitation 14, 21–23
sawtoothed grain beetle 16, 154
scale insect 82, 83, 85, 86, 90, 91, 93, 94
scorpion 114, 135
secondary screwworm fly 104
sewer rat. *See Norway rat*
shaker can 46
Shigella 68
silica gel 79, 80
silverfish 24, 27, 149, 168–169
slime mold 153
smokybrown cockroach 68. *See also cockroach: smokybrown*
snake 178, 195, 197, 198
social wasp 130, 131, 133
soldier fly 102, 103
southeastern bat 199, 200
southeastern pocket gopher 194–195
southern fire ant 90
southern flying squirrel 196
sowbug 172–173
spider 24–27, 114, 125, 128, 134, 135–138
black widow 135, 136
northern 137
southern 137
brown recluse 135, 136–137
brown widow 137
garden 135–136
Paykull's jumping 135
red widow 137
violin. *See spider: brown recluse*
spider management guidelines 138
springtail 170–171
starling 196, 197, 207, 208, 212
sticktight flea 120
stored product insect 24, 27
beetle 24, 27, 149, 154–157
black carpet 142–144
cigarette 156
confused flour 24, 155–157
drugstore 156–157
merchant grain 154
red flour 24, 155
sawtoothed grain 154
moth 24, 27
almond 157
Indianmeal 157
weevil
bean 156
cowpea 156
granary 24, 155–156
rice 155–156
stored product insect management guidelines 158–161
Bacillus thuringiensis 160
chemical control 160–161
environmental modification 160
exclusion 159

insect growth regulator 160–161
inspection, detection 158–159
monitoring 158–159
sanitation 159–160
stored product mite 149, 153, 162
stored product pest. *See stored product insect*
controlling losses 149
storing pesticide 41
straw itch mite 167
Streptococcus 68
Surinam cockroach 77

T

tapeworm 106, 120
termite 24, 26–27
thief ant 82. *See also ant: thief*
tick 24, 27, 114, 116
American dog 125, 127–128
black-legged 116
brown dog 125, 126–128
deer 128
wood 125
tick management guidelines
chemical control 128
removal 128
tick paralysis 128
tobacco moth 16
toxaphene 145
transporting pesticide 63–64
trap 16–19, 27, 35
bird 212–213
carpet beetle 144
cockroach 78–81
electric light 101,109
fly 107–109
pheromone 108
rodent 184–192
stored product insect 158–159
trichinosis 178
tropical fowl mite 166
tropical rat mite 167, 178
true bug 114, 117
bed bug 27, 117–120
bloodsucking conenose 117, 119–120
tularemia 127
turtle 197, 198
typhoid 68
typhoid fever 106

U

ULD treatment 30
ULV treatment 30, 79, 96
umbrella wasp 127

V

varied carpet beetle 142–143, 144
velvety tree ant 82
vinegar fly. *See fly: fruit*
violin spider. *See spider: brown recluse*
visual inspection 15–16, 77, 78, 81, 85

W

warehouse beetle 16
wasp 24–26, 48, 114, 128–134
social 130, 131, 133
hornet 131, 132–134
paper wasp 131
umbrella wasp 131, 134
yellowjacket wasp 131–134
solitary 130, 134
mud dauber 134
wasp allergy problem 129–130
wasp management guidelines
social wasp 133
solitary wasp 134
webbing clothes moth 142, 145–146
weevil 149, 155–156. *See also stored product insects*
wharf rat. *See Norway rat*
wheat jointworm 167
whipworm 106
widow spider 136–137
wood-boring beetle 24, 27
wood tick 125
woodlouse 172
woodpecker 200, 207, 208, 213

Y

yaws 106
yeast 153
yellow fever 114
yellow fever mosquito 114
yellowjacket wasp 131–134. *See also wasp: social*

Appendix A: Answers to Study Questions

Chapter 1: Introduction

1: C
2: A
3: The Federal Insecticide Fungicide and Rodenticide Act (FIFRA)
4: D

Chapter 2: Pest Management

1: B
2: E
3: B
4: B
5: C
6: D

Chapter 3: Using Pesticides Safely

1: A
2: D
3: A
4: B
5: A
6: B
7: D
8: A

Chapter 4: Pests On Or Near Food

1: C
2: B
3: A
4: A
5: A
6: B
7: C

8: B
9: B
10: A
11: B
12: C
13: B
14: A
15: Drosophila, or fruit flies, often have red eyes, visible veins and cross veins in their wings, and are attracted to yeast-producing materials such as overripe fruit, sour mops, etc. Phorids have a hump-backed appearance, move in jerks and have wings with four indistinctly seen veins. Phorids infest manure, garbage and other rotting materials and can infest buried refuse and emerge in buildings. Both are small.

16: House flies have dark, indistinctly striped thoraxes and gray and tan abdomens; flesh flies usually have gray thoraxes with three distinct stripes. Blow flies are solid metallic green, bronze, blue or black; cluster flies, in the same family as blow flies, have yellow or gray hairs covering the thorax.

17: Locate the breeding sites.
Find ways they are entering.
Investigate garbage pickup schedules and garbage handling procedures.
Caulk entry points.
Advocate screening entry points.
Investigate ways to use air curtains, light traps.
Apply pesticides in cracks and crevices where flies enter or hide.
Investigate the need for fly bait.
Educate workers and supervisors on fly biology and control.

18: Seek out infested materials that are producing yeast: overripe fruit and vegetables, open or broken cans of fruit and vegetables, sour mops and rags, moist pet food and bedding. Use traps baited with ripe banana to locate the main infested area. Eliminate yeast-producing materials.

Chapter 5: Parasitic, Biting, and Stinging Arthropods

1: Lyme disease and Rocky Mountain spotted fever.
2: None
3: None
4: B
5: A
6: A
7: A
8: C
9: A
10: Several species of yellowjackets make suspended aerial nests. They attach a paper comb of cells to a structure or plant limb and construct a

paper envelope around it. These combs are enlarged, and tiers are added as the colony grows. The envelope is also enlarged to accommodate growth. A common example of this yellowjacket group is the bald faced hornet. Many other species nest in the ground and start the first paper comb of cells in an existing hole; later, they add combs and enlarge the hole. Several species make nests in wall voids and attics of structures.

11: Species of Polistes, the paper wasps, attach a single paper comb of cells to a structure of plant twigs. This comb is enlarged around the edge but additional tiers are not added nor is it covered by a paper envelope.

12: Mud daubers are nonsocial wasps with fertile, single queens that gather mud and construct cells attached to structures. These females sting and paralyze spiders and place them in cells along with a wasp egg. The wasp grub hatches, eats the paralyzed spiders, pupates, and the following spring, emerges as an adult male or female. These wasps mate, and the females continue the annual cycle.

13:
(a) A division of labor by groups within the colony e.g., a queen, worker daughters, and males.
(b) Several "generations" of young are produced by the same mother, some of which enter into colony life expanding the nest and caring for the young (infertile worker daughters), while others (fertile males and females) leave the nest to mate with other reproductives. Some colonies exist only one or at most two years, e.g., yellowjackets. Others exist for many years, e.g. ants, honeybees.

14:
(a) Aerial yellowjacket: Locate aerial nest. Wearing a bee suit, apply canned pressurized pesticide to the entrance at the time of day when most wasps are in the nest. Cut the nest out of the shrub etc. and discard it when occupants are dead.
(b) Ground-nesting yellowjacket: Locate nest entrance in ground. Wearing a bee suit at the most appropriate time of day, spray or dust pesticide in entrance hole. Dust a plug of steel wool, etc. and insert it in the entrance.
(c) Yellowjacket in wall void: Locate the nest entrance in the structure. Wearing a bee suit, approach the entrance in the safest manner, inject spray from a canned pressurized pesticide and plug the entrance with pesticide dusted steel wool. Caulk up entrance after assurances that the nest is no longer active.
(d) Honeybee in wall void: Locate the colony entrance. Inspect inside the structure as well as outside. Wearing a bee suit, inject spray in the entrance using a canned pressurized pesticide, and plug the hole with pesticide-dusted steel wool. As soon as it can be ascertained that honeybees are no longer alive remove comb, dead bees, honey, etc. Do not let the comb and honey supply melt and run.

15: The female black widow has a shiny, jet black body and legs. Her globose abdomen is proportionally large with a red hour glass design on the belly. This design can be easily seen and taken as a warning since the black widow hangs upside down in her cobweb. Male black widows are small, striped and harmless.

16: The brown recluse spider *Loxosceles reclusa* has a brown cephalothorax with a dark violin-shaped design on the dorsal surface. The abdomen is a tan brown color with no distinctive markings. The brown recluse is found in houses within an arch-shaped geographical range encompassing states in the south and midwest bordered by Texas, Oklahoma, Kansas, Missouri, Iowa, Illinois, Kentucky, Tennessee and Alabama. Several other species of closely related recluse spiders are found in the southwestern deserts and one is regularly introduced from the Mediterranean area.

17: Inspect accumulations of logs, wood, bricks, construction materials as well as stacks of baskets and equipment that has not been moved for some time. Sheds and inside such things as water meters are potential nesting places. Black widows move into secluded spaces and remain if they are not disturbed. Be careful when reaching into potential black widow nesting places.

18: Inspect rooms and spaces in a home that are little used by occupants. Examples are guest rooms, furniture, little used closets, behind heavy furniture, clothes hanging from past seasons without being disturbed or worn. When spiders live outside in the southern portion of its range look in accumulations of undisturbed materials near the structure.

19: Caulk and tighten structures to keep spiders from wandering in.
Get rid of accumulations of trash near structures.
Modify lighting arrangements that attract flying insects that become spider prey.
Inspect flower arrangements brought inside.
Keep webs brushed out.
Use residual sprays or dusts in spider harborage.
Use barrier spray around buildings where spiders are an obvious and threatening problem but follow with other pest management proce-dures also.

Chapter 6: Fabric Pests

1: B
2: A
3: B
4: B
5: A

Chapter 7: Stored Product Pests

1: A
2: B
3: C
4: D

Chapter 8: Occasional Invaders

1: Millipedes are cylindrical arthropods with two pairs of legs per segment. These pests live in moist plant material and feed on plant parts and fungi in decaying leaves. Centipedes are cylindrical or long flattened arthropods with one pair of legs per body segment. Centipedes feed on very small insects. Like millipedes, they live in decaying plant material. The house centipede lives in basements of homes and buildings. They have very long legs and usually live inside rather than outside.

   Millipedes and centipedes must be excluded from buildings by tightening cracks and crevices that serve as entrances. Their breeding sites such as mulching and leaf litter should be removed from the foundations and doorways of buildings. These sites can be replaced by plastic ground cover and gravel. Barrier sprays can be used when migrations are high. Dusts, where they can be used, control house centipedes best.

2: Cricket problems are usually caused by black field crickets migrating into buildings and homes when dry weather hits or weeds and other plants on which crickets feed die or become unpalatable in late summer. Inside field crickets are disruptive because of their chirping and the fact that they will feed on soiled clothes on closet floors.

   Crickets should be excluded by caulking, weatherstripping, etc., especially around doors, ground level windows, etc. Where high populations are seen in roadside ditches or in landscaping around buildings they can be sprayed before movement starts.

   Cave crickets or camel crickets are wingless insects with long hind legs and antennae. These insects live in basements or ground level apartments and are occasionally bothersome. They can be killed with contact sprays or dusts.

3: B
4: A
5: B
6: C
7: C
8: A

Chapter 9: Vertebrate Pests

1: B
2: B
3: A
4: E
5: B
6: D
7: A
8: D
9: A
10: C
11: D
12: D
13: A
14: B
15: B

GENERAL HOUSEHOLD PEST CONTROL

This GHP Manual is full of comprehensive information about general household insect and vertebrate pests. It is an ideal study guide to prepare pest control operators for their certification exams.

Inside the GHP Manual you will learn about:

- ✔ Insect biology and life cycles
- ✔ Integrated Pest Management
- ✔ Pesticide laws
- ✔ Pesticide safety
- ✔ Pesticide handling
- ✔ Pesticide disposal

UF UNIVERSITY of FLORIDA
IFAS Extension

syngenta®

demand® CS

Insecticide

For use in, on and around buildings and structures for the control of listed pests, including on lawns, ornamental trees and shrubs around residential, institutional, public, commercial, agricultural and industrial buildings; and parks, recreational areas and athletic fields.

with iCAP technology

Active Ingredient: Lambda-cyhalothrin[1] [1α(*S**),3α(*Z*)]-(±)-cyano-(3-phenoxyphenyl)methyl-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethylcyclopropanecarboxylate	9.7%
Other Ingredients:	90.3%
Total:	100.0%

[1]*Synthetic pyrethroid, capsule suspension (microencapsulated)*

KEEP OUT OF REACH OF CHILDREN.

CAUTION/PRECAUCÍON

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

See additional precautionary statements and directions for use in booklet.

EPA Reg. No. 100-1066
EPA Est. 61282-WI-1

Product of the United Kingdom
Formulated in the USA

FIRST AID	
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Do not give **any** liquid to the person. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If Inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.

FIRST AID *(continued)*

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

HOT LINE NUMBER
For 24-Hour Medical Emergency Assistance
(Human or Animal)
Or Chemical Emergency Assistance
(Spill, Leak, Fire or Accident)
Call
1-800-888-8372

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUTION/PRECAUCÍON

Harmful if absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals. Avoid contact with skin, eyes, or clothing. Avoid breathing spray mist or vapor. Wash thoroughly with soap and water after handling, and before eating, drinking, chewing gum or using tobacco. Remove contaminated clothing and wash before reuse.

Environmental Hazards

This product is extremely toxic to fish. Do not contaminate water when cleaning equipment or disposing of equipment washwater. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Apply this product only as specified on this label. When making applications, care should be used to avoid household pets, particularly fish and reptile pets.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

Physical and Chemical Hazards

Do not use this product in or on electrical equipment due to the possibility of shock hazard.

CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

NOTICE: Read the entire Directions for Use and Conditions of Sale and Limitation of Warranty and Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

The Directions for Use of this product must be followed carefully. It is impossible to eliminate all risks inherently associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as manner of use or application, weather or crop conditions, presence of other materials or other influencing factors in the use of the product, which are beyond the control of SYNGENTA CROP PROTECTION, Inc. or Seller. To the extent permitted by applicable law, Buyer and User agree to hold SYNGENTA and Seller harmless for any claims relating to such factors.

SYNGENTA warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, when used in accordance with directions under normal use conditions. To the extent permitted by applicable law: (1) this warranty does not extend to the use of this product contrary to label instructions, or under conditions not reasonably foreseeable to or beyond the control of Seller or SYNGENTA, and (2) Buyer and User assume the risk of any such use. To the extent permitted by applicable law, SYNGENTA MAKES NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS WARRANTED BY THIS LABEL.

To the extent permitted by applicable law, in no event shall SYNGENTA be liable for any incidental, consequential or special damages resulting from the use or handling of this product. **TO THE EXTENT PERMITTED BY APPLICABLE LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE EXCLUSIVE LIABILITY OF SYNGENTA AND SELLER FOR ANY AND ALL CLAIMS, LOSSES, INJURIES OR DAMAGES (INCLUDING CLAIMS BASED ON BREACH OF WARRANTY, CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, SHALL BE THE RETURN OF THE PURCHASE PRICE OF THE PRODUCT OR, AT THE ELECTION OF SYNGENTA OR SELLER, THE REPLACEMENT OF THE PRODUCT.**

SYNGENTA and Seller offer this product, and Buyer and User accept it, subject to the foregoing Conditions of Sale and Limitation of Warranty and of Liability, which may not be modified except by written agreement signed by a duly authorized representative of SYNGENTA.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

IMPORTANT: Not for use on plants being grown for sale or other commercial use, or for commercial seed production, or for research purposes. For use on plants intended for aesthetic purposes or climatic modification and being grown in interior plantscapes, ornamental gardens or parks, or on lawns or grounds.

This product is restricted for use in the State of New York.

STORAGE AND DISPOSAL

Prohibitions

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

Storage

Keep container closed when not in use. Do not store near food or feed. Shake well before use. Protect from freezing. In case of spill or leak on floor or paved surfaces, soak up with sand, earth, or synthetic absorbent. Remove to chemical waste storage area until proper disposal can be made.

Pesticide Disposal

Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative of the nearest EPA Regional Office for guidance.

Container Disposal

Completely empty container into application equipment. Triple rinse (or equivalent), then offer for recycling or reconditioning, or puncture and dispose of empty container in a sanitary landfill, or by other procedures approved by state and local authorities.

GENERAL INFORMATION: STRUCTURAL AND PERIMETER PEST CONTROL

For use as a general surface, crack and crevice, or spot treatment in, on, and around buildings and structures and their immediate surroundings, and on modes of transport. Permitted areas of use include, but are not limited to, aircraft (cargo and other non-cabin areas only), apartment buildings, boiler rooms, buses, closets, correctional facilities, decks, entries, factories, fencing, floor drains (that lead to sewers), food granaries, food grain mills, food manufacturing, processing and serving establishments; furniture, garages, garbage rooms, greenhouses (non-commercial), hospitals, hotels and motels, houses, industrial buildings, laboratories, livestock/poultry housing, landscape vegetation, locker rooms, machine rooms, mausoleums, mobile homes, mop closets, mulch, nursing homes, offices, patios, pet kennels, porches, railcars, restaurants, storage rooms, schools, sewers (dry), stores, trailers, trees, trucks, utility passages, vessels, vestibules, warehouses, wineries and yards.

For indoor applications, retreat at 21 day intervals or as necessary to maintain control.

Mixing Instructions

Demand CS Insecticide is intended for dilution with water for application using hand-held or power-operated application equipment as a coarse spray for crack and crevice or spot and general surface treatments. Application equipment that delivers low volume treatments, such as the Micro-Injector® or Actisol® applicator, may also be used to make crack and crevice or spot and general surface treatments. Fill applicator tank with the desired volume of water and add Demand CS Insecticide. Close and shake before use in order to ensure proper mixing. Shake or reagitate applicator tank before use if application is interrupted. Mix only amount of treatment volume as required. A general surface treatment of Demand CS Insecticide may be applied by using a paintbrush or other porous applicator attached to a handle.

Tank Mixing

Demand CS Insecticide may be tank mixed with other currently registered pesticides unless expressly prohibited by the product label. A small volume mixing test with the other products is recommended to ensure compatibility. If mixed with sanitizers, Demand CS Insecticide should be added to the tank first. If other chemicals are added to the applicator tank, Demand CS Insecticide should be added last. If mixed with EC formulations, use within 24 hrs. Fill tank to desired volume and continue to agitate while making applications.

Demand CS Insecticide may be tank mixed with an Insect Growth Regulator (IGR) such as Archer® Insect Growth Regulator.

Observe all restrictions and precautions which appear on the labels of these products.

Foam Applications

Demand CS Insecticide may be converted to a foam and the foam used to treat structural voids to control or prevent pests including ants, bees, termites (above ground only), wasps, or other arthropods harboring in walls, under slabs, or in other void areas.

RATES FOR STRUCTURAL PESTS (HAND APPLICATION EQUIPMENT)

Pests	Concentration of A.I.	Dilution Rate
Ants Bedbugs (adult) Bees Beetles Boxelder Bugs Carpenter Bees Carpet Beetles Centipedes Cigarette Beetles Clover Mites Cockroaches[1] Confused Flour Beetles Crickets Earwigs Firebrats Fleas[2] Flies Lesser Grain Borers Millipedes Mosquitoes Red Flour Beetles Rice Weevils Saw-toothed Grain Beetles Silverfish Sowbugs Spiders Termites (above ground only) Ticks Wasps	0.015–0.03%	0.015%: 0.2 fl.oz.(6mL)/gal. of water 0.03%: 0.4 fl.oz.(12mL)/gal. of water

continued...

RATES FOR STRUCTURAL PESTS (HAND APPLICATION EQUIPMENT) *(continued)*

Pests	Concentration of A.I.	Dilution Rate
Cockroaches[1] Crickets[6] Flies[5]* Litter Beetles[3] (such as Darkling, Hide, and Carrion) Mosquitoes[4] Pillbugs Scorpions Spiders[6] Spider Mites (Twospotted, Spruce) Ticks[6]	0.06%	0.8 fl.oz.(24mL)/ gal. of water

*Not approved for use in California at the high rate.

[1]For cockroaches, the recommended rate for maintenance treatments is 0.015% and for clean-out treatments is 0.03%. For control of SEVERE infestations, use 0.06% rate.

[2]For outdoor use only and use 0.03% rate.

[3]For control of LIGHT beetle infestations, use 0.03% rate.

[4]For residual control, use 0.06% rate.

[5]Rates for flies may be increased to 0.06% when environmental conditions are severe and/or populations are high.

[6]For clean-out/severe infestations, use 0.06% rate.

SPECIFIC USE DIRECTIONS

Ants

Apply to any trails around doors and windows and other places where ants may be found. For best results, locate and treat nests. Where ants are trailing inside, apply as a residual surface treatment to active areas such as baseboards, corners, around pipes, in and behind cabinets, behind and under refrigerators, sinks, furnaces and stoves, cracks and crevices. When combining baits and residual surface insecticides, apply surface insecticides in cracks and crevices, along baseboards, and infested surfaces and outside barrier treatments. Treatment of perimeter landscaping can reduce honeydew-producing insects and limit this ant food source. Use baits in other areas that are untreated by residual insecticides; also see **Outdoor Surfaces Use**.

Cockroaches, Crickets, Earwigs, Firebrats, Silverfish, and Spiders

Apply as a coarse, low pressure spray to areas where these pests hide, such as baseboards, corners, storage areas, closets, around water pipes, doors and windows, attics and eaves, cabinets, behind and under refrigerators, furniture, sinks, furnaces and stoves, the underside of shelves, drawers and similar areas. Pay particular attention to cracks and crevices; also see **Outdoor Surfaces Use**.

Bedbugs

Recommend cleaning of floors and surfaces by vacuuming. Apply as a coarse, low-pressure spray to harborage areas including crevices, baseboards, loose plaster, behind bed frames and headboards, beneath beds and furniture, and to bedsprings and bed frames. Do not apply to furniture surfaces or mattresses where people will be laying or sitting. Infested bedding should not be treated, but should be removed, placed in sealed plastic bags, and taken for laundering and drying at high temperatures.

Bees, Flies, Mosquitoes, and Wasps

Apply directly to walls, ceilings, window screens, and other resting areas as a residual surface treatment. May be used inside residential buildings as well as in and around carports, garages, and storage sheds; also see **Outdoor Surfaces Use**. Use caution when treating nests of stinging insects as Demand CS Insecticide does not provide instant knockdown. Protective equipment for the applicator may be required. For best results, treat bee, wasp and hornet nests late in the day when most insects will be present. Allow 2-3 days for colony to die and retreat if necessary.

For mosquito control, apply as a general structural perimeter spray to landscape plantings, turf, and building foundations to control mosquitoes. Yards or other frequented areas enclosed by landscaping can benefit from the creation of a mosquito barrier to reduce invading mosquitoes by the treatment of perimeter vegetation. For best results, apply Demand CS Insecticide at recommended rates in 2–5 gals. of water per 1,000 sq. ft. Higher volumes applied result in better coverage and, as a rule, will improve control. Application to vegetation away from structures may require additional certification, e.g. in turf or ornamental categories. Consult your state regulatory agency for requirements.

Carpenter Bees

Apply coarse spray to thoroughly wet wood surfaces where bees have been previously active or to provide protection against further damage. Apply early in the spring to prevent bees from invading wood. When bees have infested wood, surface applications can help control embedded larvae and bees that emerge from the wood. Applications can be made on a monthly basis to maintain protection of treated areas.

Pantry Pests (i.e., Carpet beetle, Cigarette beetle, Confused flour beetle, Lesser grain borer, Red flour beetle, Rice weevil, and Saw-toothed grain beetle)

Apply to cupboards, shelving, and storage areas. Remove all utensils, uncovered foodstuffs (or any having original package opened), and shelf paper before making application. Allow treated surfaces to dry and cover shelves with clean paper before replacing any utensils, foodstuff, or other items. Any foodstuff accidentally contaminated with treatment solution should be destroyed.

Boxelder Bugs, Centipedes, Millipedes, Pillbugs, and Sowbugs

Apply around doors and windows and other places where these pests may be found or where they may enter premises. Treat baseboards, storage areas, and other locations. Apply barrier treatments to prevent infestation as described below; also see **Outdoor Surfaces Use**.

Fleas and Ticks

To control nuisance fleas and ticks (e.g. dog ticks) apply to kennels, yards, runs, and other areas where pets may frequent. For best coverage to control ticks, apply using a coarse fan spray to vegetation brush, branches, rock walls, and other areas near habitation where ticks may harbor or frequent. Treat entire area rather than making spot treatments, and retreat as necessary to maintain control. Do not apply to pasture or cropland, and do not allow animals and people access to treated areas until the deposit has dried. Applications can be made on a monthly basis, begining in the spring and can continue until frost to control both larvae and adult ticks. Also, treat pets with a product registered for flea and tick control. See **Outdoor Surfaces Use**.

Cluster Flies

Apply in late summer or early fall before flies are observed alighting on surfaces. Apply thoroughly on siding, under eaves, and around windows and doors, paying particular attention to south-facing surfaces. Apply just enough dilution to adequately cover the area without excessive dripping or runoff. Volume can vary depending on the surface type treated. Heavy precipitation prior to frost may require retreatments to maintain protection. In winter and spring when flies become active and are emerging, interior crack and crevice and void treatments can help reduce the infestation, along with ULV or general surface application in infested attics or unoccupied lofts.

Litter Beetles (Darkling, Hide, and Carrion Beetles) and Flies In Animal Housing (Such As Poultry Houses)

To control adult litter beetles, apply Demand CS Insecticide to walls and floors at cleanout, before reintroduction of animals. This will suppress beetles that escaped earlier treatment and will help delay onset of future infestations. Pay attention to areas where beetles frequently occur, such as walls, supports, cages, stalls, and around feeders. To help control flies, apply a directed application to horizontal surfaces and overhead areas and allow to dry before reintroduction of animals; also see **Livestock/ Poultry Housing Structures and Pet Kennels**.

Application Within Food Handling Establishments (places other than private residences in which exposed food is held, processed, prepared, or served) including, but not limited to, areas for receiving, storage, packing (canning, bottling, wrapping, boxing), preparing foods, edible waste storage and enclosed processing systems (mills, dairies, edible oils, syrups), and serving areas.

Use as a crack and crevice or spot treatment in and around both food and nonfood areas. Apply in small amounts directly into cracks and crevices, using equipment capable of delivering a pin stream of insecticide, in points between different elements of construction, between equipment and floor, openings leading to voids and hollow spaces in walls, equipment and bases. Food contact surfaces and equipment should be cleaned with an effective cleaning compound and rinsed with potable water before using.

Limit individual spot treatments to an area no larger than 20% of the treated surface. Individual spot treatments should not exceed 2 sq. ft. Take extreme care that the product is not introduced into the air. Avoid contamination of food and food processing surfaces.

Application Within Food Serving Areas (facilities where foods are served, such as dining rooms)

Apply as a crack and crevice or spot treatment to selective surfaces such as baseboards, under elements of construction, and into cracks and crevices. Avoid treating surfaces likely to be contacted by food. (Do not apply when facility is in operation or foods are exposed.) Food must be covered or removed in area being treated. Do not apply directly to food or allow applications to contaminate food.

Application of this product in the Food Areas and/or Food Serving Areas of Food Handling Establishments other than as a spot and/or crack and crevice treatment is not permitted. Use of application equipment such as the Micro-Injector or Actisol applicator in food areas should be limited to crack and crevice treatment only.

Livestock/Poultry Housing Structures and Pet Kennels

Apply as a general surface (including directed sprays) and/or crack and crevice treatment. Control is enhanced when interior and exterior perimeter applications are made in and around the livestock, poultry, and pet housing structures. Normal cleaning practices of the structure also must be followed along with applications of Demand CS Insecticide to effectively control the crawling and flying insect pests listed in the table.

For unoccupied areas of livestock barns or housing structures, apply to floors, vertical, and overhead surfaces where crawling or flying insect pests are or may be present. Feeders, waterers, and feed carts should be covered before application to prevent contamination. Do not apply to milk rooms or feed rooms. Pay attention to animal areas including stanchions, pipes, windows and doors, and areas where insect pests hide or congregate. Exterior applications to south facing walls and foundation perimeters can help prevent interior infestations of flying and crawling insect pests.

For poultry houses, apply to floor area (birds grown on litter) or to walls, posts, and cage framing (birds grown in cages). Application should also be made into cracks and crevices around insulation. Reapply after each growout or sanitization procedure. Indoor control can be enhanced by making perimeter treatments around the outside of building foundations to prevent immigrating adult beetles. Apply in a uniform band 1–3 ft. up and 2–6 ft. out from foundation. Maintaining a year-round treatment program will prevent background populations from reaching problem levels.

Do not make interior applications of Demand CS Insecticide in areas of facility where animals other than cattle or calves are present. Allow treated surfaces to completely dry before restocking the facility.

DO NOT make applications to any animal feedstuffs, water, or watering equipment.

DO NOT contaminate any animal food, feed, or water in and around livestock, poultry, or pet housing when making applications.

Outdoor Surfaces Use

For control of ants, bees, centipedes, cockroaches, crickets, fleas, flies, millipedes, mosquitoes, scorpions, sowbugs, pillbugs, spiders, termites (above ground only), ticks, wasps, and other similar perimeter arthropod pests. Apply with either hand or power application equipment as a residual treatment to ornamental plants next to foundations of buildings and to surfaces of buildings, porches, screens, window frames, eaves, patios, garages, refuse dumps, and other similar areas where these insect pests are active. For termites, this type of application is not intended as a substitute for soil treatment labeled termiticides or mechanical alteration to control subterranean termites, or fumigation for extensive infestation of drywood termites or other wood-infesting insects. The purpose of such applications of Demand CS Insecticide for termites is to kill workers or winged reproductive forms which may be present in treated channels at the time of treatment. Such applications are not a substitute for mechanical alteration, soil treatment or foundation treatment, but are merely a supplement. This product is not recommended as sole protection against termites. For active termite infestations, get a professional inspection.

Structural Perimeter Barrier Treatments

Applying a continual band of insecticide around a building foundation and around windows, doors, service line entrances, eaves, vents, and other areas can greatly reduce the potential for entry by crawling pests. To facilitate application, remove debris and leaf litter from next to the foundation, cut back vegetation and branches that touch the foundation, and move or rake back rocks, deep mulch, or other potential pest harborage next to the foundation. Apply the band up to 10 ft. wide around the structure (or according to state regulations governing commercial pest control) and upwards along the foundation to 3 ft. and around windows, doors, and roof overhangs. Apply as a coarse spray to thoroughly and uniformly wet the foundation and/or band area so that the insecticide will reach the soil or thatch level where pests may be active.

Amount of concentrate is dependent upon pest species (see pest table and comments), infestation levels, and service interval desired.

Rate Table For Structural Perimeter Barrier Applications

Application Rate: Fl. oz. (mL) of Demand CS Insecticide	Gals. of Water[1]	Area of Coverage (sq. ft.)
0.2 fl. oz. (6mL)	1–5 gals.	800–1600 sq. ft.
0.4 fl. oz. (12 mL)	1–5 gals.	800–1600 sq. ft.
0.8 fl. oz. (24 mL)	1–5 gals.	800–1600 sq. ft.

[1]Application volume may be greater than 5 gals./800–1600 sq. ft. if required under heavy vegetative or landscaping materials in order to obtain desired coverage.

Examples of Dilutions For Structural Perimeter Barrier Applications

Application Volume Gals. of Solution/ 1000 sq. ft.	Application Rate Fl. oz. (mL) of Demand CS Insecticide/ 1000 sq. ft.	Fl. oz. (mL) of Demand CS Insecticide to Dilute in Water According to Spray Tank Volumes		
		5 gals.	10 gals.	50 gals.
1 gal./1000 sq. ft.	0.2 fl. oz. (6mL) 0.4 fl. oz. (12 mL) 0.8 fl. oz. (24 mL)	1 fl. oz. (30 mL) 2 fl. oz. (60 mL) 4 fl. oz. (120mL)	2 fl. oz. (60 mL) 4 fl. oz. (120mL) 8 fl. oz. (240mL)	10 fl. oz. (300mL) 20 fl. oz. (600 mL) 40 fl. oz. (1200mL)
2 gal./1000 sq. ft.	0.2 fl. oz. (6mL) 0.4 fl. oz. (12 mL) 0.8 fl. oz. (24 mL)	0.5 fl. oz. (15 mL) 1 fl. oz. (30 mL) 2 fl. oz. (60 mL)	1 fl. oz. (30 mL) 2 fl. oz. (60 mL) 4 fl. oz. (120 mL)	5 fl. oz. (150 mL) 10 fl. oz. (300 mL) 20 fl. oz. (600 mL)
5 gal./1000 sq. ft.	0.2 fl. oz. (6mL) 0.4 fl. oz. (12 mL) 0.8 fl. oz. (24 mL)	0.2 fl. oz. (6 mL) 0.4 fl. oz. (12 mL) 0.8 fl. oz. (24 mL)	0.4 fl. oz. (12 mL) 0.8 fl. oz. (24 mL) 1.6 fl. oz. (48 mL)	2 fl. oz. (60 mL) 4 fl. oz. (120 mL) 8 fl. oz. (240 mL)

Example calculation: to apply the mid-rate of Demand CS Insecticide at a volume of 5 gal./1000 sq. ft., mix 4 fl. oz. of concentrate in 50 gallons of water.

The percent active ingredient in the finished Demand CS Insecticide dilution can be calculated with the following formula:

mL needed to add times 9.7% active in concentrate, divided by gal. finished dilution times 3785 ml/gal. = % active in dilution. (Example: 4 fl. oz. in 50 gal. is 120 mL, times 9.7 equals 1164, and 50 gal. times 3785 is 189250. Dividing 1164 by 189250 equals 0.006% active in the tank dilution).

NOTE: Do not use water base sprays of Demand CS Insecticide in conduits, motor housings, junction boxes, switch boxes, or other electrical equipment because of possible shock hazard. For best results, thoroughly wash out sprayer and screen with water and detergent before using Demand CS Insecticide. Demand CS Insecticide has not stained or caused damage to painted or varnished surfaces, plastics, fabrics, or other surfaces where water applied alone causes no damage. However, treat a small area and allow to dry to determine whether staining will occur.

LET TREATED SURFACES DRY BEFORE ALLOWING HUMANS AND PETS TO CONTACT SURFACES.

Do not use this product with oil.

Do not apply this product in any room being used as living, eating, sleeping, or recovery area by patients, the elderly, or infirm when they are in the room.

Do not apply to classrooms when in use.

Do not apply to institutions (including libraries, sports facilities, etc.,) in the immediate area when occupants are present.

Do not apply this product to edible growing crops or stored raw agricultural commodities used for food or feed.

Do not allow applications to contact water inhabited by fish, such as in aquariums and ornamental fish ponds that are located in/around structures being treated.

GENERAL INFORMATION: LAWNS/TURFGRASS AND ORNAMENTALS

Demand CS Insecticide may be used for applications to maintain indoor or outdoor areas where turf and ornamentals are grown such as residential landscaped areas and non-residential landscapes around institutional, public, commercial and industrial buildings, parks, recreational areas, and athletic fields. Application rates for turf and ornamental applications of Demand CS Insecticide are lower than structural pest control rates, reflecting that treatment intervals are generally more frequent.

Applicators must ensure that they are certified in the necessary pesticide certification categories to allow application of Demand CS Insecticide away from structures, such as to turf and ornamental plantings. Structural pest control certification categories may limit the distance away from structures for pesticide application. Consult your state extension office or pesticide regulatory officials for further information.

IMPORTANT: Time application to flowering plants during periods when pollinating insects are not present, such as early morning or late evening.

Do not apply this product through any type of irrigation system.

Do not apply this product to edible crops.

Do not apply this product by aerial application.

Use of this pesticide adjacent to water may affect aquatic organisms. To protect these organisms, do not apply this pesticide within 25 ft. of lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds.

Do not make outdoor broadcast applications to turf and ornamentals when wind speed is 15 mph or greater.

In the state of New York, do not apply within 100 ft. of coastal marshes or streams that drain into coastal marshes.

Mixing Instructions (Turf and Ornamental Dilutions)

Demand CS Insecticide is to be mixed with water and may be used in all types of standard application equipment. Fill applicator tank with the desired volume of water and add Demand CS Insecticide. It is suggested that the water be 5–7 pH. Adjust water pH with a buffering agent if necessary. Slowly add Demand CS Insecticide to applicator tank water with maximum agitation. Close and shake or reagitate applicator tank before use if application is interrupted. Make up only amount of treatment volume as required.

Tank Mixing (Turf and Ornamental Dilutions)

Demand CS Insecticide may be tank mixed with other currently registered pesticides unless expressly prohibited by the product label. Adjuvants such as spreader stickers, wetting agents, and penetrants may also be added. A small volume mixing test with the other products is recommended to ensure compatibility. If other chemicals are added to the applicator tank, Demand CS Insecticide should be added last. Fill tank to desired volume and continue to agitate while making applications. If mixed with EC formulations, use within 24 hours.

Observe all restrictions and precautions which appear on the labels of these products.

Tank Dilution Rates for Ornamental Pests

Use	Pest	Amount of Demand CS Insecticide
Ornamentals in Residential Landscaped Areas and Landscaped Areas Around Institutional, Public, Commercial and Industrial Buildings, Parks, Recreational Areas, and Athletic Fields (Including Trees, Shrubs, Flowers, Evergreens, Foliage Plants and Groundcovers)	Ants (Including Imported fire ants) Armyworms Azalea caterpillars Aphids Bagworms Black vine weevils (adult) Boxelder bugs Budworms California oakworms Cankerworms Cockroaches Crickets Cutworms Eastern tent caterpillars Elm leaf beetles European sawflies Fall webworms Flea beetles Forest tent caterpillars Gypsy moth larvae Japanese beetles (adults) June beetles (adults) Lace bugs Leaf-feeding caterpillars Leafhoppers Leafminers (adults) Leafrollers Leaf skeletonizers Midges Mosquitoes Oleander moth larvae Pillbugs Pine sawflies Pine shoot beetles Pinetip moths Plant bugs Root weevils Sawflies Scale insects (crawlers) Spiders Spittlebugs Striped beetles Striped oakworms Thrips Tip moths Tussock moth larvae Wasps	1.5–5 fl. oz./ 100 gals. or 44–148 mL/ 100 gals.
	Broadmites Brown soft scale California red scale (crawlers) Clover mites Mealybugs Pineneedle scale (crawlers) Spider mites Whiteflies	3–5 fl. oz./ 100 gals. or 88–148 mL/ 100 gals.

Example calculation: to prepare a mid-rate dilution of Demand CS Insecticide, mix 3 fl. oz. (88 mL) of concentrate in 100 gals.

Application to ornamentals should be started prior to the establishment of high insect pest populations. Make reapplications as necessary to keep pest populations under control, using higher rates as pest pressure increases.

Apply at 7-day intervals if retreatment is necessary. More frequent treatments should be limited to spot treatments. Recognize that as plants grow, new foliage will be unprotected until treated.

Do not apply more than 0.36 lbs. of the a.i. (52.4 fl. oz. of concentrate)/A per year.

Good spray coverage is necessary to provide the most effective level of control. Addition of a spreader-sticker at recommended rates may enhance the control of insects on certain species of ornamentals having waxy, hard to wet foliage.

For spot treatments use 0.5 fl. oz. Demand CS Insecticide per 1–2 1/2 gals. of water.

Consult your state university or local Cooperative Extension Service office for specific pest control application timing in your area.

NOTE: While phytotoxicity testing has been carried out on a wide range of ornamental plants under various environmental conditions, and no phytotoxicity has been observed, certain cultivars may be sensitive to the final spray solution.

It is advised to prespray a selection of ornamental plants and observe them for 7–10 days prior to treating large areas if local use experience is unavailable. This is especially advisable if Demand CS Insecticide is being mixed with another product or ingredient besides water. [See **Tank Mixing (Turf and Ornamental Dilutions)** instructions].

Scale: Thoroughly cover the plant with Demand CS Insecticide spray, including trunks, stems, twigs, and foliage for control of scale insects (crawler stage).

Bagworm: Apply Demand CS Insecticide when bagworm larvae begin to hatch. Spray directly on the larvae. Application is the most effective when the larvae are young.

Demand CS Insecticide Mixing Chart for Ornamental Insect Pest Control

Rate of Demand CS Insecticide	25 Gals.	50 Gals.	100 Gals.	200 Gals.	300 Gals.
1.5 fl. oz.[1]	0.4 fl. oz.	0.8 fl. oz.	1.5 fl. oz.	3.0 fl. oz.	4.5 fl. oz.
3.0 fl. oz.[2]	0.8 fl. oz.	1.5 fl. oz.	3.0 fl. oz.	6.0 fl. oz.	9.0 fl. oz.
5.0 fl. oz.[3]	1.3 fl. oz.	2.5 fl. oz.	5.0 fl. oz.	10.0 fl. oz.	15.0 fl. oz.

[1]Equivalent to 3.5 mL/1000 sq. ft. (or 5 fl. oz./A) when applied at 8 gal./1000 sq. ft.

[2]Equivalent to 7 mL/1000 sq. ft. (or 10 fl. oz./A) when applied at 8 gal./1000 sq. ft.

[3]Equivalent to 9.5 mL/1000 sq. ft. (or 14 fl. oz./A) when applied at 8 gal./1000 sq. ft.

Power Spray Rates for Lawn and Turfgrass Pests

Use	Pest	Amount of Demand CS Insecticide
Lawns/ Turfgrass Around Residential, Institutional, Public, Commercial and Industrial Buildings, Parks, Recreational Areas and Athletic Fields	Ants (Including Imported fire ants) Armyworms Centipedes Crickets Cutworms Earwigs Fleas (adult) Grasshoppers Japanese beetles (adult) Millipedes Mites Mosquitoes (adult) Pillbugs Sod webworms Sow bugs Ticks (including species which transmit Lyme disease)	3.4–7 mL/1000 sq. ft. or 5–10 fl. oz./A
	Bluegrass billbugs (adult) Black turfgrass ataenius (adult) Chiggers Fleas (adult) Grubs (suppression) Hyperodes weevils (adult) Mole crickets (nymphs and young adults)	7 mL/1000 sq. ft. or 10 fl. oz./A
	Mole Crickets[1] (mature adults) Chinch Bugs[1]	14 mL/1000 sq. ft. or 20 fl. oz./A

[1]Not for use on mature adult mole crickets and chinch bugs in New York State.

Example calculation: to treat listed turf pests at the mid-rate for Demand CS Insecticide of 7 mL/1000 sq. ft., determine gals. dilution/1000 sq. ft. needed to cover turf. At 5 gal./1000 sq. ft., add 7 mL ÷ 5 or 1.4 mL per gallon. For a 50 gallon tank, this would be equivalent to 70 mL or 2.5 fl. oz. in 50 gals. water.

Application to turf should be started prior to the establishment of high insect pest populations and significant turf damage. Make reapplications as necessary to keep pest populations under control, using higher rates as pest pressure increases.

Apply at 7-day intervals if retreatment is necessary. More frequent treatments should be limited to spot treatments.

Do not apply more than 0.36 lbs. of a.i. (52.4 fl. oz. of concentrate)/A per year.

For spot treatments, use 0.5 fl. oz. of Demand CS Insecticide per 1–2.5 gals. of water.

Do not apply when turfgrass is waterlogged or when soils are saturated with water (i.e. will not accept irrigation).

KEEP CHILDREN AND PETS OFF TREATED AREAS UNTIL SPRAY HAS DRIED FOLLOWING THE APPLICATION.

Surface Insect Control (armyworm, cutworms, fleas, etc.)

For best results, apply Demand CS Insecticide at recommended rates in 2–5 gals. of water per 1,000 sq. ft. The use of a spreader-sticker may be useful if high rainfall amounts are forecast, otherwise the addition of adjuvants is not necessary under normal conditions for surface insect control in turf. Delay watering or mowing for 12–24 hours for optimum control of surface-feeding insect pests.

Thatch Inhabiting Insect Control (chinch bugs, billbugs, etc.)

For best results, apply Demand CS Insecticide at recommended rates in 2–10 gals. of water per 1,000 sq. ft. The use of a nonionic wetting agent, penetrant or similar adjuvant is recommended at label rates. Lightly irrigate after application with up to 1/2 inch of water to move the Demand CS Insecticide into the thatch layer. If irrigation is not available, then use high water application rates for optimum results.

Subsurface Insect Control (mole crickets, grubs, etc.)

For best results, apply Demand CS Insecticide at recommended rates in 4–10 gals. of water per 1,000 sq. ft. The use of a nonionic wetting agent, penetrant or similar adjuvant is strongly recommended following label rates. Use the highest water application rates possible with your sprayer. Apply Demand CS Insecticide to turf wet with dew, rain or irrigation. Water-in immediately after application with 1/4 –1/2 inch of water for optimum results.

Fire Ant Control

Treat individual mounds with a drench application using a watering can. Use 0.5 fl. oz. of Demand CS Insecticide per 2.5 gals. of water. Thoroughly soak each mound and a 3 ft. diameter circle around each mound. Gently apply the mixture to avoid disturbing the mound. Disturbing the mound may cause the ants to migrate and reduce the effectiveness of the treatment. For best results, apply in early morning or late evening hours. Applications can be made on a monthly basis to maintain protection of treated areas.

Mosquito Control

Apply as a general spray around landscape plantings, turf, and building foundations to control mosquitoes. Yards or other frequented areas enclosed by landscaping can benefit from the creation of a mosquito barrier to reduce invading mosquitoes by the treatment of perimeter vegetation. For best results, apply Demand CS Insecticide at recommended rates in 2–5 gals. of water per 1,000 sq. ft. Higher volumes applied result in better coverage and, as a rule, will improve control.

Demand CS Insecticide Mixing Chart for Turf Insect Pest Control (Demand CS Insecticide to add per 100 gal. spray tank)

Rate of Demand CS Insecticide	Application Rate Per 1,000 Sq. Ft. of Turf				
	2 gal.	4 gal.	6 gal.	8 gal.	10 gal.
5 fl. oz./A	5.7 fl. oz.	2.9 fl. oz.	1.9 fl. oz.	1.4 fl. oz.	1.2 fl. oz.
10 fl. oz./A	11.5 fl. oz.	5.7 fl. oz.	3.8 fl. oz.	2.9 fl. oz.	2.3 fl. oz.
20 fl. oz./A	23.0 fl. oz.	11.5 fl. oz.	7.7 fl. oz.	5.7 fl. oz.	4.6 fl. oz.

Conversion Rate: 1 fluid ounce (fl. oz.) equals 29 milliliters (mL).

For non-emergency
(e.g. current product information) call
Syngenta Crop Protection at 1-800-334-9481.

Manufactured for:
Syngenta Crop Protection, Inc.
P. O. Box 18300
Greensboro, North Carolina 27419-8300
www.syngenta-us.com

SCP 1066A-L1G 0308

BAYER

Maxforce®

FC MAGNUM
Roach Killer Bait Gel

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79418124C 061204B

FOR USE IN COMMERCIAL, INDUSTRIAL AND RESIDENTIAL AREAS

Quick kill formula
Starts working in hours
See visible results overnight
Easy to use
Kills Roaches and Keeps on Killing
Kills by ingestion and contact
Kills American roaches and Palmetto Bugs
No vapor, fumes or odor

ACTIVE INGREDIENT:
Fipronil*: [5-Amino-1-(2, 6-dichloro-4-trifluoromethyl) phenyl)-4-(1, R, S)-(trifluoromethyl) sulfinyl)-1H-pyrazole-3-carbonitrile]........................0.05%
OTHER INGREDIENTS: 99.95%
Total:..100.00%
*CAS NO. 120068-37-3

EPA Reg. No. 432-1460
EPA Est. No. 071106-GA-001

STOP - Read the label before use.
Keep out of reach of children.
CAUTION

Product may stain textiles and clothing.

FIRST AID	
IF ON SKIN OR CLOTHING:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
IF IN EYES:	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. • Call a poison control center or doctor for treatment advice.
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-334-7577 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS:
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes and clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum or using tobacco.

PHYSICAL AND CHEMICAL HAZARDS: Do not use this product in or on electrical equipment where a possibility of shock hazard exists.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in a cool, dry area out of reach of children.

DISPOSAL: If Empty: Do not reuse container. Place in trash or offer for recycling if available.

If Partly Filled: Call your local solid waste agency for disposal instructions. Never place unused product down any indoor or outdoor drain.

If you have questions regarding the use of this product, please call 1-800-331-2867.

Provides FAST CONTROL in 2 days (German roaches).

Dual Action kills roaches two ways.

Contains Fipronil, which kills roaches by ingestion and contact. During-or- After foraging roaches either eat or contact the bait, they return to the harborage and contaminate -or- kill other roaches.

Kills roaches in their harborage.

Inject bait into cracks and crevices or apply as a spot where roaches harbor or enter a structure.

This product effectively controls large roaches†.

This product contains Fipronil, a fast-acting active ingredient that kills American roaches. This product controls large [American] roach† populations in 8 days.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

Use MAXFORCE® FC MAGNUM Roach Killer Bait Gel as a spot or crack and crevice treatment for the indoor and outdoor (adjacent to homes & structures) control of cockroaches in residential areas and the non-food/non-feed areas of institutional, warehousing and commercial establishments, including warehouses, restaurants, food processing plants, supermarkets, hospitals, nursing homes, motels, hotels, apartment buildings, bakeries, beverage plants, breweries, bottling facilities, candy plants, canneries, cereal processing and manufacturing plants, dairies and dairy product processing plants, frozen food plants, schools, laboratories, computer facilities, sewers, "aircraft," buses, boats/ships, trains, homes, houses, industrial buildings, office buildings, kennels, kitchens, manufacturing facilities, spice plants, stores, wineries and similar structures, mausoleums, meat processing and packaging plants, meat and vegetable canneries, pet shops and zoos. Non-food/non-feed areas include bedrooms, living rooms, bathrooms, closets, media rooms, garbage rooms, lavatories, entries, and vestibules, offices, locker rooms, machine rooms, boiler rooms, garages, mop closets and storage (after canning or bottling). This product may also be used in food/feed areas of food/feed handling establishments as outlined below.

May stain textiles, fabrics and or porous surfaces.

USE RESTRICTIONS

Do not treat food preparation surfaces. Keep gel away from foods and food contact surfaces. Do not apply bait gel to areas which have been recently sprayed with insecticide, and do not spray insecticide over gel as it may cause the bait to become repellent. USE ONLY IN AREAS NOT EASILY ACCESSIBLE TO CHILDREN AND PETS. In pet shops and zoos place bait out of reach of pets and zoo animals.

GENERAL DIRECTIONS

INDOOR USE:

For roach gel: Application rate is dependent on level of infestation and species to be controlled. See Application Rate Table. Inject bait as a bead into cracks and crevices or apply as a spot. The lower application rate should be used for low to moderate infestations or re-treatments, and the higher rate for more severe infestations or where the population occurs in inaccessible areas. Gel placements should be at or near harborages or aggregation areas, such as corners or cracks and crevices. Numerous smaller placements will provide faster control than fewer larger spots, especially for German cockroach control.

Place bait under baseboards, sinks, countertops, seats, around water pipes, water heaters, dishwasher equipment, in crack and crevices as well as voids where insects harbor.

PANTRY PESTS: To control exposed, adult stages of beetles: cadelle, cigarette beetle, confused flour beetle, dermestid, drugstore beetle, flat grain beetle, granary weevil, lesser grain borer, lesser mealworm, mealworm, merchant grain beetle, red flour beetle, rice weevil, rusty grain beetle, saw-toothed grain beetle, spider beetle, or warehouse beetle. After removing infested foodstuffs and cleaning up spilled foodstuffs and dust, applications of this product will kill adult stages of beetles remaining in area. Apply in voids, cracks and crevices, behind and under cupboards, and other difficult to reach areas where insects may hide. Application rate is dependent on level of infestation. See Application Rate Table.

Applications in Food/Feed Handling Establishments: Application within food/feed areas of food/feed handling establishments is limited to crack and crevice treatment only. If gel contacts an exposed surface where food is handled, remove gel and wash exposed surface with an effective cleaning compound followed by a potable water rinse prior to use. Apply with Maxforce Bait Injector directly into cracks and crevices. Place applicator tip 1/2 inch into cracks, crevices, holes and other small openings where roaches may be a problem. Apply small amounts of gel.

Use Restrictions in Food/Feed Handling Establishments:

Do not apply bait to areas where food/feed, utensils or processing surfaces may become contaminated. Do not apply bait to areas that are routinely washed such as cracks and crevices in tops of tables, food/feed preparation and prepared food holding surfaces as bait may be removed by washing. Do not apply bait to surfaces where the temperature exceeds 130°F as bait may run. Examples include, but are not limited to, portions of stoves, ovens, grills, fume hoods, heat lamps, coffee urns, steam tables, toasters, fryers, dishwashers and hot water pipes. Care should be taken to avoid depositing gel onto exposed surfaces. If gel contacts an exposed surface, remove gel and wash exposed surface.

Food/feed areas include areas for receiving, storage, packing (canning, bottling, wrapping, boxing), preparing edible waste storage, and enclosed processing systems (mills, dairies, edible oils, syrups). Serving areas are also considered a food/feed area when food is exposed and facility is in operation. Apply bait in small amounts between different elements of construction, between equipment and floors, openings leading into voids and hollow spaces in floors, walls, ceilings, equipment legs and bases, around plumbing pipes, doors and windows, behind and under refrigerators, cabinets, sinks, closets, stoves and other equipment where cockroaches hide. During follow-up visits inspect bait placements and reapply when necessary.

Application of this product in food/feed areas of food/feed handling establishments other than as a crack and crevice treatment is not permitted.

Gel placements should be at or near harborages or aggregation areas, such as corners or cracks and crevices. Numerous smaller placements will provide faster control than fewer larger spots, especially for German cockroach control.

For outdoor use (adjacent to home -or- structure): Place bait in areas adjacent to structures where [large] roaches may nest or breed. Apply bait to potential points of insect entry, such as eaves, sills, and expansion joints.

Apply bait in protected areas whenever possible. Environmental stresses such as direct sunlight and water will reduce the residual effectiveness. Priority treatment areas may be identified by visual inspection of such areas listed above or aided by trapping techniques or spot flushing.

Refillable stations: This product may be used in the Maxforce Refillable Bait Station or B&G Perimeter Patrol Station. Refillable stations should be placed every 20 to 30 feet around the perimeter of a structure. Use approximately 2 stations per side of a typical single family home. The quantity of MAXFORCE FC MAGNUM Roach Killer Bait Gel bait added to the bait station will vary depending on the severity of infestations, see the application rate table. Do not exceed 2-4 spots per station (3”-6” bead). For best results, place stations near: air conditioning units, water faucets, foundation vents and weep holes, decks, utility entryways (e.g. electrical, cable TV) and wherever cockroaches are frequently found. Regularly inspect all stations and replace bait as needed for continual control. Position Refillable Bait Stations adjacent to structure in areas where they will not be damaged by lawn equipment such as mowers and trimmers. When placing the station in turf remove sod layer and place station base plate against the soil.

Applicator should not exceed 1/5 teaspoon of gel in refillable bait stations.

If the station is not equipped with a sticker to identify the contents, apply a sticker to the inside of the station.

Directions for loading reservoirs and operation:

1. With the teeth of the drive rod facing up, pull the drive rod all the way back. If the drive rod is initially hard to move, simply un-screw (turn counter-clockwise) the black portion of the applicator that holds the gel reservoir until the drive rod moves easily.
2. Attach a pre-filled reservoir of gel with a twist-locking motion. Remove the outlet cap and attach a dispensing tip. After use, the reservoir may be resealed with the enclosed black outlet cap. The black outlet cap is reusable.
3. Turn the knob of the drive rod so that the teeth are facing down and move it slightly forward so that the trigger mechanism will engage. Squeeze the trigger until the drive plunger seats against the piston in the gel reservoir. Gently squeeze the trigger until the gel flows out.
4. If gel continues to flow after the trigger is released, simply un-screw the portion of the bait applicator that holds the reservoir to a point where gel does not continue to flow after the trigger is released.

Directions for changing reservoirs: With the arrow on the drive rod pointing up, pull the drive rod out as far as it will go. Remove the empty reservoir and follow instructions in the Storage and Disposal box. Reservoirs that still contain gel can be sealed with the end cap and outlet cap for future use. To attach a new reservoir follow the above directions.

Pest population reduction will be apparent with 2 -or- 3 days for German roaches and 8 days for American roaches.

Application Rate Table

SPECIES/LEVEL OF INFESTATION	APPLICATION RATE (PER SQ YD)
MODERATE INFESTATIONS OR RE-TREATS FOR GERMAN OR BROWN-BANDED ROACHES: LIGHT TO MODERATE INFESTATIONS OF PANTRY PESTS	1-2 SPOTS (DIME SIZED) OR 1 1/2” – 3” BEAD
SEVERE OR HEAVY INFESTATIONS FOR GERMAN OR BROWN-BANDED ROACHES HEAVY INFESTATIONS OF PANTRY PESTS	2-4 SPOTS (QUARTER SIZED) OR 3” -6” BEAD
LARGE ROACHES SUCH AS AMERICAN, SMOKEY-BROWN OR ORIENTAL:	RECOMMENDED SPOT SIZE 1/3” - 1/2”

Most important locations:

Behind appliances, along baseboards, under appliances and under sink.

IMPORTANT: READ BEFORE USE

Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of Liability before using this product. If terms are not acceptable, return the unopened product container at once.

By using this product, user or buyer accepts the following Conditions, Disclaimer of Warranties and Limitations of Liability.

CONDITIONS: The directions for use of this product are believed to be adequate and must be followed carefully. However, it is impossible to eliminate all risks associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Bayer CropScience LP. All such risks shall be assumed by the user or buyer.

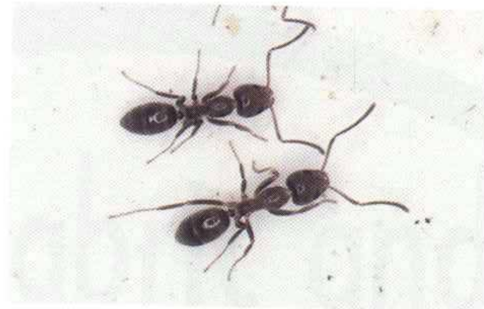
DISCLAIMER OF WARRANTIES: TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, BAYER CROPSCIENCE LP MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer CropScience LP is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, Bayer CropScience LP disclaims any liability whatsoever for special, incidental or consequential damages, resulting from the use or handling of this product.

LIMITATIONS OF LIABILITY: TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID, OR AT BAYER CROPSCIENCE LP 'S ELECTION, THE REPLACEMENT OF PRODUCT.

Produced for:
Bayer Environmental Science
A Division of Bayer CropScience LP
2 T. W. Alexander Drive
Research Triangle Park, NC 27709
Product of China

Pest Ants

Acrobat ant



Argentine ant

Bigheaded ant

Crazy ant

Florida carpenter ant

Ghost ant

Imported fire ant

Little fire ant

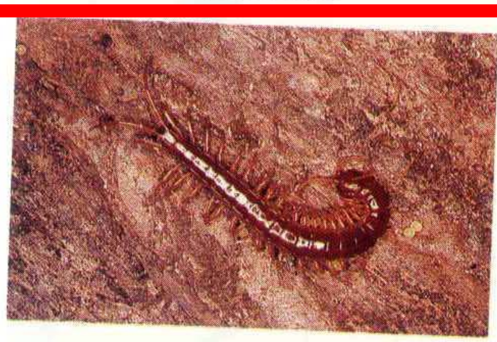
Native fire ant

Pharaoh ant

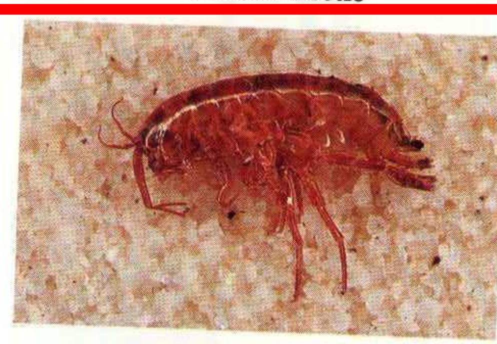
Pests Associated with Mulch and Moisture

Booklouse

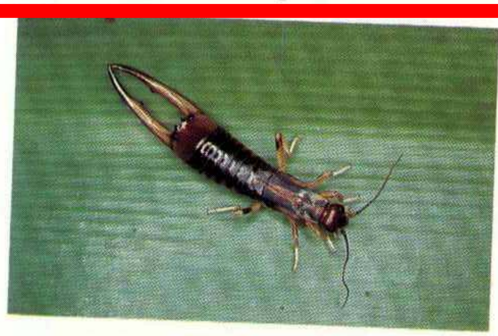
Plaster beetle



Centipede



Amphipod



Earwig

Millipede

Pillbug

Sowbug

Fungus gnat

Springtail

Pests that Occasionally Invade Structures

Silverfish

Scorpion

Cricket

Bark beetle

Long-horned wood boring beetle

Ground beetle

Thrips

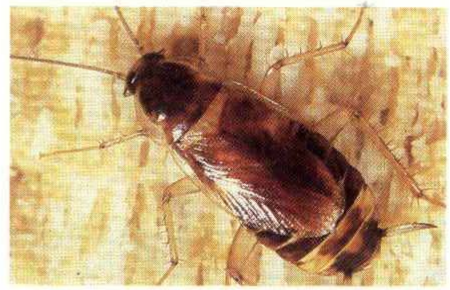
Scarab beetle

Ambrosia beetle

Plaster bagworm

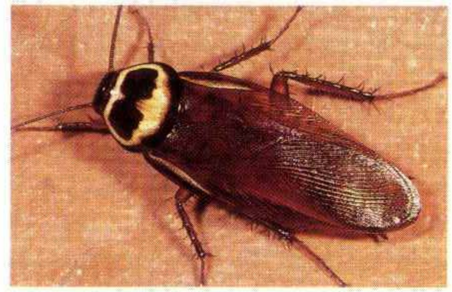
Cockroaches

German cockroach



Brown-banded cockroach

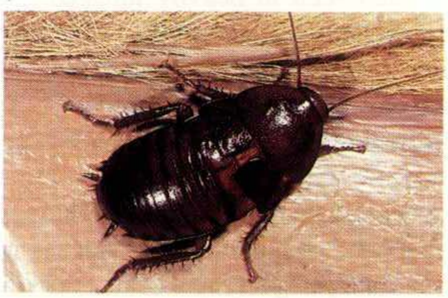
American cockroach



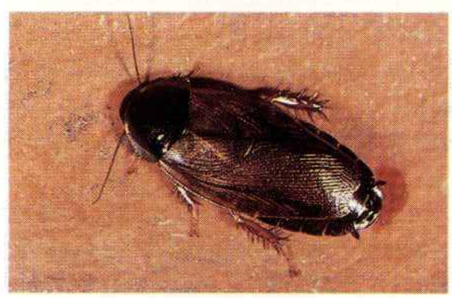
Australian cockroach

Smoky-brown cockroach

Brown cockroach



Florida woods cockroach

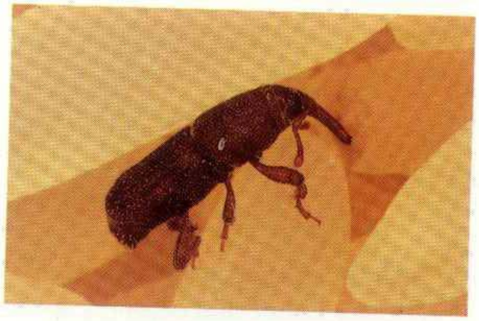


Surinam cockroach

Oriental cockroach

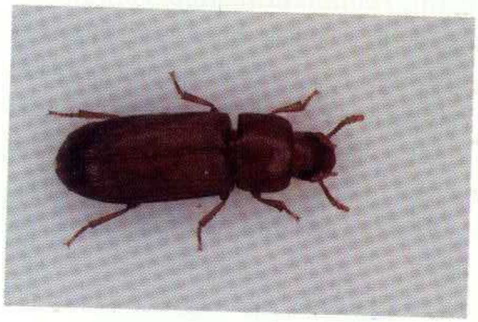
Cuban cockroach

Stored Product Pests



Rice weevil

Lesser grain borer



Red flour beetle

Sawtoothed grain beetle

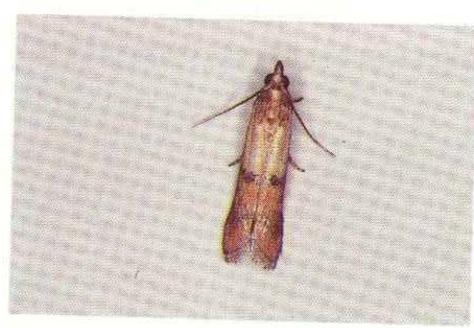
Cigarette beetle

Drugstore beetle

Cowpea weevil

Mealworm adult

Almond moth



Indianmeal moth

Venomous Spiders in Florida

Southern black widow

Southern black widow

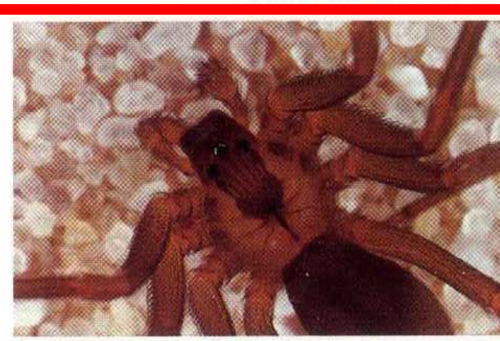
Red widow

Red widow

Brown widow

Brown widow

Brown recluse



Brown recluse

Wasps and Bees

Bumble bee

Cicada killer

Honey bee

Honey bee swarm

Mud dauber wasp

Mud dauber brood chamber

Paper wasp

Paper wasp nest

Yellowjacket

Yellowjacket nest

Questions on Recent GHP Exams

The following information has been on previous GHP Certified Operator State Exams. The information highlighted in yellow has been on the most recent tests (last 2 or 3)

Identification/Pictures on Test

Booklice/psocids	Smoky-brown roach	Scorpion
Surinam roach	Lesser grain borer	Acrobat ant
Brown-banded roach	Ground beetle	German roach
Mud dauber wasp	Millipede	Field roach
Cow pea weevil	Centipede	Springtail
Fungus fly/gnat	Red flour beetle	Silverfish
Paper wasp	Indian meal moth	Sawtoothed grain beetle
Florida woods roach	Black widow spider	Cigarette beetle
Carpenter ant	Brown recluse	
Earwig	Lawn shrimp/Amphipod	
Plaster bagworm	Pillbug	

Core and IPM

- Know the Signal Words
    - o Extremely Toxic = Danger
    - o Moderately Toxic = Warning
    - o Low/Slight Toxic = Caution
- MUST BE ON ALL LABELS= "Keep out of reach of children"
- Your SALESMAN NEEDS TO HAVE AN ID CARD!
- EACH Licensed Business Location NEEDS: Copies for all labels of materials used, records of pesticides applied, copies of 13645s completed, The Cert Operator's Certificate.
- MUST BE IN PHONE BOOK if licensed business: Licensees name or trade name registered with the Dept., complete business location and address and telephone numbers.
- Letters on sides of vehicles need to be at least 1.5 inches high
- Magnetic signs are prohibited except with vehicles used without chemicals such as in sales/managers.
- If not renewed, a business license automatically expires 60 days after the renewal date.
- Your business license automatically expires: after a change in business location or business name
- EPA registers all pesticides and approves product labels and makes it illegal to store or dispose of pesticides/containers other than directed.

- EPA Establishment # = facility that produced the product (also includes Manufacturer and Chemical)
- EPA Registration #= Manufacturer and chemical
- If not timely renewed, a certificate or special ID card will expire 180 days after the RENEWAL DATE.
- To obtain an occupational license, show them your: FDACS pest control LICENSE
- LD50: lethal dose of a pesticide necessary to kill 50% of the test population
    - If the LD50 of a pesticide is 50, how many test animals will die if fed this product? 25
    - If the LD50 of a pesticide is 2345, how many will die? ½.
- If applicators clothing has been contaminated with pesticide spray, it should be: WASHED IN HOT water using phosphate soap + 2 WARM water rinses.
- Acute effects = WITHIN 24 hours
- If poisoning by EITHER dermal or oral exposure will result in ACUTE illness, the POISON & Skull/Crossbones must be on the label.
- Solvent = a liquid such as water, kerosene, alcohol, that will dissolve a pesticide to form a solution.
- Leaching = movement of pesticide in water or liquid form DOWNWARD through the soil or medium
- Skin/dermal usually gets the most exposure when mixing/applying pesticides.

- Point source contamination: is from one major spill that contaminated a body of water with a known point of spill
- Non-point source contamination: is from movement of pesticides via a large rain that washes many treatments into a body of water.
- Adsorption = attachment of pesticide to soil particles so they stay there
- Absorption = sucking up like a sponge
- MSDS = Material Safety Data Sheet
    - MSDS for every product used must be available at SC
- Know difference between label and labeling
- Licensees need to maintain training records for at least a 2-year period for all ID cardholders within their employ and make these records available to State Inspectors during routine inspection
- Certified Operator in Charge = needed for all categories a company is doing business in: CO needs to have primary occupation in Pest Control, Employed full-time by the licensed company, and have primary duty of supervising the licensee's operation.
- Vehicles AND trailers used in treatment of customer's homes need to be marked with the licensee's NAME THAT IS REGISTERED WITH THE DEPT.
- Licensee name must be on truck

- License expires 60 days from anniversary date
- NOT REQUIRED TO HAVE ID CARD= office, secretarial, clerical, trenchers, diggers, rakers, hose pullers, putting up/clipping/taking down tents, carrying debris.
- Respirator CARTRIDGES are approved by NIOSH (National Institute for Occupational Safety & Health) or the US BUREAU OF MINES/MSHA (Mine Safety & Health Administration)
- Respirators should be stored SEALED IN CLEAN PLASTIC BAGS/CONTAINERS
- Must apply for ID card for each employee within 30 days of hire.
- ID cardholder needs 5 days of training before performing pest control under Ch.482.
- Days to notify change of CO's ADDRESS OR PHONE= 10 days
- It is not necessary to keep copies of business records at the licensed business location.
- Pesticide that can cause serious acute poisoning has all: DANGER/POISON/SKULL/CROSSBONES
- Florida CEU's can be obtained out of state! As long as: you have proof of attendance, proof it was at least 50 minutes, a copy of the program. Generally these programs have prior approval from FL and they tell you at the out-of–state location. The program DOES NOT have to be DACS approved.
- Need 2 hours of core for certification renewal
- What are the topics that can be covered for core: pesticide safety, formulations, IPM, Laws
- Know the late fee for Initial certificate and Renewal of Certificate
- Emergency certificates occurs immediately on the Date of the LOSS or EMERGENCY.
- After a certificate has been revoked, reapplication can be made for another certificate after 3 years
- Triple rinsing: know definition
- The outdoor sign that yard was treated stay off till dry is best posted:
    - **by road**
    - by front sidewalk to main entry
    - middle of the yard
    - between driveway and front sidewalk

Answer is the most conspicuous location, which in this case guess A.

- What is the maximum distance that a chemically sensitive person can request pre-notification?
    - Adjacent/contiguous
    - ¼ mile
    - 1/8 mile
    - **½ mile = correct answer**

- If clothing is contaminated…wash in hot water and **phosphate** soap
- ID card holder can apply a restricted use pesticide, if under the supervision of a Certified Operator
- *What is the best way to clean a vehicle because of a spill (not sure of the exact wording of this answers)*
  - *Do you just use water*
  - *Straight bleach, water, and detergent*
  - ***Bleach/water solution, detergent, and water (correct answer)***
- Magnetic signs be used on vehicles not carrying chemicals
- EPA registers and approves pesticides
- You have a spill: do you report if more than 10 gallons and/or SARA act
- Letters on vehicle: 1.5 inches high
- Permanently marked vehicle or trailer if used for pest control
- Don't have to keep business records at business location
- When in doubt, check the label for PPE requirements
- ID cardholders must keep in contact with CO for changes in formulations, mixing procedures, PPE, etc
- A person cannot perform fumigation on his own property without a certificate
- Can temporarily move an ID cardholder from one business location to another as long as they are not the CO in charge
- ID card training record: if on an inspection, the Service Center does not have them, what happens
  - Take away the licensees assets
  - Close down the business
  - **Fines/penalty**

Issuance and Renewal Fees
For Certificate: $150
For Special ID card (fume): $100
For Employee ID card: $10

Late fee for a Certificate: $50

- Employee ID card is renewed annually on the anniversary date of the business license
- When a certificate is revoked, reapplication can be made after 3 years
- Probation can be no longer than 2 years

Chemicals

- The most pervasive and well-known energy inhibiting insecticide is hydramethylnon. Found in Amdro bait, Seige Gel Bait
- Mixing chemicals: The order to mix them is, use the acronym, WALE
    - **W**ettable powder/water dispersable
    - **A**gitate
    - **L**iquids
    - **E**mulsifiable Concentrates
- The 3 C's of chemical spills are Confine, Control, and Clean-up
- When buying a pesticide, what do you look for to ensure you are getting the right active ingredient:
    - Brand name
    - **Chemical Name**
    - Formulation
    - Pesticide class
- You can apply a chemical to an area that is on the label even if the insect is not on the label
- You can never have enough PPE as long as you have what the label calls for.
- Organophosphates, Carbamates, Nicotine can cause
    - Headaches, dizziness, weakness, shaking, nausea
    - Stomach cramps, diarrhea, sweating
- Arerosols are not categorized as fumigants.
- It is illegal to apply a chemical to a site not listed on the label
- The best way to get rid of a extra chemical/rinse water, it to put on labeled site
- What is back-siphoning: getting into the water source
- Best way to avoid exposure to a chemical when handling is to wash hands after use.
- If have LARGE spill, what is the most important equipment to have:
    - **Shovel**
    - Absorption snake
    - Activated charcoal
- The 2 major responsibilities when applying pesticides:
    - Protecting yourself and the environment
    - Ensuring the pesticide gets applied correctly
- Know why you call CHEMTRAC: in case of emergency
    - Question asks what do you call for (true or false question):
        - 1. **spills (correct answer)**
        - 2. storage and disposal
- You can find all information on storage and handling of a pesticide on the label and MSDS
- You can find all information on spill cleanup of a pesticide on the label and MSDS

- When can a restricted use pesticide be used and by whom: can be used by an ID holder, but only under the supervision of a CO
- Use of foam added to a pesticide mixture improves the coverage
- Study all listed IGR Methoprene, Hydroprene, Fenoxycarb, etc. and what each does to kill the pest.
- Hydroprene, Methoprene, fenoxycarb, pyriproxyfen are juvenoids (also known as Juvenile Hormone Analogs)
- Lufenuron is a Chitin Synthesis Inhibitor
- Hydramethylnon = A slow-acting insecticide that DISRUPTS ENERY METABOLISM
- Which soil is most permeable? Sand, muck, loam, or clay?
- Resistance develops genetically within a population.
- Know formulation types
    - Wettable powders, EC's, Microencapsulates, etc
- OP's, Carbamates, and Nicotine can cause headaches, dizziness, weakness, shaking, nausea, stomach cramps, and diarrhea

1. Nervous System
   Pyrethroids
   Organophosphates
   Carbamates
   Avermectin: derived from a fungus
   Imidicloprid
   Fipronil

2. The production of energy- the insect runs out of gas
   Hydramethylnon: active ingredient in Seige and Amdro
   Sulfluramid
   Sulfluryl fluoride: fumigant

3. Endocrine System
   - Also known as Insect Growth Regulators (IGR)
   - Low mammalian toxicity, persistent in the environment, slowly cause death
   - Mimic the action of juvenile hormone
       - Keep insect in mature state, they are unable to molt successfully
   - In adult stage, they cannot reproduce normally
   - Hydroprene, methoprene, pyriproxyfen, fenoxycarb

4. Inhibition of Cuticle Production
   - Known as chitin synthesis inhibitors
   - Inhibit the production of chitin

- Do not allow the insect to synthesize new cuticle, preventing them from molting to the next stage of the life cycle
- Lufenuron, diflubenzuron, hexaflumuron
    - Lufenuron: used in Flea control

5. Water Balance
- Boric acid and diatomaceous earth
    - When they come in contact with the waxy covering on the insect's cuticle, it is absorbed it results in rapid water loss from the cuticle.

2) Know starlings tail size

3) Understand dangers of bacteria & disease in pigeon droppings..the bacteria in droppings or bird mites more dangerous?

4) The new replacement CO begins NOT when they're hired, it begins from the date of the loss of the replaced CO.

5) Honeybee stingers should NOT be pinched or squeezed off with tweezers..THEY SHOULD BE **SCRAPED** OFF with a credit card, hard paper edge, etc. so as not to squeeze venom in any more

6) Head lice and ticks ~6 Q's.

7) Indianmeal moth photo & 1 Q. about

8) The Q. about the photo of a carpenter ant deals with how it can become resistant to insecticides...it's a genetic carryover from survivors.

Rodents

- Mouse traps should be placed about every 6 feet in double sets in areas of activity along perimeter of walls.
- Vitamin K is the antidote of 2nd generation AND conventional anticoagulant rodenticides.
- Warfarin is a multifeedant rodenticide = MANY feedings needed.
- Openings into hollow walls, particularly between floor sills should be closed up with no larger than ½ inch (19-guage) mesh galvanized wire cloth.
- Mouse foraging territory is between 10-30 feet from the nest.
- Rats will travel 25-100 feet from the nest
- Roof rats' tails are longer than head AND body combined.
- Roof rat is also known as black rat.
- Main difference between a mouse and young rat?
- Know the diseases caused by rodents…including plagues, Murine Typhus, Rickettsial pox, Leptospirosis (weil's disease), food poisoning (salmonellosis), trichinosis, rabies,
- Plague: most widely known and feared disease
- Leptospirosis (Weil's Disease): most widespread and most prevalent zoonotic disease (transferable from lower animals to man)
- Water needs for rodents
- Rodents can detect contaminants and chemicals in their food in parts of less than 1 part per million
- Rodent urine will fluoresce under ultraviolet light
- Know identifying characteristics of rodent feces
- Know Anticoagulant and Non-anticoagulant rodent baits
  - Know which were 1st generation and which were 2nd generation
- Active ingredient of the rodenticide, Colecalciferol is vitamin D_3
- Vitamin K_1 is the antidote for anticoagulant rodenticides

Fleas

- Young fleas hatch within 2 days in egg and then feed on dandruff, grain particles, skin particles, and adult flea feces.
- New adults can emerge from cocoons just 2 weeks after cocoon forms
- They can develop faster at higher temps but can remain dormant for up to 12 months.
- "Flea-Dirt" is dried reddish brown fecal pellets of dried up digested blood dropping from adult fleas clinging onto the host, falling off of host into environment where flea larvae exist and eat the flea dirt.
- 3 things needed to encourage pupae to emerge from cases
  - Vibrations and/or increase in CO2 stimulate adult emergence.
  - Heat is also needed
- IGR's for flea control include: Lufenuron, pyriproxifen, & methoprene.
- These are highly important in flea control.
- Also, adulticides = Permethrin, fipronil (Front Line), Imidicloprid

- Imidacloprid, applied as a spot-on had almost 100% efficacy for 1 month against fleas on dogs and cats.
- Female fleas can increase their body weight up to 15 times when feeding.
- Adult fleas have piercing-sucking mouthparts.

Ticks

- American Dog Tick may carry Rocky Mountain spotted fever, tularemia, and other diseases from animal to people.
- In 1988 5,600 cases of Lyme disease (only 5,000 cases from 1975-87)
- Very few cases of Lyme disease in FL
- Lyme now most significant Tick borne disease, surpassing Rocky Mtn Spotted Fever

Lice

- Read information on head lice
- Read information on lice on animals: how to treat for dog lice

Ants

- Ant antennae are used for: SMELL/TOUCH.
- Fission or Budding occurs with : Pharaoh and Argentine ants
- Trophallaxis aids in the distribution of LIQUIDS= feeding from ant to ant through liquid regurgitation.
- Carpenter ants enter buildings to nest or forage. They excavate nests in softer wood creating smooth tunnels and galleries.
- Carpenter and crazy ants have circle of hair around the tip of their abdomen

Cockroaches

- Cockroaches go through gradual metamorphosis
- German roaches:
    - Pheromones found in feces influence aggregation in cracks and crevices
    - Younger nymphs are more effected by aggregation pheromones than older nymphs and adults
- Female German roaches will carry egg case until nymphs hatch from eggs inside the egg case
- Male brown-banded roaches fly indoors and outdoors.
- American roaches: have stylets present
- Brown roaches: no stylets
- Brown roach nymph: the first 8 and last 4 antennal segments are white, the middle segments are brown
- Brown banded roach is more likely to be found in the kitchen in the motor of the refrigerator

- Female American roaches GLUE their egg capsules to suitable surfaces… often the capsules are painted over, but the roaches try and place the capsules in crevices or bury them in soft wood or material.
- The smoky-brown roach is easily recognized by its uniform MAHOGANY BROWN coloration. It is slightly smaller than the American Roach.
- Cockroach aversion occurs most commonly with GLUCOSE.
- Which of the following formulations are least effective against cockroaches
  - Wettable powders
  - **<u>Emulsifiable Concentrates</u>**
  - Dust
  - Microencapsulates

Because EC's do not adhere well to non-porous surfaces and are absorbed into porous surfaces, they are not typically the best choice for cockroach control or crawling pests in general.

<u>Stored Product Pests</u>

- Cigarette beetle infests stored <u>tobacco</u> as well as many other stored dry foods such as rice, ginger, dried fish, and pyrethrins.
- Pheromones are excellent IPM tools when used in TRAPS.
- Sawtoothed grain beetle has 6 projections on EACH side of thorax, flattened body, and adapted for crawling onto crevices.
- Sawtooth grain beetles do not fly
- Male sawtoothed grain beetle has a tooth on femur of hind leg, female does not.
- Control of these beetles includes discarding infested packages, heat or cold will kill them if a small package, or residual crack/crevice trts.
- Red flour beetle: club of four segments/ Confused flour beetle: no club.
- Indianmeal moths: wingspan 5/8 inch, outer 1/3 has reddish-copper scales.
- Drugstore Beetles have grooves in elytra (upper shell).

<u>Fabric Pests</u>

- Black carpet beetle is the most abundant and widespread and the most destructive of the carpet beetles

<u>Bed Bugs</u>

- Read material on biology, inspection, identification, and control measures

<u>Other Pest Questions</u>

- <u>Plaster bagworms</u> are small moths that develop as caterpillars inside a "Plaster" (gathered bits of plaster around bag) sac that looks like a watermelon seed. They can feed on woolens/rugs, but normally feed on spider webs.

- Africanized bees are more dangerous than European because they protect their nests more aggressively.
- Masses of field crickets during mating season caused power outages by clogging air filters because they were attracted to lights.
- "Jumpiness" is evidently a reaction of nervousness some people exhibit from bites of bedbugs.

Questions or portions of questions remembered from March 2010 GHP Exam:

- **Sulfluramid:**
  Is fast-acting?
  Is a good bait?
  Is a chitin synthesis inhibitor?
  Is for ants?
  All of the above? Research this topic.

- **The ground beetle photo –This beetle is a predator.**
- **When Danger AND Skull & Crossbones are <u>both</u> on a label, what does this indicate? How does this differ from just Danger on the label?**
- **For pigeon control – what is the best method?**
  Getting rid of the nest? Exclusion? Trapping them in a cage? Bait that sickens and scares them away? Research for best method(s).

- **Exactly how many days after a new Team Member who starts with Massey and begins to train can we apply for an ID card without penalty? We can actually wait up to _____ days.**
- **4 questions on IGR- Juvenoids**
- **1 Q on type of rodenticide such a common name for a 2nd generation anticoagulant (choose from 4 names) is named _______.**
- **2 questions about hydramethylnon – being a chitin synthesis inhibitor or a bait or a juvenoid or how does it act to kill a bug?**
- **When does a CO need to report an employee injury in writing? When slightly cut, when minor bruising occurs?**
- **2 Q's about mites: Are they attracted to fruits, grain, flour? 2nd and third stages are called?**
- **On Allectus G label, use the 5.7/1000 label direction section.**
- **For the license, beware of questions that deal with license and certificate. The Certificate is not the license. One has a sixty day renewal period. What expires if not renewed in 180 days?**
- **The smokybrown roach is even, dark greasy mahogany colored. The American roach is also mahogany but has a marking of a lighter halo on the pronotum.**
- **Asian roach and German roach differ: one flies and is attracted to light, living mainly outside. The German roach lives only indoors.**
- **The mosquito is a type of fly.**
- **Know the difference between a suspension and a solution…what has a carrier and what only has water?**
- **Toxic tracking powder is used for: Killing rodents? Tracking rodents? Only one, or both?**
- **WHICH SPECIES OF RODENT IS BEST BAITED BY USING A RAISIN?**
- **Which spray type is best when drift is a possible problem? Course or fine mist?**

- **The brown dog tick: how many eggs produced? ~1600-3000? Found in wooded areas? (The brown dog tick is the most commonly found indoor tick in Florida)**
- **If you only have 5 employees or less you do not have to report an injury accident.**
- **If you have over 11 employees you must report lost time accidents and adhere to the OSHA rules.**

Questions or portions of questions remembered from December 2010 GHP Exam:

- **Know photos of:**
  - ❖ **Widow spider**
  - ❖ **Brown Recluse**
  - ❖ **Red flour beetle**
  - ❖ **Drugstore beetle**
  - ❖ **Cigarette beetle**
  - ❖ **Indianmeal moth**
  - ❖ **Almond moth**
  - ❖ **Cowpea weevil**
  - ❖ **Bark Beetle**
  - ❖ **Plaster Beetle**
  - ❖ **Book Louse (Psocid)**
  - ❖ **Centipede**
  - ❖ **Amphipod**
  - ❖ **Green Bottle fly**
  - ❖ **Bed bug**
  - ❖ **Yellowjacket**
  - ❖ **American Dog Tick**
  - ❖ **Deer Tick**
  - ❖ **(1 of 3 photos above have a question associated with the photo)**

- **Do NOT have to know any rodenticide names (like bromodialone or Contrac Blox)**
- **American Roaches are the most common roaches in Florida= correct answer, even though we would think that German roaches are.**
- **There are at least 10 questions on Allectus…a given…you should get all questions correct as the label is open reading…just find answers.**
- **5-7 questions on the humpbacked fly (phorid fly)**
- **5-6 flea life cycle questions (one involves difference between cat flea and dog flea (know head length differences and how legs differ)**
- **4-5 questions on habitats of cockroaches**
- **5-6 questions on CO Certificates**
- **2 questions on houseflies**
- **Insurance coverage "in aggregate" must be purchased to cover damages to : ?? Answer $400,000.**
- **The active ingredient in Termidor is??? in Demand? in Suspend? Amdro?**

GHP Sample Exam

I. The most common tick in Florida found indoors is __________________.
   A. the American Dog Tick
   B. the Brown Dog Tick
   C. the deer tick (black-legged tick)
   D. the Lone Star Tick

2. The tick that can carry Rocky Mountain spotted fever is:
   A. the American Dog Tick
   B. the brown dog tick
   C. the deer tick
   D. the Florida dog tick

3. The following statement is false:
   A. There are very few cases of Lyme disease in Florida
   B. Lyme disease is now more prevalent than Rocky Mountain Spotted Fever
   C. The American Dog Tick can carry Tularemia
   D. Brown Dog Ticks often bite humans as well as other animals

4. The following tick is the main carrier of Lyme Disease:
   A. the American Dog Tick
   B. the brown dog tick
   C. the deer tick
   D. the Florida dog tick

5. IGR's for flea control include
   A. Lufenuron, methoprene and fipronil
   B. Pyriproxifen, imidicloprid and permethrin
   C. Hydroprene, methoprene and novaflumeron
   D. Methoprene, pyriproxifen and lufenuron

6. Adult fleas have:
   A. Stylets for sucking blood
   B. Sword-like mandibles
   C. Rasping/sucking mouthparts
   D. Piercing-sucking mouthparts

7. The eggs of head lice are called:
   A. grains
   B. nits
   C. ovae
   D. specks

8. The following are not insects:
   A. head lice
   B. ticks
   C. silverfish
   D. book lice

9. The difference between the cat flea and dog flea is ________________.
   A. The cat flea's head is twice as long as high but not with the dog flea
   B. The dog flea's head is twice as long as high but not wit the cat flea
   C. The cat flea's head is twice as long as the dog flea's head
   D. The dog flea's head is 2x as long as the cat flea's head

10. The difference between the rice and granary weevil is that___________.
    A. The granary weevil is attracted to light and the rice weevil is not.
    B. The granary weevil has red markings on the back
    C. The rice weevil has red markings and flies to light but the granary weevil does not.
    D. The granary weevil is considered to be the most important stored product pest.

11. The beetle with 6 projections on each side of the thorax is:
    A. The granary weevil
    B. Sawtoothed grain beetle
    C. Hide beetle
    D. Red Flour beetle

12. The bird often seen in parks, suburbs and farms from late summer to spring, primarily a ground feeder, about 7.5 -8.5 inches long with a SHORT TAIL is:
    A. Wren
    B. Pigeon
    C. Starling
    D. House sparrow

13. The main danger posed by pigeon droppings is:
    A. bird mites surrounding the area
    B. pharaoh ants trailing through the area
    C. bacteria and viruses in the droppings
    D. stains on the sides of the building and on the ground

14. To properly remove a honeybee stinger:
    A. scotch tape it out
    B. pinch it and pull
    C. pull it out with tweezers
    D. scrape it out sideways with a credit card or hard paper

15. This pest is most common in grocery stores, warehouses and kitchens, especially in flour, cornmeal, broken grains, dried fruit, nuts and chocolate bars, spinning webs that also contaminate the food even more:
   A. Drugstore beetle
   B. Granary weevil
   C. Carpet beetle
   D. Indianmeal moth

16. Mouse foraging distance from their nest is typically:
   A. 5-10 feet
   B. 10-30 feet
   C. 30-50 feet
   D. 50-75 feet

17. The rodent whose tail is longer than the head and body length combined is:
   A. Norway rat
   B. Roof Rat
   C. House mouse
   D. Mole

18. The main difference between a mouse and young rat is:
   A. The tail length of the rat is much longer
   B. The mouse typically has lighter fur
   C. The size of the feet and head in relation to the body are larger on the rat
   D. all of the above

19. Some of the diseases rodents can spread are:
   A. Malaria and plague
   B. Murine typhus and encephalitis
   C. Leptospirosis and rabies
   D. all of the above

20. The rodenticide with an active ingredient being vitamin D3 is:
   A. bromodialone
   B. bromethalin
   C. colecalciferol
   D. Contrac Blox
   E. Generation

21. The most widespread and most prevalent zoonotic disease from lower animals to man is:
   A. Leptospirosis (Weil's Disease)
   B. Malaria
   C. Yellow fever
   D. Swine Flu

22. Rats exhibit a fear of new objects or changes around them. This condition is commonly called:
    A. Cryophobia
    B. Necrophobia
    C. Narcophobia
    D. Neophobia

23. Rats have:
    A. Great sense of smell. touch and vision
    B. Poor sense of smell and vision
    C. Great sense of taste and hearing
    D. Poor ability to swim
    E. Both A & C

24. Norway rats:
    A. usually nest in the ground
    B. are larger than roof rats
    C. have blunter noses and larger feces than roof rats
    D. have smaller ears and tails than roof rats
    E. all of the above

25. Roof rats normally have:
    A. about 6 litters from 6-8 per litter
    B. about 8 litters from 4-6 per litter
    C. about 4 litters from 8-10 per litter
    D. about 10 litters from 4-6 per litter

26. Roof rats can squeeze through a hole:
    A. about ½ inch in diameter
    B. about ¼ inch in diameter
    C. about 1/8 inch in diameter
    D. that must be at least ¾ inch in diameter, that’s why ½ inch mesh screen is advised for rodent proofing

27. Like rats, mice can also spread:
    A. leptospirosis
    B. rickettsialpox
    C. salmonellosis
    D. A & C
    E. all of the above

28. Direction of rodent urine trails can be detected as activity increases using:
    A. your nose to smell the location
    B. a mist of vinegar water over the area to darken the color
    C. an ultraviolet light over the area to make the trail fluoresce
    D. all of the above methods

29. Mice :
    A. have a litter every month producing an average of 6 per litter
    B. have a litter every 2 weeks producing an average of 8 per litter
    C. have a litter every 50 days with about 6 per litter
    D. have a litter every month with about 8-10 per litter

30. Which roach needs the least amount of moisture to survive and is usually found in drier locations?
    A. American
    B. Australian
    C. Brown-banded
    D. Smokybrown
    E. Brown

31. These roaches are least associated with leaf litter:
    A. Surinam, Asian and Smokybrown
    B. American, German and Brown-banded
    C. Surinam, Asian and Brown
    D. Australian, Oriental and Surinam

32. Exotic nuisance birds include:
    A. Starlings and Least Terns
    B. English (House) Sparrows and Peafowl
    C. Barn Owls and Mynah birds
    D. English (House) Sparrows and Starlings

33. These birds are protected and need State/Federal Permits to control:
    A. Swallows, swifts and woodpeckers
    B. Least terns, Muscovy ducks and starlings
    C. Chimney swifts, wild chicken and peafowl
    D. Carolina Wren, sparrows and pigeons

34. Avitrol is an avicide that controls birds and can only be used with a Florida Avitrol permit to control:
    A. any local birds not federally or state protected such as Muscovy ducks
    B. only starlings and pigeons
    C. only pigeons
    D. Avitrol can no longer be used in Florida

35. The following rodenticides are not anticoagulants:
    A. Bromadiolone and Coumafuryl
    B. Difethialone and Bromethalin
    C. Diphacinone and Warfarin
    D. Zinc Phosphide and Brodificoum

36. The following rodenticide causes hypercalcemia:
    A. Vengeance
    B. Maki
    C. Quintox
    D. Contrac
    E. Talon

37. Bromadialone is the active ingredient in:
    A. Maki
    B. Final
    C. Vengeance
    D. Generation

38. Brodificoum is the active ingredient in:
    A. Generation
    B. Contrac
    C. Final
    D. Vengeance

39. Examples of Multi-dose anticoagulants are:
    A. Final and Talon
    B. Talon and Contrac
    C. Rozol and d-Con
    D. Quintox and Maki

40. Anticoagulants include:
    A. Single dose and multiple dose
    B. multiple dose and hypercalcemic
    C. anti-vitamin K materials
    D. all of the above

41. Bromadialone is a :
    A. single-dose anticoagulant
    B. multiple dose anticoagulant
    C. anti-vitamin K agent
    D. causes hypercalcemia

42. When using pellets or grain rodenticide:
    A. always place them in a protected station
    B. place them in an immovable protected station
    C. place them only in voids and attics
    D. all of the above

43. When placing out single-dose rodenticides:
   A. Be sure stations are marked to indicate “Keep out of reach of Children”
   B. Relocate stations when no activity is seen
   C. Record the location of the placement on paperwork
   D. Eliminate competing food sources first
   E. all of the above

44. Tracking powder should be used:
   A. carefully in ceilings above the dining area when trap shy rodents can not be controlled
   B. in baited rodent stations
   C. only after placing on a dust mask or respirator
   D. all of the above

45. When competing food sources can never be removed, then
   A. use tracking powder
   B. bait heavily with fixed single-dose blox
   C. place out liquid baits in fixed stations away from kids or pets
   D. none of the above

46. Histoplasmosis is
   A. most associated with bird droppings that have massed for over 3 years
   B. especially common under pigeon roosts
   C. easily decontaminated with soap and water
   D. often created by huge flocks of annually migrating birds roosting in trees
   E. A & B
   F. A & C
   G. A & D
   H. all of the above

47. Budding, or breaking up of a colony into subcolonies occurs most commonly:
   A. with white-footed ants
   B. with fire ants
   C. with pharaoh ants
   D. with acrobat ants

48. Carpenter ants:
   A. can eat wood
   B. nest and forage in wood
   C. excavate nests in soft or rotten wood
   D. all of the above
   E. B & C

49. Cockroaches undergo this form of development:
    A. complete metamorphosis
    B. have no metamorphosis
    C. gradual development
    D. hatch from ootheca

50. These materials do not cling well, but are absorbed into porous surfaces and therefore not the best for roach control:
    A. Dusts
    B. WPs
    C. Microcaps
    D. EC's

51. Cockroach aversion occurs most commonly when _______ is added to bait:
    A. fructose
    B. any sugar
    C. lactose
    D. glucose

52. This pest infests stored tobacco, and other dried teas, rice, ginger dried fish:
    A. merchant grain beetle
    B. cigarette beetle
    C. larder beetle
    D. carpet beetle
    E. angoumois grain moth

53. The cigarette beetle differs from the drugstore beetle by:
    A. its smaller size
    B. its larger size
    C. its smooth elytra (upper shell)
    D. its grooved elytra

54. This moth has 2 color sections on its upper wings: pale gray on the first 1/3 and reddish-copper scales on the outer 2/3 of the front wings:
    A. The almond moth
    B. The plaster bagworm
    C. The angoumois grain moth
    D. The indianmeal moth

55. The most abundant, widespread and destructive carpet beetle is the:
    A. furniture
    B. varied
    C. black
    D. common

56. The larva of this pest gathers small bits of cement around itself for protection, looks like a cement watermelon seed and lives on spider webs:
    A. leaf beetle
    B. bagworm moth
    C. plaster bagworm
    D. spider wasp

57. Africanized bees are more dangerous than European honeybees because:
    A. they are no more dangerous – its just because they attack more aggressively in large numbers, but the stinger is no more potent
    B. their venom is more potent
    C. they are slightly larger than European bees
    D. B & C
    E. A & C

58. The human condition of “jumpiness” sometimes occurs after ________ bites.
    A. flea
    B. tick
    C. spider
    D. bedbug

59. When controlling pigeons, Avitrol can be administered with a license and is effective:
    A. in long-term control
    B. at controlling a local population only if it is used to kill the flock
    C. whenever it is used because the pigeons give out a poisoning distress call
    D. none of the above

60. Effective control of a local starling population is best accomplished with:
    A. flight interrupter lines
    B. prebaited funnel traps, then baited funnel traps
    C. an electronic frightening device
    D. an ultrasonic device

61. Smokybrown roaches prefer a _____________ environment :
    A. warm
    B. high
    C. open
    D. moist

62. Roaches most prevalent in leaf litter include:
    A. Florida Woods Roaches and Asian Roaches
    B. Asian and german roaches
    C. Australian and brown-banded
    D. American and Australian

63. Ways to reduce cockroach resistance include:
   A. alternate control methods and different active ingredients
   B. lower the pesticide application frequency
   C. use non-repellent materials
   D. use sanitation often
   E. All of the above

64. Because they are similar in size, these 2 birds are sometimes confused:
   A. Scrub Jay and Blue Jay
   B. Blackbirds and Starlings
   C. House Sparrows and Wrens
   D. Pigeons and Gulls

65. Cat fleas can carry:
   A. plague
   B. murine typhus
   C. intermediate host for tapeworms
   D. all of the above

66. Flea larvae:
   A. are cream colored and eyeless
   B. are negatively phototaxic (go away from light)
   C. live on dried blood and flea excrement and other organic particles
   D. all of the above

67. The best control for fleas in the long run is:
   A. Termidor
   B. A veterinarian prescribed spot treatment on the pet
   C. A vet-prescribed treatment for the pet, vacuuming, and a residual application of a flea adulticide mixed with methoprene
   D. steam cleaning the entire interior of the home

68. Ant caste members include:
   A. The queen, sterile females and males
   B. The queen, males, soldiers and minims
   C. The queen, majors, soldiers and workers
   D. The queen, soldiers and workers

69. The fruit fly:
   A. is a common pest in bars
   B. lives on fermenting foods
   C. is also called the vinegar fly
   D. are controlled by sanitation and knockdown insecticides
   E. all of the above

70. House flies:
    A. are best controlled by sanitation and exclusion
    B. are best monitored by periodic pest inspections
    C. feed at night and during the day as adults
    D. are most attracted to UV insect traps

71. Bed bugs can survive without a blood meal for:
    A. 6-7 months as adults and even up to1.5 years
    B. usually 30 days but up to a maximum of 6 months
    C. 1.5 years as adults and long as 2 years
    D. over 2 years

72. Bedbugs:
    A. like mosquitoes secrete a salivary solution to prevent coagulation
    B. hide in cracks, crevices, behind headboards and baseboards in the daytime
    C. are carried into homes and transfer from place to place in used furniture and suitcases by people
    D. feed at night when people are asleep
    E. all of the above

73. Adult fleas are stimulated to hatch from cocoons mainly due to:
    A. the maturation process over time
    B. the presence of a nearby blood meal
    C. increased temperature, vibrations and the presence of slightly increased CO_2
    D. all of the above

74. The most practical treatment for pets to reduce fleas is:
    A. Yeast
    B. Garlic
    C. Shampoo
    D. Ultrasonic collar

75. Fleas can remain in the pupal case for up to:
    A. 1 month
    B. 6 months
    C. 1 year
    D. 2 years

76. One difference between African honeybees and European honeybees is:
    A. Africanized bees attack faster for a very short distance
    B. Africanized bees need a lot of provoking before they get aggressive
    C. Africanized bees abscond (re-hive) more often
    D. Africanized bees tend to swarm less than do European honeybees

77. The spider with an orange to yellowish-red hourglass marking is most likely:
   A. The brown widow
   B. The brown recluse
   C. The brown wolf
   D. The brown orb weaver

78. Recognized by the dark violin marking behind the eyes is:
   A. The brown widow
   B. The brown recluse
   C. The wolf spider
   D. The giant crab spider

79. The most likely place(s) to find a carpet beetle would be:
   A. in the pantry
   B. in the garage
   C. near a wool carpet, leather, silk, animal skin or nest, wasp nest or outdoor flower blossom
   D. hiding in cracks and crevices

80. The webbing clothes moth:
   A. is a golden moth with red-golden hairs on the head
   B. spins webs and partially encloses itself within the rug, fur, feathers, felt in which it feeds
   C. do not carry a silken case around them like the casemaking clothes moths
   D. all of the above

81. Clothes moths can be controlled by:
   A. dry cleaning will kill all stages of the moth
   B. regular cleaning of infested materials
   C. vacuuming well to remove eggs and larvae
   D. maintaining a low humidity
   E. all of the above

82. The following pest(s) attacks and chews through seed coats of whole grains:
   A. Red Flour Beetle
   B. Rice Weevil
   C. Psocids or grain mites
   D. Sawtooth and Merchant Grain Beetles
   E. none of the above

83. The following beetles do not fly:
   A. Sawtooth Grain Beetle and Granary Weevil
   B. Cigarette and Drugstore Beetles
   C. Ground Beetles and Dung Beetles
   D. all of the above

84. This beetle produces about 30 eggs over a 4 week period that hatch in about 1-2 weeks:
   A. Sawtooth Grain Beetle
   B. Granary Weevil
   C. Red Flour Beetle
   D. Cigarette Beetle

85. When monitoring stored product pests in storage facilities such as distribution centers and warehouses, place on trap every______________ square feet of storage space.
   A. 50-100
   B. 100-200
   C. 250-500
   D. 500-1000

86. Mites are occasional invaders. They can
   A. feed on cheese, flour, grains, fruit, cereal, pet food and other foods
   B. be colorless or cream colored and large numbers may look like dust
   C. be seen better under a microscope
   D. A & C
   E. all of the above

87. Head lice can:
   A. survive only over the weekend without a blood meal
   B. be reduced by washing all clothes in hot soapy water and dried on high heat in the dryer
   C. be reduced by bathing in soapy water, regularly inspecting bedding and using a doctor prescribed lice cream or shampoo
   D. all of the above

88. Which pest will feed on linen, rayon, and cotton, starched fabrics, book bindings and dead animals, flour and starches?
   A. Springtails
   B. Book Lice
   C. Silverfish
   D. Plaster bagworm

89. This pest has 2 pairs of legs per body segment:
   A. Centipedes
   B. Amphipods
   C. Sowbugs
   D. Millipedes

90. Flies undergo <u>complete</u> metamorphosis. The stages are:
- A. egg, nymph, adult
- B. egg, nymph, pupa, adult
- C. egg, nymph, larva, adult
- D. egg, larva, pupa, adult
- E. egg, nymph, puparium, adult
- F. egg, nymph, maggot, puparium, adult

91. Honey bees have 3 castes:
- A. The Queen, workers and soldiers
- B. The Queen, worker bees, and drones
- C. The Queen, guard bees, and foraging workers
- D. The Queen, the King, the Workers

92. The minimum heat range needed to kill all stages of bedbugs is:
- A. 100-110 F
- B. 110-113 F
- C. 113-115 F
- D. 160-175 F

93. The W-A-L-E method of mixing insecticides means they do not glob up if mixed in the following sequence:
- A. Water, Alkaline material, Liquid formulation, Emulsifiables last
- B. Water, Agitate, Leavening Agent, Emulsifiable Concentrates
- C. Wettable Powders, Add any liquids, Labelled Surfactants, EC’s last
- D. Wettable Powders & WDGs, Agitate with water, Liquids and flowables, Emulsifiables last.

94. This cockroach prefers to live with lots of heat and moisture:
- A. Brown Banded
- B. Surinam
- C. American
- D. Smokybrown

95. This cockroach prefers to live around palm trees and tropical garden areas:
- A. German
- B. American
- C. Australian
- D. Oriental

96. This cockroach is the best flier in Florida:
- A. Smokybrown
- B. Asian
- C. American
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97. This pest is least likely to sting you:
   A. Mud Dauber
   B. Yellowjacket
   C. Paper wasp
   D. Honeybee

98. A ID Cardholder at one office working under one CO at a company must:

   A. Re-apply for another ID card once he transfers to another CO's office at the same company
   B. Need not re-apply for another ID card if transferred to another CO's office
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99. A triangle sign or placard on the side of a vehicle designates:

   A. Radioactive materials being carried
   B. A Hazmat warning to "Beware of chemicals or pesticides in storage". Depending on the number or signage it will designate contents to DOT.
   C. Carrying gasoline
   D. First aid

100. Of these 4 biological control agents available for German roach control, the one presently used most often in commercial pest control is:

   A. Fungi
   B. Bacteria
   C. Nematodes
   D. Parasitic wasps

GHP Sample Exam

I. The most common tick in Florida found indoors is ___________________.
   A. the American Dog Tick
   B. the Brown Dog Tick
   C. the deer tick (black-legged tick)
   D. the Lone Star Tick

2. The tick that can carry Rocky Mountain spotted fever is:
   A. the American Dog Tick
   B. the brown dog tick
   C. the deer tick
   D. the Florida dog tick

3. The following statement is false:
   A. There are very few cases of Lyme disease in Florida
   B. Lyme disease is now more prevalent than Rocky Mountain Spotted Fever
   C. The American Dog Tick can carry Tularemia
   D. Brown Dog Ticks often bite humans as well as other animals

4. The following tick is the main carrier of Lyme Disease:
   A. the American Dog Tick
   B. the brown dog tick
   C. the deer tick
   D. the Florida dog tick

5. IGR's for flea control include
   A. Lufenuron, methoprene and fipronil
   B. Pyriproxifen, imidicloprid and permethrin
   C. Hydroprene, methoprene and novaflumeron
   D. Methoprene, pyriproxifen and lufenuron

6. Adult fleas have:
   A. Stylets for sucking blood
   B. Sword-like mandibles
   C. Rasping/sucking mouthparts
   D. Piercing-sucking mouthparts

7. The eggs of head lice are called:
   A. grains
   B. nits
   C. ovae
   D. specks

8. The following are not insects:
   A. head lice
   B. ticks
   C. silverfish
   D. book lice

9. The difference between the cat flea and dog flea is _________________.
   A. The cat flea's head is twice as long as high but not with the dog flea
   B. The dog flea's head is twice as long as high but not wit the cat flea
   C. The cat flea's head is twice as long as the dog flea's head
   D. The dog flea's head is 2x as long as the cat flea's head

10. The difference between the rice and granary weevil is that___________.
   A. The granary weevil is attracted to light and the rice weevil is not.
   B. The granary weevil has red markings on the back
   C. The rice weevil has red markings and flies to light but the granary weevil does not.
   D. The granary weevil is considered to be the most important stored product pest.

11. The beetle with 6 projections on each side of the thorax is:
   A. The granary weevil
   B. Sawtoothed grain beetle
   C. Hide beetle
   D. Red Flour beetle

12. The bird often seen in parks, suburbs and farms from late summer to spring, primarily a ground feeder, about 7.5 -8.5 inches long with a SHORT TAIL is:
   A. Wren
   B. Pigeon
   C. Starling
   D. House sparrow

13. The main danger posed by pigeon droppings is:
   A. bird mites surrounding the area
   B. pharaoh ants trailing through the area
   C. bacteria and viruses in the droppings
   D. stains on the sides of the building and on the ground

14. To properly remove a honeybee stinger:
   A. scotch tape it out
   B. pinch it and pull
   C. pull it out with tweezers
   D. scrape it out sideways with a credit card or hard paper

15. This pest is most common in grocery stores, warehouses and kitchens, especially in flour, cornmeal, broken grains, dried fruit, nuts and chocolate bars, spinning webs that also contaminate the food even more:
   A. Drugstore beetle
   B. Granary weevil
   C. Carpet beetle
   D. Indianmeal moth

16. Mouse foraging distance from their nest is typically:
   A. 5-10 feet
   B. 10-30 feet
   C. 30-50 feet
   D. 50-75 feet

17. The rodent whose tail is longer than the head and body length combined is:
   A. Norway rat
   B. Roof Rat
   C. House mouse
   D. Mole

18. The main difference between a mouse and young rat is:
   A. The tail length of the rat is much longer
   B. The mouse typically has lighter fur
   C. The size of the feet and head in relation to the body are larger on the rat
   D. all of the above

19. Some of the diseases rodents can spread are:
   A. Malaria and plague
   B. Murine typhus and encephalitis
   C. Leptospirosis and rabies
   D. all of the above

20. The rodenticide with an active ingredient being vitamin D3 is:
   A. bromodialone
   B. bromethalin
   C. colecalciferol
   D. Contrac Blox
   E. Generation

21. The most widespread and most prevalent zoonotic disease from lower animals to man is:
   A. Leptospirosis (Weil's Disease)
   B. Malaria
   C. Yellow fever
   D. Swine Flu

22. Rats exhibit a fear of new objects or changes around them. This condition is commonly called:
    A. Cryophobia
    B. Necrophobia
    C. Narcophobia
    D. Neophobia

23. Rats have:
    A. Great sense of smell. touch and vision
    B. Poor sense of smell and vision
    C. Great sense of taste and hearing
    D. Poor ability to swim
    E. Both A & C

24. Norway rats:
    A. usually nest in the ground
    B. are larger than roof rats
    C. have blunter noses and larger feces than roof rats
    D. have smaller ears and tails than roof rats
    E. all of the above

25. Roof rats normally have:
    A. about 6 litters from 6-8 per litter
    B. about 8 litters from 4-6 per litter
    C. about 4 litters from 8-10 per litter
    D. about 10 litters from 4-6 per litter

26. Roof rats can squeeze through a hole:
    A. about ½ inch in diameter
    B. about ¼ inch in diameter
    C. about 1/8 inch in diameter
    D. that must be at least ¾ inch in diameter, that's why ½ inch mesh screen is advised for rodent proofing

27. Like rats, mice can also spread:
    A. leptospirosis
    B. rickettsialpox
    C. salmonellosis
    D. A & C
    E. all of the above

28. Direction of rodent urine trails can be detected as activity increases using:
    A. your nose to smell the location
    B. a mist of vinegar water over the area to darken the color
    C. an ultraviolet light over the area to make the trail fluoresce
    D. all of the above methods

29. Mice :
    A. have a litter every month producing an average of 6 per litter
    B. have a litter every 2 weeks producing an average of 8 per litter
    C. have a litter every 50 days with about 6 per litter
    D. have a litter every month with about 8-10 per litter

30. Which roach needs the least amount of moisture to survive and is usually found in drier locations?
    A. American
    B. Australian
    C. Brown-banded
    D. Smokybrown
    E. Brown

31. These roaches are least associated with leaf litter:
    A. Surinam, Asian and Smokybrown
    B. American, German and Brown-banded
    C. Surinam, Asian and Brown
    D. Australian, Oriental and Surinam

32. Exotic nuisance birds include:
    A. Starlings and Least Terns
    B. English (House) Sparrows and Peafowl
    C. Barn Owls and Mynah birds
    D. English (House) Sparrows and Starlings

33. These birds are protected and need State/Federal Permits to control:
    A. Swallows, swifts and woodpeckers
    B. Least terns, Muscovy ducks and starlings
    C. Chimney swifts, wild chicken and peafowl
    D. Carolina Wren, sparrows and pigeons

34. Avitrol is an avicide that controls birds and can only be used with a Florida Avitrol permit to control:
    A. any local birds not federally or state protected such as Muscovy ducks
    B. only starlings and pigeons
    C. only pigeons
    D. Avitrol can no longer be used in Florida

35. The following rodenticides are not anticoagulants:
    A. Bromadiolone and Coumafuryl
    B. Difethialone and Bromethalin
    C. Diphacinone and Warfarin
    D. Zinc Phosphide and Brodificoum

36. The following rodenticide causes hypercalcemia:
    A. Vengeance
    B. Maki
    C. Quintox
    D. Contrac
    E. Talon

37. Bromadialone is the active ingredient in:
    A. Maki
    B. Final
    C. Vengeance
    D. Generation

38. Brodificoum is the active ingredient in:
    A. Generation
    B. Contrac
    C. Final
    D. Vengeance

39. Examples of Multi-dose anticoagulants are:
    A. Final and Talon
    B. Talon and Contrac
    C. Rozol and d-Con
    D. Quintox and Maki

40. Anticoagulants include:
    A. Single dose and multiple dose
    B. multiple dose and hypercalcemic
    C. anti-vitamin K materials
    D. all of the above

41. Bromadialone is a :
    A. single-dose anticoagulant
    B. multiple dose anticoagulant
    C. anti-vitamin K agent
    D. causes hypercalcemia

42. When using pellets or grain rodenticide:
    A. always place them in a protected station
    B. place them in an immovable protected station
    C. place them only in voids and attics
    D. all of the above

43. When placing out single-dose rodenticides:
    A. Be sure stations are marked to indicate “Keep out of reach of Children”
    B. Relocate stations when no activity is seen
    C. Record the location of the placement on paperwork
    D. Eliminate competing food sources first
    E. all of the above

44. Tracking powder should be used:
    A. carefully in ceilings above the dining area when trap shy rodents can not be controlled
    B. in baited rodent stations
    C. only after placing on a dust mask or respirator
    D. all of the above

45. When competing food sources can never be removed, then
    A. use tracking powder
    B. bait heavily with fixed single-dose blox
    C. place out liquid baits in fixed stations away from kids or pets
    D. none of the above

46. Histoplasmosis is
    A. most associated with bird droppings that have massed for over 3 years
    B. especially common under pigeon roosts
    C. easily decontaminated with soap and water
    D. often created by huge flocks of annually migrating birds roosting in trees
    E. A & B
    F. A & C
    G. A & D
    H. all of the above

47. Budding, or breaking up of a colony into subcolonies occurs most commonly:
    A. with white-footed ants
    B. with fire ants
    C. with pharaoh ants
    D. with acrobat ants

48. Carpenter ants:
    A. can eat wood
    B. nest and forage in wood
    C. excavate nests in soft or rotten wood
    D. all of the above
    E. B & C

49. Cockroaches undergo this form of development:
    A. complete metamorphosis
    B. have no metamorphosis
    C. gradual development
    D. hatch from ootheca

50. These materials do not cling well, but are absorbed into porous surfaces and therefore not the best for roach control:
    A. Dusts
    B. WPs
    C. Microcaps
    D. EC's

51. Cockroach aversion occurs most commonly when ________ is added to bait:
    A. fructose
    B. any sugar
    C. lactose
    D. glucose

52. This pest infests stored tobacco, and other dried teas, rice, ginger dried fish:
    A. merchant grain beetle
    B. cigarette beetle
    C. larder beetle
    D. carpet beetle
    E. angoumois grain moth

53. The cigarette beetle differs from the drugstore beetle by:
    A. its smaller size
    B. its larger size
    C. its smooth elytra (upper shell)
    D. its grooved elytra

54. This moth has 2 color sections on its upper wings: pale gray on the first 1/3 and reddish-copper scales on the outer 2/3 of the front wings:
    A. The almond moth
    B. The plaster bagworm
    C. The angoumois grain moth
    D. The indianmeal moth

55. The most abundant, widespread and destructive carpet beetle is the:
    A. furniture
    B. varied
    C. black
    D. common

56. The larva of this pest gathers small bits of cement around itself for protection, looks like a cement watermelon seed and lives on spider webs:
    A. leaf beetle
    B. bagworm moth
    C. plaster bagworm
    D. spider wasp

57. Africanized bees are more dangerous than European honeybees because:
    A. they are no more dangerous – its just because they attack more aggressively in large numbers, but the stinger is no more potent
    B. their venom is more potent
    C. they are slightly larger than European bees
    D. B & C
    E. A & C

58. The human condition of “jumpiness” sometimes occurs after _________ bites.
    A. flea
    B. tick
    C. spider
    D. bedbug

59. When controlling pigeons, Avitrol can be administered with a license and is effective:
    A. in long-term control
    B. at controlling a local population only if it is used to kill the flock
    C. whenever it is used because the pigeons give out a poisoning distress call
    D. none of the above

60. Effective control of a local starling population is best accomplished with:
    A. flight interrupter lines
    B. prebaited funnel traps, then baited funnel traps
    C. an electronic frightening device
    D. an ultrasonic device

61. Smokybrown roaches prefer a _____________ environment :
    A. warm
    B. high
    C. open
    D. moist

62. Roaches most prevalent in leaf litter include:
    A. Florida Woods Roaches and Asian Roaches
    B. Asian and german roaches
    C. Australian and brown-banded
    D. American and Australian

63. Ways to reduce cockroach resistance include:
   A. alternate control methods and different active ingredients
   B. lower the pesticide application frequency
   C. use non-repellent materials
   D. use sanitation often
   E. All of the above

64. Because they are similar in size, these 2 birds are sometimes confused:
   A. Scrub Jay and Blue Jay
   B. Blackbirds and Starlings
   C. House Sparrows and Wrens
   D. Pigeons and Gulls

65. Cat fleas can carry:
   A. plague
   B. murine typhus
   C. intermediate host for tapeworms
   D. all of the above

66. Flea larvae:
   A. are cream colored and eyeless
   B. are negatively phototaxic (go away from light)
   C. live on dried blood and flea excrement and other organic particles
   D. all of the above

67. The best control for fleas in the long run is:
   A. Termidor
   B. A veterinarian prescribed spot treatment on the pet
   C. A vet-prescribed treatment for the pet, vacuuming, and a residual application of a flea adulticide mixed with methoprene
   D. steam cleaning the entire interior of the home

68. Ant caste members include:
   A. The queen, sterile females and males
   B. The queen, males, soldiers and minims
   C. The queen, majors, soldiers and workers
   D. The queen, soldiers and workers

69. The fruit fly:
   A. is a common pest in bars
   B. lives on fermenting foods
   C. is also called the vinegar fly
   D. are controlled by sanitation and knockdown insecticides
   E. all of the above

70. House flies:
   A. are best controlled by sanitation and exclusion
   B. are best monitored by periodic pest inspections
   C. feed at night and during the day as adults
   D. are most attracted to UV insect traps

71. Bed bugs can survive without a blood meal for:
   A. 6-7 months as adults and even up to1.5 years
   B. usually 30 days but up to a maximum of 6 months
   C. 1.5 years as adults and long as 2 years
   D. over 2 years

72. Bedbugs:
   A. like mosquitoes secrete a salivary solution to prevent coagulation
   B. hide in cracks, crevices, behind headboards and baseboards in the daytime
   C. are carried into homes and transfer from place to place in used furniture and suitcases by people
   D. feed at night when people are asleep
   E. all of the above

73. Adult fleas are stimulated to hatch from cocoons mainly due to:
   A. the maturation process over time
   B. the presence of a nearby blood meal
   C. increased temperature, vibrations and the presence of slightly increased CO2
   D. all of the above

74. The most practical treatment for pets to reduce fleas is:
   A. Yeast
   B. Garlic
   C. Shampoo
   D. Ultrasonic collar

75. Fleas can remain in the pupal case for up to:
   A. 1 month
   B. 6 months
   C. 1 year
   D. 2 years

76. One difference between African honeybees and European honeybees is:
   A. Africanized bees attack faster for a very short distance
   B. Africanized bees need a lot of provoking before they get aggressive
   C. Africanized bees abscond (re-hive) more often
   D. Africanized bees tend to swarm less than do European honeybees

77. The spider with an orange to yellowish-red hourglass marking is most likely:
   A. The brown widow
   B. The brown recluse
   C. The brown wolf
   D. The brown orb weaver

78. Recognized by the dark violin marking behind the eyes is:
   A. The brown widow
   B. The brown recluse
   C. The wolf spider
   D. The giant crab spider

79. The most likely place(s) to find a carpet beetle would be:
   A. in the pantry
   B. in the garage
   C. near a wool carpet, leather, silk, animal skin or nest, wasp nest or outdoor flower blossom
   D. hiding in cracks and crevices

80. The webbing clothes moth:
   A. is a golden moth with red-golden hairs on the head
   B. spins webs and partially encloses itself within the rug, fur, feathers, felt in which it feeds
   C. do not carry a silken case around them like the casemaking clothes moths
   D. all of the above

81. Clothes moths can be controlled by:
   A. dry cleaning will kill all stages of the moth
   B. regular cleaning of infested materials
   C. vacuuming well to remove eggs and larvae
   D. maintaining a low humidity
   E. all of the above

82. The following pest(s) attacks and chews through seed coats of whole grains:
   A. Red Flour Beetle
   B. Rice Weevil
   C. Psocids or grain mites
   D. Sawtooth and Merchant Grain Beetles
   E. none of the above

83. The following beetles do not fly:
   A. Sawtooth Grain Beetle and Granary Weevil
   B. Cigarette and Drugstore Beetles
   C. Ground Beetles and Dung Beetles
   D. all of the above

84. This beetle produces about 30 eggs over a 4 week period that hatch in about 1-2 weeks:
   A. Sawtooth Grain Beetle
   B. Granary Weevil
   C. Red Flour Beetle
   D. Cigarette Beetle

85. When monitoring stored product pests in storage facilities such as distribution centers and warehouses, place on trap every_______________ square feet of storage space.
   A. 50-100
   B. 100-200
   C. 250-500
   D. 500-1000

86. Mites are occasional invaders. They can
   A. feed on cheese, flour, grains, fruit, cereal, pet food and other foods
   B. be colorless or cream colored and large numbers may look like dust
   C. be seen better under a microscope
   D. A & C
   E. all of the above

87. Head lice can:
   A. survive only over the weekend without a blood meal
   B. be reduced by washing all clothes in hot soapy water and dried on high heat in the dryer
   C. be reduced by bathing in soapy water, regularly inspecting bedding and using a doctor prescribed lice cream or shampoo
   D. all of the above

88. Which pest will feed on linen, rayon, and cotton, starched fabrics, book bindings and dead animals, flour and starches?
   A. Springtails
   B. Book Lice
   C. Silverfish
   D. Plaster bagworm

89. This pest has 2 pairs of legs per body segment:
   A. Centipedes
   B. Amphipods
   C. Sowbugs
   D. Millipedes

90. Flies undergo complete metamorphosis. The stages are:
   A. egg, nymph, adult
   B. egg, nymph, pupa, adult
   C. egg, nymph, larva, adult
   D. egg, larva, pupa, adult
   E. egg, nymph, puparium, adult
   F. egg, nymph, maggot, puparium, adult

91. Honey bees have 3 castes:
   A. The Queen, workers and soldiers
   B. The Queen, worker bees, and drones
   C. The Queen, guard bees, and foraging workers
   D. The Queen, the King, the Workers

92. The minimum heat range needed to kill all stages of bedbugs is:
   A. 100-110 F
   B. 110-113 F
   C. 113-115 F
   D. 160-175 F

93. The W-A-L-E method of mixing insecticides means they do not glob up if mixed in the following sequence:
   A. Water, Alkaline material, Liquid formulation, Emulsifiables last
   B. Water, Agitate, Leavening Agent, Emulsifiable Concentrates
   C. Wettable Powders, Add any liquids, Labelled Surfactants, EC's last
   D. Wettable Powders & WDGs, Agitate with water, Liquids and flowables, Emulsifiables last.

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   B. Surinam
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C. Paper wasp
D. Honeybee

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A. Re-apply for another ID card once he transfers to another CO's office at the same company
B. Need not re-apply for another ID card if transferred to another CO's office
C. Need not re-apply for a new ID card if they quit and go to work at another pest company.
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C. Carrying gasoline
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A. Fungi
B. Bacteria
C. Nematodes
D. Parasitic wasps

Additional Questions From March/June 2012 Exams

I. If you forget your PPP and need to apply Termidor:
   A. Use a plastic bag(s) for protection
   B. Use hair spray first and let it dry
   C. Protect yourself with fabric
   D. Don't do the treatment

2. The tick that can carry Lyme disease is:
   A. the American Dog Tick
   B. the brown dog tick
   C. the *Ixodes* deer tick
   D. the Florida dog tick

3. Lyme disease is spread by the:
   A. bacterium, *Bacillus thuriengensis*
   B. spirochete, *Borrelia burgdorferi*
   C. nematode, *Steinernema carpocapsae*
   D. fungus, *Beauvaria bassiana*

4. Cat flea larvae are:
   A. attracted to light
   B. repelled by light (negatively phototactic)
   C. not affected by light
   D. are repelled only by the heat of the light

5. Mites are often associated with insects. The most common insects in order of importance that are associated with mites are:
   A. beetles, wasps and bees
   B. wasps, beetles, and flies
   C. bees, wasps and beetles
   D. beetles, termites and flies

6. Pigeons spread this disease(s) through contact with their droppings:
   A. *Bacillus thuriengensis,* BACTERIUM
   B. *Borrelia burgdorferi* SPIROCHETE
   C. *Beauvaria bassiana* FUNGUS
   D. *Histoplasmosis* and *Cryptococcus* FUNGI

7. The flea life cycle from egg to adult normally takes:
   A. 45 days (30 in many references, but 45 is closest to actual normal time)
   B. 60 days
   C. 90 days
   D. 120 days

Study Guide for GHP Applicator Training Manual

The following notes are from the main study guide from for the GHP State Certified Operator Study Guide, "General Household Pest Control Applicator Training Manual."
The highlighted portion is material that has shown up on previous tests.

Introduction, Pest Management, Using Pesticides Safely

- Why is pesticide usage becoming a concern?
    - Pesticides have been and will continue to be focus of public attention. Many people have genuine concern over the use of pesticides, although many others who use them to manage pest problems find the risks acceptable.

- EPA:
    - Registers all pesticides
    - Registers all uses of that pesticide
    - Approves product labels

- Pest control applicators may be certified in either of two classifications
    - Certified and limited certification

- Certified Operator – in charge of the licensee's pest control activity. Primary role is to supervise the pest control activities at the business location, such as
    - Selection of proper, correct chemical for the particular pest control work
    - Safe and proper use of these pesticides
    - Correct concentration and formulation of pesticide used
    - Training personnel
    - Control measures and procedures used
    - 24-hour notification of FDACS of accidental poisoning or death connected with pest control work

- Certificate Renewal:
    - 2 hours training in each category licensed in + 2 hours core training

      OR

    - Certified operators can retake the appropriate exam to renew their license or certificate

- Identification Cards
    - An employee may not perform, solicit, inspect, or apply pest control without first having been provided <u>at least 5 days</u> of field training in the appropriate category
- Light traps
    - Some are electrically charged grids that kill insects as they approach the light
    - Electrocutor traps are usually not used for insect monitoring

- Use light traps inside warehouses, grocery stores, and other enclosed areas for monitoring adult stages of flies
- Use of light traps are not effective for outdoor insect control

- Glueboards and traps
  - To monitor rodent activity, set glue boards along known runways and areas believed to be nesting sites

- Action Thresholds *(There are 2 questions about thresholds. You will be given a scenario and you will have to determine which threshold it is)*
  - Health and Safety Threshold
    - Dealing with pests that are associated with structures, stored food products, food prep facilities, hospitals that have the potential for causing injuries to people or transmitting disease to people or animals
    - Mosquitoes, biting bugs, fleas, spiders, bees, wasps, rats, mice, roaches, flies, etc
    - Others: insects that cause damage that makes structures unsafe or reduces their value. Rodents, fungi, termites, wood boring beetles
  - Legal Thresholds
    - Deal with health codes, marketing orders, public safety codes.
    - Legal thresholds dictate when pest control methods must be used.
  - Pest Acceptance Threshold
    - People have different degrees of acceptance of pests in their homes and work places.
  - Economic Threshold
    - This is the level of pest abundance at which the potential loss caused by the damage is expected to be greater than the cost of controlling the pest.
    - In certain instances, the cost of control measures may need to be justified.
    - Economic thresholds may apply if there are no health or safety, legal, or tolerance thresholds to be considered.

- Equipment
  - Hand-held Compressed Air Sprayers Spray Patterns
    - Pin streams
      - Can be coarse or fine
      - Overall the most effective spray pattern for cockroach pesticide application
      - even when set for fine spray, the stream splashes back from all but the widest of cracks
    - Pressure
      - Spray tank air pressure varies depending on the amount of air pumped into the tank

- Low pressure: recommended for spray application inside structures
- Constant use of high pressure with compressed air sprayers sets up the possibility of over use and misapplication. This wastes material and causes drift.

- Pesticide Types
  - Liquids
    - Pesticides may dissolve in the carrier to from a solution or may remain suspended in the liquid to form an emulsion.

Exact question on test: Pesticides dissolved in a liquid are called _______

a. Concentrates

*b. Solutions ****

c. Formulations

d. Mixtures

- Toxic Tracking Powder: Question on either the use or placement of toxic tracking powder
  - Apply tracking powder to travelways along walls, inside walls, attics, crawlways.
  - Blow powder into inaccessible areas were rodents are known to travel
  - Can place in rodent bait stations
  - Do not put powder where it can be dispersed by air currents or tracked by pests onto food, eating utensils, or food prep surfaces
  - Never use toxic tracking powder on shelves, cupboards, or ceiling beams overhead in food prep areas or eating area.

- Transporting Pesticides
  - Transport pesticides in truck where cargo is separate from passenger area.
  - Secure containers and equipment containing pesticides.
  - Do not stack pesticide containers higher than the sides of vehicle
  - During transport, keep undiluted pesticides in their original containers or in approved, labeled service containers.

What are flies related to: Mosquitoes
Newly hatched lice must take a blood meal within 24 hours

If a business moves, and gets a new license, it will expire in 1 year

Cockroaches

Cockroaches: know environment/habitat that each live in

Know which cockroaches live in leaf litter

- Gradual metamorphosis
- Nocturnal
- Hide in dark, warm areas; especially narrow spaces where surfaces touch them on both sides.
- Can contaminate food and eating utensils, destroy fabric and paper products, cause stains and odors to surfaces they contact
- Know the diseases cockroaches may transmit
    - Bacteria responsible for food poisoning: salmonella and shigella and viral hepatitis organisms.
    - Staphylococcus, streptococcus, and coliform bacteria responsible for allergies and asthma
    - German roaches have been implicated in the spread of typhoid, dysentery, and leprosy organisms.

German Roaches

- Most common indoor species
- ½ inch long, brown, 2 longitudinal bands on top of thorax
- Females produce 30-50 eggs at a time contained in an ootheca
- Egg laying occurs more frequently during warm weather
- Favor warm, humid areas: 70-75° F is most suitable
- Do not fly, but can jump and glide
- Highest reproductive potential of all the roaches
- Eggs can hatch in 28 days at room temperature

Brownbanded Roaches

- Not commonly found in Florida
- Infests warm, dry areas (temperatures greater than 80° F): behind pictures, under furniture, among books, radios, television, and refrigerators. (areas opposite of where German roaches would be found)
    - Germans and brownbanded roaches are rarely found together
- 5/8 inch long; males have wings that extend past abdomen and female's wings do not extend past abdomen.
- Both males and females have distinctive horizontal brown bands of color across abdomen
- Females attach eggs in clusters to hidden vertical surfaces; on furniture or in appliances.

Oriental Roaches

- Live in dark, damp, moist areas
- Never been found in Florida, but have been misidentified as Florida woods roach
- 1 to 1 ½ inches long and are dark brown; almost black.
- Males have fully developed wings but are shorter than the body.
- Females have rudimentary wings
- Prefer to live in areas that are dark and damp: both indoors and outdoors

Study Guide for GHP Applicator Training Manual

American Roaches

- Females will drop the egg case right after it is formed. They will glue it in a safe place; usually a hidden, moist surface.
- Common pest in zoos and animal rearing facilities
- Lives in sewers, water meter boxes, and steam tunnels
- Prefer warm, humid environments (temps in excess of 82 degrees) but will forage from sewers and other areas of structures.
- One of the largest cockroaches that invade structures: 1 ½ to 2 inches long
- Reddish brown in color
- Fly and are attracted to street lights at night.
- Active throughout the year in temperatures of 70° F or higher

Smokybrown Roaches

- Prefer to live in <u>moist</u> environments
- Found in garages, decorative planting/planter boxes, woodpiles, water-meter boxes, under shingles/siding, trees, shrubs, and other vegetation. Occasionally lives in sewers
- Can be found in upper parts of structures including attic, although it is not specifically attracted to heated areas of buildings.
- 1 ¼ inches long
- Uniformly dark brown to mahogany in color
- Attracted to lights at night
- Well developed wings and is able to fly.

Brown Roaches

- Often mistaken for the American roach
- Occurs mainly outdoors under bark of trees and also in sewers
- Adults are reddish brown, but darker than the American roach in color
- Males have cerci and styli (structures on the tip of the abdomen). Females only have cerci
    - Brown roach: cerci are stout and triangular in shape
    - American roach: long and thin
- Females glue egg cases to hidden surfaces and guard them
- First stage nymphs-the first 4 and the last 8 segments of the antenna are white.

Australian Roaches

- Most abundant in Florida; within Florida they are most prevalent in South Florida
- Prevalent in <u>leaf litter</u>
- It is a pest when it enters homes and eats holes in clothing and feeds upon books
- Lives outdoors around the perimeter of houses
- About 1 ¼ inches long. Wings cover abdomen for both males and females
- Closely resembles the American roach; but is smaller, have yellow margins on the thorax, and light yellow streaks on the sides at the base of the wings.

- Later instar nymphs have distinct bright yellow spots along the edges of the abdomen.

Florida Woods Roaches

- Prevalent in leaf litter
- 1 ½ to 1 ¾ inches long; dark brown to almost black.
- Wings are very short; leaving the abdomen almost completely exposed.

Asian Roaches

- Prevalent in leaf litter
- Adults are strong fliers and will enter houses
- Wild and peridomestic species of roach
- Attracted to light (television screens, walls illuminated by lights, outdoor lighting, etc; will invade openings in structures.
- Almost identical in appearance to the German roach
- Wings of an Asian roach are longer and narrower than those of the German roach.
  - Wings of the Asian roach extend beyond the tip of the abdomen
  - In females, wings cover the egg case. (wings do not cover the egg case in German roaches)
- Can be positively identified and distinguished from the German roach by using gas chromatography analysis of the waxes of the exoskeleton.

Surinam Roaches

- Burrowing insect that is capable of destroying various places
- Hides during the day in soil under potted plants, debris, etc
- Active at night, when they come out to eat on plants
- Approximately ¾ inch long
- Shining black to brown in color
- Front edge of the pronotum has a pale, white band

Management Guidelines for Cockroaches

1) Management Guidelines for Cockroaches
   a. Sticky traps to monitor activity and identification
   b. Use of IGR and residual products in cockroach control (last 2 paragraphs page 77 and all of page 78)
   c. Cockroach population may, thru genetics, develop resistance to insecticides. This occurs thru the overuse and indiscriminate application of products. To reduce resistance problems:
      i. Lower the frequency of insecticide application

Questions on Test

1. Oriental cockroaches prefer a __________ environment

a. moist (correct answer)
b. warm
c. high
d. small

2. Brownbanded cockroaches prefer a _______ environment
a. cool
b. warm (correct answer)
c. sanitary
d. very moist

3. Smokybrown cockroaches prefer a ________ environment
a. open
b. warm
c. moist (correct answer)
d. high

Indoors

- Successful management depends on identifying the species then selecting the most effective control methods.
    1. Location: look for hiding places: cracks, crevices, behind baseboards, etc.
        - Using flushing agent to dislodge roaches from these areas
            - Pyrethrin flushing agent: very effective
            - Pyrethrin is not effective control method because it does not have residual action.
    2. Sanitation
        - Eliminate sources of food and water
        - Vacuum all cracks and crevices to remove food and debris
        - Trim shrubs around buildings to increase light and air circulation
        - False-bottom cupboards, hollow walls, etc are common refuges.
    3. Exclusion
        - Look for areas of entry from the outside
        - Look for other areas of entry such as potted plants
        - Locate cracks/crevices where they are hiding
    4. Chemical Control
        - Combine chemical control with non-chemical control when possible
        - For quick knock-down used synergized pyrethrin or synthetic pyrethroid
        - For long lasting, use insecticides with residual activity: dusts, dessicants, liquid sprays, and IGR
            - IGR: sterilizes or kills immature nymphs.
            - May take months for control with IGR so mix with an insecticide with rapid action for long term effects
        - Methods to help reduce resistance problems

- Alternate control methods
- Lowering frequency of insecticide application
- Alternate formulations and types of active ingredients
- Using insecticides that do not repel roaches

5. Monitor and Evaluate
   - Use traps and/or visual inspections to determine if re-treatment is necessary, if food and water sources were eliminated, and if pockets of active roaches were missed.

Ants

- Members of ant colony/caste system
  - Queen
  - Female workers
  - Males
- Acrobat Ant
  - Raises abdomen over head
- Carpenter Ant
  - Prefer to nest in wood that has been damaged by termites or decay.
  - They do not eat sound wood, they excavate galleries to rear young in
  - Will feed wood that has been softened by decayed or by other insect's damage.
  - Pre-inspection is key to control
- Crazy Ant
  - Easy to identify by its rapid and erratic movements
- Ghost Ant
  - Appendages are pale or milky white in color
  - Abdomen is white
- Pharaoh Ant
  - Spread thru budding; not swarming
- General Management Guidelines for Ants
  - Baits are effective way to get poison into the nest
    - Hydramethylnon is used in ant baits
  - Treat the perimeter of the building with a <u>persistent</u> insecticide

Flies

- Fungus Gnat
  - Slender, mosquito like fly with long legs
  - Live on fungi or in decaying vegetation
  - Electric light traps are effective because flies are attracted to light
- Humpbacked Fly
  - Smallest Fly
  - Found in areas of decaying vegetation
- Fruit, Vinegar, or Pomace Fly
  - Commonly seen wherever fruit or other food rot or ferment
  - Feeds on yeast associated with fermentation

   - Use knockdown spray to reduce population of flying adults in enclosed areas
   - Synergized Pyrethrin insecticides used as a knockdown have short residual life, so these should be used along with a sanitation program
- Bottle Flies
   - Blue or green bright metallic luster
   - Eggs are laid in decomposing animal flesh or garbage containing animal matter
   - Management: sudden appearance indicates the presence of a dead animal, which should be removed.
- House Flies
   - Claimed by some to be the greatest threat to people's health of any species of insect due to their ability to transmit so many disease and parasite organisms.
   - Adult stages: feed on feces, decaying organic matter, and variety of liquid foods.
   - Leave straw colored spots of regurgitated food and dark spots of fecal matter on surfaces where they feed or rest.
   - What is the best treatment for the common house fly? Sanitation
   - Traps and sticky tape are for <u>monitoring</u> fly populations.
   - Exclude flies by using screens on doors and widows. Air curtains or fans in commercial buildings can also help prevent entry.
   - Store garbage in closed containers away from the building
   - Traps with bait attractants will lure adults.
   - Sticky paper traps, pheromone traps, and electrocutor traps work well indoors.
   - Chemical controls: because of their high reproductive rate, house fly populations can quickly develop insecticide resistance.

Bed Bugs

- Feed mainly on blood of humans, but also suck blood from other animals, birds, and bats
- Feed at night when people are asleep
- As they feed, they secret salivary secretion into the wound to prevent coagulation
- Approximately ¼ inch long, brown and do not have wings
- Hide in cracks, crevices, behind baseboards and wallpaper, etc during the day
- They are carried into homes via clothes, second-hand beds, furniture, suitcases, or by people.
- Adult bed bugs can survive 6-7 months without a blood meal and have been known to live without a blood meal for 1 ½ years.
- Steam cleaning mattresses can kill bed bugs living in seams.
- Treat cracks/crevices harboring bed bugs with liquid residual
- Take bed apart and treat all areas with a liquid residual.
- Treat woodwork and all walls in room at least 2 feet above the floor.

Fleas

- Adult fleas feed only on liquid blood
- Cat flea larvae feed on digested blood in the dried excrement of adult fleas to complete development.
- Increased temperature, direct physical contact, and vibration stimulate adult fleas to emerge from the cocoon
- When treating for fleas, because of their biology, wait 14 days before retreating
- Laterally compressed bodies

- Treatment
  - Spray carpets, pet sleeping areas, baseboards, window sills and other harborage areas
  - Combine knockdown spray with insect growth regulator (IGR) to prevent immature stages from developing into adults. IGR provides long term control
    - IGR should be applied as diluted space spray or as residual fog.
    - The question will ask about product used for the above functions
    - Soaps and Shampoos: most suitable for dogs
    - Powder and dusts: suitable for flea control on cats
    - Spray on Liquids: among the most common type of flea control products for pests
    - Flea collars: suitable for dogs and cats
    - Systemic Control: administered on a regular basis in the form of a pill as internal medication. Example: “The Program” active ingredient is Lufenuron

Test question will ask what is the recommended treatment for pets with fleas. You will be given the following choices

  - *<u>Shampoos</u>*
  - *Yeast*
  - *Garlic pill*
  - *Ultrasonic collar*

- Some flea species can transmit serious disease organisms
  - Bubonic plague: through bites or feces
  - Murine typhus: through bites or feces
    - caused by a Rickettsia microorganism
    - occurs in rodent populations
    - can be vectored to people by fleas
  - Oriental rat flea; primary vector for plague causing bacterium
  - Can serve as intermediate hosts for dog and rodent tapeworm; which can be transmited to pets and people

Cat Flea

- Most common flea pest worldwide
- Have been identified as an occasional vector for the plague bacterium
- Can vector the organism causing murine typhus
- They are intermediate host for tapeworms
- Description
  - Adult 0.008 inch long
  - Dark reddish brown to black
  - Have powerful legs: have been observed to jump 8 inches vertically and 15 inches horizontally
  - Adults (both sexes) feed only on liquid blood. Females need blood meal to produce eggs
  - Eggs can hatch in one to 6 days
  - Optimum conditions for eggs include warm temperatures and high humidity.
- Larvae
  - do not possess eyes
  - feed on digested blood in the dried excrement of adult fleas to complete development. (places where animals sleep have the highest concentration of flea droppings)
  - a protected, moist environment is required for larval development.
    - Relative humidity conditions below 75% are often fatal.
  - Under optimum conditions, larval stages last 7-21 days
  - Upon completion of the larval stage, spin a silken cocoon which becomes covered in debris; camouflaging them from predators
- Pupae
  - Usually lasts 7-14 days, but can take longer under extreme environmental conditions
  - Fleas can remain inactive in pupal case for up to a year
  - Increased temperatures and direct physical contact stimulate fleas to emerge from cocoons.
- Management Guidelines
  - Flea larvae are <u>not</u> usually found in
    - areas with high pedestrian traffic
    - locations that receive exposure to sunlight
    - areas where adult flea feces containing dried blood is not present
  - Areas with all life cycle stages should be cleaned thoroughly and on a weekly basis
    - Vacuum carpets, rugs, upholstery, furniture, etc
  - Vacuuming is very effective in picking up adults, feces, and stimulates pre-emerged adults to leave the cocoons
  - Vacuuming will not pick up larvae because they attach to carpet fibers

Ticks

- Several species attack dogs, cats are rarely infested

- Brown dog ticks rarely bites humans, but infestations are frequently found on dogs in the home.
- American dog tick attacks wide variety of hosts, including humans, but rarely will infest home.
- Lyme disease is transmitted by deer ticks, but few cases have been reported in Florida. Deer ticks are not prevalent in Florida.
- American Dog and Brown Dog ticks are not considered important vectors of Lyme disease.
- Brown Dog Tick
  - Adult female lays 1,000-3,000 egs
  - Seed tick remains attached for 3 to 6 days, turns bluish in color and then drops to the floor.
- Outdoors, ticks hide near foundations of buildings, in crevices of siding, or beneath the porch.

- American Dog Tick
  - Nymphal stages of the American Dog Tick usually do not attack rodents.
  - Young tick removal: Early removal is important since disease organisms are not transferred until the tick has fed for several hours
- Management Guidelines for Ticks
  - Keep clothing buttoned, shirts tucked in pants, and pants tucked in shoes
  - Do not sit on ground or logs in grassy/bushy areas
  - Keep brush cleared along frequently traveled areas
  - Repellants will protect exposed skin, but ticks will crawl over treated skin to untreated parts of the body.

Africanized Honey Bees vs European Honey Bee

Bees and Wasps

1) African bees sting, swarm and abscond much more than European bees
2) African bees become alert to disturbances and prepare for colony defense much quicker than European bees
3) African bees sting ten times more than European bees and continue to attack for longer periods of time and at much greater distances from nest or hive.
4) Honeybees are extremely beneficial insects.

Scorpions

- Flattened, crab-like animals that have 10 legs and a fleshy tail which bears a stinger
- Vary in size from 1 to 4 inches long
- Young scorpions are born alive then climb on mothers back and remain there until their first molt.
- They are cannibalistic and will eat other species or smaller individuals of their own.
- Female will often eat their young

Spiders

Management Guidelines: Use door/window screens and insect traps and caulk or fill small cracks and other openings.

Black Widow

- 1½ inches with legs extended
- Glossy, jet black in color, with a large bulbous abdomen with a red hourglass marking on the underside
- Found in inconspicuous areas such as wood piles, garages, etc
- Very poisonous

Brown Widow

- Vary in color from gray to light brown or black
- Abdomen has markings of black, white, red, and yellow.
- Under the abdomen it has an orange or yellowish-red hourglass marking

Brown Recluse

- Medium sized spider: ¼ to ½ inch
- Recognized by its dark, violin shape mark behind the eyes
- Has 3 pairs of eyes, while most spiders have 4 pair
- Mainly lives in the eastern US
- Has tendency to live in old boxes, furniture, houses and farm buildings; so it is easily transported by man.

Management Guidelines for Spiders

- Eliminate food sources
- Cut down on debris in area
- If liquid treatment is applied for spiders, it must actually come in contact with the spiders or its webbing to be effective
- Remove spiders by sweeping, vacuuming or washing.

Fabric Pests

Carpet Beetles

- Varied Carpet Beetle:
  - Black and has irregular pattern of white, brown, and dark yellow scales on the elytra.
  - Older adults have lost scales, so they appear solid brown or black
- Black Carpet Beetle: Shiny black and dark brown with brownish legs
  - Can be a pest of fabric and stored product: beans, peas, wheat, rice, and many types of seeds
- Female beetles search for nests of bees, wasps, birds, and spiders in which to lay their eggs because they contain dead insects, beeswax, pollen, feathers, or other pest debris that can serve as food for larvae.
- In a structure, they deposit eggs on or near wool carpets and rugs, animal skins, furs, stuffed animals, leather, hair, silk, dried plants etc that can be used as larval food
- Management

  - Among the most difficult to control because of their ability to find in obscure places and to disperse widely
  - Control depends on integrating the use of sanitation, exclusion, and where necessary, insecticides
  - Eliminate accumulations of lint, hair, dead insects, etc that serve as food.
  - Regular cleaning of rugs, drapes, mounted animals, upholstered furniture, etc where beetles can be found
  - Keep fabrics clean: food and perspiration stains on fabric attract carpet beetles.
  - Cleaned fabrics should be stored in plastic bags or other closed containers
  - Apply residual insecticides as spot applications: cracks/crevices where larvae are found

Clothes Moths

- Unlike most moths, clothes moths are not attracted to light
- Larvae of clothes moths spin silken webs
- **Webbing Cloths Moth**
  - Most common fabric moth
  - Golden colored with reddish golden hairs on the top of the head.
  - Adults are usually found next to the source of the infestation
  - Eggs are attached to the threads of fabric with adhesive secretion
  - Larvae are shiny white with dark head capsule
    - Spin webbing as they feed and may partially enclose themselves in a webbing cover or feeding tube.
    - Feeding tubes are usually extended along floor cracks under carpets.
    - Excrement of the webbing clothes moth may contain dyes from cloth fibers being consumed and will be the color of the fabric they are infesting
    - The same color appears as a median streak thru the outer parts of the larvae.
    - Feed on wool clothing, carpets, rugs, upholstered furniture, furs, animal bristles in brushes, and even wool felts in pianos.
    - Larvae will eat synthetics if blended with wool
    - Fabrics stained by foods, perspiration, or urine are more subject to damage.
- **Casemaking Clothes Moth**
  - Roughly the same size/slightly smaller than webbing clothes moth
  - Distinguished from the webbing clothes moth by their wings: more brownish, and their forewings are dimly spotted with a darker color.
  - The hairs on the head of the casemaking clothes moth are lighter in color.
  - Larvae always carry a silken case with them as they feed. They NEVER leave the silken tube behind. It enlarges as they grow.
  - The case takes on the color of the fabric they are infesting.
  - Pupation takes place inside the case.
- **Management of Clothes Moths**

- Control depends on prevention of infestation, protecting fabrics, and using insecticides when necessary.
- Low humidity creates an unsuitable environment for these moths.
- Regular cleaning of susceptible materials
- Use of vacuums to remove eggs and larvae.
- Cold storage at temperatures between 40°F and 42°F can protect expensive clothing and furs.
- Pyrethrins can provide quick knock-down

Stored Product Pests

- To control losses from stored product pests
  - Use management methods that prevent pest infestation
  - Eradicate existing infestations
  - Stops the spread of the pest or contamination of other food
  - Establish an integrated program that includes periodic inspection and monitoring, sanitation, exclusion, and appropriate chemical and non-chemical methods
  - Use mechanical techniques that can control moisture, temperature
  - Rotation of products by the customer
- **Birds**
  - Can consume large quantities of grain and other items
  - Can contaminate stored food with feces and feathers
  - Feces may contain salmonella bacteria and fugal spores that can produce serious intestinal poisoning of people

- **Rodents**
  - Pests of stored products, can chew through wood, and squeeze through every small openings
  - Can damage cloth, plastic, paper, and cardboard
  - Good climbers
  - Can contaminate food with urine, feces, and hair
  - Can chew on electrical wiring and cause serious fire or equipment malfunction.
  - Exclusion
    - Most important control method
    - Seal openings with heavy gauge sheet meta, heavy wire screen mesh of ¼ inch or less, or concrete with heavy wire embedded in it.
  - Sanitation
  - Trapping, Baiting, and Fumigation
    - Trapping requires daily checking for trapped animals and servicing of equipment. If baited, bait must be kept fresh
    - Poisonous baits must be kept fresh to be attractive; therefore bait stations need to be check and re-filled frequently.

- Once started, bait stations must not allowed to become empty, otherwise rodents may recover from toxic effects
- Use of rodenticides within storage facilities creates risk of product contamination and may not be allowed in some situations
- Baits may not be effective as long as the rodents have access to the stored food product.
- Poisoned animals may wander off and die, making if difficult to find.
- Fumigation may leave dead animals inaccessible.

Insects

Important economic pests that contaminate stored food with excrement, cast skins, dead bodies, and webbing.

- **Sawtooth Grain Beetles and Merchant Grain Beetles**
  - About 1/10 inch, long, reddish brown to dark brown, and flat
  - Lateral margins of the thorax contain 6 sawtooth projections on each side.
  - Because of flattened bodies, they are able to access small cracks and crevices.
  - Both species have well-developed wings, but sawtooth grain beetle does not fly.
  - Temperature and humidity affect the development time
  - Sawtooth grain beetle larvae feed on rice, wheat, and nuts.
    - Probably cannot attack whole, undamaged grains
    - May be associated with other whole-grain pests and feed on kernels damaged by other pests.
  - Merchant grain beetle is not a major pest of grains or cereals, but prefers seeds and nuts

- **Confused Flour Beetle and Red Flour Beetle**
  - Most common and serious pests of flour, cereal, and broken grains
  - Both are about 1 inch long, flattened, and shiny reddish brown
  - Both emit foul smelling, gaseous secretion when disturbed and will contaminate material they feed on.
  - Confused flour beetle: the last four segments on the antennae gradually enlarge to form a club-like shaped.
  - Red flour beetle: antennae abruptly terminate in 3 larger, club-like segments
  - Do not attack whole grains
  - Feed on damaged grains, flours, cereals, and other stored products.
- **Granary Weevil and Rice Weevil**
  - Attack whole grains
  - Weevils are distinguished from other beetles by the slender elongation of their heads giving rise to the common name of snout beetles
  - Both granary and rice weevil are serious grain pests
  - Granary weevil
    - About 1/8 inch long

        - Top, center of the thorax is covered with elongated depressions or punctures
        - Have wings, but they do not fly
    - Rice weevil
        - Very good fliers
        - Slightly smaller than the granary weevil
        - Reddish brown to black and usually has 4 reddish or yellowish spots on its elytra
        - Top, center of the thorax is covered with round punctures
- **Cigarette Beetle and Drugstore Beetle**
    - Distinguished by their humped appearance due to their downward bent head
    - Cigarette Beetle
        - Reddish yellow to brownish red
        - Adults are about 1/8 inch long
        - Eggs are attached to food sources such as **tobacco**, rice, raisins, grains, pepper, etc
    - Drugstore Beetle
        - About the same size as the cigarette beetle
        - Reddish brown
        - Has longitudinal striations or ridges on their elytra
        - Have a slightly less humpbacked appearance
        - Feed on practically every type of stored product
            - Spices, drugs, books, and wood.
            - They can survive on items of low food value because of yeast like organisms in their digestive system that produce some essential vitamins.

- **Indian Meal Moth**
    - Most common pest of coarsely ground flours (whole wheat flour and cornmeal
    - Also infests shelled or ear corn, broken grains, dried fruit, seeds, peas, dried fruit, seeds, beans, crackers, biscuits, nuts, powdered milk, chocolate, red peppers, candy, dry dog food, etc
    - Spin large amounts of webbing in food they are infesting
    - About ¾ inch long
    - Wings are pale gray with the bottom 2/3 of the forewing colored reddish brown with coppery luster
    - Females lay eggs at night
    - Larvae are dirty-white but may take on different colors depending of the food they eat.
    - Pupation takes place in a silken cocoon
- **Almond Moth**
    - Considered less of a pest than the Indian Meal Moth, but is capable of causing considerable damage to cereals, dried fruits, flour, grain, seeds, and shelled nuts.

- Mottled gray in color and may have a fawn-colored pattern on the forewing.
- Larvae are dirty-white tinged with brown or purple dots; giving them a striped appearance.
- They leave a matted webbing as they feed

1) Sawtooth grain beetle cannot attack whole, undamaged grains. Feed on kernels damaged by other pests
2) Merchant grain beetle is not a major pest of grains or cereals, preferring seeds and nuts.
3) Flour beetles usually do not attack whole grains. They feed on damaged grains, flour, cereal, and other stored products
4) Granary Weevil and Rice Weevil attack undamaged grains
5) Cigarette beetle: Females produce about 30 eggs over a 4-week period. They usually hatch within one week (on test: 1-2 weeks)

Test question:
Some common store product pests that attach whole grains and chew through the seed coat are ______________

*a. **rice and granary weevils (correct answer)*****
b. red and confused flour beetles
c. psocids and grain mites
d. sawtooth and merchant grain beetle

Management for Stored Product Pests

1) Management relies on inspection and monitoring to detect and identify pests. This is followed by integrated program of control which includes
   a. Sanitation practices
   b. Exclusion techniques
   c. Habitat modification
   d. Careful insecticide use
2) Control can be throwing infested material away and storing uncontaminated food products in insect-proof containers
3) Use pheromone traps inside a building to monitor pest activity
4) Pheromones are available for most insects that damage stored food
5) Traps using mating pheromones generally catch individuals of one sex, usually males
6) When using pheromone traps or food attractants, place one trap per 250-500 sq feet of storage space.
7) Use traps for control, so no pesticides used.

- **Management of Stored Product Insects**
  - Relies on inspection and monitoring to detect and ID pest, followed by an integrated program of control that includes sanitation, exclusion techniques, habitat modification, and careful insecticide use.

- Control can be as simple as throwing away infested materials and storing uncontaminated food products in insect proof containers
- Inspection and Detection
  - Monitoring is used to detect, locate, and ID pests, determine the proper time to apply control techniques and evaluate the success of the management program
  - Use of pheromone traps inside a building to monitor
  - Traps using mating pheromones usually attract males
  - Traps using aggregation pheromones attract both sexes
  - Food attractants can lure larvae and adults
  - When using pheromones or food attractants for monitoring, place one trap per 250-500 sq feet.
  - For flying insects: put traps near storage containers
  - For insects that do fly: place traps inside containers
  - The use of more than one type of pheromone in an enclosed area may prevent target insects from efficiently locating traps.
  - Exclusion: prevent insect entry by inspecting grains, cereals, and flours. Check packaging for holes, webbing, insect frass, eggs, living insects, and insect parts.
  - Sanitation: clean up spilled materials to eliminate food sources.
  - Environmental modification: manipulation of storage temps or humidity can destroy many stored product pests.
  - Heat kills some pests outright; while cold will block the development
  - Temps of 60°F prevents insect feeding; 40°F` kills insects over a period of time.
  - Insecticide: Safest type of insecticide for use on food items is *Bacillus thuringiensis*. This organism produces toxins that are fatal to certain species of insects but have no known effect on people.
  - Insect growth regulators (IGR) have low toxicity to humans.
    - IGRs: chemicals that alter the insect's ability to develop normally or pass through developmental stages at the proper time.
    - Some IGRs prevent larvae from becoming adults and others force insects to pass into the adult stage before they are mature enough to reproduce.

Occasional Invaders

Mites

- Occasionally infest stored food. Feed on cheese, flour, grains, dried fruit, dried meats, cereal, pet food, animal feeds
- Use a microscope to inspect stored products for moving mites that are small and colorless or cream colored.

Lice

How long can they go between blood meals? Adult head lice can survive 1-2 days without a blood meal.

There are 1-2 questions on the treatment of body lice.

Clothes should be washed in hot, soapy water and dried using a clothes drier on high heat. This will kill eggs, nymphs, and adults. The individual should bathe in soapy water. Inspection of bedding and personal belongings should occur; if lice are observed, materials should be washed as described above.

- **House Dust Mites**
    - Produce allergic reactions when humans inhale them
    - Female: 1/64 inch long. Males are even smaller
    - Because of their size, mites are often overlooked in home.
    - Dust near the bed and in mattresses is the most common habitat for the mite
- **Book Lice**
    - Also known as pscoids
    - Must have high humidity to survive
    - Known as booklice because they are often among books or papers
    - Feed on mold, fungi, cereals, pollen, fragments of dead insects or other similar materials.
    - They cause loss of little food products because the chiefly feed on mold
    - Damage to books may be more direct because booklice eat the starch sizing in the bindings and along paper edges.

- **Silverfish and Firebrats**

1) Feed on fabrics such as linen, rayon, and cotton
2) Attract to starched fabrics
3) Also feed on paper, book bindings, and dead animals
4) Feed on any type of human food, but are especially attracted to flour and starches

- Attracted to moisture

- **Crickets**
    - Can damage fabrics: silks and woolens
    - Attracted to perspiration and other stains on clothing and fabrics
    - Usually invade a structure at night
    - Attracted to lights
    - About ½ to ¾ inch in length
    - Yellowish with dark bands on the head or solid shiny black in color
- **Springtails**
    - Can invade in large numbers in structures with high humidity
    - Can be found indoors in potted plants or decaying flower bulbs
    - White or gray in color

  - Have a forked appendage to the rear of the abdomen that is used as a lever which allows these insects to jump or spring into the air
  - Best method of control is to control moisture source they are attracted to by decreasing humidity.
- **Plaster Bagworms**
  - Larvae of a moth that lives in flattened, gray, watermelon seed-shaped case approximately ½ inch long
  - Case is made of silken fibers and sand particles, lint, paint, etc
  - Case has a slit like opening at each end so that larva is able to move around and feed from the other end.
  - Control: removal of spider webs they are feeding on and removal of the casing of the plaster bagworm
- **Sowbugs and Pillbugs**
  - Not insects
  - Wingless, oval or slightly elongated about ½ inch long.
  - Slate-gray in color
  - Feed primarily on decaying organic matter, but occasionally will feed on roots of green plants.
  - Sowbugs: possess 2 tail-like appendages, seven pairs of legs, and well developed eyes. They are incapable of rolling into a ball
  - Pillbugs or roly-polies lack the tail-like appendages and are able to roll into balls.
  - Both require high moisture and are active at night

- **Centipedes and Millipedes**
  - Neither damage furnishings, homes, or food
  - Centipedes
    - One pair of legs per body segment
    - poorly developed eyes and active at night
    - Active predators: feed mainly on insects and spiders
    - Use venom to immobilize prey; but species we deal with cannot penetrate human skin
    - Associated with dark, damp areas: under stones, leaf litter, bark, soil.
    - Can be found inside where there are areas of high humidity
  - Millipedes
    - Have 2 pairs of legs per body segment
    - Coil up tightly when disturbed and some species emit foul-smelling fluid
    - Scavengers: feed on decaying vegetable matter
    - Found under stones, flower pots, debris where there is abundant moisture

Rats

- Several human diseases are associated with rat infestations

- Salmonellosis; intestinal disorder transmitted to people who ingest food contaminated by salmonella bacteria in rat urine or feces
- Murine typhus, leptospirosis, listeriosis, and trichinosis are other rat-transmitted diseases
- Tropical rat mite: an external rat parasite causes severe itching and skin irritation in people.
- Rats have been known to bite people: causing rat-bite fever
- Plague bacteria: transmitted from rats to people through the bite of rat flea

1) *Test question asking how to determine a young rat from an adult house mouse*
    a. *Answer: size of the body and parts*
2) The pictures of the rodents may not be clear, but the description are very specific to the species in question
3) Rats are extremely wary of new items or situations and will sometimes take several days to adjust to changes in the environment before they investigate new food or nest items.
4) Rats can squeeze through openings <u>½ inch in diameter</u>

Norway Rat
1) Hairless tail that is colored dark brown above and lighter on the underside
2) Has small, closely set ears
3) Blunt muzzle
4) Small eyes
5) <u>Prefer greasy meat</u> and other animal products, but will generally feed on any type of food

Roof Rat
1) Also known as black, fruit, or citrus rats
2) Smaller than Norway rats
3) Tail is longer than the length of the head and body
4) Pointed muzzle
5) Large, prominent ears
6) Eyes are larger and more pronounced than those of Norway rats

House Mouse
1) Will eat most human food; meat, grains, cereals, seeds, fruits, and vegetables
2) Capable of eating up to eight pounds of food per year, but destroys much more then this due to fecal and urine contamination
3) Capable of crawling through openings as small as ¼ inch wide.
4) Adjust rapidly to changes in the environment and explore new objects
5) Will try new food within a few hours after it is put out
6) Maximum range of travel is 30 feet

Birds

1) Can become nuisances when their activities conflict with human needs. Most common problem involves birds nesting in or on buildings
2) Question on test asking about the problems with pigeon droppings: contaminates food products and transmits disease to humans and domestic animals.
3) Histoplasmosis and birds
4) Starlings: about 7.5 to 8.5 inches.
5) Starlings: short tails

6) Why are starlings a problem?
   - Abundant in city parks, suburbs.
   - They are gregarious birds and use large communal roosts from late summer until early spring.
   - They are primarily ground feeders and will feed in areas near people.
   - The dry plant material used in their nests can be fire hazard
   - Uric acid in feces is unsightly and can cause damage to finish on automobiles
   - They have been associated with numerous disease organisms transmissible to humans and livestock
   - They can be a source of stick-tight fleas, soft ticks, bed bugs, and carpet beetles.
   - Large populations in agricultural settings can cause economic loss due to consumption and contamination of livestock feed

7) *Question on test asking what the size of a starling is compared to ______. Some people confuse the house sparrow with the Carolina wren, because they have the same nesting habits and are approximately the same size.*

Rodenticide Information

Anticoagulants

- Cause death as a result of internal bleeding which occurs as the animal's blood loses its clotting ability and capillaries are destroyed.
- First Generation Anticoagulants
  - Multiple dose; usually only cause death after they are consumed for several days in succession by the rodent.
  - Must be available continuously until the rodent ingests enough doses for death to occur
- Second Generation Anticoagulants
  - Invented as a result of resistance developing to first generation anticoagulants
  - Single dose; cause death following one feeding. Resistance does not have a chance to occur.

Anticoagulants Rodenticides

Active ingredient	Trade Names	Other Info
Brodifacoum	Talon, Enforcer, Ropax, Final	Single dose; kills warfarin resistant rodents
Bromadiolone	Contrac, Maki, Boothill, Hawk	Single dose; kills warfarin resistant rodents
Difethialone	Generation	Single dose; kills warfarin resistant rodents
Diphacinone	Ditrac, Ramik Green	May cause death after one feed, but usually 2-4 multiple feeds are required
Chlorophacinone	Rozal, Eaton's AC 90	Single dose; kills warfarin resistant rodents
Warfarin	D-Con	Multiple dose

Other Types of Rodenticides/Non-Anticoagulants

Bromethalin	Vengenance Assault, Fastrac	Single dose, stops rodent's feeding action. Kills warfarin resistant rodents
Cholecalciferol	Quintox	One to three feedings are lethal. Kills warfarin resistant rodents.

GHP Sample Exam – CORE

1. The Signal word “Caution” refers to a material that is __________________.
   A. the least toxic
   B. the most toxic
   C. moderately toxic
   D. slightly toxic
   E. non-toxic

2. IPM or Integrated Pest Management means___________________.
   A. integrating multiple pest control techniques
   B. using weather and habitat modification to control pests
   C. using least toxic methods to control pests
   D. A & B only
   E. all of the above

3. Vehicles and trailers used in pest control need to be permanently marked with the licensee’s name that is at least _________________ in height.

   A. 1 inch
   B. 1.5 inches
   C. 2 inches
   D. 2.5 inches
   E. 3.5 inches

4. Examples of mechanical control measures include:

   A. Handheld sprayer
   B. Traps and screens
   C. Bait application
   D. Lady bug releases

5. When controlling a pest, your first action should be:

   A. Lock your vehicle
   B. Have the customer leave the home or business area
   C. Identify the pest
   D. All of the above

6. Unless timely renewed, a license automatically expires ____ days after the anniversary renewal date.

   A. 30
   B. 60
   C. 90
   D. 180

7. Labeling refers to:

   A. The directions on the label
   B. The MSDS
   C. The product itself and all other information about it from the manufacturer
   D. Signal word on the product

8. All products classified as “Restricted Use” will indicate this:

   A. as “Restricted” on the bottom of the label
   B. with the signal word “Danger” on the label
   C. with “Restricted Use Pesticide” on the front panel
   D. with skull and crossbones symbol on the label

9. Which of the following must be kept at the business location?

   A. The Certificate of the CO in charge, labels of materials used, pest control license
   B. Labels of materials used, business records, pest control license
   C. The Certificate of the CO in charge, business records, labels of materials used
   D. Pest Control license, the CO’s Certificate, business records

10. New employees must get _____ days of training before treating in the field alone.

    A. 5
    B. 10
    C. 15
    D. 20

11. Hazard is best defined as:

    A. Risk of the harmful effects of pesticides
    B. Potential to harm the environment
    C. Measure of the ability to cause harmful effects to people
    D. Total amount of exposure to a pesticide

12. If not renewed, your Certificate will expire _________ days after its renewal date.

    A. 60
    B. 90
    C. 180
    D. 90 with a 30-day grace period

13. During application of a material, the most likely route of exposure is:

    A. Oral
    B. Ocular
    C. Dermal
    D. Inhalation
    E. All of the above are likely to occur

14. The formulation abbreviation D stands for:

    A. Dry Flowable
    B. Dust
    C. Soluble Dust
    D. Desiccant

15. Rules of Chapter 482 say that Certificates must be renewed by ________ in order to avoid a late fee.

    A. June 1^{st}
    B. June 30^{th}
    C. midnight July 1^{st}
    D. midnight May 31^{st}

16. Which Organization is responsible for registering all pesticides?

    A. The EPA
    B. State Dept. of Agriculture
    C. DACS
    D. USDA
    E. FIFRA

17. A disadvantage of aerosols is that:

    A. They pose an inhalation risk
    B. They retain potency for a long period of time
    C. They can be easily stored
    D. All of the above

18. An advantage of using baits is that:

    A. They can control pests that move in and out of an area
    B. They even kill non-target pests
    C. They cause pests to die in large numbers when no one is around
    D. They are volatile

19. FIFRA is an abbreviation for:

A. First Insecticide & First Rodenticide Act
B. Federal Insecticide, Fungicide and Rodenticide Act
C. First Insect and Federal Rodenticide Act
D. Federal Insect & Federal Rodent Control Act
E. First Insecticide and Federal Rodent Control Act

20. All pest control technicians must have 2 hours of continuing education before:

A. June 1^{st}
B. they can renew the ID card
C. each year's license anniversary renewal date
D. submission of the ID card renewal form
E. they can qualify for the next ID card

21. Which statement is False?

A. Pest control does not include the ID of an infestation on an ornamental.
B. The CO in charge needs to know how to contact the nearest poison control center.
C. A CO can keep his Certificate active for years if he never does any business by simply getting the proper recertification training and paying his renewal fee on time annually.
D. A licensee must notify the Department immediately if he looses the CO in charge.

22. Microencapsulated pesticides are:

A. More difficult to mix and apply
B. Are much safer to use around bees
C. Are much safer for operator exposure
D. Are abrasive to many pumps and nozzles

23. Which statement is true?

A. "Infestation" refers to the presence of living or dead pests in or under a structure, lawn, or ornamental.
B. The rear end of a vehicle does not have to be identified
C. A special ID cardholder is responsible only as an ID cardholder.
D. All of the above

24. Certificates expire:

A. December 1st
B. June 30th
C. 90 days following the renewal date
D. 180 days following the renewal date
E. none of the above

25. Drift refers to :

A. Pesticide movement through the soil to a non-target area
B. Pesticide movement through a body of water
C. Pesticide accumulation in a non-target area
D. Pesticide movement from the release site in the air
E. All of the above

26. Factors affecting movement of pesticide in ground water include:

A. Distance to ground water and permeability of the soil
B. Presence of paved areas
C. Amount of turf
D. Height of turf
E. All of the above

27. The best way to prevent ground water contamination is to:

A. Prevent back-siphoning
B. Be careful when treating prior to a rainstorm
C. Do not treat at all when you know the ground water level is high
D. Follow labeling directions exactly

28. A sign of pesticide poisoning is:

A. Pinpoint pupils
B. Coughing
C. Sweating
D. Extreme thirst
E. All of the above

29. PPE stands for:

A. Personal Pesticide Equipment
B. Protective Pesticide Equipment
C. Personal Protection Equipment
D. Personal Protective Equipment

30. Probation in violation of the Rules is for no longer than ____ year(s).

A. 1
B. 2
C. 3
D. 5

31. The Certified Operator is responsible for ___________.

A. Application of pesticides by the licensee
B. Mixing of pesticides
C. Safe use of pesticides
D. All of the above

32. Who is responsible for registering all pesticides?

A. Each manufacturer
B. DACS
C. USDA
D. National Pesticide Registration Board
E. The EPA

33. All certificates expire:

A. On the anniversary date of the exam
B. On the anniversary date of the licensee
C. on June 1^{st} each year
D. 180 days from the renewal date

34. Upon a CO changing his/her address or phone number, the Division must be notified within ________ days.

A. 7
B. 10
C. 14
D. 30

35. Prior to the renewal of a certificate, the certificate holder must __________.

A. complete the required continuing education
B. pass a DACS exam
C. both A & B
D. either A or B

36. The Dept.-issued license will expire when____________.

A. the business phone number changes
B. the location or business name changes
C. the CO's home address changes
D. all of the above

37. _____________ is required for telephone book advertisement.

A. full street address
B. licensed business name
C. phone number
D. B&C
E. all of the above

38. The EPA establishment number on a pesticide label indicates _________.

A. the "lot" number of the pesticide
B. that the label has been approved by the US government
C. the specific facility that produced the product
D. all of the above

39. Once a certificate has been revoked, it can be re-applied for _____________.

A. after 3 years
B. after 2 years
C. in one year
D. in 180 days

40. Rinsate refers to:

A. The tiny amount of pesticide left at the bottom of a concentrate jug
B. The small amount of mix left at the bottom of a sprayer unit
C. The small amount of liquid at the bottom of a cleaned out tank
D. Water and an unknown amount of pesticide resulting from cleaning out a sprayer or concentrate jug

41. Toxicity refers to:

A. How volatile a material is
B. How much exposure a pesticide applicator can get
C. Whether a material is in liquid or granular state
D. A measure of the ability of a material to cause allergic effects

42. FIFRA allows a CO to use a pesticide _______________.

A. at a concentration less than that directed by the label
B. at a concentration greater than that directed by the label
C. for a non-target pest as long as the site is listed on the label
D. all of the above
E. A & C only

43. The 3 “C”s of spill control in order of managing a spill are:

A. Confine, Control, Clean Up
B. Clean Up, Control, and Confine
C. Call, Control, and Clean Up
D. Call, Contain, and Control
E. Control, Contain, and Clean UP
F. Control, Clean Up and Call

44. Desiccants kill by:

A. causing the loss of body fluids
B. causing internal bleeding
C. blocking the breathing process
D. blocking the nervous system

45. Wettable powders were created to:

A. dissolve in water
B. suspend in water
C. dissolve in an oil base
D. suspend in an oil base

46. To safely remove safety gloves after a pesticide application one should:

A. properly wash and dry the gloves before removal
B. rinse the gloves in water, then remove the gloves and hang them to dry
C. remove the gloves by peeling them off and inverting them from the wrist to the fingers and place them into a cleaning solution to soak
D. remove the gloves in a container of wash water while hands are under the water

47. Wetting agents, emulsifiers, spreader-stickers, and anti-foaming agents are:

A. known as soluble concentrates
B. called solutions
C. called adjuvants
D. all insecticides

48. A solvent ________________________________.

A. is a liquid that will dissolve a pesticide to form a solution
B. is a material that will make a pesticide highly active
C. is added to a pesticide to make it thicker
D. is an additive in all pesticides to make them less corrosive
E. all of the above

49. Which statement is false?

A. "Pest Control" does not include the identification of infestation on an ornamental
B. An ID Cardholder is responsible for the safe and proper use of insecticides
C. The CO must know how to contact the nearest poison control center
D. The Licensee's name/trade name must be at least 1.5 inches high on each side of the service vehicle

50. The Statement of Practical Treatment:

A. Deals with how, in practical terms, one should use or apply the material during a treatment
B. Deals with environmental hazards of the labeled material
C. Summarizes directions for proper treatment using the material
D. Includes instructions on how to respond to an emergency exposure

51. There are ________ known bodily routes of pesticide exposure.

A. 2
B. 3
C. 4
D. 5

52. Triple rinsing of liquid chemical containers prior to disposal should be done this way:

A. Empty the original container and let it drain for a couple of seconds, then fill it about ½ full of water, shake it vigorously and then let it drain for a few seconds until empty, and repeat a total of 3 rinses.
B. Empty the original container and let it drain for a couple of seconds, then fill it about 1/4 full of water, shake it vigorously and then let it drain for 30 seconds until empty and inner surfaces are rinsed, and repeat for a total of 3 rinses.
C. Empty the original container and let it drain for 30 seconds, then fill it about ½ full of water, cap and shake it vigorously and then let it drain for

30 seconds until empty, and repeat two times for a total of 3 rinses.
D Empty the original container and let it drain an extra 30 seconds, then fill it about ¼ full of water, cap the container and shake it vigorously and then let it drip drain for another 30 seconds until all inner surfaces are rinsed. Then drain this water and let it drip drain for another 30 seconds. Repeat the ¼ fill and drain procedure for a total of 3 rinses.

53. Criminal penalties under FIFRA for commercial applicators can reach:

A. $5,000 and 1 year in prison
B. $10,000 and 1 year in prison
C. $5,000 and 30 days in prison
D. $25,000 and 1 year in prison

54. MSDS stands for __________________.

A. Material Sheet Data Survey
B. Market Survey Data Sheet
C. Molecular Scientific Data Sheet
D. Material Safety Data Sheet
E. Medical Safety Data Summary

55. The term “acute” effects refers to:

A. Exposure-related illness that results within the hour
B. Exposure-related illness that occurs within 24 hours of overexposure
C. Exposure-related illness occurring within a week of exposure
D. Poisoning resulting in death

56. Resistance in a roach population develops mainly ____________.

A. through regular use of pesticides
B. because not all of the roaches were killed initially
C. because food sources were available to compete with the bait
D. genetically

57. A “sensitive area” refers to:

A. One where kids play
B. One near an endangered species
C. An area where food is being prepared
D. An area 10 feet from a pond
E. All of the above

58. Select the statement that is false:

A. The CO must know how to contact the nearest poison control center.
B. The licensee's name or trade name must be at least 1.5 inches in height on each side of the service vehicle.
C. An ID cardholder is responsible for the safe and proper use of insecticides.
D. "Pest Control" does not include the identification of infestation on an ornamental.

59. All ID Cardholders must:

A. If accidentally poisoned, be reported to DACS by the CO within 24 hrs.
B. Have had their ID card applied for prior to being hired.
C. Have the CO in charge notify DACS when their duties change
D. Take 2 hours of continuing education annually unless they are SPID holders.

60. The following person is not required to hold an ID card

A. The Certified Operator in Charge who never goes out in the field
B. The Salesman who never uses any materials to treat a home or business
C. The head secretary who sets up pest sales over the phone
D. The part-time technician who only works three days a week

61. Acute poisoning refers to a pesticide that will cause poisoning orally or dermally and requires "POISON <u>and</u> the SKULL AND CROSSBONES" on the label. That means that the material can cause poison effects within __________ hour(s).

A. 1
B. 8
C. 12
D. 24

62. A substance that contains undissolved particles in a liquid is called a _____.

A. diluent
B. suspension
C. solvent
D. rinsate

63. A "threshold" refers to:

A. a population level of a pest where control action needs to take place
B. a population level of a pest that causes injury or harm
C. a population level of a pest that is reached just prior to being treated on a service
D. a known pest population level in a specific area

64. Fipronil is the ___________.

A. brand name
B. common name
C. trade name
D. scientific name

65. The licensee must apply for an ID card for a new employee within the first ____ days of hire.

A. 5
B. 10
C. 14
D. 30

66. The most well-known energy-inhibiting insecticide is:

A. Chlordane
B. Dursban
C. Termidor
D. Hydromethylnon

67. Toxicity depends on:

A. type and amount of active ingredient
B. acute dermal effects
C. amount of exposure
D. amount inhaled
E. All of the above

68. Your Certified Operator in charge of a Service Center left for a 20 day vacation. What must be done at the Service Center?

A. A temporary CO from another Company must be hired.
B. You must hire an emergency certified operator.
C. Designate another CO in the company as temporary CO in charge.
D. A Special ID Cardholder at your S.C. can sit in as CO in charge.

69. The most likely causes of spray tip failure are:

A. Debris or corrosion clogging the tip and/or overworn tip
B. Debris in the tank and failure of the main pump gasket
C. Debris in the tank, overworn tip and leaking application gun
D. Overworn tip, pump gasket failure and overpressurized sprayer

70. Florida applicators are regulated by:

A. FDACS
B. FDA
C. Florida Certified Operator's Bureau
D. EPA

71. Which formulation would be most likely to cause nozzle abrasion or clogging?

A. ECs
B. WPs
C. Ms
D. Aerosols

72. A systematic method of observing pest signs over time is:

A. the customer
B. the sticky trap
C. monitoring
D. indoor and outdoor inspections

73. Pheromones are:

A. used in monitoring traps
B. chemicals produced by insects to affect individuals of the same species
C. often used to attract moths beetles and some flies
D. all of the above

74. The most likely cause of nozzle tip failure is:

A. Improper cleaning caused a worn tip
B. Debris clogged the tip
C. The tip aged and corroded
D. Any of the above

75. DACS updates a chemically sensitive persons list quarterly. The list indicates the distance from each sensitive person's residence that a pest operator is allowed to treat due to a professional doctor's prescription. The operator must notify the sensitive person prior to treatment at any residence within a maximum distance of ___________ from the chemically sensitive person's residence.

A. the adjacent/contiguous residences
B. ½ mile radius
C. ¼ mile radius
D. 1 city block

76. The company license expires:

A. 180 days from the anniversary date
B. 90 days from the anniversary date
C. 60 days from the anniversary date
D. on the anniversary date of the certificate

77. Your new CO Certificate will be sent:

A. within a month of passing the exam
B. after paying an issuance fee within 60 days of passing
C. after 90 days of passing as long as the issuance fee and $50 late fee are paid.
D. B & C

78. If applicator clothing is contaminated with spray it can be cleaned:

A. in a washing machine or by hand prior to re-using
B. in hot water, heavy duty detergent and rinsed in cold water
C. washed in hot water and soap and 2 more warm water rinses
D. destroyed so that it cannot be re-used

79. FDACS must be notified ___________________ upon accidental poisoning or death connected to pest control work.

A. immediately
B. within 8 hours
C. within 12 hours
D. within 24 hours

80. Toxic tracking powder such as Zinc Phosphate (ZP) :

A. can be applied on overhead ceiling beams and in bait stations
B. can be applied in bait stations and on the upper shelf where rodents run
C. can be placed in attics and inside wall voids
D. all of the above

81. When the licensee changes the company address the state must be notified in _________days and the customers must be notified in ________ days.

A. 10/10
B. 10/30
C. 30/10
D. 30/30

THE FOLLOWING QUESTIONS COVER MAXFORCE MAGNUM ROACH BAIT GEL: (no calculations required)

82. Maxforce:

A. is the chemical name
B. is the manufacturer name
C. is the trade name
D. is the label name

83. The % active ingredient in this product is:

A. 0.20%
B. 0.05%
C. 0.5%
D. 99.95%
E. 100%

84. Use of Maxforce Magnum Gel is restricted in/on:

A. Areas not easily accessible to kids and pets
B. Food preparation and food contact surfaces
C. Commercial kitchens
D. Areas that not have been recently sprayed by insecticides
E. All of the above

85. Maxforce Magnum can stain:

A. glass
B. stainless steel back of a microwave
C. certain textiles or fabrics
D. all of the above

86. Outdoors, use Maxforce Magnum:

A. out in an open area where roaches can locate the bait
B. at potential points of insect entry
C. in any area of the yard
D. all of the above

87. This product should be applied for severe German roach infestations at the rate of:

A. 2-4 spots per square foot
B. 1-2 spots per square yard
C. 2-4 spots per square yard
D. 1/3 inch to ½ inch spot size

THE FOLLOWING QUESTIONS COVER DEMAND CS:
(1 calculation required)

88. Do not make broadcast applications to turf when wind speed exceeds :

A. 5 mph
B. 10 mph
C. 15 mph
D. 20 mph

89. Use _________ oz. per gallon of Demand CS for a severe roach cleanout in a residential kitchen:

A. 0.2
B. 0.4
C. 0.8
D. 0.16

90. In garden areas around the home foundation, Demand CS can be applied in a band up to _______ ft. high from the foundation, including around windows and doors.

A. 1
B. 3
C. 5
D. 10

91. Applying the mid rate of Demand CS (4 oz. in 50 gallons of water) at the rate of 5 gallons/1000 square feet, you will apply _______oz. of concentrate over 5,000 sq.ft.?

A. 1 oz.
B. 2 oz.
C. 3 oz
D. 4 oz.

92. For SEVERE roach infestations, the recommended rate for clean-out treatments is:

A. 0.03%
B. 0.04%
C. 0.05%
D. 0.06%

93. The following statement is false:

A. Do not apply to edible crops
B. Do not apply within 25 feet of lakes
C. Do not apply when wind speed is 20 mph.
D. Demand CS can be applied in classrooms when they are in use
E. None of the above is false.

---

94. Applicants for the GHP CO exam must have completed ____ jobs in the category.

A. 0
B. 10
C. 15
D. 45

95. To obtain a City or County Occupational License, you need to present your:

A. FDACS pest control certificate
B. FDACS Pest Control ID Card
C. FDACS pest control license
D. FL. Driver's License only

96. The EPA Registration number on a pesticide CS label indicates:

A. that the material is patented
B. it is registered with DACS
C. the manufacturer and the product
D. the account number with the Federal Government
E. none of the above

97. Insecticide registration decisions are based upon demonstration of no unreasonable human health or environmental effects. The law that mandates this is:

A. The Florida Pest Control Act, Chapter 482
B. The Rules for DACS, Chapter 5E-14
C. The Federal Food and Drug Administration Act of 1933
D. The Federal Insecticide, Fungicide and Rodenticide Act
E. The Federal Pesticide and Public Protection Act of 1977

98. A solvent is:

A. A substance containing un-dissolved particles mixed with the liquid
B. A liquid like water or kerosene that will dissolve a pesticide into solution
C. Anything used to dilute pesticides
D. All of the above

99. A suspension is:

A. A substance containing un-dissolved particles mixed with the liquid
B. A liquid like water or kerosene that will dissolve a pesticide into solution
C. Anything used to dilute pesticides
D. All of the above

100. An adjuvant is :

A. often a wetting agent or spreader-sticker
B. a chemical added to a substance to increase it's effectiveness
C. a thickener or buffer
D. All of the above

GHP Sample Exam – CORE ANSWER SHEET

1. The Signal word "Caution" refers to a material that is ___________________.
   A. the least toxic
   B. the most toxic
   C. moderately toxic
   D. slightly toxic
   E. non-toxic

2. IPM or Integrated Pest Management means____________________.
   A. integrating multiple pest control techniques
   B. using weather and habitat modification to control pests
   C. using least toxic methods to control pests
   D. A & B only
   E. all of the above

3. Vehicles and trailers used in pest control need to be permanently marked with the licensee's name that is at least __________________ in height.

   A. 1 inch
   B. 1.5 inches
   C. 2 inches
   D. 2.5 inches
   E. 3.5 inches

4. Examples of mechanical control measures include:

   A. Handheld sprayer
   B. Traps and screens
   C. Bait application
   D. Lady bug releases

5. When controlling a pest, your first action should be:

   A. Lock your vehicle
   B. Have the customer leave the home or business area
   C. Identify the pest
   D. All of the above

6. Unless timely renewed, a license automatically expires ____ days after the anniversary renewal date.

   A. 30
   B. 60
   C. 90
   D. 180

GHP Sample Exam – CORE ANSWER SHEET

7. Labeling refers to:

   A. The directions on the label
   B. The MSDS
   C. The product itself and all other information about it from the manufacturer
   D. Signal word on the product

8. All products classified as “Restricted Use” will indicate this:

   A. as “Restricted” on the bottom of the label
   B. with the signal word “Danger” on the label
   C. with “Restricted Use Pesticide” on the front panel
   D. with skull and crossbones symbol on the label

9. Which of the following must be kept at the business location?

   A. The Certificate of the CO in charge, labels of materials used, pest control license
   B. Labels of materials used, business records, pest control license
   C. The Certificate of the CO in charge, business records, labels of materials used
   D. Pest Control license, the CO’s Certificate, business records

10. New employees must get _____ days of training before treating in the field alone.

   A. 5
   B. 10
   C. 15
   D. 20

11. Hazard is best defined as:

   A. Risk of the harmful effects of pesticides
   B. Potential to harm the environment
   C. Measure of the ability to cause harmful effects to people
   D. Total amount of exposure to a pesticide

12. If not renewed, your Certificate will expire _________ days after its renewal date.

   A. 60
   B. 90
   C. 180
   D. 90 with a 30-day grace period

GHP Sample Exam – CORE ANSWER SHEET

13. During application of a material, the most likely route of exposure is:

    A. Oral
    B. Ocular
    C. Dermal
    D. Inhalation
    E. All of the above are likely to occur

14. The formulation abbreviation D stands for:

    A. Dry Flowable
    B. Dust
    C. Soluble Dust
    D. Desiccant

15. Rules of Chapter 482 say that Certificates must be renewed by _________ in order to avoid a late fee.

    A. June 1st
    B. June 30th
    C. midnight July 1st
    D. midnight May 31st

16. Which Organization is responsible for registering all pesticides?

    A. The EPA
    B. State Dept. of Agriculture
    C. DACS
    D. USDA
    E. FIFRA

17. A disadvantage of aerosols is that:

    A. They pose an inhalation risk
    B. They retain potency for a long period of time
    C. They can be easily stored
    D. All of the above

18. An advantage of using baits is that:

    A. They can control pests that move in and out of an area
    B. They even kill non-target pests
    C. They cause pests to die in large numbers when no one is around
    D. They are volatile

19. FIFRA is an abbreviation for:

A. First Insecticide & First Rodenticide Act
B. Federal Insecticide, Fungicide and Rodenticide Act
C. First Insect and Federal Rodenticide Act
D. Federal Insect & Federal Rodent Control Act
E. First Insecticide and Federal Rodent Control Act

20. All pest control technicians must have 2 hours of continuing education before:

A. June 1^{st}
B. they can renew the ID card
C. each year's license anniversary renewal date
D. submission of the ID card renewal form
E. they can qualify for the next ID card

21. Which statement is False?

A. Pest control does not include the ID of an infestation on an ornamental.
B. The CO in charge needs to know how to contact the nearest poison control center.
C. A CO can keep his Certificate active for years if he never does any business by simply getting the proper recertification training and paying his renewal fee on time annually.
D. A licensee must notify the Department immediately if he looses the CO in charge.

22. Microencapsulated pesticides are:

A. More difficult to mix and apply
B. Are much safer to use around bees
C. Are much safer for operator exposure
D. Are abrasive to many pumps and nozzles

23. Which statement is true?

A. "Infestation" refers to the presence of living or dead pests in or under a structure, lawn, or ornamental.
B. The rear end of a vehicle does not have to be identified
C. A special ID cardholder is responsible only as an ID cardholder.
D. All of the above

GHP Sample Exam – CORE ANSWER SHEET

24. Certificates expire:

A. December 1st
B. June 30th
C. 90 days following the renewal date
D. 180 days following the renewal date
E. none of the above

25. Drift refers to :

A. Pesticide movement through the soil to a non-target area
B. Pesticide movement through a body of water
C. Pesticide accumulation in a non-target area
D. Pesticide movement from the release site in the air
E. All of the above

26. Factors affecting movement of pesticide in ground water include:

A. Distance to ground water and permeability of the soil
B. Presence of paved areas
C. Amount of turf
D. Height of turf
E. All of the above

27. The best way to prevent ground water contamination is to:

A. Prevent back-siphoning
B. Be careful when treating prior to a rainstorm
C. Do not treat at all when you know the ground water level is high
D. Follow labeling directions exactly

28. A sign of pesticide poisoning is:

A. Pinpoint pupils
B. Coughing
C. Sweating
D. Extreme thirst
E. All of the above

29. PPE stands for:

A. Personal Pesticide Equipment
B. Protective Pesticide Equipment
C. Personal Protection Equipment
D. Personal Protective Equipment

GHP Sample Exam – CORE ANSWER SHEET

30. Probation in violation of the Rules is for no longer than ____ year(s).

A. 1
B. 2
C. 3
D. 5

31. The Certified Operator is responsible for ___________.

A. Application of pesticides by the licensee
B. Mixing of pesticides
C. Safe use of pesticides
D. All of the above

32. Who is responsible for registering all pesticides?

A. Each manufacturer
B. DACS
C. USDA
D. National Pesticide Registration Board
E. The EPA

33. All certificates expire:

A. On the anniversary date of the exam
B. On the anniversary date of the licensee
C. on June 1st each year
D. 180 days from the renewal date

34. Upon a CO changing his/her address or phone number, the Division must be notified within ________ days.

A. 7
B. 10
C. 14
D. 30

35. Prior to the renewal of a certificate, the certificate holder must __________.

A. complete the required continuing education
B. pass a DACS exam
C. both A & B
D. either A or B

GHP Sample Exam – CORE ANSWER SHEET

36. The Dept.-issued license will expire when____________.

A. the business phone number changes
B. the location or business name changes
C. the CO's home address changes
D. all of the above

37. _____________ is required for telephone book advertisement.

A. full street address
B. licensed business name
C. phone number
D. B&C
E. all of the above

38. The EPA establishment number on a pesticide label indicates _________.

A. the "lot" number of the pesticide
B. that the label has been approved by the US government
C. the specific facility that produced the product
D. all of the above

39. Once a certificate has been revoked, it can be re-applied for _____________.

A. after 3 years
B. after 2 years
C. in one year
D. in 180 days

40. Rinsate refers to:

A. The tiny amount of pesticide left at the bottom of a concentrate jug
B. The small amount of mix left at the bottom of a sprayer unit
C. The small amount of liquid at the bottom of a cleaned out tank
D. Water and an unknown amount of pesticide resulting from cleaning out a sprayer or concentrate jug

41. Toxicity refers to:

A. How volatile a material is
B. How much exposure a pesticide applicator can get
C. Whether a material is in liquid or granular state
D. A measure of the ability of a material to cause allergic effects

GHP Sample Exam – CORE ANSWER SHEET

42. FIFRA allows a CO to use a pesticide _______________.

    A. at a concentration less than that directed by the label
    B. at a concentration greater than that directed by the label
    C. for a non-target pest as long as the site is listed on the label
    D. all of the above
    E. A & C only

43. The 3 “C”s of spill control in order of managing a spill are:

    A. Confine, Control, Clean Up
    B. Clean Up, Control, and Confine
    C. Call, Control, and Clean Up
    D. Call, Contain, and Control
    E. Control, Contain, and Clean UP
    F. Control, Clean Up and Call

44. Desiccants kill by:

    A. causing the loss of body fluids
    B. causing internal bleeding
    C. blocking the breathing process
    D. blocking the nervous system

45. Wettable powders were created to:

    A. dissolve in water
    B. suspend in water
    C. dissolve in an oil base
    D. suspend in an oil base

46. To safely remove safety gloves after a pesticide application one should:

    A. properly wash and dry the gloves before removal
    B. rinse the gloves in water, then remove the gloves and hang them to dry
    C. remove the gloves by peeling them off and inverting them from the wrist to the fingers and place them into a cleaning solution to soak
    D. remove the gloves in a container of wash water while hands are under the water

47. Wetting agents, emulsifiers, spreader-stickers, and anti-foaming agents are:

    A. known as soluble concentrates
    B. called solutions
    C. called adjuvants
    D. all insecticides

48. A solvent ________________________________.

A. is a liquid that will dissolve a pesticide to form a solution
B. is a material that will make a pesticide highly active
C. is added to a pesticide to make it thicker
D. is an additive in all pesticides to make them less corrosive
E. all of the above

49. Which statement is false?

A. “Pest Control” does not include the identification of infestation on an ornamental
B. An ID Cardholder is responsible for the safe and proper use of insecticides
C. The CO must know how to contact the nearest poison control center
D. The Licensee’s name/trade name must be at least 1.5 inches high on each side of the service vehicle

50. The Statement of Practical Treatment:

A. Deals with how, in practical terms, one should use or apply the material during a treatment
B. Deals with environmental hazards of the labeled material
C. Summarizes directions for proper treatment using the material
D. Includes instructions on how to respond to an emergency exposure

51. There are ________ known bodily routes of pesticide exposure.

A. 2
B. 3
C. 4
D. 5

52. Triple rinsing of liquid chemical containers prior to disposal should be done this way:

A. Empty the original container and let it drain for a couple of seconds, then fill it about ½ full of water, shake it vigorously and then let it drain for a few seconds until empty, and repeat a total of 3 rinses.
B. Empty the original container and let it drain for a couple of seconds, then fill it about 1/4 full of water, shake it vigorously and then let it drain for 30 seconds until empty and inner surfaces are rinsed, and repeat for a total of 3 rinses.
C. Empty the original container and let it drain for 30 seconds, then fill it about ½ full of water, cap and shake it vigorously and then let it drain for

30 seconds until empty, and repeat two times for a total of 3 rinses.

D Empty the original container and let it drain an extra 30 seconds, then fill it about ¼ full of water, cap the container and shake it vigorously and then let it drip drain for another 30 seconds until all inner surfaces are rinsed. Then drain this water and let it drip drain for another 30 seconds. Repeat the ¼ fill and drain procedure for a total of 3 rinses.

53. Criminal penalties under FIFRA for commercial applicators can reach:

A. $5,000 and 1 year in prison
B. $10,000 and 1 year in prison
C. $5,000 and 30 days in prison
D. $25,000 and 1 year in prison

54. MSDS stands for ___________________.

A. Material Sheet Data Survey
B. Market Survey Data Sheet
C. Molecular Scientific Data Sheet
D. Material Safety Data Sheet
E. Medical Safety Data Summary

55. The term “acute” effects refers to:

A. Exposure-related illness that results within the hour
B. Exposure-related illness that occurs within 24 hours of overexposure
C. Exposure-related illness occurring within a week of exposure
D. Poisoning resulting in death

56. Resistance in a roach population develops mainly _____________.

A. through regular use of pesticides
B. because not all of the roaches were killed initially
C. because food sources were available to compete with the bait
D. genetically

57. A “sensitive area” refers to:

A. One where kids play
B. One near an endangered species
C. An area where food is being prepared
D. An area 10 feet from a pond
E. All of the above

GHP Sample Exam – CORE ANSWER SHEET

58. Select the statement that is false:

A. The CO must know how to contact the nearest poison control center.
B. The licensee's name or trade name must be at least 1.5 inches in height on each side of the service vehicle.
C. An ID cardholder is responsible for the safe and proper use of insecticides.
D. "Pest Control" does not include the identification of infestation on an ornamental.

59. All ID Cardholders must:

A. If accidentally poisoned, be reported to DACS by the CO within 24 hrs.
B. Have had their ID card applied for prior to being hired.
C. Have the CO in charge notify DACS when their duties change
D. Take 2 hours of continuing education annually unless they are SPID holders.

60. The following person is not required to hold an ID card

A. The Certified Operator in Charge who never goes out in the field
B. The Salesman who never uses any materials to treat a home or business
C. The head secretary who sets up pest sales over the phone
D. The part-time technician who only works three days a week

61. Acute poisoning refers to a pesticide that will cause poisoning orally or dermally and requires "POISON and the SKULL AND CROSSBONES" on the label. That means that the material can cause poison effects within ___________ hour(s).

A. 1
B. 8
C. 12
D. 24

62. A substance that contains undissolved particles in a liquid is called a _____.

A. diluent
B. suspension
C. solvent
D. rinsate

63. A "threshold" refers to:

A. a population level of a pest where control action needs to take place
B. a population level of a pest that causes injury or harm
C. a population level of a pest that is reached just prior to being treated on a service
D. a known pest population level in a specific area

64. Fipronil is the ___________.

A. brand name
B. common name
C. trade name
D. scientific name

65. The licensee must apply for an ID card for a new employee within the first ____ days of hire.

A. 5
B. 10
C. 14
D. 30

66. The most well-known energy-inhibiting insecticide is:

A. Chlordane
B. Dursban
C. Termidor
D. Hydromethylnon

67. Toxicity depends on:

A. type and amount of active ingredient
B. acute dermal effects
C. amount of exposure
D. amount inhaled
E. All of the above

68. Your Certified Operator in charge of a Service Center left for a 20 day vacation. What must be done at the Service Center?

A. A temporary CO from another Company must be hired.
B. You must hire an emergency certified operator.
C. Designate another CO in the company as temporary CO in charge.
D. A Special ID Cardholder at your S.C. can sit in as CO in charge.

69. The most likely causes of spray tip failure are:

A. Debris or corrosion clogging the tip and/or overworn tip
B. Debris in the tank and failure of the main pump gasket
C. Debris in the tank, overworn tip and leaking application gun
D. Overworn tip, pump gasket failure and overpressurized sprayer

GHP Sample Exam – CORE ANSWER SHEET

70. Florida applicators are regulated by:

A. FDACS
B. FDA
C. Florida Certified Operator's Bureau
D. EPA

71. Which formulation would be most likely to cause nozzle abrasion or clogging?

A. ECs
B. WPs
C. Ms
D. Aerosols

72. A systematic method of observing pest signs over time is:

A. the customer
B. the sticky trap
C. monitoring
D. indoor and outdoor inspections

73. Pheromones are:

A. used in monitoring traps
B. chemicals produced by insects to affect individuals of the same species
C. often used to attract moths beetles and some flies
D. all of the above

74. The most likely cause of nozzle tip failure is:

A. Improper cleaning caused a worn tip
B. Debris clogged the tip
C. The tip aged and corroded
D. Any of the above

75. DACS updates a chemically sensitive persons list quarterly. The list indicates the distance from each sensitive person's residence that a pest operator is allowed to treat due to a professional doctor's prescription. The operator must notify the sensitive person prior to treatment at any residence within a maximum distance of ___________ from the chemically sensitive person's residence.

A. the adjacent/contiguous residences
B. ½ mile radius
C. ¼ mile radius
D. 1 city block

76. The company license expires:

A. 180 days from the anniversary date
B. 90 days from the anniversary date
C. 60 days from the anniversary date
D. on the anniversary date of the certificate

77. Your new CO Certificate will be sent:

A. within a month of passing the exam
B. after paying an issuance fee within 60 days of passing
C. after 90 days of passing as long as the issuance fee and $50 late fee are paid.
D. B & C

78. If applicator clothing is contaminated with spray it can be cleaned:

A. in a washing machine or by hand prior to re-using
B. in hot water, heavy duty detergent and rinsed in cold water
C. washed in hot water and soap and 2 more warm water rinses
D. destroyed so that it cannot be re-used

79. FDACS must be notified ___________________ upon accidental poisoning or death connected to pest control work.

A. immediately
B. within 8 hours
C. within 12 hours
D. within 24 hours

80. Toxic tracking powder such as Zinc Phosphate (ZP) :

A. can be applied on overhead ceiling beams and in bait stations
B. can be applied in bait stations and on the upper shelf where rodents run
C. can be placed in attics and inside wall voids
D. all of the above

81. When the licensee changes the company address the state must be notified in __________days and the customers must be notified in _________ days.

A. 10/10
B. 10/30
C. 30/10
D. 30/30

THE FOLLOWING QUESTIONS COVER MAXFORCE MAGNUM ROACH BAIT GEL: (no calculations required)

82. Maxforce:

A. is the chemical name
B. is the manufacturer name
C. is the trade name
D. is the label name

83. The % active ingredient in this product is:

A. 0.20%
B. 0.05%
C. 0.5%
D. 99.95%
E. 100%

84. Use of Maxforce Magnum Gel is restricted in/on:

A. Areas not easily accessible to kids and pets
B. Food preparation and food contact surfaces
C. Commercial kitchens
D. Areas that not have been recently sprayed by insecticides
E. All of the above

85. Maxforce Magnum can stain:

A. glass
B. stainless steel back of a microwave
C. certain textiles or fabrics
D. all of the above

86. Outdoors, use Maxforce Magnum:

A. out in an open area where roaches can locate the bait
B. at potential points of insect entry
C. in any area of the yard
D. all of the above

87. This product should be applied for severe German roach infestations at the rate of:

A. 2-4 spots per square foot
B. 1-2 spots per square yard
C. 2-4 spots per square yard
D. 1/3 inch to ½ inch spot size

THE FOLLOWING QUESTIONS COVER DEMAND CS:
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B. 10 mph
C. 15 mph
D. 20 mph

89. Use __________ oz. per gallon of Demand CS for a severe roach cleanout in a residential kitchen:

A. 0.2
B. 0.4
C. 0.8
D. 0.16

90. In garden areas around the home foundation, Demand CS can be applied in a band up to ________ ft. high from the foundation, including around windows and doors.

A. 1
B. 3
C. 5
D. 10

91. Applying the mid rate of Demand CS (4 oz. in 50 gallons of water) at the rate of 5 gallons/1000 square feet, you will apply ________oz. of concentrate over 5,000 sq.ft.?

A. 1 oz.
B. 2 oz.
C. 3 oz
D. 4 oz.

92. For SEVERE roach infestations, the recommended rate for clean-out treatments is:

A. 0.03%
B. 0.04%
C. 0.05%
D. 0.06%

93. The following statement is false:

A. Do not apply to edible crops
B. Do not apply within 25 feet of lakes
C. Do not apply when wind speed is 20 mph.
D. Demand CS can be applied in classrooms when they are in use
E. None of the above is false.

---

94. Applicants for the GHP CO exam must have completed ____ jobs in the category.

A. 0
B. 10
C. 15
D. 45

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A. FDACS pest control certificate
B. FDACS Pest Control ID Card
C. FDACS pest control license
D. FL. Driver's License only

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A. that the material is patented
B. it is registered with DACS
C. the manufacturer and the product
D. the account number with the Federal Government
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B. The Rules for DACS, Chapter 5E-14
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98. A solvent is:

A. A substance containing un-dissolved particles mixed with the liquid
B. A liquid like water or kerosene that will dissolve a pesticide into solution
C. Anything used to dilute pesticides
D. All of the above

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A. A substance containing un-dissolved particles mixed with the liquid
B. A liquid like water or kerosene that will dissolve a pesticide into solution
C. Anything used to dilute pesticides
D. All of the above

100. An adjuvant is :

A. often a wetting agent or spreader-sticker
B. a chemical added to a substance to increase it's effectiveness
C. a thickener or buffer
D. All of the above