Employee Registration Manual

This manual is intended to prepare technicians for the Employee Registration Examination in Georgia.

This manual was published jointly by the Georgia Department of Agriculture and Georgia Structural Pest Control Commission

Revised Edition January 2015

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CHAPTER 1
INTRODUCTION

The public demands professionalism from service providers including members of the pest management industry. Services provided by the pest management professional include but are not limited to:

- Inspections of reported and potential pest infestations
- Recommendations on options and procedures for managing pest infestations
- Applications of pesticides
- Assisting with interventions to reduce pest populations by
    - Modifying structures to reduce the chance of pest infestations
    - Changing landscape features to reduce pest populations
    - Reducing 'clutter' in and around structures to decrease pest harborage
    - Cleaning to remove potential food sources for pests

A professional is aware that the 'latest' knowledge is constantly changing and to remain at the top of their profession they must make an effort to stay at the cutting edge. Pest management professionals must show the public that they have the training and skills to perform efficient, cost effective and environmentally responsible service. These professional services include providing customers with relevant information on pest identification and biology while using the tools and tactics most suited to managing pests.

The Georgia Structural Pest Control Commission (GSPCC) and Georgia Department of Agriculture (GDA), with the support of the professional pest management industry, developed and established an employee registration program.
This program requires all employees of a pest management company that make inspections, propose interventions, develop action plans or apply pesticides must meet the following pre-registration requirements certified by the GSPCC:

- Attend a minimum of 10 hours of classroom training
- Complete 70 hours of supervised "on the job" training
- Pass a written exam

The employee that provides proof of the aforementioned training and passes the GSPCC examination becomes a registered technician. A registered technician must attend GSPCC-approved training to maintain their registration. The intent of the ongoing training is to expose the registered technician to information to keep them up-to-date with changes in the various registration categories within the pest management industry.

This manual is intended to help the employee prepare for the registration exam. It also can serve as a future reference. The pest management community is an essential part of today's society that helps protect citizens and their possessions from damage and disease caused by animal pests. You can be proud to be part of this important profession by reading, understanding, and implementing the regulatory and knowledge requirements outlined in this manual.

CHAPTER 2
LAWS AND RULES

Pest management professionals (PMPs) train and are knowledgeable in the selection, application, storage and disposal of pesticides useful in managing pests. That training includes understanding the toxicity, environmental impact, safe handling, application, disposal, and regulatory aspects of pesticides. The United States Congress has passed and continues to pass laws that affect registration and use of pesticides. PMPs must comply with these laws. In addition, individual States pass laws and regulations to balance the need for protection of citizens and the environment through responsible use, storage and disposal of pesticides. The following section outlines federal and state laws and regulations that apply to every registered technician working in the pest management industry in Georgia.

Federal Statutes and Regulations:

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

Congress passed the first Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) in 1947 to regulate the registration and labeling of pesticides. In 1972 congress amended FIFRA to include a classification system for types of pesticides and created requirements for:

- Certification of applicators/operators authorized to apply pesticides
- Safety of workers using pesticides
- Pesticide disposal
- Protection of the environment from contamination by pesticides
- Creation of the Environmental Protection Agency (EPA) to administer FIFRA

One year later, 1973, Congress passed the Endangered Species Act that required EPA to ensure that using registered pesticides would not harm species placed on the Endangered Species Act list. Congress took 23 years before they again addressed pesticide issues with the Food Quality Protection Act of 1996 (FQPA) which amended FIFRA and directed EPA to regulate pesticides through establishment of tolerance levels for pesticides from dietary (food levels), drinking water, and non-occupational (residential) exposure in conjunction with the Federal Food, Drug, and Cosmetic Act. The Food Quality Protection Act also mandated a minor-use program for pesticide registration, a review of antimicrobial products and review of pesticide registrations every 15 years.

Important aspects of Federal laws affecting the pest management industry include:

Labeling and Use of Pesticides

THE LABEL IS THE LAW! This phrase should be committed to memory because the label is *the* legal document that controls the use, storage, and disposal of any pesticide. It is important to remember that "labeling" includes any other printed or electronically available information from the manufacturer, such as guidance documents, installation instructions or technical bulletins. "Labeling" carries the same enforcement weight as the actual label provided on the pesticide container. The pest management professional is

responsible for knowing the most up-to-date information on the pesticide products they use and this is another reason why continuing education is so important for those working in pest management.

Classification and Registration of Pesticides

The Environmental Protection Agency (EPA) and the Georgia Department of Agriculture (GDA) register all pesticides used in Georgia. In order to obtain a registration, pesticide manufacturers are required to provide prescribed, detailed information to EPA including:

- Toxicity of the pesticide
- Hazard to the applicator
- Effect on the environment

Based on this information EPA decides, according to details required by the FQPA, how each pesticide is classified - either for general use or restricted use. Pesticides that are less likely to cause damage to the environment are classified as a "General Use Pesticide". Pesticides that may cause human injury or damage to the environment are classified as restricted use and have the words "Restricted Use Pesticide" on the label. Only a certified operator or someone operating under his or her direct supervision (as specified in the definition section 620-2-.01 of the Georgia Structural Pest Control Commission Rules) may apply a restricted use pesticide.

Certification of Operators

Certification is the process by which a pest management professional becomes qualified as an Operator. An Operator has proven that he or she knows the details of safe handling, use, storage and disposal of a pesticide according to FIFRA. Certification is required to purchase restricted use pesticides. If an Operator violates FIFRA they are subject to civil penalties up to $5,000 and violations of the law may also result in criminal penalties up to $25,000 and/or one year in prison. Any Operator accused of a violation has the right to ask for a hearing in their city or county of residence.

Occupational Safety and Health Act

The Occupational Safety and Health Administration (OSHA) in the United States Department of Labor administers the Occupational Safety and Health Act of 1970. It requires any company with 10 or more employees to keep certain records and make reports including all work related deaths, injuries, and illnesses. A report is not required for minor injuries needing only first aid treatment. A report must be filed with the local OSHA office if the injury involves medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job. More information on OSHA reporting can be found at the following website: http://www.osha.gov/recordkeeping/

Endangered Species Act

The Endangered Species Act of 1973 provides legal protection for endangered and threatened species. It also requires all federal agencies such as EPA ensure that their actions do not threaten any endangered species. If the U.S. Fish and Wildlife Service determine that the use of a pesticide could threaten an endangered species, EPA can restrict the use of that pesticide to designated areas. The killing of an endangered species

can result in a maximum fine of $20,000 and/or one year in prison. A list of endangered species can be found at the following website: http://www.fws.gov/endangered/

Georgia Structural Pest Control Act

The Georgia Department of Agriculture and the Georgia Structural Pest Control Commission administer the Structural Pest Control Act (SPCA). The SPCA is the primary law for the pest management industry in Georgia. The Department of Agriculture is the enforcement agency for the SPCA. Details and a copy of the Act can be found at the following website: http://agr.georgia.gov/spcc

Requirements of the Georgia SPCA include:

Company License

All pest management companies must be licensed before they begin operation.

Certified Operator

Every pest management company must employee at least one person who has taken and passed a Certification Examination. The Certification Examination is a more extensive and rigorous examination than the Employee Registration Examination. The categories of Certification are household pest control (HPC), wood destroying organisms (WDO), and fumigation (FUM). A company may only operate in the categories in which it currently employs a Designated Certified Operator (DCO).

Registered Employees

All not-certified technicians and salespersons must take and pass the Employee Registration examination before they can work without the direct supervision of a Certified Operator or Registered Employee.

Recertification/Reregistration

All Registered Employees and Certified Operators must be periodically recertified or reregistered. Certified Operators must, every five years, accumulate the following training hours in the following certification categories for recertification:

- Household Pest Control (HPC) - 25 hours
- Wood Destroying Organisms (WDO) – 25 hours
- Fumigation (FUM) - 12 hours

Computer based training shall be limited to no more than 10 hours for each of the HPC and WDO categories and 5 hour for FUM.

Reregistration

Registered Employees must, every two years, accumulate the following training hours for the following registration categories:

- Household Pest Control (HPC) - 8 hours
- Wood Destroying Organisms (WDO) - 8 hours
- Fumigation (FUM) - 3 hours

Computer based training shall be limited to no more than 4 hours for the HPC and WDO categories and 1 hour for FUM.

All reregistration training credits must be earned before March1st of each odd numbered year. All registrations, certifications, and licenses expire on June 30th of each odd numbered year.

Contracts for the control of Wood Destroying Organisms

A contract must be issued for every WDO service and before the work begins. Copies of all contracts and supporting documentation must be kept for 2 years following the expiration of the contract.

The contract must include:

- The specific type of treatment to be performed
- The effective date and contract period
- Diagram of the structure(s) showing area(s) of active or previous infestation(s)
- Price of treatment
- Terms of guaranty or warranty with a disclosure statement on type of guarantee
- If the work is bonded
- The conditions for renewal including reinspection interval
- Provisions for a limitation of liability
- What happens if the structure is changed
- The three day right to cancel the contract
- Property owner or property owner's authorized agent's signature
- For baiting systems, the statement about removal of the system and a diagram showing the location and number of stations installed
- Insurance requirement statement

Post construction subterranean termite control warranty-only contracts are limited to one and two family dwellings and townhomes. Subterranean termite control warranty-only contracts without an initial treatment must also include:

- An initial inspection of the structure along with a dated diagram indicating the location of any visible active or previous infestation
- Type of treatment to be performed at the first occurrence of termite activity
- An annual inspection of the structure
- The inspection and repair statement

The company must maintain reports of all monitoring, inspections and/or reinspections of the structure(s), baiting systems and devices under contract. Reports are to be provided to the property owner and maintained by the company during the contract period and for a period of two years after expiration of the contract.

Reinspection Recordkeeping Requirements

Reports of all monitoring, inspections and re-inspections of structures, baiting systems or devices under contract must be maintained for two years. The reports must include:

- Date of monitoring, inspection or re-inspection
- Name of technician performing the monitoring, inspection or reinspection
- Whether or not wood destroying organisms or signs of termite infestation were found

- Baiting system inspections also require documentation of inspection results for each station including a notation of any stations that were not monitored and the addition of any station(s)

Official Georgia Wood Infestation Inspection Report

All wood infestation inspection reports must be issued on the state approved form. The report is a statement of what was observed and recorded when the structure was inspected. It requires the inspection and documentation of previous and active infestations of:

- Subterranean termites
- Powder post beetles
- Wood boring beetles
- Dry wood termites
- Wood decaying fungus

Regulations for Minimum Treatment Standards

Treatment of Subterranean Termites

Minimum adequate subterranean termite control measures shall include:

Comprehensive Post Construction Soil Termiticide Application

- Removal of all cellulosic material from under the building
- Removal of all wood to earth contacts except pressure treated wood designed for ground contact
- Removal of all visible and accessible termite tunnels
- Application of an approved termiticide to all exterior and interior soils, consistent with the products label and labeling directions. State regulations may exceed label requirements for drill intervals.

Defined Post Construction Soil Termiticide Application

- Removal of all cellulosic material from under the building
- Removal of all wood to earth contacts except pressure treated wood designed for ground contact
- Removal of all accessible termite tunnels
- Application of an approved termiticide consistent with product label and labeling directions State regulations may exceed label requirements for drill intervals

Post Construction Non Soil Termiticide Applications, Other Than Baits

- Removal of all cellulosic material from under the building
- Removal of all wood to earth contacts except pressure treated wood designed for ground contact
- Removal of all visible and accessible termite tunnels
- Application of an approved termiticide consistent with product label and labeling directions

Post Construction Termiticide Bait Applications

- Removal of all cellulosic material from under the building

- Removal of all wood to earth contacts except pressure treated wood designed for ground contact
- Removal of all visible and accessible termite tunnels

Pre-Construction Termiticide Bait Applications

- Systems must be monitored consistent with the product/system label for one year at no additional cost when installed for pre-construction or to control infestations found during the coverage period of an Official Georgia Wood Infestation Inspection Report

Treatment of Powder Post Beetles and Wood Borers

Treatment of powder post beetles and wood borers shall include application of an approved pesticide consistent with the product's label and labeling directions, ventilation of the under-floor space between the bottom of the floor joists and the earth to meet the requirements of the International Residential Building Code for one and two family dwellings, the latest edition as adopted and amended by the Georgia Department of Community Affairs and installation of a vapor barrier to cover a minimum of 70% of the exposed soil surface in a crawlspace.

Treatment of Wood Decay Fungi

Treatment of wood decaying fungi shall include ventilation of the under-floor space between the bottom of the floor joists and the earth to meet the requirements of the International Residential Building Code for one and two family dwellings, the latest edition as adopted and amended by the Georgia Department of Community Affairs and installation of a vapor barrier to cover a minimum of 70% of the exposed soil surface in a crawlspace. If an infestation of water conducting fungi is located in the under-floor space, then additional control measures are required.

Treatment of Dry Wood Termites

Treatment of dry wood termites shall include application of an approved pesticide consistent with the products label and labeling directions.

Inspection

The enforcement agency may inspect treated structures and require the correction of any deviations from the minimum treatment standards.

Household Pest Control

Only pesticides registered with the EPA and the Georgia Department of Agriculture are permitted for use. All pesticides must be applied consistent with the product label and labeling directions.

Household Pest Control Contracts

A contract must be issued for all treatments. All Residential contracts must contain the three-day right to cancel the contract.

Treatment of Schools

The treatment of schools involves taking special precautions that minimize the potential exposure of students to pesticides. Schools include any school, public or private, or licensed child daycare center. Schools do not include colleges, universities, home schools, trade or adult education facilities. Special precaution requirements include:

- Application of pesticides to a room only if students are not expected to be present for a minimum of three hours or longer if directed by the pesticide products label or labeling directions
- Applications of bait formulations, rodenticide baits in tamper-resistant containers or bait stations, as well as botanical insecticides, insect growth regulators and insecticidal soaps only when students are not present in the room or if in a multi-use area, there is a 10-foot limit with a clearly marked or secured barrier around the application site
- Application of insecticide or rodenticide baits in tamper-resistant containers or bait stations, as well as botanical insecticides, insect growth regulators and insecticidal soaps may be made at any time to any open area or multi-purpose area if a clearly marked off and secured barrier area within 10 feet of the application site and no students are present within the secured area
- All other pesticide applications are allowed to outdoor school grounds if students are not expected to be present within twenty feet of the application site. These areas must be clearly marked or secured by a fence or similar barrier
- All pesticide use dilutions must be prepared outside student occupied areas
- All services must be consistent with any written pest management policy of that school
- Liquid termiticide applications in schools must be performed when students are not present and are not expected to be present for 3 hours or longer
- Termiticide bait system installations and inspections may be performed when students are not present within (20) feet of the application site

<u>Precautions</u>

To avoid accidental injury or poisoning of humans and animals all pesticide applications must be made consistent with all label directions. Pesticide applications must also avoid contamination of the environment.

Fair Business Practices Act

The Georgia Office of Consumer Affairs administers the Fair Business Practices Act, requires all contracts signed at the customer's home or business contain a notice that the contract may be canceled for up to three business days after signing. It also requires that all work will be done in a quality manner.

Hazardous Waste Management Act

In 1979 Georgia passed the Georgia Hazardous Waste Management Act to follow the Federal Resource Conservation and Recovery Act (RCRA). This law protects human health and the environment from improper activities involving hazardous waste. It is certain that changes will continue to be made to both federal and state regulations. Anyone who produces hazardous waste should stay advised about changes through their trade organizations or through the Georgia Environmental Protection Division,

Hazardous Waste Management Program at the following website: http://www.gaepd.org/Documents/index_haz.html

Pesticide Use and Application Act

The Georgia Department of Agriculture also enforces the Georgia Pesticide Use and Application Act. This law deals with the regulation and licensing of certain areas related to structural pest control. These include areas such as mosquito control and applications of pesticides to lawns. You may obtain additional information about this program at (404) 656-4958 or http://agr.georgia.gov/pesticides.aspx

CHAPTER 3
PEST IDENTIFICATION AND BIOLOGY

Human beings often create circumstances that favor pest infestations by providing one or more of the three life-support requirements a pest needs to survive: **food, water, and harborage** (a place to hide). Pest infestations can result from our fondness for a 'pretty' landscape or the conditions we maintain in our living or work space. The professional's first task is to identify the cause (or causes) while recognizing and properly identifying the pest involved in an infestation. The services provided by the pest management professional address pests that can be put into three major groups:

- Insects and other arthropods (mites, ticks, and spiders)
- Vertebrates (birds, squirrels, rats and mice)
- Wood decay fungi

A professional pest management service should provide an action plan based on the biology of a pest and the conditions found at the customer's location. For example, an action plan for a German cockroach infestation would be very different from one for a Smokybrown cockroach or bed bug infestation… therefore identification of the pest is critical. This chapter provides basic information on selected pests to help the professional communicate with their customers about pest biology. In addition to this manual, there are publications and websites with information on arthropod, insect, vertebrate and fungi identification to assist the professional with accurate pest identification. Local experts such as the county extension service are a recommended resource for pest identification. It is also recommended that each company keep and maintain an insect pest collection, which contains examples of properly identified pests, for training and reference. Many pests are repeatedly encountered at most accounts and professionals should be very familiar with the identification and treatment of the most common pests.

Arthropods and Insects

Arthropods are a group of animals that includes insects, spiders, mites and ticks. All arthropods share some biological characters with humans including:

- A central nervous system – a main nerve cord that runs the length of the body
- Striated skeletal muscles – like in humans but arthropod muscles are attached inside the exoskeleton
- Bilateral symmetry – like humans, if you cut an arthropod down the middle… both halves look like mirror images

But all arthropods differ from humans because they have:

- Segmented body and appendages – a body with at least 2 segments and legs and antennae that are divided into sections
- Chitinous exoskeleton – the skeleton is on the exterior and made of a protein called chitin. This 'skin' must be shed in order for the arthropod to grow
- Open circulatory system – the exoskeleton creates a body cavity and 'blood' flows inside this cavity. Arthropods don't have a system of veins and arteries

- The arthropod central nervous system - has main nerve cord but it includes several 'control' centers or little brains (called ganglia), usually one ganglia per body segment, not a single 'brain' like humans

Insects can be separated from their arthropod 'cousins' by the following features:

- Segmented body divided into three sections – head, thorax, abdomen
    - Head with one pair of antennae
    - Thorax with three pairs of legs and/or two pair of wings
    - Abdomen has no locomotion appendages

Basic Biology

Insects are a diverse group of animals that make up about 85% of all known and described life on earth. Insects live on the earth's surface, in the soil, and in the water. They are at home in deserts, rain forests, hot springs, snowfields, and dark caves and can feed on a wide variety of food. This diversity means that some insects will eventually end up in our living space or landscape. Insects can be classified as pests for a variety of reasons. Some insects carry or cause disease(s) that result in illness or death to man and animals. Certain insects can damage structures, food items, clothing and items used or constructed by humans. Other insects become pests because they take up residence in our homes, build large populations in the surrounding landscape or simply cross paths with us on their way to some other place. It is important to remember that most insects go unnoticed by the average citizen and a large number are beneficial because they pollinate plants or serve as food for other animals.

Adult insects (not mites, ticks, and spiders) are divided - for purposes of identification – into categories that include 3 "super orders" and 32 "orders". For example, flies belong to the order Diptera, cockroaches and termites to the Blattodea and bed bugs to the Hemiptera. Professionals interested in more details can access websites such as: http://bugguide.net/node/view/222292 that describes 32 insect orders.

Insects also can be classified using a variety of schemes including the habitat where they live (terrestrial, aquatic), their lifestyle according to feeding habits (plant feeder, omnivore, predator, parasite, scavenger), and/or type of mouthparts (chewing, biting/sucking, sponging/lapping). One type of categorization is important the purpose of pest management – the type of insect development or metamorphosis.

Insects have an external skeleton (exoskeleton) and it is this exoskeleton or 'outer skin' that gives an insect its physical identity and aids in identification. The exoskeleton forces insects to grow in stages or increments called **instars**. Insects as they mature toward becoming an adult must shed their exoskeleton, before they can grow into the next stage or instar. This shedding event is called a **molt**. The stages of **metamorphosis** (from the Greek word for "transforming"), or change between instars, must be understood and appreciated in order to conduct efficient pest management.

An insect will grow and molt through several immature stages before becoming an adult.

All insects go through several instars where the outward appearance of the insect may change in shape, color, form and/or size as it matures to adulthood. This process is called metamorphosis. There are several different types of metamorphosis. The stages of insect metamorphosis include the egg, several immature stages (called the larva, nymph or naiad), some insects have a 'resting' or pupal stage, and finally the adult stage. It is important to remember that most insects do not grow or change *after* becoming an adult. Most adult insects will live and die in their, one-and-only, final exoskeleton.

The different categories of insect development or metamorphosis include:
[terms in italics… *a-*, *pauro-*, *hemi- and holometaboly* are provided for reference to terminology found in scientific papers or websites and will not be on the exam]

Gradual Metamorphosis (*Ametaboly*)
Insects that develop without much visible change between their immature instars to the adult – except to increase in size. The food and habitat for the immature stages and the adults are similar. The adult is wingless and looks like the immature but is usually larger and sexually mature. Examples include: springtails and silverfish

Incomplete Metamorphosis (*Pauro- and Hemimetaboly*)
Insects that undergo change from egg through several immature instars to a final, winged adult stage. The immature stages resemble the adult stage in that they clearly have 3 body regions (head, thorax and abdomen) and six legs, but lack wings. This category of insects is sometimes divided into two additional classifications termed:

Paurometabolous insects have an immature stage (called nymphs) and adults that live in the same habitat. Examples would be roaches, lice, aphids, praying mantis, termites, earwigs, grasshoppers, cicadas and crickets.

Hemimetaboulus is a term used for insects that have immature stages (called naiads) that live in a different habitat from the adults. Examples would be the so-called 'aquatic' insects - dragonflies, mayflies, and stoneflies, whose immature stages develop in water while the adults live on land.

Complete Metamorphosis (*Holometaboly*)
Life stages of *holometabolous* insects include the egg, several larval instars, a pupa stage and a winged adult. The appearance of these insects changes drastically from the immature (larva) to the adult form. This drastic change in form requires a resting stage (called the pupa) in order to make the 'complete' transformation from the immature instars. The immature stages often don't even have clear divisions between the three body regions and many appear legless. The larva and adult typically feed on different food resources and can be found in completely different habitats. Examples would include: ants, bees, butterflies, flies, wasps, beetles and fleas.

Common General Pests
There are over one million different species of insects. Fortunately, only a few hundred are of concern to the pest management professional. You should be familiar with the most common of these insects. The following section lists some of the most commonly encountered insect pests and describes important aspects of their biology.

Roaches undergo Incomplete metamorphosis (*Paurometabolous*) and the immature and adult stages live in the same area and feed on the same things. Roaches are active at night (nocturnal) and they eat most any kind of food (omnivore). Adult females lay eggs in a case called an ootheca that can contain from 10-50 eggs (depending on the species of roach). Roaches live in groups (aggregations, roaches are not considered 'social insects') in cracks, crevices, or voids that provide darkness, moisture and no air movement (called a harborage site). Adult male roaches leave the harborage every night for food and water; older nymphs (late instar nymphs that are one or two molts before becoming an adult) are also likely to leave the harborage with some regularity. Adult females generally don't leave the harborage while the egg case or ootheca is developing (which could be weeks). Early instar roaches (the very young) almost never leave the harborage – they feed on the feces (or frass) of the other roaches in the harborage.

German Cockroach

- Adults are 1/2 inch long; tan to light brown with two dark strips running lengthwise on the area behind the head (pronotum)
- Short life cycle; egg to adult in 6-12 weeks; adults live for 6-9 months
- Females carry the ootheca until it is ready to hatch
- Adults have wings but cannot fly
- Most common small roach infesting buildings in Georgia

American Cockroach

- Adults about 1 1/2 inches long, dark to light reddish brown with two light spots on the area behind the head (pronotum)
- Long life cycle; egg to adult 4-15 months; adults live for 1 to 1.5 years
- Prefer moist dark areas associated with sewers/storm drains and plumbing chases
- Adults have wings and can glide but are not good at powered flight

Smokybrown Cockroach

- Adults are 1 1/4 inches long and are a uniform dark brown color
- Long life cycle; from egg to adult about 4-12 months; adults live for 1 year
- Live outdoors in tree-hole and migrate in spring and fall into homes
- Adults have fully developed wings in both sexes and are excellent flyers

Brownbanded Cockroach

- Adults are 1/2 inch long and are a light brown color with two lighter bands across the base of the wings and top of the abdomen
- Prefer dryer conditions than the German roach and are not common in Georgia
- Have a short life cycle; egg to adult in 3-4 months; adults live for about one year
- Adults have wings, but wings of the female don't cover the tip of the abdomen while the males' wings are longer and males are good flyers

Oriental Cockroach

- Adults are 1 inch long and are a uniform dark brown to black color
- Have a long life cycle; egg to adult 6 to 12 months; adults live for 1 to 1.5 years

- Adult female has short non-functional wings, males have wings that cover ¾ of the abdomen, neither sex can fly
- Prefers cool temperatures and does not do well in warm conditions
- Found in damp places such as basements and sewer lines

Other roaches often reported as pests in Georgia include the Brown, the Australian, and the Asian roach. All these cockroaches can carry diseases like the bacteria responsible for food poisoning and all have been associated with being a cause of allergies as well as a trigger for asthma.

Fleas undergo Complete Metamorphosis *(holometabolous)* that means the immature and adult stages live in different areas and feed on different types of food. The adult flea feeds on the blood of warm-blooded animals and they spend their adult life on the host (the animal on which they feed). The adult female flea lays eggs on the host animal but those eggs drop off when the host moves. Flea eggs hatch on the ground and immature fleas feed on a variety of foods that they can scavenge. The larvae prefer to eat on the frass, the fecal material, of the adult flea (often called "flea dirt") and therefore most fleas develop near where their host nests, rests or spends most of their time.

The flea larva spins a silk cocoon that protects the pupal stage during the transition to the adult stage, which takes about a week. The adult flea can stay in the cocoon for months until a suitable host is near at which time the adult emerges from the cocoon and jumps, immediately, on a host. This explains sudden infestations that arise when a new resident moves into a previously vacant unit or residents returning home from vacation. Most fleas are very host specific and can be found on only one type of animal. The cat flea is different because it will feed on cats, dogs, opossums, raccoons, foxes and humans. Most flea infestations encountered by the professional are the result of the cat flea.

Cat Flea

- Adults are 1/8 to 1/6 inch long, dark brown, flattened side to side, and wingless
- Adults feed on the blood of warm-blooded animals. The larvae feed on organic debris but prefer the dried blood found in the frass of the adult flea
- Eggs are laid on the host and fall off on to the ground
- Can transmit diseases and parasites such as plague and tapeworms

Ticks are arthropods (not insects) that have a body divided into two sections – the head and the abdomen. Ticks are blood-feeding parasites that must take a blood meal in each life stage to develop through their immature stages to become an adult. The ticks common to Georgia have a larva stage (1-2 instars), a nymph stage (1-2 instars) and a final adult stage. Each stage requires a new host that is usually larger in size. The larva and nymphs will feed on small mammals, birds or reptiles while the adults feed on large mammals.

Ticks will wait on plants for a host to pass by at which time they grab onto the animal and find a suitable place to attach for blood-feeding. The attachment process takes about 24 hours before feeding begins and feeding takes 2-4 days before the tick drops to the

ground to molt to the next stage. It can take a year for a tick to develop from egg to adult. Eggs are laid by adult females on the ground in a clump of several thousand that must be out of direct sunlight or the eggs will dry out and die. Ticks will climb onto vegetation or other objects and wait for a host to pass by and then 'hitch a ride' in search of a meal.

- Ticks are flattened from top to bottom
- Adult ticks have 8 legs
- Larvae and nymphs have 6 legs
- All stages feed on blood
- Can transmit diseases such as Lyme disease and Rocky Mountain Spotted Fever

Stored Product Pests include several types of beetles and some moths that go through Complete Metamorphosis (*holometabolous*). They can be divided into four categories based on feeding habits:

- Internal feeders – larvae develop within the kernels of whole grains or seeds
- External feeders – larvae develop outside the whole grains or seeds but are capable of feeding on both finished and unfinished food products (like flour or cereal)
- Scavengers – feed only on processed products or products previously damaged by the other two groups
- Secondary pests – feed on out-of-condition or moldy food products

The stored product pests include moths and beetles that can spread throughout a kitchen and may be brought in on dried flower arrangements and potpourri or infested food products purchased from a store. They are small in size, less than one inch as adults, and destroy food products but are generally not a health problem.

The moths that feed on stored products include 70 species of which 10 are considered pests. The adult female moth lays eggs on the food and the larvae (caterpillars) develop through 3-5 instars while feeding on the product. The mature larva will move some distance from the food source to build a silk cocoon, turn into a pupa and then emerge as an adult moth. The immature stage (larvae) of most stored product pest moths leave a silk thread in the food source as they feed and this 'spider-web-like' material is a telltale sign of infestation. Most moth pests of stored food are external feeders or scavenger pests as larvae while the adults do not feed and it takes 1-2 months for them to develop from egg to adult. Examples include the Indianmeal moth and the Mediterranean flour moth.

The beetles that feed on stored products have larval and adult stages that feed on the same food at the same time. The time for development from egg to adult varies from 1-6 months although most complete their life cycle in about 2 months. The pupal stage is not protected by a cocoon and is often in the food, not a separate location like with the moths. Examples by category include:

- Internal feeders – rice weevil, granary weevil, lesser grain borer
- External feeders – drugstore beetle, cigarette beetle, khapra beetle
- Scavengers – saw-toothed grain beetle, confused flour beetle

- Secondary pests – mealworms, spider beetles, flat grain beetle

Fabric Pests are a group of insects that also includes both beetles and moths that undergo Complete Metamorphosis (*holometabolous*).
Fabric pests:

- Damage is caused by the immature stage (larvae)
- Feed mainly on animal materials: wool, silk, fur, and feathers
- Do not feed on cotton but can damage mixed-fiber material

The moths lay their eggs on the food and the larvae (caterpillars) feed on keratin, a substance found in dried hair or animal material like wool and hides. The adults do not feed but only mate, lay eggs then die. The larvae move off the food source to spin a cocoon and pupate before emerging as an adult moth. The life cycle from egg to adult can take 2-8 months. Examples of fabric pest moths include the casemaking clothes moth and the webbing clothes moth.

The beetles in this group usually feed, as adults, on pollen while the larvae complete their 3-5 larval instars feeding on hair and animal material. It takes the beetles from 1-6 months to complete their development from egg to adult. Examples of fabric pest beetles include the varied carpet beetle, the black carpet beetle, and the furniture beetle.

Ants are a group of insects that, in Georgia, includes over 100 species and they display Complete Metamorphosis (*holometabolous*). Ants are called "social insects" because they live in organized groups called colonies. Social insects cannot survive as individuals (no one has problems with one ant) and because the individuals interact (communicate, coordinate activities) an ant colony can be considered a single, larger animal. The activity of an ant colony is centered on a nest that contains the reproductive female(s) (called the queen) as well as all eggs and larval stages ('the brood'). Male ants appear once a year, during the mating season, when the colony sends out adult reproductives to start new colonies (a swarming event). Male ants mate - with new queens at swarming time - and die within hours or days.

Ants that are seen outside of an established nest are sterile adult females called workers. Worker ants live for 6 months to one year and spend most of their life inside the nest taking care of the brood and building/repairing the nest. A few older workers (called foragers) leave the nest to find food for the brood and other workers. Only 1-10% of the workers (the foragers) in an ant colony leave the nest to search for food. Worker ants can't swallow solid food so the foragers carry any solid food they find back to the nest and feed it to the larvae that 'process' and regurgitate that solid food to feed the workers and queen. This food sharing (trophallaxis) means that the ant colony can be viewed as having a single, "social stomach". Worker ants communicate by using chemicals called pheromones to tell each other things like where to find food and water or issue an alarm.

The different types of ants can be divided into groups based on a number of factors but one system involves the number of queens in a nest: single- or multiple-queen colonies. Single-queen ant colonies generally have queens that can live for 10 years or longer while multiple-queen colonies have queens that live for about 1 year. Carpenter ants, some fire

ants, and acrobat ants have single-queen colonies. Argentine ants, odorous house ants, and pharaoh ants are examples of ants that have multiple-queen colonies.

- Ants are social insects that live in colonies
- Worker ants, depending on the species, can have stingers and may sting - the venom can cause allergic reactions or anaphylactic shock in some people
- Ants seen outside of the nest are called foragers and they are less than 10% of the colony population
- Most ants will feed on a wide variety of foods and share that food in the nest
- Most ants can recruit large numbers of workers to feed at a single site.
- Ants have four types of castes in a colony: workers, brood, males, and females
- Ants can be health threats by stinging, damaging our food, causing structural damage when they build a nest, injuring livestock and wildlife as well as short-circuiting electrical equipment

Flies are insects that undergo Complete Metamorphosis (*holometabolous*) and are good at flying, in the adult stage. Flies usually have 3-5 instars in the immature stage (called maggots) that live and feed in areas different than the adult stage. The immature stages move away from the food source during the last instar to pupate. Mature flies have one, obvious, pair of wings while the second pair is reduced to a balancing organ (halteres). The common name of a true fly is spelled as two words – house fly, fruit fly - while other insects such as dragonfly and stonefly, not 'true' flies, are spelled as one word. The pest species commonly encountered by the pest management professional can be divided into three groups:

- small flies
- nuisance flies
- biting flies

Flies in the small fly category are less than ½ inch long as an adult. The maggots generally feed on rotting fruit, decaying organic matter, dung or fungus (for example in potted plants). Eggs are laid by adult female flies on or near the larval food and after hatching the maggots feed before moving away from the food source to pupate and then emerge as adults. The life cycle is often short, from egg to adult in one week. Examples include: scatter or humpback flies, fruit flies, moth flies, fungus gnats, and eye gnats.

Nuisance flies are medium sized (¾ inch) as adults. The maggots feed on dung or rotting, dead animal and plant material. The last instar larva will move away from the food to pupate. The life cycle from egg to adult can be as short as one week. Adult nuisance flies are strong fliers and can travel many miles from the larval food source in search of new food. Examples include the house fly, face fly, flesh fly and cluster fly (an exception whose larvae are parasites of earthworms).

Biting flies are a diverse group that includes small- to medium-sized adults. The immature stages of some are maggots that feed on dung or rotten vegetative matter while others are filter feeders that live in water (called wrigglers). The biting flies can transit diseases when the adult female takes a blood meal, which is required for the development of her eggs. Therefore, these flies can be a threat to public health. Examples include the

mosquito, deer flies, stable flies and biting midges (no-see-ums).

- Flies can carry diseases because the larval stage lives and adults feed in decaying matter while other flies can transmit disease by biting
- The larva of most flies are called maggots but in the case of filter-feeding mosquito larvae are called wrigglers
- Adult flies have one, obvious, pair of wings

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Silverfish develop through Gradual Metamorphosis (ametabolous) which means there is little visible difference, except size, between the immature and adults. Silverfish are wingless insects with long antennae and three appendages (called cerci) at the tail end. Both adults and immatures live and feed on the same food that consists of anything that contains starch, such as, glue, book bindings, paper, sugar, coffee, hair, and cotton, silk or dead insects. They are nocturnal and require 75% or greater relative humidity. Silverfish can take one year to go from egg to adult and can live for 2- 8 years… even going one year without food.

- Gray to brown in color as immatures that get 'silvery' scales in the adult stage
- Adults are 1/2 inch in length and have three long cerci at the tail-end of the body and a head with two long antennae
- Feed on almost anything containing starch and require high humidity to survive

Spiders are arthropods (not insects) that have eight legs and a body divided into two regions, the cephalothorax (head and thorax are combined) and the abdomen. Spiders start out life as an egg usually laid by the female in a silk sac containing many dozens of eggs. The spiderlings (immature spiders) look like miniature versions of the adult and will shed their skin (molt), depending on the species of spider, 4-14 times and it can take 1-5 years for them to reach adulthood. Adult spiders can live 1-20 years depending on the species. All spiders common in Georgia are predators that eat other arthropods and insects. Adult spiders can survive many months without food or water. Many spiders have venom that they inject into their prey through modified mouthparts. Most spiders do not bite people but spiders may bite, in self-defense, if bothered or threatened. It is difficult to confirm a spider bite on people and most diagnosed 'spider bites' are some other skin reaction or infection.

- Spiders are not insects and have 8 legs and two body regions
- Adult spiders can survive months without food
- Many kinds of insects (spider food) are attracted to lights and so spiders in search of food may be found at lights
- Only a few types of spiders like the black widow and the brown recluse are considered dangerous to humans
- Most spiders are considered beneficial… because they feed on insects

Bed bugs are nocturnal insects that feed exclusively on blood. They are small (3/16 inch long and 1/8 inch wide) oval, flattened top to bottom, reddish-brown bugs that undergo Incomplete Metamorphosis (*paurometabolous*). It can take 4-5 weeks to develop from egg to the adult under warm, humid conditions while at cool temperatures and low humidity, growth to the adult stage can take 4 months. There are 5 instars (the animal that hatches from the egg molts, or sheds it's skin, 5 times before becoming an adult) and a

single blood-meal is required to develop through each instar. Adults can live for several months but that life span can be extended if food is scarce… there are reports of adult bed bugs surviving for a year without food. As nocturnal animals, bed bugs spend the day hidden in harborages, cracks and crevice, usually a short distance from where they feed.

- Blood-feeding, nocturnal insect
- Adults are oval and about 3/16 to 1/4 inch in length
- After feeding the reddish brown flat body is often more red and swollen
- Infestations may produce a foul odor
- Adults and nymphs can be transported from one location to another by human activity… in luggage, on clothing or furniture

Termites are social insects that feed on the cellulose found in wood, wood by-products and, in rare cases, living plants or fruit. They are social insects that live in colonies where there is a division of labor between the different life stages, or castes. Termites are different from the other social insects (ants and bees) because termites undergo Incomplete Metamorphosis (*paurometabolous*) means the immature stages look similar to the adult form. The majority of the life stages in a termite colony are immature insects. Termites in the first and second instar are termed larvae but after the third instar they are called workers. The workers do all the tasks needed to maintain the colony that include things like feeding on wood, searching for food by tunneling, and taking care of the eggs and larvae. Workers make up at least 80% of the colony numbers. A form called the soldier is also present in the colony and they have a larger head and jaws [mandibles]. Soldier termites protect the colony from attack by enemies like ants. Another immature form is called the nymphal stage. Nymphs are workers that are progressing - through several molts, over several months - to become adults, called alates. The only adults found in a termite colony are the king and queen and, on a seasonal (once a year) schedule, the alates. Alates leave the colony in an annual flight called a swarm. All termite colonies have at least one king and queen. However, termite colonies can, and usually do, contain neotenic reproductives that are physically immature but sexually mature forms. Neotenics are often called replacement (when they replace a king or queen that died) and secondary or supplementary (when they are in a colony that has a king and queen) reproductives.

The primary reproductive caste, the king and queen, at the beginning of their life have wings (at this time they are called alates). The alates take flight in a swarm, usually in the spring but in Georgia swarms can occur in any month of the year. After their flight, the alates pair up – males and females - to form new colonies. A small proportion of the workers in a colony forage for food by following cracks and crevices in the soil. When the foragers locate food they recruit others to the food that is eaten following the grain of the wood. Termites do share food but that food sharing is not as intense or rapid as the 'social stomach' used by ants.

Swarming termites and swarming ants look similar. They can be separated by the following traits:

Trait	Termite	Ant
Antennae	Straight	Bent (elbowed)
Wings	2 pair equal length	2 pair unequal length
Waist	Broadly	Narrow

There are two different types of termites that are common in Georgia, subterranean termites and drywood termites.

Subterranean termites include the Formosan subterranean termite and 5 native species including the Eastern subterranean termite that accounts for most structural infestations in Georgia.

- The colonies infesting a building usually maintain a connection with the soil because they require moisture
- The workers follow cracks and crevices while searching for food
- Worker termites use soil and excrement to build shelter tubes – a visible sign of infestation
- Swarming: Formosans subterranean termites fly at dusk in late May or early June while the native subterranean termites swarm morning or early afternoon with most species (4 of the 5) swarming from February through early June

Drywood Termite biology very similar to subterranean termites except:

- Drywood termites do not require contact with the ground and get their moisture from the humidity in the air and their food source
- Drywood termites produce distinctive hard fecal pellets that appear in piles below the infested wood
- Drywood termites, depending on the species, swarm in the late evening from spring until early fall.

Carpenter Ants have single queen colonies and nest in rotten wood or voids in buildings. A queen carpenter ant can live for a decade and older colonies can contain thousands of workers. These ants are nocturnal and have a main nest while older colonies will have several 'satellite' nests.

- Carpenter ants do not eat wood but chew out wet/rotten wood to make a nest area
- Carpenter ants are the largest ants found in Georgia
- Carpenter ants leave small piles of course wood shavings outside a nesting location, these piles also contain pieces of their insect prey

Wood-Boring Beetles are represented by four different families of beetles including:

- True Powderpost beetles or lyctid powder post beetles (Family Bostricidae, subFamily Lyctinae)
- Deathwatch or Anobiid Powderpost beetles (Family Anobiidae)
- False Powderpost beetles (Family Bostrichidae)

- Old House Borer (Family Cerambycidae)

All beetles undergo Complete Metamorphosis (*holometabolous*). Female powderpost beetles lay their eggs on wood and the larvae that hatch and borrow into the wood which they eat in order to complete their development. Powderpost beetles have between 3-5 instars feeding their entire life inside the wood and it can take 1- 4 (or more) years before the larva pupates inside the piece of wood and emerge as an adult. The larvae produce frass that often falls from holes in infested lumber. The adult powderpost beetles emerge from the wood and this emergence event leaves a hole that indicates infested wood.

- The True or Lyctid powderpost beetle feed on hardwood lumber (oak, hickory, maple) and usually don't re-infest wood while the larvae produce a fine powdery frass that is shaped as 'pellets' when fresh
- The Deathwatch or Anobiid powderpost beetles feed on softwood lumber (pine) can re-infest wood and produce a very fine, powdery frass
- The False Powderpost beetles feed on a variety of wood and plant materials like dried vines or flower stems and produce a frass with 'chunks' of wood that leave a gritty feel to the frass when rubbed between your fingers and emerging females will re-infest wood
- Old House borers prefer softwoods and are the largest of the powderpost beetles that produce a gritty frass often formed into pellets and will re-infest wood

Wood Decay Fungi are a diverse group of organisms that are different than plants and animals that live in the soil, water, and air. Wood decay fungi feed on the structural (cellular) components of wood (lignin, cellulose, hemicelluloses) and require moisture to be able to infest and digest lumber. Fungi produce spores - the equivalent of seeds in plants or eggs in animals - that germinate when they encounter enough moisture and the right type of food. Wood decay fungi germinate on wet wood and produce damage by digesting the wood using structures called hyphae. Sometimes hyphae accumulate into a visible bundle and form root-like structures called rhizomorphs that are used to supply water to the fungus growing in structural lumber. Damage to structural lumber associated with fungi is called rot.

- Wood decay occurs due to the activity of a fungus
- Water does not rot wood, fungus does
- Surface molds do not rot wood
- If the wood moisture content is lowered, fungi will stop growing, except the water-conducting fungi that for control require disconnecting the rhizomorphs

Wood decay fungi are often divided into two categories based on the structural part of wood that is used as food. Those categories are the Brown rot and White rot fungi.

Brown rot fungi digest hemicellulose and cellulose, which causes the wood to shrink, turn brown, and crack into cuboidal (cube-like) pieces. One type of brown rot is called dry rot because those fungi have the ability (because of water-conducting vessels called rhizomorphs) to carry water from the soil to decay (feed on) dry wood. All other types of decay fungi require wood that is made wet by an external source – like rain, irrigation,

leaking pipes.

White rot fungi digest lignin and cellulose which leaves the wood a lighter color and fibrous (not cracked into cubes like the brown rots).

Commensal rodents live near areas inhabited by humans and depend on food intended for man and his animals. A single rat can eat about 20 to 40 pounds of food per year. They will, however, contaminate much more with their urine, feces and hair. Rodents are serious public health pests that can transmit, Haverhill (or rat-bite) fever, typhoid, and Hantavirus as well as carry organisms like bacteria and virus responsible for food poisoning. They spend a lot of time gnawing on hard surfaces. This gnawing can damage electrical wires and start fires.

There are three common structure-infesting rodents found in Georgia. All live for about 1 year. They have poor eyesight and are colorblind. They also have excellent senses of hearing, taste, and smell.

- Norway Rat
    - Large, robust in appearance, weighs up to 18 ounces
    - Has small eyes, small ears, and a blunt snout
    - Usually nest in ground burrows
    - Will eat anything but prefer meats
    - Has 4 - 7 litters per year with 8 - 12 young per litter
- Roof Rat
    - Sleek appearance, weighs up to 9 ounces
    - Has large eyes, large ears, and a pointed snout
    - Usually nests in vines, walls, trees and attics
    - Will eat anything but prefer fruits and vegetables
    - Has 4 - 6 litters per year with 4 - 8 young per litter
- House Mouse
    - Slender appearance, weighs up to 1 ounce
    - Has small eyes, large ears, and a pointed snout
    - Usually nests within structures
    - Will eat anything but prefer grains
    - Has 8 litters per year with 4 - 7 young per litter

CHAPTER 4
INTEGRATED PEST MANAGEMENT- IPM

Integrated Pest Management (IPM) is a term used to describe a process that outlines a comprehensive approach to pest control. The IPM process combines information about pest biology and the local surroundings to design an economically feasible plan of action aimed at limiting the risks associated with pests while emphasizing communication with the client. The term IPM, first used in agricultural entomology over 50 years ago, has been defined in many ways for different types of pest control. The Georgia Structural Pest Control Commission (GSPCC) endorses the following definition of IPM:

"Integrated Pest Management (IPM) for Structural Pest Control is a philosophy of pest management outlining a decision-making process aimed at achieving sustainable reductions in pest populations and their potential for growth. Successful IPM programs incorporate judicious application of control methods including, but not limited to, sanitation, habitat modification, exclusion, repellents and pesticides."

The professional that practices IPM uses a variety of interventions or "control methods" that include:

- Exclusion – reducing or eliminating the ways pests can enter into a building. Examples include using screens, door sweeps, air curtains, netting, caulking around windows and utility penetrations
- Habitat Modification – reducing sources of food, water, and harborage for a particular pest. Examples include *indoors*; caulking cracks and crevices or fixing leaking pipes, putting food and garbage into sealed pest-proof containers. *outdoors*; adjusting irrigation timing and location, reducing the depth of mulch, putting exterior lights on a timer or motion sensor, putting extensions on downspouts and condensate lines
- Sanitation – cleaning up and removing items that a particular pest can use as food. Examples include disposal of food waste and cleaning drains.
- Repellents – using a chemical or physical device to keep pests away from an area. Examples are bird spikes or insect repellents sprayed on clothing
- Mechanical/Physical – fly swatters, all types of traps – glue boards, snap traps
- Pesticides – the application of materials defined by the US EPA as pesticides (see chapter 5 in this handbook)

The concept of IPM is usually defined in a broad way to allow the pest management professional (PMP) to design a unique program that is appropriate for a particular customer/client. IPM is often outlined as a series of "steps" that mention the importance of pest identification, inspection, education, intervention, and monitoring.

This training manual describes the IPM process as having eight features:

1. Identification
2. Inspection
3. Communication
4. Action Plan Development
5. Action Plan Implementation
6. Action Plan Monitoring
7. Action Plan Revision
8. Continued Monitoring

Those features could be considered pieces of a puzzle that can be fit together in different ways while still meeting the GSPCC definition of IPM. This list of 8 features is provided as a guideline and it is not necessary to follow these as 'steps' in a strict sequence. For example, the first two features (identification and inspection) are presented in sequence because an inspection can, and should, identify pests found during the inspection but sometimes a pest sighting/identification can happen before and therefore provoke an inspection.

It is important to recognize that IPM involves gathering information to formulate a set of actions (called interventions) organized into a site-specific action plan aimed at solving a pest-related issue and limiting future infestation. An IPM program must emphasize communicating with all stakeholders. The number of stakeholders will vary by the type of account but could include the PMP, homeowner, business manager, and maintenance personnel. Educating stakeholders by providing information, answering questions and keeping records of all actions and communications are essential to successful IPM. A brief explanation of each feature follows as an instructional guide.

Feature 1: Identification

Identify the pest. Proper identification of the pest allows the PMP access to the body of knowledge on the biology and life cycle of a particular pest. Identification can be accomplished using a variety of published identification guides, by taking specimens to County Extension specialist or other identification experts. Another good identification tool is to maintain a company insect pest collection from specimens encountered in the normal course of doing business. The collection is used to identify pests by matching specimens found at an account with those already correctly identified in the company collection.

Feature 2: Inspection

Inspection is the foundation of any IPM program. An inspection should focus on those features at an account that relate to the biology/life cycle of the pest found at that account. This information provides the clues used to solve many pest problems. Features at a site that a pest can use to gain access to food, water and shelter should be identified and conditions at the time of the inspection recorded in writing aided by photographs/graphs. An inspection report should provide anyone with all the information a stakeholder needs to identify the same features recorded at the time of the 'original'

inspection (a common error is to take close up photographs without any regard to other features at the site that can be used to correctly identify that unique location).

Feature 3: Communication

Record keeping is the basis of the communication required for effective IPM. The IPM process involves recording and reporting information to the appropriate stakeholder including, business owners, property residents/managers or any group/organization that holds an interest in on-site operations. The report should be updated after each site visit or inspection. Operational report forms can be developed to standardize and/or individualize the process. Standardized forms should provide (extra) space for listing the unique, site-specific information collected on each visit. The report should be considered an ongoing dialog of visits, actions, and interventions taken to control a pest at a particular account. All these reports/records verify an IPM program and provide the customer with tangible proof of a professional service.

Feature 4: Action Plan Development

Information gathered during the inspection is used to formulate a plan of action. The action plan takes the information on pest identification and biology and combines that with information on the local landscape and construction to formulate actions (interventions) appropriate for that particular account. Action plans should be recorded in the inspection report as a list of suggested interventions and monitoring programs. The most appropriate intervention for an account will, over time, change with new technologies and conditions (better sanitation, construction alterations or landscape modification) at each account. Interventions thought to be appropriate for a particular account should be ranked in order from no action through sanitation and habitat modification schemes — not normally the purview of the PMP – to targeted application of pesticides. The final action plan should be decided with stakeholder input for determining the appropriate course of action(s), who (PMP or client) is responsible for which intervention and outline the related cost(s).

Feature 5: Action Plan Implementation

Enact the action plan while paying attention to the details of preparation, application, and maintenance of each and every intervention. The actions taken in implementing any intervention should be recorded and communicated with all involved/appropriate stakeholders. For example, if the action plan requires the property owner to fix or clean an area, the progress that stakeholder makes on that portion of the IPM plan is recorded - on subsequent inspections - and included in the latest report.

Feature 6: Action Plan Monitoring

Selection of an appropriate monitoring program for a particular pest and account is a critical component of any IPM program. The purpose of monitoring is to provide an early warning on the status of a growing pest problem and to check the effect and progress of interventions described in the action plan. There are a variety of monitoring programs that range from elaborate schemes aimed at recording insect numbers to a client-maintained pest log that reports sighting or complaints. The choice of monitoring

program will vary by pest, site, and stakeholder because of the wide variance in pest tolerance and legal and health-related issues that are involved in urban pest management. Successful IPM programs use a monitoring program tailored – as are interventions – to the situation and the account. The details of any monitoring program should be recorded and communicated with stakeholders.

Feature 7: Action Plan Revision

Results from the monitoring program are reviewed, at some point, and the agreed-to action plan evaluated and revised as time passes. This step highlights the fluid, changeable nature of the IPM process that requires recording keeping and communication to maintain contact with the customer and changing conditions at each account. This step acknowledges the value of a professional service by proving that one size, or set of interventions, will rarely solve the variety of pest problems that can present themselves at an account over time.

Feature 8: Continued Monitoring

This last characteristic, continued monitoring, illustrates the ongoing, sustainable, nature of the IPM process. The concept and practice of IPM is not new to urban pest management but is defined in such broad terms that PMP's have the opportunity to utilize their experience to design and implement a pest management program that is identifiable to a company and in the best interest of each customer.

IPM is a process that involves time… the time to inspect, record, maintain records, and communicate with the client. Practicing IPM means doing more than the service of scheduled pest control where the PMP is expected to solve a pest problem on their own, without stakeholder involvement. IPM programs are verifiable because of the records associated with communicating the process to the customer/stakeholder and likewise success is measured by client response as recorded in those same records. An IPM program can be communicated using standardized forms that are unique to a company or personalized for each and every account. There are numerous resources available from US EPA, State Departments of Agriculture, and State Cooperative Extension services on implementing IPM, including sample forms, and those resources apply to structural IPM as defined by the Georgia Department of Agriculture SPCC.

CHAPTER 5
PESTICIDES

A pesticide is any chemical or mixture of chemicals used to control a pest. A pest is defined as an insect or other small animal that harms plants, food, property as well as the mental or physical health of people. A pesticide may kill, attract, repel or change the normal growth or reproduction of a pest. The type of pest controlled by a pesticide is indicated by the name provided on a pesticide label.

Types of Pesticide as found on the label:

- Insecticide - controls insects
- Rodenticide - controls rodents
- Avicide - controls birds
- Miticide - controls mites
- Acaricide - controls mites, ticks and spiders
- Nematicide - controls nematodes
- Molluscicide - controls snails and slugs
- Ovicides – kill eggs of insects and mites
- Antimicrobials – kill microorganisms
- Fumigants – produce gas or vapor intended kill certain types of pests

Pesticide Types

The US EPA classifies pesticides into 3 categories, based on the active ingredient:

- *Chemical pesticides* directly kill the target pest and include all synthetic or man-made active ingredients such as pyrethroids, neonicotinoids, and pyroles that have modes of action targeting the nervous system, muscles, reproduction, growth or energy production
- *Biopesticides* are any pesticide derived from materials found in nature for example – pesticide products derived from plants such as the botanical pyrethrum, azadiractin from the neem tree, or eugenol from clove seeds; minerals such as silica gel, diatomaceous earth, zinc phosphide, mercury, copper or boron; in addition to microbial pesticides that consist of microorganisms (e.g. bacteria, fungi, virus) that infect and kill pests
- *Biochemical pesticides* are naturally occurring substances that control pests by non-toxic modes of action such as pheromones that disrupt mating in an insect population. Pheromones are sex or food attractants that are used to lure insects to traps and to monitor pest populations

How a pesticide affects (kill, repel, or attract) an insect, or any animal, depends on a number of factors including:

- The age and size of the insect or other pest
- Length of time the pest is exposed to the pesticide
- The type of formulation
- The manner that the pest is exposed to the pesticide – route of entry
- The type of active ingredient in the pesticide formulation – mode of action

- The amount of active ingredient in the pesticide formulation

In general, an important consideration regarding the toxicity of a pesticide is to consider the amount(s) of formulation and number of times and length of exposure. A pesticide also must enter the pests' body to be effective. This can happen in several ways and are termed *routes of exposure or routes of entry*.

Routes of Entry

By Mouth (Oral or Ingestion) - Pesticides may enter the body through the mouth when a pest swallows the pesticide. This can occur when the pest drinks a liquid formulation, eats it as part of a bait formulation or cleans pesticide particles from its body parts (e.g. when a cockroach cleans its antennae or legs) that were applied as a liquid or dust formulation.

By penetrating the skin (Dermal) - Pesticides can affect a pest when they pass through the body covering… which for insects and arthropods is the exoskeleton and for rats or birds the skin.

By breathing (Respiratory or Inhalation) – Insects have openings in their exoskeleton that are used for the exchange of air. These openings are called spiracles. Certain pesticides such as fumigants and fine aerosols can enter the pest's body through the spiracles.

There is one additional route of entry that is important for pesticide applicator safety, the eyes. This route of entry is important because the human eye has a large capacity for absorbing liquids more than human skin. Pesticide exposure to eyes is usually addressed as a separate safety issue, as noted on pesticide labels.

Pesticide Formulations

All pesticide formulations have two components:

1. A biologically or chemically active portion called the active ingredient (AI)
2. A not-active portion called the inert ingredient

The AI is the part of a formulation that controls the pest while inert ingredients have little or no toxic effects. The inert ingredients can include a carrier (a solvent or mineral clay that 'carries' the active ingredient) and/or adjuvants such as spreaders, stickers, foaming agent, or stabilizers. Pesticide formulations can contain dyes to make the formulation more visible, and/or that act as a synergist. A synergist is an additive that helps make the active ingredient 'more active' against a pest.

There are many different types of pesticide formulations. Each type of formulation has advantages and disadvantages. Some of the factors to consider when choosing a certain type of pesticide formulation include:

- The type of substrate to which the pesticide will be applied
    - (e.g. Concrete, wood, soil, tiles, carpet)
- Chance for exposure to non-target organisms

    - (e.g. humans, pets, other animals)
- Chance for disturbance of the area where the pesticide will be applied
    - (e.g. Exposure to sunlight, high temperature, cleaning, removal)
- Identification of pest to be controlled
    - (e.g. plant, insect, spider, rat, bird)
- Type of application equipment
    - (e.g. hand held compression sprayer, duster, power sprayer, foam machine, backpack sprayer, bait station)
- Environmental safety
    - (e.g. chance for water runoff/erosion, proximity of wells and bodies of water, use of the area by humans and pets)

Types of Pesticide Formulations (abbreviated letters in parenthesis are the code used to further identify the type of formulation on a pesticide label)

Emulsifiable Concentrates (EC or E)

An emulsifiable concentrate consists of a pesticide mixed with a solvent and an emulsifier in a liquid formulation. An emulsifier is a detergent-like material that will allow oil droplets (chemical and solvent) to be suspended in water. Emulsifier's usually cause the diluted material to take on a milky appearance. Emulsifiable concentrates will remain mixed for hours requiring moderate agitation because EC and E formulations are designed to prevent the active ingredient from settling out of the dilution or tank mix.

The advantages of using an emulsifiable concentrate (EC or E) include:

- Little visible residue on treated surfaces when applied properly
- Easy to mix
- Not abrasive
- Will not plug screens or nozzles
- Little agitation needed = will not settle out or separate when equipment is running

The disadvantages of using an emulsifiable concentrate (EC or E) include:

- Easily absorbed through skin of humans or animals
- Solvents may damage rubber or plastic hoses, gaskets, and pump parts if left in equipment overnight
- May cause pitting/discoloration of painted finishes or harm plants (phytotoxicity)
- Porous surfaces may absorb the formulation
- Flammable, should be used and stored away from heat or open flame.

Microencapsulated Pesticides (ME or FM)

Microencapsulated pesticides are made by enclosing tiny droplets of the active ingredient in very small polymer (gel or plastic-like material) beads in a liquid formulation. The active ingredient is released as these tiny beads break down. These materials are usually diluted (mixed) with water before application.

The advantages of using a microencapsulated (ME or FM) pesticide includes:

- Remains on the surface of porous materials

- Provides a longer residual because of the slow release of active ingredient
- Low toxicity to plants

The disadvantages of using a microencapsulated (ME or FM) pesticide includes:

- Require frequent agitation because the beads settle to the bottom of a tank
- Can leave a visible residue

Wettable Powder (W or WP)

Wettable powder is a dry formulation that has the active ingredient attached to a dust-like (powder) particle. A wetting agent is added to the powder so it can be mixed with water prior to application. The wetting agent increases the ability of the powder to mix with water to form a suspension. A suspension means that the wettable powder does not dissolve in water, like sugar does, but instead stays suspended (floating/sinking) in the dilution.

The advantages of using a wettable powder (W or WP) include:

- Remains on the surface of porous materials
- Low toxicity to plants
- Not readily absorbed by the skin of humans and domestic animals

The disadvantages of using a wettable powder (W or WP) include:

- Requires frequent agitation to keep the powder from settling to the bottom of the tank
- Leaves visible residue on most surfaces
- Easily inhaled by the applicator when mixing
- Produces wear on spray nozzles due to abrasion caused by the powder or carrier in suspension

Water-Dispersible Granules (WDG)

Water-Dispersible Granules are just like Wettable Powders except the particle size is not small or dust-like and instead WDG's are formulated as small easily measured granules that are less likely to get airborne and be inhaled during mixing and measuring. WDG's must be mixed with water prior to application.

The advantages of using a water-dispersible granule (WDG) include:

- Reduced risk of inhalation

The disadvantages of using a water-dispersible granule (WDG) include:

- Application equipment must have good agitation to suspend heavy granules

Dusts (D)

Dusts are very small, finely ground particles of an active ingredient usually mixed with an inert powder such as clay or talc. Dusts (D) are a ready-to-use dry formulation. Dust formulations can act as a contact insecticide (route of entry through the insect's exoskeleton) or by ingestion (the insect swallows the insecticide when they groom or clean themselves) or by drying the insect (the dust formulation breaks the wax layer on

the exoskeleton and the insect loses all internal water). Dust formulations that kill by drying out the insect are called desiccants. Dusts, when applied properly, will remain effective for a long time. If, however, they become damp, they tend to be ineffective. Over application of dusts (too thick) present a human health risk - due to inhalation, when people accidentally breathe-in the dust.

The advantages of using a dust (D) include:

- Long residual life… if kept dry
- Ready to use
- Remain on the surface of porous materials
- Not readily absorbed through the skin of humans or domestic animals

The disadvantages of using dusts (D) include:

- Leave a visible residue that is easily moved off target by wind or water
- Application can require special equipment
- Can become airborne and may be breathed by applicator or non-target organisms

Baits (B)

Bait is a formulation of a pesticide designed to be eaten or swallowed, is generally marketed as ready-to-use and can be formulated as a dry dust, dry granular, dry pellet or a semi-liquid gel or liquid. Baits (B) usually contain different (secret or proprietary) materials to make the formulation 'taste good' to the pest. Pesticide baits can be contained within a specially designed station or come in a ready-to-use device for directed application or to reduce the chance of non-target exposure. Baits (B) also can include a label-directed application of a pesticide to foods such as seeds and fruits. Bait formulations are used to control many different pests including insects, rodents and birds.

The advantages of using baits include:

- Placement is targeted by the applicator, reducing non-target exposure
- Most are ready to use
- Easy to apply

The disadvantages of using baits include:

- Must compete with other available foods
- May be attractive to humans and domestic animals
- Repeated applications can cause unsightly buildup of not-eaten bait

Granules (G)

Granular pesticides are dry formulations with a particle size that is not uniform but much larger than dust. Coarse porous particles such as ground up corncobs, walnut or pecan shells, or clay are used as the inert carrier. Granular formulations must be kept dry until application. Granular (G) formulations act as contact insecticides and are not intended to be eaten by the target pest. The granules are designed to absorb moisture and slowly release the active ingredient; however, heavy rains after application can shorten the residual life of this type of pesticide formulation.

The advantages of using granules (G) include:

- Low drift hazard
- Easy to apply
- Pre-mixed
- Longer residual life than WP or EC formulations

The disadvantages of using granules (G) are:

- Difficult to calibrate application equipment and apply uniformly
- Short residual life if heavy rains occur after application
- May be ineffective during periods of dry weather

Ultra Low Volume (ULV)

Ultra low volume formulations contain a concentrated form of the active ingredient in a carrier or solvent. ULV formulations require special equipment for application. They are applied, as the name suggests, at very low volumes usually outdoors as a contact insecticide.

The advantages of using ULV include:

- Act quickly on the pest
- Not abrasive to equipment
- Will not plug screens and nozzles
- Leave little visible residue on treated surfaces

The disadvantages of using ULV include:

- Readily absorbed through skin of animals (non-targets) as well as porous surfaces
- The solvents may damage plastics and rubber; wire insulation or sprayer parts
- Calibration and application must be carefully conducted because of the high concentration of active ingredient
- Risk of exposure by inhalation

Aerosols (A)

Aerosols are usually liquid formulations of an active ingredient and solvent. There are two types of aerosol formulations: 1) a ready-to-use product available in sealed pressurized containers, and 2) products intended for use in electrical or gasoline-powered aerosol generators that release the formulation as a 'smoke' or 'fog'.

The advantages of using Aerosols (A) include:

- Portable
- Easily stored

The disadvantages of using Aerosols (A) include:

- Risk of inhalation exposure
- Hazardous if punctured, overheated, or used near an open flame
- Difficult to direct application to target site or pest

Fumigants

Fumigants are pesticides that are a gas at room temperature. They have no residual activity and kill pests when absorbed through the skin or inhaled. They are used by the pest management industry against wood destroying organisms and stored product pests. Fumigants are usually released as a gas under pressure to a product or building covered by a tarp to contain the gas long enough to kill the target pest. Fumigants also can be a solid that vaporizes into a gas. Fumigants pose a serious safety risk because they are highly toxic, easily inhaled and can also burn the skin. Fumigants can only be applied by PMPs holding a special category license.

Desiccants

These pesticides are chemical agents that absorb moisture. When used against insect's desiccants are a contact pesticide that damages the protective wax coating on the insect exoskeleton. The result is dehydration. Desiccants are usually formulated as a dust and must be kept dry to be effective.

Mode of Action of Insecticides

For the purpose of the registration exam, the applicant or test-taker should be able to list the biological functions attacked by pesticides, display an understanding of pesticide resistance and that the IRAC Main Group numbers on a label reference the appropriateness of an insecticide for inclusion in an insecticide resistance program.

It is important to read the pesticide label and know not only the brand name but also the active ingredient. Pesticide products with different brand names can contain the same active ingredient and it is the active ingredient that controls the pest.

The Insecticide Resistance Action Committee (IRAC) is a group of scientists supported by pesticide manufacturers that maintain a list of all registered insecticide Active Ingredients (AIs) classified by Mode of Action (MoA). The MoA describes the target site of an AI. The target site is that part of the body or body-function of a pest that is affected by the active ingredient (AI). The complete IRAC list can be found on the website: http://www.irac-online.org/content/uploads/MoA-classification.pdf

The IRAC MoA list includes 28 Main Group and primary site of action categories. The Main Group number indicates the specific target site of an active ingredient. The Main Group categories include AIs that affect the following 6 Biological Functions;

- *Nerve action* those active ingredients (AI's) that disrupt nerve function
- *Muscle action* (AI's) that prevent muscles from functioning
- *Energy metabolism* (AI's) that affect energy production
- *Insect growth regulation* (AI's) that mimic hormones found in the insect body
- *Chitin synthesis inhibitors* (AI's) that prevent growth of a chitinous exoskeleton
- *Disruption of insect guts* (AI's) that destroy the midgut of an insect

The various IRAC Main Group numbers represent different primary sites of action for a particular MoA. For example there are nine Main Groups numbers (1-5, 9, 14, 19, and 22) for active ingredients that affect the biological function "Nerve Action", which means those AIs 'attack' a different part of the insect nervous system. The IRAC Main Group numbers found on an insecticide label are useful in managing insecticide

resistance. Insecticide resistance can occur from repeated application of the same type of insecticide (IRAC Main Group number) at an account. Insecticide resistance occurs because insects that survive exposure to an insecticide pass on that ability to survive (resist) to their offspring. Insecticide Resistance is defined as "the ability of a pest population to survive application of a pesticide that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendations for that pest". Insecticide resistance can be overcome by using a rotation or sequence of products from different IRAC Main Groups. This means you must apply insecticide products that have a different IRAC Main Group number, over time, at the same account.

The IRAC Main Group categories of insecticide MoA listed according to the six biological functions targeted by active ingredients (AIs) are:

- Disruption of Nerve Action
    - Many pesticides act by damaging some function of the nerve cells that make up the 'nervous system' of a pest. There are nine IRAC groups 1-5, 9, 14, 19 and 22 that can disrupt a pests' nervous system. These AIs can affect all insect life stages
- Disruption of Muscle Action
    - This mode of action involves a class of pesticides that affects muscles and the nerves associated with muscle action. There are two IRAC groups (6 and 28) and these AIs can affect all insect life stages
- Energy Metabolism or Metabolic Inhibitors
    - Pesticides that affect the complex of structures that allow cells to produce energy are called metabolic inhibitors. These AIs are slow acting and often used in baits. Metabolic inhibitors are represented in 6 different IRAC groups (12, 13, 20, 21, 24 and 25) and these AIs effect all insect life stages
- Insect Growth Regulators (IGR's)
    - Insect growth regulators are active ingredients that mimic hormones found in an insect's body. Exposure to these chemicals can result in sterility in adult insects but more commonly are used against immature stages because IGR's affect insect metamorphosis. There are 4 IRAC groups considered IGR's (7, 10, 17 & 18) and these active ingredients affect any insect life stage that molts (sheds the exoskeleton) so they are usually not able to kill adult insects.
- Chitin Synthesis Inhibitors (CSIs)
    - This type of pesticide interferes with an insect's ability to produce a protein called chitin, which is a major part of any arthropod (insects, spiders, scorpions, mites) and crustacean (crabs, shrimp) exoskeleton. Two IRAC groups (15 & 16) are CSIs that can affect any insect life stage that molts (sheds the exoskeleton) so they are not considered effective against adult insects (although some CSI's stop egg production in adult insects)
- Disruption of Insect Guts
    - A crystal-protein found in the bacteria *Bacillus thuringiensis* (usually abbreviated as Bt) is the AI in this mode of action group. Bt must be eaten because the crystal destroys the midgut (or stomach) in susceptible insects.

In urban pest management the most frequently used Bt is called Bti (*Bacillus thuringiensis israelensis*) for control of larval mosquitoes. There are no Bt products effective against roaches, ant, or termites. There is one IRAC group for Bt products (11)

In addition to insecticides PMPs often use rodenticides. The mode of action of rodenticides includes:

- Anticoagulants – (rodenticides) These AIs prevent the blood of mammals from clotting. There are two different types:
    - First Generation rodenticide anticoagulants generally require bait consumption over several feedings (days) in order to get a lethal dose
    - Second Generation rodenticide anticoagulants are lethal after a single ingestion of bait

Other rodenticide active ingredients include Inorganics such as zinc phosphide formulated as a bait or dust.

Pest Control Devices (tools - intervention types - that help identify IPM programs)

There are a number of devices that do not involve pesticides but are considered instruments of mechanical pest control. Pest control devices include air curtains, various types of traps as well as protective netting, wires or spikes.

Air Curtains

Air curtains or air doors are blower-type devices placed over doorways that direct a strong current of air to prevent flying insects from entering a building.

Sticky Traps

Sticky traps are used in certain monitoring programs to record the numbers of a pest or to locate nesting, feeding and harborage areas (often called "pest hot spots"). They are of limited use in controlling established pest problems.

Electrocution Traps

Electrocution traps use ultraviolet light (UV) to attract some flying insects. The insects are killed when they touch an electric grid placed inside the trap. Electrocution traps are generally effective for about 20 – 30 feet and must be properly placed for the intended pest. The placement should be 'away' from the area to be protected because the light may attract more insects to that area than without the trap.

Light traps

Light traps use UV light to attract flying insects and employ a glue board or other device to trap the insects. A light trap should be placed so that it is not attracting outdoor insects into a building. These devices when used indoors cannot compete with sunlight and should not be place near other light sources. The devices should be maintained as per instructions on how often to change the UV light bulb and trapping device to maintain effective attraction and trapping of insects.

Live Traps

Live traps capture rodents and other small mammals without harming them. The animals can then be handled in compliance with state regulations.

Glue Boards, Snap Traps, and Multiple Catch Traps

Glue boards, snap traps, and multiple catch traps are devices used for rodent control. It is important to inspect these traps frequently and clean or replace them as necessary. Dead animals left in these traps will begin to decay, smell and attract other pests.

Protective Netting, Wires and Spikes

Protective netting, wires and spikes are used in bird control. The netting is placed over an area to prevent birds from entering. Wires and spikes are devices attached to ledges, statues, etc. to prevent birds from landing on that surface.

Ultrasonic Pest Control Devices

Research reports in scientific journals have demonstrated that ultrasonic pest management devices do not kill, repel, or eliminate insect or rodent pests. Accordingly, ultrasonic pest control devices have no value for professional pest management services.

CHAPTER 6
HOW TO READ A LABEL AND SAFETY DATA SHEET (SDS)

There are two documents associated with every pesticide product that have important information about a pesticide and its application – the label and the safety data sheet (SDS). The label is the legal document under FIFRA that provides information on the use, storage, and disposal of that pesticide. Remember - ***the label is the law*** - it is a violation of state and federal law to use any pesticide in a manner that is inconsistent with the label directions. All labels must have certain basic information, such as:

Brand or Product Name
The product name is often the most prominent name on a label and the name used in advertisements. The product or brand name is the name used when ordering a product from a supplier or manufacturer. Yet the product name contains no information on the active ingredient – two companies may use different names for the same active ingredient.

Type of Formulation
The type of formulation is shown on the label and often accompanied by an abbreviation. Such as emulsifiable concentrates (EC), wettable powders (WP), dusts (D), or granules (G). The different formulations have different requirements for methods of handling, application, storage and disposal.

Net Contents
The net contents section of the label declares the amount of formulation that is originally packaged in the container. It is shown in gallons, quarts, or ounces for liquids and pounds or ounces for dry formulations.

Ingredient Statement
The same active ingredient may be available in more than one type of formulation under different product names. The amount of active ingredient is listed as a percentage by weight of the amount in a container when purchased. The active ingredient is listed by either the chemical or common name. The label also shows what percent of the total weight of a product are inert ingredients - these contents do not need to be listed.

Common Name, Chemical Name and IRAC MoA Category Number
The AI in a pesticide has two names to identify it. The chemical name gives the chemical structure while the second name is called the common name.
An example is:
Chemical name; 5-amino-1-(2,6-dichloro-4-(trifuoromethyl) phenyl)-4-((1,R,S)-(trifluoromethyl)sulfinyl)-1-H-pyrzole-3-carbonitrile
Common name; fipronil.

A pesticide AI may have several different product names but will always have the same

chemical or common name.

Labels also have the IRAC Main Group number to help identify the AI mode of action. This number corresponds to one of the 28 Main Group and primary site of action categories (see page 33 of this manual). The purpose of this number is to identify which pesticide products are appropriate to use in a pesticide resistance management program. A pesticide resistance management program requires using products with different IRAC Main Category numbers over time at the same account.

Name and Address of the Manufacturer
The name and address of the manufacturer/distributor of a pesticide must be on the label.

Registration and Establishment Numbers
Each registered pesticide has its own unique registration number provided by the EPA when the product is registered. This number must appear on the label, usually on the front panel. It appears as EPA Reg. No. xxxx-xxxx. This number must be on any pesticide container used to store that pesticide. All manufacturers also must indicate the identity of the manufacturing facility that produced the product using a separate establishment number. It appears as EPA Est. No. xxx-xx-xx.

Signal Words and Symbols
All pesticides are toxic substances and may be hazardous. Pesticide labels often include a signal word that indicates the potential danger of that pesticide to humans, animals, and the environment. The signal word and symbol provides an idea of the relative toxicity of a product. Customers should not be told that any pesticide product is safe or non-toxic.

Signal words are based on five criteria of exposure/route of entry to laboratory animals:

- Swallowing - (oral route of entry)
- Applied to the skin (dermal route of entry)
- Inhaled (inhalation route of entry)
- Irritation or corrosiveness to the skin (dermal route of entry)
- Irritation or corrosiveness to the eye (exposure to eyes)

The signal word must appear in large letters on the front panel of the label along with the statement "Keep Out of Reach of Children."

The signal words, symbols, and estimated human toxicity are as follows:

- Danger - The pesticide is highly toxic. A taste to a teaspoonful of the undiluted product, taken by mouth, can kill an average size adult. A label with the signal word Danger also will have the word *Poison* printed in red with the symbol of skull and crossbones.
- Warning - The pesticide is moderately toxic. A teaspoonful to a tablespoonful of the undiluted product, taken by mouth, can kill an average size adult. It carries no symbol.
- Caution - The pesticide is slightly toxic. An ounce to more than a pint of the undiluted product, taken by mouth, can kill an average size adult. It carries no

symbol.

Precautionary Statements

All pesticide labels contain precautionary statements usually listed under the heading "Hazards to Humans and Domestic Animals."

Precautionary Statements include:

- Statement of Practical Treatment - Recommended first aid treatment to be followed in case of pesticide exposure. Some labels contain a section for physicians describing the appropriate medical procedure for poisoning emergencies.
- Environmental Hazard - Contains precautions concerning hazards to the environment.
- Physical or Chemical Hazards - Potential hazards such as fire or explosion posed by that pesticide.
- Storage and Disposal – How that product should be stored as well as the disposal of the pesticide and pesticide container. Every pesticide must be properly stored when in inventory or transport. All pesticides left over after application, whether in equipment or product containers, must be disposed in a manner consistent with the label instructions.
- Personal Protective Equipment (PPE) – The equipment an applicator must use when mixing or applying a particular product. PPE requirements are usually described under the Precautionary Statements section of the label.
- Precautionary Statements section also includes the *re-entry statement or restricted entry interval* (REI). This section describes the length of time required before a person without protective clothing can safely entry a pesticide-treated area. This statement will not appear in the Precautionary Statements section if there is no restricted entry interval (REI) for that product.

The front panel on a Restricted Use Pesticide will also contain the following statement: **RESTRICTED USE PESTICIDE**. For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

Directions for Use

The directions for use include details on the proper way to mix and apply the pesticide. Use instructions will show:

- The list of pests the product is labeled to control
- The area where the product may be applied
- In what form the product is to be applied
- The amount of the product to use
- Mixing directions
- Compatibility with other products
- Phytotoxicity (potential for killing plants) or staining problems
- When application should be made
- Proper equipment to use

Misuse Statement

This section serves as a reminder that it is against the law to use a pesticide inconsistent with its label directions. All registered pesticide labels have the following statement "It is a violation of Federal law to use this product in a manner inconsistent with its label". This is where we get the saying that '**the label is the law**'.

Labeling

All printed material, such as guidance documents, technical bulletins, safety data sheets and similar materials that are produced by the registrant or manufacturer of a pesticide are called "labeling". Labeling is enforceable just the same as the label attached to the product container.

Safety Data Sheet (SDS) provides information that may not be on the label. This information will include:

- The active ingredient chemical formula
- Health and safety information
- First aid and procedures
- Information for a physician
- Fire and explosion information
- Spill and clean-up information
- Product disposal
- Special precautions
- Toxicological information

CHAPTER 7
EQUIPMENT USED IN THE PEST MANAGEMENT INDUSTRY INCLUDING CARE, MAINTENANCE, AND CALIBRATION

A Pest Management Professional (PMP) must understand their equipment and how it compliments their training and experience. Selecting the proper equipment for the job and knowing how to properly and safely use that equipment will help support a professional approach. All equipment must be properly maintained, stored and used in a manner consistent with the manufacturers' manual or instructions for use/care as well as state and federal guidelines. A well planned and properly followed maintenance program is necessary for preventing potentially dangerous, embarrassing and costly mistakes as a result of faulty equipment. Maintenance ultimately saves time and money. It is very important to keep all equipment used to apply pesticides clean and in working order by establishing and following a scheduled equipment maintenance program.

A professional keeps a written equipment maintenance procedure for all equipment that includes a signed and dated record of what, when and who conducted maintenance. Any PMP involved in applying a pesticide depends on the reliability of their equipment to deliver pesticide to the appropriate target. The equipment used to apply pesticides influences the quality of a professional pest management service.

ALWAYS READ THE LABEL FOR ANY SPECIFIC CLEANING INSTRUCTIONS.

In general, all equipment should be rinsed daily and cleaned according to the manufacturers' recommendation. It is recommended that different equipment be used for different pesticides and a thorough rinsing and cleaning should be conducted if different pesticides (as indicated by a different IRAC number) are to be used in the same equipment.

It is recommended that the PMP rinse their equipment at the end of every day. Remember that pesticide residues on equipment can be harmful. You must use the same safety precautions during mixing and application. Wear the label recommended personal protective equipment (PPE) even when you clean pesticide equipment. Pesticide application equipment should be cleaned in a designated area that conforms to GDA guidelines for handling pesticide-contaminated rinse water.
For spray equipment:

- Drain all pesticide dilution and properly store it for future use
- Flush with clean water – saving the rinsate (the rinse water)
- After flushing, fill the tank 1/8 to 1/4 full with clean water, pressurize, and spray water through the hose, control valve and application tip for at least 1 minute – saving the diluent
- Hold the control/application valve open to drain the nozzle and hose, dispose of the water remaining in the sprayer
- Dispose of the rinsate as per label instructions

- Never pour excess pesticide or rinse material down the drain
- Read and follow all label directions for disposal of excess pesticide and rinsate

Cleaning is recommended on a regular schedule – at least a weekly cleaning.

- Follow the rinsing protocol and then add recommended detergent solutions to the tank and leave that mixture in the tank for at least 10-15 minutes before again following the rinse procedure
- Never mix the cleaning rinsate with the pesticide rinsate that is collected when rinsing pesticide from the equipment)
- Dispose of the cleaning rinsate according to label or manufacturer instructions

Equipment types and hints for use/maintenance

Hand-held Compressed Air Sprayer

A common piece of equipment is the hand-held compressed air sprayer. When properly maintained it is a durable and efficient way to deliver pesticides to a specific area. Always follow a procedure appropriate for the pesticide formulation when filling a compressed air sprayer. Fill the sprayer with water or the label-directed solution to ¼ or ½ full, add the pesticide formulation, replace the sprayer top and agitate the entire mixture in the sprayer. After agitating/shaking the partially filled sprayer remove the top and add the remaining water/or labeled diluent, replace the top, and agitated as before.

Pesticide formulations such as wettable powders and microencapsulated can settle to the bottom of a sprayer rapidly so you must frequently shake the sprayer to be sure of a proper mixture. Most pesticide labels call for application at low pressures (around 20 - 30 psi). This will prevent splash back or splattering of the pesticide. Calibrate each hand-held sprayer on a regular schedule (weekly or less) to ensure that the number of plunger pumps used to pressurize the equipment meets the low-pressure requirement of a label. As the pesticide is dispensed/applied from a hand-held sprayer, the pressure in the tank will drop. When this occurs additional pressurization is necessary.

Emergency procedure for hand-held compression sprayers - If the hose attached to a hand-held sprayer suddenly breaks turn the tank upside down. This will allow the pressure to escape but not the chemical.

Routine Maintenance guidelines presented by the separate components of a pesticide application system include the:

Tank

Thoroughly clean any tanks associated with a sprayer that is used daily at least once a week and inspect it for pinholes. Repair holes according to the tank manufacturer recommendations. Tanks also often have strainers between the tank and connections to the pump or hoses. Check the strainers associated with a tank and clean them during the tank cleaning operation. Do not use any spray equipment without the strainer that is recommended for use with that equipment.

Hoses

Pesticide sprayer tanks are connected to a pump and application tools/tips by hoses. Check the hoses daily (along with any connections between hoses, the tank and application tools) for cracks, pinholes or other leaks. After flushing a tank with clean water 'back flush' all hoses and drain them by releasing the pressure and holding the hose and valve assembly above the tank while squeezing the application tool trigger. Preform back flushing at the end of each workday so no chemical solution is left in hose and valve assembly. Use care when attaching hoses and only use manufacturer-approved clamps and fittings for all hoses.

Pump

There are a variety of electric or gasoline powered pumps used with pesticide spray equipment. The pump assembly and associated gaskets for any pesticide application equipment should be checked for cracks, leaks, wear, dirt and grit as recommended by the manufacturer of that type of pump.

Shut-Off Valve

The valves associated with pesticide application equipment generally have two gaskets, the soft seat gasket and the valve packing. Valve packing's have a tendency to expand and contract with temperature changes and should be inspected on a schedule determined by the manufacturer recommendations and added to the maintenance program records.

Back-flow Preventers

Back-flow preventers are just what the name implies; they prevent water and pesticides from being drawn back into the water supply system when filling tanks with a hose if there is a sudden drop in water pressure. These devices should be installed and maintained on spray equipment according to regulatory and manufacturer recommendations.

Application Control Valve and Nozzle Tips

A control valve is located at or near the end of the hose that dispenses the liquid pesticide formulation. The control valve (usually a trigger or other hand operated button) opens the spray equipment to release the pesticide formulation to an application tool that ends in a tip. Tips are designed to release the pesticide in a variety of patterns – for example a pin-stream, a fan or a cone pattern. The application control valve and tips should be rinsed and cleaned when the other components of the sprayer are rinsed and cleaned as part of any professional maintenance program. All control valves and tips must be cleaned according to manufacturer instructions.

Safety Precautions for leaks observed during operation of spray equipment

If a hose ruptures or if a slow leak develops during operation, immediately turn off the system and rap/cover the leaking area with a paper towel or rag. Open and apply the spill kit that is standard equipment in a professional's toolbox. The best course of action is to read and/or follow the product label directions for the pesticide and equipment.

Winterization

Cold temperatures can damage spray equipment. To prevent freezing, if possible, drain all chemical from the tank. After draining pour a mixture of water and anti-freeze into the tank, run the pump and spray the mixture through the hose. The anti-freeze will protect the pump and hose.

Dusters

Hand Dusters - The most common hand dusters are bulb and bellows dusters that require lightly squeezing the device to produce a thin layer of dust. Always hold the bellows duster with the stem at the top. Attempting to use a bellows duster with the stem at the bottom will apply too much pesticide formulation (over-application).

Power Dusters - This type of duster is powered by a fan and is used to treat areas such as wall voids, attics, and crawl spaces.

Calibration of Equipment

Calibration is best defined as adjusting the equipment to apply the desired rate of pesticide. Calibration is an essential task performed by any professional that ensures the accurate application of the labeled amount of pesticide. If equipment is not properly calibrated you cannot verify that the proper volume of pesticide was applied. Verification of pesticide application is an essential part of any professional pest management program.

A simple method for calibrating spray equipment

Start the pump or pressurize the hand-held sprayer and get it to normal operating pressure. Always have your standard hose and application tool attached. Open the valve and let the solution run into a container. Using a watch, measure the time it takes to spray one gallon. Repeat this procedure three times and record each time to assure accuracy. From the time(s) you record, take the average (add the three times together then divide the sum by 3) and do the same for the amount of solution in the container after each timed-spray. The average time and average amount acquired in the three repetitions is used to calculate the flow rate in gallons per minute or ounces per second. This is calculated by dividing the average amount you sprayed into the container by the average time, in minutes or seconds. Any time you change hoses, nozzles, treating tips or adjust the pressure you must recalibrate.

Suggested Reading

There are many more types of equipment available to you. For further information you may consult:

- Manufacturers instruction booklets that are supplied with the equipment and products
- "Handbook of Pest Control – Mallis"
- Various UGA extension publications such as:
  http://www.caes.uga.edu/commodities/spray/pubs/documents/HAND.PDF

CHAPTER 8
APPLICATION TECHNIQUES

Pesticide application is the controlled placement of a pesticide to an area where the pest is likely to contact the product. How and where a pesticide is applied are two of the most important factors in effective and safe pest management. The most effective pesticide will not overcome improper placement of the product. Proper application makes any pesticide more effective in addition to reducing the risk of exposure to non-targets such as people, pets, and the environment.

It is important to follow the steps outlined in Chapter 4 (IPM) to implement any attempt at pest management. There are three critical steps that should be completed when making any pest management action plan that includes the use of pesticides:

- Identify the Pest
- Make a Thorough Inspection
- Communicate Findings with the Client

The process used in developing an action plan that includes the selection of a pesticide also includes making certain of the following:

- Labeling on the selected product allows for the *intended use*
- Selection uses the most appropriate pesticide *formulation*
- Selection of the proper *application equipment*

Follow the action plan by applying the pesticide according to the label instructions:

- On how the site may be treated
- How to dilute the chemical
- Application methods

There are different application methods that are referenced on pesticide labels including:

- Liquid formulations applied through some type of *spray equipment*
- Liquid formulations applied through a *fogging device*
- Dry formulations applied using a variety of application devices
- Bait formulations (Solid or Liquid) applied with specific devices or in ready-to-use stations
- Gas formulations applied using any number of application devices

Liquid pesticide formulation applications should, in general, be made at low pressure to surface areas, such as floors, sub-flooring, exterior walls or the landscape outside of a building. In many cases, you will need to determine the square footage of the area to be treated to determine how much formulation to mix and apply.

Question: How much pesticide would you need to mix and apply if your action plan calls for making a liquid pesticide application to a room that is 20 feet wide and 20 feet long?

Example: The pesticide label states under the heading “directions for use” … *apply 1 gallon (of the labeled pesticide dilution) to 1600 square feet.*
Step #1 - Determine square footage by multiplying the length by the width.

The square footage of the room in this example is determined by multiplying:

20 feet x 20 feet = 400 square feet (20 ft X 20 ft = 400 ft^2)

Step #2 – Divide 400 square feet by the label-required application rate of 1600 square feet per gallon: (400 ft^2 ÷ 1600 ft^2/gal = 0.25 or ¼ gallon)

Answer: In this example the label directions require application of 1/4 of a gallon (also equal to one quart) of mixed or diluted pesticide to treat that room with a liquid formulation applied through spray equipment.

Terms that reference pesticide application methods

Spot treatment

These are pesticide applications to surfaces not larger than two square feet.
Two square feet is *not* a 2-foot x 2-foot area (which is 4 square feet). Two square feet is equal to two, one-foot squares. Two square feet is also equal to 6 inches by 4 feet, two square feet is equal to 288 square inches, etc.

Crack and crevice

This method of application involves placing insecticides into cracks and crevices where pests hide or through which they may enter a building. Such openings commonly occur at expansions joints, between different elements of construction, and between equipment and floors. Crack and crevice applications can involve the use of sprays, dusts, or baits. A crack and crevice treatment is a directed application that results in placing pesticide where many types of pests spend time hiding or traveling to food and water sources. When making a crack and crevice application avoid splashing, spraying or dusting the pesticide out of the crack. As soon as there is pesticide on an exposed surface the application is NOT a crack and crevice application.

Dusts

These are dry formulations that are applied in a THIN layer to voids (wall and cabinet voids). Hand and power dusters can be used to apply pesticide dusts. Hand dusters should have a plastic tip at the end to reduce the chance for electric shock when used near electrical outlets or conduits. When used properly, the stem or spout of the hand duster is in the upper-most (top) position. Power or plunger (pump) dusters are used to treat large voids such as an attic or crawl space. Always read and follow the manufacturer and label instructions when applying any pesticide dust. Inhalation risk is a safety issue when using any pesticide dust. Never use a dust formulation around sensitive electrical equipment such as computers or in aircraft because the dust could cause failure of the equipment.

ULV, Space and Fog treatments

Ultra Low Volume (ULV) pesticide applications are a type of liquid application that use a very small particle or droplet size (but not a gas/vapor). The term "clean out" sometimes references the practice of using ULV, also referred to as fogging.

The following example comes from a pest management action plan that includes a

fogging intervention and explains how to calculate the amount of pesticide to apply in when fogging.

Question: Using the following example, how long would you let the fogger run if you want to fog a room? There are three pieces of information needed to answer this question. First, determine the cubic feet of the room to be treated. Cubic footage is calculated by multiplying the length of the room by the width of the room by the height of the room.
Example: The room is 25 feet long and 20 feet wide and 10 feet high (25X20X10).
The answer is… that room contains 5000 cubic feet.
What are the label instructions for the pesticide product you intend to apply?
Example: The pesticide label in the 'directions for use' section states; "apply 1 oz. per 1000 cubic feet".
You also must know the output or application rate of the equipment.
Example: The equipment manual states "This fogging equipment can deliver pesticide at the rate of 1 oz. per minute."

Using the information obtained by measuring the room, reading the label and the equipment manual you can answer the application rate question:
Step #1 - Determine the cubic feet in the room… by multiplying 25 ft by 20 ft by 10ft which equals 5000 cubic feet. (25ft X 25ft X 20ft = 5000 ft^3)
Step #2 - The amount of pesticide you need to apply is calculated by dividing the cubic feet in the room by the pesticide label 'directions for use' amount in cubic feet per oz… in this example you take 5000 cubic feet and divide by 1000 cubic feet per oz. Therefore the total amount of chemical needed to treat that room according to the label is 5 oz.
(5000 ft^3 ÷ 1000 ft^3/1 oz = 5 oz)
Step #3 - The fogger delivery rate is 1 oz. per minute. We need to apply 5 oz of pesticide therefore you divide 5 oz. by 1 oz./min. which equals 5 minutes.
(5 oz ÷1 oz/min = 5 min)

Answer: You need to run the fogger for 5 minutes.

Termite Control
Termite management specialists must be knowledgeable on a variety of topics including building construction, termite biology and behavior, proper graphing techniques, termite regulations (minimum treatment requirements), volume calculations, in addition to the safe use and maintenance of equipment. Termite management specialists, therefore, must use considerable judgment in planning and executing every termite management plan because every site/building/job will have its own features that make it different from the last job.

The major objective of a soil-applied liquid termiticide is to establish a chemical barrier between the termites in the soil and the wood in a structure. The type of construction as well as label and state regulations determines the details required for any set of termite treatment options. In buildings under construction this is accomplished by keeping wood out of contact with the ground and by applying termiticide to the soil that will be beneath a slab foundation (pre-treating, prior to pouring the concrete). As construction continues,

if there is a raised foundation, the hollow masonry voids and exposed soil around both the exterior and interior perimeter of the building are also treated with a termiticide. In buildings already constructed (post-construction treatments), the termiticide is placed in the soil below any concrete slab by drilling through masonry and/or concrete substrates and applying the product according to label instructions. In addition, the soil around all exterior foundation elements is treated with termiticide by trenching and rodding as per label directions and state minimum standards. A complete termite management plan may involve any or all of the following basic steps.

Mechanical alteration involves modifying the structure to provide a physical barrier that termites cannot penetrate. Mechanical alteration also involves removing conditions favorable to termite foraging or that promote termites finding and accessing the structure. Therefore, this type of intervention could involve using metal barriers, the removal of cellulose (wood) debris, elimination of moisture near/on/or in the structure, and removal of wood to soil contact. Mechanical alterations are always a part of a termite IPM program.

Soil treatment involves application of a termiticide product to the soil under and adjacent to the foundation of a building. The purpose of a soil treatment is to create a continuous insecticide barrier in the soil around the foundation of the structure.

Foundation treatment is the application of termiticide product to specific elements of a buildings foundation. The objective is to place the insecticide in all known cracks and voids at the footing as well as cracks (or expansion, cold joints) in a foundation wall. Treating the inside of hollow concrete block walls or the void behind brick veneer and the structural walls are examples of a foundation treatment.

Wood treatment is the application of insecticide directly to wood.

Termite baiting systems involve the application of a termiticide with a slow-acting active ingredient in a food source for termites. The intent is to kill termites. Always follow the label instructions when installing and maintaining a termite baiting system.

The application of the proper amount of termiticide as well as proper placement is important to achieving effective termite management. The termiticide product label and the Rules of the Structural Pest Control Commission give directions for minimum termite treatment standards. You should be familiar with the information provided by these documents before you engage in any termite management action plan.

The Rules specify that a comprehensive minimum treatment for termite control using soil-applied liquid termiticides include the following:

- Remove all cellulose material from underneath the building or areas adjacent. Also remove any other debris that would interfere with inspection or treatment.
- Remove all wooden contacts between buildings and outside soil, other than those wooden supports that have been treated with preservatives for ground contact. The minimum clearance between untreated wood and soil must be no less than six

(6) inches.

- Remove all wooden contacts between buildings and inside soil, other than those wooden supports that have been treated with preservatives for ground contact. In no case shall the minimum clearance between wood and soil in a crawl space be less than eighteen (18) inches.
- Remove all visible accessible termite tunnels.
- Trench and rod the soil along the outside and inside of foundation walls and around pillars and other supports to a minimum depth of six (6) inches, but not lower that the top of the footing in contact with the soil.
- Application of an approved termiticide registered by EPA and the Georgia Department of Agriculture.
- Apply at four (4) gallons per ten (10) linear feet per foot of depth from the soil surface to the top of footings or a minimum of four feet. Apply to the trenches and backfill or with pressure application through rodding of the intact soil beneath the trench. Soil into which pipes extend from the structure, soil under expansion joints, and soil in any other critical point of potential termite entry must also be treated at the above application rate.
- Take steps to prevent back siphoning and the contamination of public water supplies during mixing and filling.
- Take precautions to prevent contamination of wells or cisterns, in or close to the structure being treated.
- Drill all masonry void areas such as tile, brick, concrete block, chimneys, hollow pillars and other similar structure parts. Apply the termiticide at two (2) gallons per ten (10) linear feet. Drill these void areas no more than twelve (12) inches apart.
- Treat the entire inside perimeter of all earth fills, such as porches, with the termiticide at four (4) gallons per ten (10) linear feet per foot of depth by one of the following methods:
    - Voiding and applying termiticide
    - Drilling and rodding from the accessible sides (not to exceed twenty (20) feet)
    - Drilling from the top at intervals of no more than twelve (12) inches around the perimeter and applying termiticide
    - Drilling and rodding from inside of an abutting raised foundation
- Treat all grade level slabs that touch the structure with the termiticide at four (4) gallons per ten (10) linear feet by drilling and applying along the entire distance where slab joins any part of structure
- Drill all concrete slabs no more than twelve (12) inches apart and no more than twelve (12) inches from the adjoining foundation wall
- Treat concrete slabs at or above grade level with the termiticide at four (4) gallons per ten (10) linear feet per foot of depth by one of the following:
    - Treat from the inside adjoining foundation by drilling through the top of slab at intervals no more than twelve (12) inches apart
    - Treat from the outside by drilling and short rodding under the entire perimeter of the slab at intervals no more than twelve (12) inches apart

- Treat monolithic slabs by trenching and/or rodding the soil along the entire perimeter and apply termiticide at four (4) gallons per ten (10) linear feet. Also apply the termiticide at the same rate to any openings through the slab such as utility penetrations

New construction treatments (pretreatments) are made during construction as a soil treatment, wood treatment, bait system or a combination of all three types of interventions. The new construction termiticide application rate for soil treatment of foundations is the same as existing construction. Surface areas to be covered by concrete slabs are treated with termiticide at the minimum rate of one (1) gallon per ten (10) square feet. The surface area that is treated with a termiticide product, when conducting a slab pre-treatment, must be covered with a plastic sheet, or similar type material if the slab is not poured on the day of termiticide treatment.

Termite baiting systems must be installed, monitored and maintained consistent with the product's label. In addition the State requirements include removing all cellulose material in accessible crawl spaces; correction of wood to earth contacts, and removal of visible accessible tunnels apply to bait treatments as they do for soil-applied termiticide treatments. Bait systems are particularly appropriate to use when there are nearby wells, cisterns, or a body of water that make a soil treatment potentially hazardous.

Termite baits installed as a pre-construction treatment or to satisfy the requirements of an Official Georgia Wood Infestation Inspection Report, must be monitored free of charge for a one year period.

Other approved pesticides (for example - borate products) intended for use in a termite management action plan must be applied consistent with that product's label in addition to the requirements to remove cellulose material, correction of wood to earth contacts, and removal of visible accessible tunnels. Additional State Minimum Standards include the use of Marker Dyes to indicate the areas treated with wood treatments.

Wood Boring Beetle Control

The list of interventions for management of wood boring beetles involves application of a pesticide registered by EPA and/or the Georgia Department of Agriculture. Treatment in crawl spaces also must include installation of a vapor barrier and compliance with the residential building code ventilation requirements.

Wood Destroying Fungi Control

The minimum treatment for control or prevention of wood destroying fungi includes the compliance with the residential building code ventilation requirements. For infestation of water conducting fungi, cut rhizomorphs and scrape visible fungal growth from the foundation walls, remove wooden contacts between building and inside under-floor space, and provide an 18-inch clearance between wood and soil in under-floor space.

Drywood Termites

The treatment for drywood termites involves application of a pesticide registered by EPA and/or the Georgia Department of Agriculture. Other methods may be used if approved by the Structural Pest Control Commission.

CHAPTER 9
PROTECTION OF THE ENVIRONMENT

The environment is defined simply as "our surroundings and the many forms of life found there". Examples of an environment can therefore be a stream, forest, desert, city, convenience store, or home. Pest management professionals are important partners in environmental protection/stewardship because they protect people and property by responsibly eliminating potentially harmful pests. PMPs also know it is important to minimize the environmental risk of pesticide contamination in any environment. Pesticides can damage the environment if applied in a manner inconsistent with the label instructions especially specific hazards, such as toxicity to non-targets like bees or fish. Knowing about and following good application practices in addition to using IPM can protect both the environment and the applicator.

Environmental Fate of Pesticides

Question: What happens to a pesticide once it is applied inside or outside of a building?
Answer: Two broad processes occur:

- The pesticide can 'break down' to a not-toxic substance
- The pesticide can move

Breakdown of pesticides

Pesticide breakdown is when the active ingredient of a pesticide changes from a molecule that is toxic into one that has no apparent toxicity. This process takes time (from hours to years) and will vary with the environmental conditions such as temperature and sunlight. The amount of time needed to breakdown any pesticide also varies by the active ingredient, formulation and conditions at the application site. Breakdown can occur in one of two ways: Biotic or Abiotic.

Biotic:

Microorganisms such as fungi and bacteria can help to breakdown a pesticide. Conditions that favor this include warm temperatures and adequate moisture. Microbial breakdown is one of the important ways pesticides are destroyed in the soil.

Abiotic:

Chemical processes that do not involve living organisms. Exposure to the UV light in sunlight is the most important way that pesticides applied to foliage, soil surfaces or structures are broken-down. Chemical reactions in the soil influenced by moisture, temperature, and pH (acid or alkaline conditions) also can breakdown a pesticide active ingredient.

Movement of pesticides

Movement in the Air

Pesticides are 'on-the-move' when they are applied. Any pesticide that is moved to a location that is not the intent of the applicator is called an off-target application. An off-target application can be minimized by the correct choice of equipment in addition to the proper care and use of that equipment. A common cause for unintended off-target pesticide applications is the wind. This process is called 'drift' and occurs when air

current moves the pesticides as it is applied. The applicator must be aware of the airflow in the area when applying pesticides – whether that airflow is the air handling system in a building or the wind when outdoors.

A general rule to remember with outdoor pesticide applications is: the higher the wind speed, the greater the chance of drift. Once pesticides are in the air they cannot be controlled. Winds are usually strongest in mid-afternoon and weakest just before sunrise and after sunset. Many factors influence pesticide drift. The smaller the particle size the greater the chance for drift. One factor that controls particle size of a liquid application is the size of the nozzle opening. All nozzles produce a range of particle sizes. It is usually best to use a nozzle with a large opening to produce a large particle size and reduce drift when applying whether inside a building or outside. When using power sprayers outside, do not use any more pressure than is necessary to get the pesticide to the target area and remember the higher the pressure, the smaller the particle size. Nozzles positioned too high or pointed into the air will dispense spray over a wider area. Because wind speed is usually less close to the ground, application of liquid pesticides should be made as close to the target as possible. Consider the proper nozzle, pressure, nozzle spray angle, and height above the target before you apply a liquid pesticide formulation.

Air currents can also move pesticides if the formulation changes from a liquid or solid to a gas. This process, which can occur only with certain types of formulations (the label will provide information on this potential), is called volatilization. Volatilization occurs when a liquid pesticide changes into a gas and drifts away from the application site. This is also called vapor drift. You can sometimes see spray or dust drift during application, but vapor drift is not visible. Volatilization increases when it is very hot, the humidity is low, and the spray droplets are small. Labels will warn of the potential of volatilization with statements such as:

- At high air or ground surface temperatures, vapors from this product may injure susceptible plants
- Under very high temperatures, vapors from this product may injure susceptible plants in the immediate vicinity

Remember, pesticide vapors inside a dwelling can also cause injury to occupants who may be sensitive. Avoid spraying around air conditioning units and forced air heating systems especially where air is being drawn into the system.

<u>Movement in the soil</u>

All pesticides applied to the soil interact with the physical and chemical properties of the soil. <u>Adsorption</u> is when the pesticide AI binds to the outside of a soil particle. Soils high in organic matter or clay are more adsorptive than sandy soils. Sometimes the label will allow you to use a higher rate due to the power of adsorption. A pesticide adsorbed to a soil particle is less likely to move through the soil profile with the water from rain or irrigation. Pesticides bound to soil particles, however, can be moved by wind or water to other locations.

<u>Runoff</u>

Occurs when water moves over a sloping surface, and carries pesticides either mixed in

the water or bound (adsorbed) to eroding soil. Pesticides applied to bare sloping ground would more easily move after a heavy rain than if vegetation or plant matter cover that soil. Pesticide runoff can damage non-target plants and animals, and contaminate surface or underground water. Correcting the grade, installation of ditches, and planting of vegetation can all help to reduce runoff as part of an IPM program action plan.

Leaching

This process is another way that pesticides move through soil with water. In contrast to runoff where water moves across the surface of the soil, leaching occurs as water moves *down* through the soil. Sandy and coarse soils or gravel have low or weak adsorption and allow water and any dissolved pesticide to leach through the soil. This is because water can de-sorb (release) an AI from a soil particle. Leaching can contaminate groundwater (underground rock, sand or gravel saturated with water). Groundwater is a major source of drinking water and therefore leaching this is a major concern. Sources for contaminating groundwater with pesticides include areas treated with a high concentration or volume of pesticide, pesticide mixing and rinsing sites, pesticide waste disposal areas and pesticide spill sites. High organic matter and clay soils increase adsorption and help to reduce leaching.

Certain pesticides are taken from the soil by plant roots and placed within the tissues of the plant. This process is called absorption. Absorption is desirable and necessary for the performance of certain herbicides and insecticides. When pesticides are adsorbed to soil particles (such as in high organic matter) less pesticide is available for absorption by the plant.

Protecting Surface Water

Pesticides can contaminate surface water (creeks, ponds, lakes and rivers) by any of the three previously discussed processes: runoff, leaching and drift. Before applying any pesticide near surface water you should check the procedures and product label instructions to reduce drift. Certain product labels require an untreated buffer zone between the treated area and any nearby surface water. Other labels do not allow application to 'non-porous' surfaces (such as concrete) exposed to rain or irrigation water. Some pesticide formulations are very toxic to fish and extra precautions may be needed as instructed by the label. A pesticide applied, or spilled, to surface water may kill fish for a long distance as the chemical flows downstream.

Protecting Groundwater

Groundwater occurs in aquifers. Aquifers are zones of below-ground rock, sand or gravel that is saturated with water. Groundwater has natural outlets in springs, streams and lakes. Groundwater is used when you drill a well – which is intended to reach an aquifer - and pump out the water. About half the U.S. population and 90% of rural residents get their drinking water from groundwater. Georgia has some of the largest aquifers in the nation. If a water soluble pesticide is applied to a sandy soil over an aquifer that is close to the soil surface, leaching is likely to occur. This is especially true if there are repeated applications in the same location, dumping of pesticide rinsate on the ground, or pesticide spills. It is illegal to dump unused pesticide mix or rinsate on the ground.

You should not mix more pesticide dilution than you need for a day's operation. If there is still pesticide left in a tank at the end of the day, it may be used at any site listed on the label in compliance with all EPA, state and local policies. Leaving the mix in the tank until the next day is permissible but less desirable for several reasons including that some pesticide formulations settle or begin to breakdown once mixed and certain formulations can be corrosive to your equipment. Spray any pesticide left in a tank from the day's work as well as the rinse water at a site listed on the label. Leaving rinse water in the tank is permissible, but not recommended. Storing unused pesticide and/or rinse water in separate holding tanks is another option permitted by product labels and EPA, state or local policies.

Review your company policy and the procedures on handling, mixing and rinsing equipment, as well as collection, storage and disposal of pesticide waste to protect groundwater and surface water.

Spills

All service vehicles are required to carry enough absorbent material to control the largest spill that can occur from that vehicle. In event of a pesticide spill, keep people and pets away from the spilled pesticide. Confine the spill by soaking it up with a label-approved absorbent material. If in a building and you don't have an approved absorbent material readily at hand a rag, baking soda, or flour can be used to contain small spills until you return with the appropriate absorbent material. Sweep the absorbed material into a double plastic bag and handle according to label instructions. In a large spill, such as overturning a tank in an auto accident, use the absorbent material to contain the spill, if possible. You should contact your supervisor as soon as possible. A major responsibility in such an event is to keep the public away from the spill until further assistance arrives.

Disposal of Containers

Never leave pesticides or pesticide containers at the application site. Always follow the product directions for container disposal. The container disposal directions will vary from product to product.

Liquid pesticide containers can be triple-rinsed as follows:

- Empty the container into the spray tank. Allow it to drain for 30 seconds
- Fill container 1/5 to 1/4 full of water.
- Replace closure/lid and rotate container so the rinse reaches all surfaces
- Drain the rinse into the spray tank for at least 30 seconds
- Repeat rinsing two more times
- Puncture and if possible crush the container.

After triple rinsing, the container is no longer considered a toxic waste and may be disposed of at any sanitary landfill

Pressure rinsing is equivalent to triple rinsing. Pressure rinsing consists of a special nozzle that screws into the end of a hose. This nozzle has a sharp point that is rammed into the bottom of the pesticide container. The container is placed so it will drain into the

spray tank. The water is turned on and jets out of the nozzle in four directions. Pressure rinsing involves rotating the nozzle in all directions for 60 seconds so that all sides of the container are washed. Pressure rinsing is quicker and more effective than triple rinsing and even puts a hole in the container in preparation for disposal.

Empty boxes or bags from dry pesticides can be disposed of at a sanitary landfill. Open burning is not permitted.

Disposal of Excess Pesticide

Every effort should be made to apply all pesticides according to label directions during the course of a day's work. Occasionally, some pesticide will be left over. There are two common ways to dispose of the extra pesticide formulation:

- Apply around the exterior of the last account of the day to use up the pesticide as per label instructions
- Add the left over pesticide to a storage or disposal container/tank

Prevent Back Siphoning

Never immerse a water hose used to fill a pesticide mix tank into the tank. The water pressure feeding the hose can drop for any number of reasons. You may have experienced this if you ever turned your water faucet on and no water came out. You probably heard air being sucked into the open faucet. This is negative pressure. It's like sucking up a soda with a straw. A hose immersed in a spray tank draws the pesticide from the tank and directly into the well or city water system. Always use an anti-backflow device to prevent back siphoning AND an air-gap device or always keep the hose end above the tank opening.

If your source of water is a well, it is safer to mix and rinse at least 100 feet from the well. Accidental spillage could contaminate the groundwater by runoff or leaching because many wells are not tightly sealed near the soil surface.

Protecting Pollinators

Pollination is the process where plants fertilize, using pollen, their flowers to produce fruit, berries or vegetables. Many insects, bees in particular, pollinate a variety of plants. Pesticide formulations and active ingredients vary in their toxicity to pollinators and the label will usually warn of any hazard associated with a particular product. There are several general rules to remember:

- Dust formulations, because bees can pick them up as if they do pollen, are more hazardous than other pesticide formulations.
- Emulsifiable concentrates are usually less toxic than wettable powders.
- Spraying liquid formulations in the late afternoon or evening will reduce pollinator exposure compared to earlier in the day when bees are most active.
- If you are treating an area adjacent to a beehive, inform the owner before beginning so they can protect the hive, if needed.

Remember that your customer as well as the public will observe your work. Pesticide safety and environmental hazards are public concerns. Anyone observing your work can complain if they believe you are being careless. You should always be a professional in

your work area and never hesitate to call or ask your supervisor if you are unsure of how to handle a situation. No one ever becomes so wise and experienced that they can afford to hesitate to ask for advice.

CHAPTER 10
SAFETY

As a pest management professional you have the legal and certified requirement to follow all pesticide label instructions. This includes limiting pesticide exposure to yourself, your customers, their pets, property and the environment. Always read the label instructions under the heading **First Aid** before using the pesticide. You should be familiar with actions to take following accidental exposure to you, your client, their pet or any other non-target.

Pesticides are by virtue of their intended use, **toxic** - at some level. The toxic qualities of any material are related to a number of factors such as; who is exposed to the substance, the amount of the material, how long is the exposure and what is the route of entry. For example if an average person breathed (inhaled) in one cup (8 oz.) of water and kept the water in their lungs for 4 minutes that water would be toxic. Although there are many factors that combine to impact the toxicity of any substance the EPA uses a common measurement to be able to compare pesticides. This measure, called the LD50, is an accepted way to compare the toxicity of all types of pesticides. The LD50 is the calculated dose needed to kill 50% of the animals in a test population (usually rats, mice, or rabbits). It is measured in metric units - milligrams of the pesticide per kilogram of target animal body weight and is presented by the units' symbol - mg/kg. The important point to remember is that the most toxic pesticides have a lower LD50 value. Thus, a pesticide with an LD50 of 10 is more toxic than a pesticide with an LD50 of 100.
A person's response to the toxic effects of a pesticide can be categorized by the severity and speed of their reaction and is termed either acute toxicity or chronic toxicity.

- Acute toxicity is a rapid response to a single exposure or multiple exposures over a short time (less than 24 hours) that result in adverse health effects within 14 hours of exposure.
- Chronic toxicity is the effect of low-level exposures or repeated exposures over a longer time period (months or years).

Pesticide Exposure
Remember that pesticide exposure can occur in three main ways: skin exposure (dermal exposure), breathing (inhalation), and mouth (oral or ingestion).

Skin Exposure (Dermal)
The skin surface is a common path of pesticide exposure. Certain pesticide formulations can easily penetrate unbroken skin. All pesticides can readily penetrate cuts and abrasions on the skin. Some pesticide formulations can cause a corrosive effect on the skin. The skin on certain body regions will absorb pesticides more quickly than other areas. Eyes, genital area, and underarms are most susceptible to skin absorption. Always wash your hands before eating, drinking, smoking, rubbing your eyes or using the lavatory after handling a pesticide.

Always follow the label directions under the heading 'First Aid' if your skin or clothes

come in contact with a pesticide formulation. At the very least, you should immediately remove the clothing and rinse the affected area with fresh water for several minutes.

Breathing Exposure (Inhalation)
Always take precautions to prevent inhaling pesticides because the lining of the lungs permits rapid absorption of pesticide active ingredients into the blood. Dusts, mists, aerosols, and fumigants offer the highest risk for inhalation. The proper use of a respirator or gas mask can reduce exposure by inhalation. It is very important to use a properly fitted respirator or mask. Air should come only through the designed openings in the device, not from around the edges. Beards can interfere with the mask's fit – always read the instructions on your respirator to ensure a proper fit prior to use.

If you inhale a pesticide you should:

- Leave the treated area immediately
- Get fresh air and take deep breaths
- Follow label directions under the heading 'First Aid' for inhalation exposure

Exposure by Mouth (Ingestion)
Ingested pesticides are, in general, more slowly absorbed compared to the other routes of exposure. Pesticides enter the mouth by two paths either by direct ingestion or by residues on the hands that can be ingested while eating or smoking. Always wash hands before eating or smoking and store pesticides away from food products.

If anyone swallows a pesticide rinse the mouth thoroughly and have them drink large amounts of water. Always follow the label instructions under the subject First Aid.

Exposure to Eyes
Eye exposure is generally an issue related to the safety of the applicator or non-targets during application. The human eye has a greater capacity for absorbing liquids compared to the skin and any exposure to the eyes should be avoided by using protective eyewear. Eye exposure should be handled as per the First Aid label instructions including thorough rinsing at an eye-wash station.

Pesticides, once they enter the body, by any of the four routes of exposure (dermal, inhalation, ingestion, eyes) are transported by the blood throughout the body. The pesticide active ingredients can reach the site of action that may be the nervous system or other organs like the kidneys, liver, or lungs. Pesticides also can be stored in fat or other tissues for extended times before their toxic action occurs (chronic toxicity).

Personal Protective Equipment (PPE)
The risk associated with handling and applying any pesticide is, in part, related to exposure and toxicity. For example, a pesticide is more hazardous in the concentrated or undiluted form than its diluted form. Proper use of protective equipment including proper laundering can reduce exposure to pesticides. You should read the label of the pesticide you are using to see what protective equipment to use.
Common PPE includes:

- Chemical resistant gloves
- Chemical resistant apron
- Goggles
- Face shield
- Respirator with proper cartridges
- Long sleeve coveralls
- Chemical resistant footwear
- Ear protection
- Hard hat

Maintenance of PPE including clothing is an important aspect of proper personal protection. Some common storage, cleaning and maintenance practices include:

- To eliminate pesticide residues, wash according to label and equipment instructions all goggles, gloves, respirators (remove cartridges), face-shields, boots, hat, and ear protection after use
- Launder all clothing such as coveralls, shirts, socks, pants, or other articles that could have been exposed to pesticides before reusing. Avoid contaminating other clothing articles prior to or during laundering
- Store any extra respirator cartridges in a sealed container
- Make certain that respirator cartridges are the proper type for the pesticide being applied and that the cartridges are changed as required by the product instructions

Symptoms of Pesticide Poisoning

Pesticide effects are categorized to include one or more of the following reactions:

- Dermatological (Skin) - produces rashes, redness, itching, and swelling
- Neurological (Nervous system) - tremors, headache, nausea, depression
- Reproductive (Testis, ovary, fetus) – infertility or birth defects
- Carcinogenic (Any organ) - presence of cancers or tumors

It is important to recognize the symptoms of pesticide exposure so that you can respond to an unintentional or accidental exposure. Acute toxicity symptoms most often occur within a few hours of pesticide exposure.

<u>General acute toxicity symptoms of pesticide poisoning include</u>:

- Headache
- Dizziness
- Runny nose
- Watery eyes
- Irritation of tender skin (face, groin)
- General allergic reaction
- Blurred vision
- Excessive sweating
- Stomach cramps
- Diarrhea
- Vomiting
- Weak feeling
- Chest tightness

- Muscle twitches
- Eye pupil constriction
- Pinpointing of eye pupils
- Increased muscle contractions
- Excess salivation
- Breathing difficulties

Anticoagulant Poisoning

- Reduced blood clotting
- Internal bleeding

The first aid recommendations provided in this training manual are only guidelines. You should always read and be familiar with the first aid procedures on the label before using a pesticide. It is also recommended that you consult with a medical professional or poison control center if you suspect exposure to pesticides.

Poison Control Centers

Poison control centers exist in all states. Keep the phone number of the national, state, and/or manufacturer poison assistance centers in your wallet, in your service kit, and inside your service vehicle for emergency situations. Poison control centers provide information to the public and the medical profession on the prevention and treatment of accidental pesticide poisoning. This service is available 24 hours a day.

The nationwide phone number for poison control centers number is 1-800-222-1222. Pesticide manufacturers have also set up a 24 hour emergency number to provide information on pesticides. This number, called CHEMTREC, is 1-800 - 424-9300. The web address for CHEMTREK is www.chemtrek.org

The National Pesticide Information Center (NPIC) also provides information on pesticide poisoning. The number is 1-(800) 858-7378. The web address for NPIC is www.npic@ace.orst.edu.

In addition, most pesticide labels also contain a 24-hour hotline number that can provide information in case of accidental poisonings.